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The Paradox of Product Portfolio Ambidexterity: Determinants and Consequences

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to the
National University of Ireland, Galway

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Declaration

I hereby declare that the material presented in this thesis, which I now submit for assessment for the degree Doctor of Philosophy, is entirely my own work and has not been taken from the work of others except where duly acknowledged.

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Executive Summary

Competence ambidexterity and innovation ambidexterity play crucial roles in organisations' strategic new product innovation activities and their long-term success. Ambidexterity is especially relevant in high technology companies operating in competitive and ever-changing environments. Performance measurement systems (PMSs) are ubiquitous in companies and while some research has shown a role for them in innovation generally, little research attention has been given to their role in ambidexterity. No research addresses if and how PMSs used during project portfolio selection, influence ambidexterity. Moreover, differences of opinion, disagreements and conflict inevitably arise during new product portfolio selection (NPPS) where resources are constrained and individuals from different functional backgrounds convene to make portfolio selection decisions. Yet, literature that focusses on these issues is scant. NPPS decisions are pivotal to achieving portfolio ambidexterity and are therefore highly influential in organisations' success. This study, therefore, investigates the antecedent and consequence roles of PMSs and associated organisational factors, for portfolio ambidexterity and performance, in the challenging and also paradoxical setting of NPPS. More specifically, the study examines the types of PMS and levels of functional diversity employed during NPPS and it investigates how debate, conflict, and type of meeting forum affect portfolio ambidexterity and performance. Building on the literature in management accounting, organisational science and ambidexterity, along with theories of paradox and conflict, data are collected for this study in two phases. Using a positivist, functional approach and a mixed method design, the first research phase captures qualitative findings from interviews with 12 managers expert in NPPS. The resultant findings form the basis for the second, quantitative research phase. Survey data are drawn from a senior manager in each of 77 cross-functional teams involved in NPPS across high technology companies operating in the medical devices and information technology industries in Ireland. Using structural equation modelling, several insights emerge.

Overall, this research contributes rare, empirical evidence and it delivers antecedent and consequence models for ambidexterity that provide guidance for the design and use of PMSs and for the use of other organisational factors, to foster portfolio ambidexterity and improve performance in contemporary challenging and intensely competitive markets. Findings add valuable new insights to the literature on innovation and portfolio management, on conflict, and on informal management control. The study also extends the ambidexterity and paradox literatures to the management of portfolio ambidexterity. Moreover, the credibility and value of the mixed method approach is advanced as it uncovers important nuances associated with the identification of a new construct, meeting forum. In conclusion, the study contributes a deeper comprehension of the complex links between PMSs, debate, cognitive conflict, meeting forum, portfolio ambidexterity and performance.

Acknowledgements

At the outset I must sincerely thank both of my supervisors and mentors, Professor Breda Sweeney and Dr Kathryn Cormican. Having mutually embraced the 'both/and' approach, and despite some speed bumps along the way, I truly benefited from the expertise, guidance, patience, and encouragement from **both** of these two exceptional and learned women without whom this project would never have seen the light of day. Thank you both very, very much.

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Publications and Research Presentations

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O'Dwyer, C., Sweeney, B., & Cormican, K. (2017). Embracing paradox and conflict: Towards a conceptual model to drive project portfolio ambidexterity *Procedia Computer Science,* Vol. 121, pp. 600-608. https://doi.org/10.1016/j.procs.2017.11.079

O'Dwyer, C., Sweeney, B., & Cormican, K. (2017). Embracing Paradox: How performance management systems engage cognitive conflict during project selection in ambidextrous organisations**.** *Proceedings of the 24th International Product Development Management Conference*, Reykjavik, Iceland, June 2017.

O'Dwyer, C., Sweeney, B., & Cormican, K. (2019). 'The Role of Performance Measurement Systems in Product Portfolio Ambidexterity.' Working paper presented at the 32nd IAFA Annual Conference and Doctoral Colloquium, Dublin City University, May 15 -17, 2019.

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O'Dwyer, C., Sweeney, B., & Cormican, K. (2017). 'Embracing paradox and conflict: Towards a conceptual model to drive project portfolio ambidexterity.' Short paper presentation at the 6th International Project MANagement (ProjMan) Conference, Barcelona, Spain, November 2017.

O'Dwyer, C., Sweeney, B., & Cormican, K. (2016). 'Embracing Paradox and Conflict: How Performance Management Systems drive Ambidexterity through Project Portfolio Selection.' Presentation of working paper at the IAFA Doctoral Colloquium, Waterford Institute of Technology, May 19-20, 2016.

Dedication

This work is dedicated to my parents Albert C.G. Parkinson and Agnes R. Parkinson (neé Duddy).

Mam and Dad spent a lifetime vocalising the importance of a good education to getting on in life. All through our early school years, my siblings and I had to complete our exercises or ekkers (the term for homework in those days!) before being allowed out to play. Thus, the foundations and respect for achieving high standards through paying attention, working hard and the commitment to doing your best, were built upon my parents' efforts. I love you both dearly.

In honour of my Dad's life-long love of the sea and sailing, and my Mother's life-long dedication to Dad, the sailing metaphor below strikes a chord I hope they can both enjoy, as it relates to my work;

'The challenge of achieving high levels of both exploration and exploitation parallels the challenge sailors face in attempting to sail into the wind. The sailor knows that laying a course directly into the wind not only slows progress but ensures regress. In contrast, skilfully configuring the boat's mainsail, foresail, and rudder to set a course 40 degrees off wind can generate tremendous speed. While traveling on this 'close-hauled' course can maintain a fast speed, the boat is not sailing directly toward the desired destination. Indeed, sailing for too long on this course takes the boat far from its desired destination. Hence, the sailor comes about, reconfigures the sails and rudder, and sets a course 40 degrees off wind. While each course correction or 'tack' imposes a loss in forward momentum, the skilful sailor masters these reconfigurations so as to minimise momentum loss and enable the boat to sail, on average, into the wind and achieve the objective faster than staying on one course for an extending period of time'

(Boumgarden, Nickerson & Zenger, 2012, p. 606)

Abbreviations and Glossary of Terms

AffCon	Affective Conflict, relationship-based disagreement
BU	Business Unit; A 'business unit' is a self-contained business or operating division of a larger company. It has its own management team, R&D, sales and marketing, operations, etc. In the case of a smaller company, the 'business unit' may be the entire company (Cooper, Edgett & Kleinschmidt, 1998, p. 16).
CA;CompAmb	Competence Ambidexterity, the pursuit (ex-ante) of exploitation and exploration;
CEO	Chief Executive or Chief Executive Officer
CogCon	Cognitive Conflict, task-based disagreement
Capability Or Competence	'the knowledge, skills, and related routines that constitute a firm's ability to create and deliver superior customer value' (Day 1994, p. 38 in Atuahene-Gima, 2005).
CMB	Common Method Bias
CSF	Critical Success Factor
EC	The European Commission
EN	European Standard
EU	The European Union
FD	Functional diversity
HTI	High Technology Industry
IA;InnAmb	Innovation Ambidexterity, the realisation (ex-poste) of CA into incremental and radical new product innovations
IMDA	Irish Medical Devices Association
IT	Information Technology
KPI	Key Performance Indicator
MA	Management Accounting
MAC	Management Accounting Control
MCS	Management Control System
MACS	Management Accounting and Control Systems

NPD	New Product Development
NPD-PPS	New Product Development- Project Portfolio Selection
NPPM	NPD Project Portfolio Management
NPI	New Product Innovation
NPPS	New Product Portfolio Selection
NPSR	New Product Success Rate
PDF	Portable Document Format; used to display documents in an electronic form independent of the software, hardware or operating system they are viewed on
PLS-SEM	Partial Least Squares-Structural Equation Modelling
PM	Project Management
PMS	Performance Measurement System
PPM	Project Portfolio Management
PPS	Project Portfolio Selection
R&D	Research and Development
R&I	Research and Innovation
RO	Research Objective
Schismogenesis	A process of self-reinforcement where "one action or attribute perpetuates itself until it becomes extreme and therefore dysfunctional" (Cameron & Quinn (1988, p6) in Papachroni, Heracleous & Paroutis, 2015, p. 73).
SPSS	Statistical Package for Social Scientists
TMT	Top Management Team

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‘‘It is not the strongest of the species that survive,

nor the most intelligent,

but the one

that is most responsive to change’’

Charles Darwin

Chapter:1 **Introduction**

Setting the Scene

1.1 Introduction

This chapter provides an overview of the research study undertaken and offers a guide to the thesis structure where details of the research process and its findings are compiled. It begins with an introduction to the context and backdrop of the research where key challenges to innovation faced by organisations are explored. Gaps in knowledge are identified followed by a description of the aims and objectives of the research. Next an introduction to the research methods employed is presented. The chapter continues with a summary of its conclusions and contributions. Finally, the thesis structure and outline of each chapter's contents are provided.

1.1 Motivation for the study

Innovation, the means by which change is exploited for opportunity or value, is central to organisational success and prosperity (Drucker, 2011). Technology-based projects (e.g. new products) are the focal point of innovation and value for many companies and indeed such companies depend heavily on the performance of their innovation project portfolio. However, these companies face particularly challenging markets because of the exceptional speed at which knowledge and technologies continue to advance, and the ever-increasing rate of product obsolescence that leads to greater pressure for more innovation. Furthermore, today's business landscape is constantly transforming and often in unpredictable and unprecedented ways. This makes the environments with which companies must contend ever more challenging; the costs of product innovation are climbing, product life cycles are shrinking, innovation budgets are under constant threat and new products that are developed in the face of such change frequently fail (Moll, 2015; Jugend & Da Silva, 2014; Droge, Calantone & Harmancioglu, 2008; Cormican & O' Sullivan, 2004). For these reasons, there has been a meteoric rise in attention given to ambidexterity with its promise to provide the innovation necessary for organisational success as well as the innovation that will protect organisations' future. However, achieving ambidexterity is a formidable challenge (Atuahene-Gima, 2005).

Ambidexterity derives from the term ambidextrous meaning the ability to use the right and left hands equally well (March, 1991; Duncan, 1976). In the context of product innovation, competence (or ex-ante) ambidexterity describes the simultaneous pursuit of exploitation and exploration; innovation ambidexterity describes the successful realisation of competence ambidexterity in the form of radical and incremental new product innovations. However, competence ambidexterity is notoriously difficult to achieve (Andriopoulos & Lewis, 2009; Cao, Gedajlovic & Zhang, 2009; Atuahene-Gima, 2005). In the first place, ambidexterity is a paradox (Cunha, Bednarek & Smith, 2019; Lin, Mc Donough, Lin & Lin, 2013; Andriopoulos & Lewis, 2009). Exploration and exploitation competences behave as polar opposites; trying to engage in both simultaneously makes oppositional and contradictory demands on companies and employees (O' Reilly & Tushman, 2011). In the second place, exploitation and exploration are often in competition for the same scarce resources. The resource demands for exploration outweigh those needed to exploit. This creates a natural bias towards exploitation. Third, it is very challenging to achieve the right balance between both. This can have serious adverse consequences; if there is too much emphasis on exploitation and incremental product developments, the company runs the risk of becoming obsolete by remaining dependant on past successes and therefore unprepared for change. Excessive focus on exploration towards radical innovation exposes the company to risks of bankruptcy before it has had the chance to profit from its investment. Furthermore, even if both exploration and exploitation competences are simultaneously and well developed, it does not guarantee that competence ambidexterity will translate successfully into innovation ambidexterity (Bedford, Bisbe & Sweeney, 2019; Lin et al., 2013; Lavie, Stettner & Tushman, 2010). Yet, companies and organisations are advised that competence and innovation ambidexterity are vital to survival and especially in turbulent environments (Birkinshaw, Crilly, Bouquet & Lee, 2016; Kortmann, 2015; Lin et al., 2013; Cao et al., 2009; Simsek, Heavey, Veiga & Souder, 2009; O' Reilly & Tushman, 2008) as exist today.

Thus, the literature is replete with enthusiasm for ambidexterity and filled with warnings about the difficulties in achieving ambidexterity. However the literature is depleted and fragmented in the solutions it offers to ambidexterity. Further, a company's portfolio of projects is key to achieving ambidexterity, yet, little attention has been given to specific organisational factors required to achieve project portfolio ambidexterity in the real-world context. Furthermore, while the extant literature in NPD and portfolio management emphasises that organisations must develop the ‘right projects’ and achieve the ‘right mix’ or ‘balance’ of projects through the project portfolio to maximise portfolio value (Eling, Griffin & Langerak, 2016; Jugend & Da Silva, 2014; Petit & Hobbs, 2012; Cooper, Edgett & Kleinschmidt, 2001), little attention is focussed on achieving this through portfolio ambidexterity. Moreover, given that project portfolio composition depends on project selection decisions, little is known about these decision processes in practice, nor how they might contribute to an ambidextrous portfolio. Yet, ambidexterity continues to be lauded as crucial for survival.

1.2 Overarching research objective

The study aims to apply the concept of paradox (with its ‘both/and’ approach) to help understand project portfolio ambidexterity. More specifically, using this lens, the aim of the study is to build and test a model of organisational factors that identify and explain determinants and consequences of ambidexterity in the context of new product portfolio selection (NPPS).

1.3 Research question

Companies typically have more NPD projects to choose from than resources available for their development; yet these companies must attempt to select from available projects a group or portfolio of NPD projects that offers the greatest potential for success (Mc Nally, Durmusoglu & Calantone, 2013; Cooper, Edgett & Kleinschmidt, 1999; Cooper & Kleinschmidt, 1988). Since ‘portfolio decisions determine the products that the company will use to compete in the market’ (Jugend & Da Silva, 2014, p. 19), portfolio performance is of critical significance to company success. NPPS is therefore crucial to both NPD portfolio and company performance. However, there is a scarcity of knowledge on portfolio-based ambidexterity. More specifically, there is a void in understanding how NPPS decisions are made by individuals tasked with making these decisions; and furthermore it is unknown how they attempt to achieve a balanced portfolio considering the overwhelming bias that exists towards exploitation and incremental product choices and away from exploration and radical product selections (O' Reilly & Tushman, 2011; Smith & Lewis, 2011).

There is growing interest in the use of PMSs in an ambidexterity context. However, most of the extant research is focussed on their effects where one or other form of innovation (exploitation or exploration) is being pursued. A performance measurement system (PMS) is defined as 'the set of metrics used to quantify both the efficiency and effectiveness of actions' (Neely, Gregory & Platts, 1995, p. 81). For example, feedback on innovation performance against expectations facilitates the control of future behaviour by indicating where adjustments should be made to the PMS that is directing the innovation strategy (Bourne, Kennerley & Santos, 2005). Among the few studies that examine the pursuit of multiple strategies (but not contradictory strategies specifically), Dekker, Groot & Schoute (2013, p. 72) find that PMSs can be designed toward 'balancing effort.' These authors explain that a diverse set of measures is important to stimulate debate, and that this debate mitigates the bias toward a single strategic direction. Previous limited research that examines PMSs in an ambidexterity setting, has found that performance measurement systems (PMSs) are important drivers of organisational ambidexterity (Bedford et al., 2019). In their empirical research in high technology ambidextrous firms, Bedford et al. (2019, p. 24) advocate that the 'PMS must be explicitly designed with a balanced representation of measures to prevent the crowding out of radical innovation efforts.' The PMS content is found to be instrumental in stimulating this debate. Scholars in the management of paradoxes (of which ambidexterity is an example), explain the important role of balancing strategic opposites (represented by a balanced PMS) in successfully managing strategic contradictions such as ambidexterity (Papachroni et al., 2015; Smith & Lewis, 2011; Andriopoulos & Lewis, 2010).

If and how PMSs may assist in portfolio ambidexterity is unclear. There is little evidence on the specific mechanisms used by individuals who are tasked with making NPPS decisions. A plethora of project selection tools including scoring cards, and mathematical and statistically based frameworks, are available for project analysis and evaluation. But, according to the literature, these tools are not used as often as might be expected. Reasons given include perceptions of over-complexity, lack of reliability in uncertain environments, being project rather than portfolio focussed, and a lack of their suitability for real-world contexts (Meifort, 2016; Hall, Long, Qi & Sim, 2015; Moll, 2015; Martinsuo, 2013; Kester, Griffin, Hultink & Lauche, 2011; Blichfeldt & Eskerod, 2008). Further and surprisingly, no attention has been given to an examination of the conflict or disagreements that are most likely to arise during NPPS, nor to its management. This area is underexplored and more needs to be learned about the role of PMSs in driving ambidexterity in general (Bedford et al., 2019) and in supporting NPD portfolio ambidexterity in particular. The promise of ambidexterity and the potential for PMSs and associated organisational factors in supporting NPD portfolio ambidexterity, along with lingering gaps in understanding NPPS 'in practice' (Jugend & Da Silva, 2014; Martinsuo, 2013; Turner, Swart & Maylor, 2013), motivate this enquiry. Hence this study addresses the following overarching research question:

What role do performance measurement systems (PMSs) and related organisational factors (tensions, debate, conflict, functional diversity) play during NPPS in the achievement and outcome of an ambidextrous portfolio?

1.4 Research objectives

In summary, to answer the research question, the research objectives of this study are as follow:

<u>Research objective 1</u>. Analyse NPPS in high technology industry (HTI) to identify key stakeholders and explore organisational constructs relevant to ambidexterity.

<u>Research objective 2</u>. Test hypothesised relationships to derive a model of specific organisational antecedents of competence ambidexterity in NPPS.

<u>Research objective 3</u>. Test hypothesised relationships to derive a model of specific consequences of competence ambidexterity in NPPS.

To address its research objectives, the study takes a more detailed look at the mechanisms used during NPPS and the achievement of a balanced, ambidextrous NPD portfolio. Following an examination of the extant literature that includes the themes of ambidexterity, NPPS, PMSs, and conflict, the theoretical underpinnings of the study are derived. Ambidexterity is itself a paradox and the literature review includes an examination of paradox to employ the paradox lens as the 'method theory' that underpins this research (Lukka & Vinnari, 2014).

As recent research indicates, certain variables (PMSs, debate, conflict) found to be relevant for ambidexterity are likely to be highly relevant in the context of portfolio ambidexterity and NPPS. This study therefore examines a role for PMS and these other organisational factors in supporting portfolio ambidexterity. Considering that NPPS decisions are made by individuals from different functional backgrounds, it is likely that conflict arises during NPPS and is highly relevant in this context. Previous literature has distinguished between task-based conflict termed cognitive conflict and personality or relationship conflict termed affective conflict and finds that cognitive conflict can have positive effects on decision quality, decision acceptance and decision implementation (Parayitam & Dooley, 2009; Jehn, 1995). Only a single study has examined conflict and PMSs in an ambidexterity setting (Bedford et al., 2019), and finds an important role for cognitive conflict, aroused by debate between individuals of diverse backgrounds and experiences, in facilitating competence ambidexterity. Previous research has not examined conflict in the setting of portfolio management where it is highly likely to arise because individuals involved in NPPS come from different functional backgrounds and their priorities are likely to differ. So, while the interplay between accounting and NPD is insufficiently understood (Moll, 2015), it seems reasonable to expect that PMSs could be designed and used in a manner to assist NPPS decisions to achieve a 'portfolio's mix of incremental, semi-radical and radical innovation' (Davila, Shelton & Epstein, 2015, p. 147). In effect this describes an ambidextrous portfolio. Therefore, as its first objective this study explores NPPS in the high technology medical devices industry, through semi-structured interviews, to identify key stakeholders and organisational constructs including PMSs, debate, and cognitive conflict, likely relevant to NPPS and ambidexterity.

Research objectives two and three are addressed by employing the interview findings in combination with the literature to develop and then quantitatively test a series of hypothesised relationships that describe and explain the antecedents and consequences of competence ambidexterity in the context of NPPS. More specifically, to test an antecedent model for competence ambidexterity, the study investigates PMSs, including their design and use, employed during NPPS. Further, the study examines functional diversity among individuals involved in NPPS, and explores debate and conflict aroused during NPPS, and their impacts on competence ambidexterity. The study then tests a consequence model for competence ambidexterity in the context of NPPS. Even if competence ambidexterity is achieved the realisation of innovation ambidexterity is not guaranteed. Similar to attempts to simultaneously explore and exploit, radical and incremental innovations make opposing demands which are extremely difficult to meet simultaneously (Bedford et al., 2019; Lin et al., 2013; Jansen, Simsek & Cao, 2012). Cognitive biases towards consistency, and tendencies towards incremental products with their lesser associated costs and risks compared to radical product developments, are some of the reasons given that favour incremental product innovation choices (Curtis & Sweeney, 2017; Birkinshaw & Gupta, 2013; Lin et al., 2013). There is relatively little research that directly examines the link between competence ambidexterity and innovation ambidexterity (for exceptions see Bedford et al., 2019; Kortmann, 2015; Wang & Rafiq, 2014). Indeed, Kortmann (2015, p. 666) contends that companies must 'simultaneously develop discontinuous and incremental innovations … for sustainable superior performance.' Project selection decisions for the NPD portfolio must therefore overcome the contradictions and provide a balanced mix of radical and incremental new product innovations following on from competences exploitation and exploration (Jugend & Da Silva, 2014). The study therefore examines the implications of competence ambidexterity for innovation ambidexterity, new product success and performance.

1.5 Design of the study

To address the research objectives and answer the research question, the study embraces the mixed methods research approach (Saunders, 2012; Tashakkori & Creswell, 2008; Mingers, 2001), discussed in more detail in chapter three. The research is carried out in two phases as represented in Figure 1.1.

Phase one is qualitative in nature and it sets out initially to address research objective one. It begins by conducting a comprehensive literature review on ambidexterity and paradox to justify the theoretical lens of paradox in the examination of ambidexterity. The review continues with a critical appraisal of other organisational factors pertinent to ambidexterity, including performance measurement systems (PMSs), the NPD project portfolio, and the management of conflict. The literature review is used to generate insight into the theoretical underpinnings of the research, to identify gaps in knowledge, and to prepare for phase one interviews. Guided by this literature, an interview schedule is prepared, and semi-structured interviews are conducted with individuals who work in NPPS in the high technology manufacturing industry based in Ireland. Twelve senior managers across different functions in the medical device industry, all of whom possess extensive experience in NPPS, are interviewed. NPPS is analysed to identify key stakeholders and explore organisational constructs relevant to ambidexterity. The findings from these first phase interviews are analysed using the NVivo software package (Bazeley & Jackson, 2013) and they provide empirical guidance to prepare for the second, quantitative phase of the research that will address research objectives two and three.

Phase two of the research is quantitative in nature. Based on findings from phase one interviews and a return to the literature, a conceptual model consisting of 10 hypotheses is developed. It sets out proposed relationships between a number of organisational variables and ambidexterity. These examine specific antecedents and consequences of competence ambidexterity during NPPS. This model guides the development of the survey instrument employed to test the hypotheses and is targeted at individuals who partake in NPPS. NPPS in the highly innovative, high technology medical device industry (MDI) and information technology (IT) industries based in Ireland, provide the context for this research. Data captured by the survey are analysed using SPSS (statistical package for social scientists) and PLS-SEM (partial least squares - structural equation modelling) to validate two conceptual models; an antecedent and a consequences model for competence ambidexterity. A return to the literature proves invaluable in substantiating the research findings, discussing their relevance and clarifying the study's unique contributions (Figure 1.1).

1.6 Contributions of the study

This study makes important theoretical and practice contributions and it provides novel and unique empirical evidence of NPPS in the HTI where ambidexterity is relevant and necessary. More specifically, the study makes five contributions to theory. **First**, the study contributes to the innovation and portfolio ambidexterity literature with competence ambidexterity antecedent and consequence models. These models identify PMSs and other related organisational factors and provide a deeper understanding of how they support competence ambidexterity in the context of NPPS. **Second**, the study builds on the theory of paradox and demonstrates that the latter's 'both/and' approach to balanced decision-making, supports the achievement of portfolio ambidexterity. **Third**, the study extends the management accounting literature in identifying a crucial role for PMS design and use by a multifunctional NPPS team, in the support of portfolio ambidexterity. **Fourth**, the study adds new insights to the literature on conflict. This includes the identification of a new antecedent construct, namely meeting forum; and the need for future attention to be directed at this construct because of its unexpected impacts on cognitive conflict and ambidexterity. **Fifth**, the study adds to the portfolio management and ambidexterity literatures with evidence that competence ambidexterity is relevant to portfolio ambidexterity and it can be supported during NPPS towards successful new product and performance outcomes.

Based on these theoretical learnings, three broad implications for practitioners are highlighted. Guided by the framework (two conceptual models) for portfolio ambidexterity developed in this study, managers are guided towards more proactive and theoretically grounded behaviours and actions in developing and benefiting from portfolio ambidexterity during NPPS. **One**, practitioners are advised of the power available to them in a specifically balanced design of the PMS employed to guide NPPS to support ambidexterity. **Two**, practitioners are encouraged to promote debate based on the PMS among a multifunctional team, when making NPPS decisions. These are valuable and specific insights that provide the means to tailor improvements in the established NPPS setting where PMSs are ubiquitous. **Three**, managers are cautioned to be cognisant of the potential for conflict when paradoxical decisions are being made and of the importance in managing such conflict. In this regard, managers are strongly advised to pay more attention to meeting forum management, as this study's findings suggest this will be critical for the future in propelling portfolio competence ambidexterity.

Finally, this study makes three rare empirical contributions. **First**, it provides data from 89 experts in NPPS (12 interviewees + 77 respondent teams) currently operating in the HTI based in Ireland, and answers calls for research on achieving ambidexterity based on real world contexts. This empirical data identifies specific organisational factors including specific performance measures that are employed during NPPS. **Second,** it provides a unique, empirical comparison between five different conceptualisations and operationalisations of the ambidexterity construct in a single study. This analysis answers calls for comparable work and serves to contribute in earnest to the debate on a more consistent approach to measuring ambidexterity. This will make future studies more amenable to comparison. **Third**, the study offers empirical support for using a mixed methods approach in research. The new construct, meeting forum, (consisting of its two variables, formal and informal meeting forum), is identified during phase one of the study. Phase two offers the opportunity for a more in-depth analysis of the construct.

Overall, the study facilitates future portfolio ambidexterity and performance outcomes. It contributes towards a better understanding for academics and practitioners, of the antecedents and consequences of competence ambidexterity in the complex and fluid context of innovation portfolios in the Irish based HTI.

1.7 Outline of chapters

The remainder of this thesis is structured as follows;

Chapter 2: reviews the extant literature. It examines theory relevant to the study domain that includes ambidexterity, the new product development (NPD) portfolio, organisational conflict and performance measurement systems. It also establishes paradox as the ideal theoretical lens for the study of ambidexterity.

Chapter:3 introduces the philosophical position (ontological and epistemological approach) of the study as a positivist, functionalist work. It then discusses the appropriateness of qualitative and quantitative research methods as it describes and justifies the mixed methods design employed. The methods used to conduct the first field phase of the study, namely the semi-structured interviews that address the first research objective, are then presented followed by a description of the data analysis techniques employed. .

Chapter:4 presents findings derived from NVivo analysis of the exploratory interviews that begin to address the second and third research objectives. The discussion identifies and confirms constructs important for NPPS and ambidexterity that include the revelation of a novel construct, meeting forum. These findings justify further investigation in research phase two.

Chapter:5 ensues and presents a conceptual model and ten hypotheses that are developed based on learnings from the literature and the interviews conducted during study phase one, further addressing second and third research objectives.

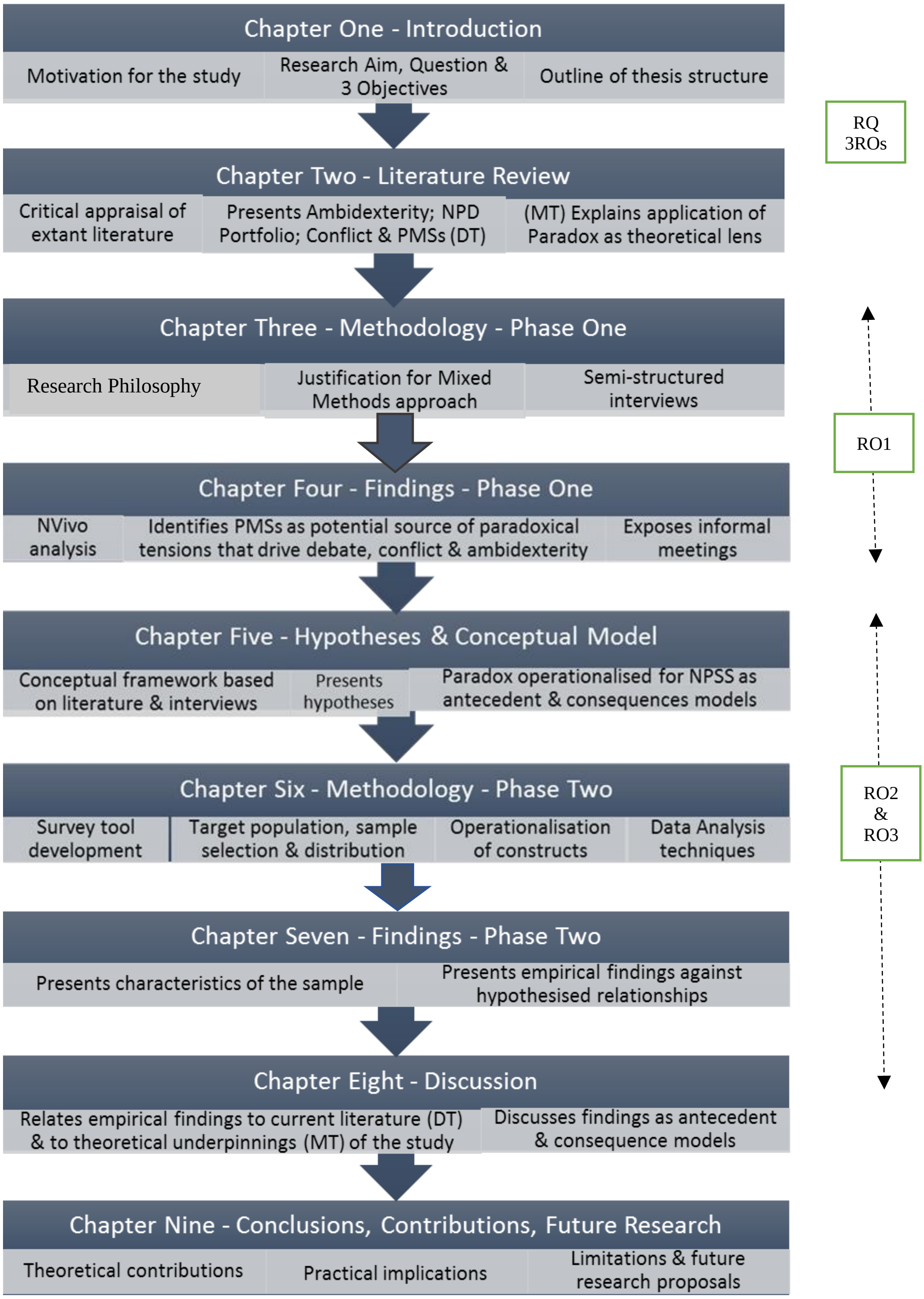
Chapter:6 presents the methods associated with the quantitative research phase and the means of more fully addressing the second and third research objectives. It describes and discusses the development of the survey instrument including the source of its variables, their operationalisation and their measurement. It includes the process of sample selection and survey distribution. The statistical analysis techniques employed are described. Preliminary statistical tests are performed and presented.

Chapter:7 presents the survey findings. It details respondent characteristics and analyses the hypothesised relationships associated with each of the antecedent and consequence models. It answers the findings regarding the hypothesised relationships in the form of two models; an antecedent and a consequence model for competence ambidexterity.

Chapter:8 discusses the research findings with specific references to the extant literature. Herein, reference is made to the research question, the study objectives, and a discussion based on the antecedent and consequent models of ambidexterity.

Chapter:9 brings this thesis to a close. It summarises the study and presents its conclusions. It details the research contributions and it includes a discussion on the study's limitations. Finally, it offers suggestions for potential future research.

See below for a graphical representation of the entire thesis in Figure 1.1.



Key: DT = Domain Theory; MT = Method Theory; RO = Research Objective

Figure 1.1 Diagrammatic representation of this thesis

Chapter:2 **Literature Review**

“Theory is always the foundation of empirical analysis”

(Hair, Hult, Ringle & Sarstedt, 2017, p. 232)

2.1 Introduction

This chapter presents themes and theories that emerge from a review of the extant literature on the theoretical and methodological foundations for the research to address its research question and objectives. It begins with an introduction to organisational ambidexterity, an extensively researched field because of its importance to organisational performance, and the challenges still faced in its implementation and achievement. The review proceeds with an analysis of paradox theory to capture insights on how to manage the conflicting tensions inherent in achieving ambidexterity, itself a paradox. Then it introduces new product portfolio selection (NPPS), the context for this study. This context (NPPS) is chosen for two reasons; one, its criticality in optimising new product development (NPD) portfolios to ensure organisational success; and two, this setting provides a paradoxical setting in which the tensions of ambidexterity can be examined. Two constructs especially pertinent to this research also receive attention in this section, namely debate and cognitive conflict. Next, the chapter focusses on performance measurements systems (PMSs) as these are ubiquitous in organisations but insufficiently researched for their potential to support the simultaneous pursuit of exploration and exploitation in general, rarely studied in regard to (NPD) project portfolios, and most rarely if ever, in the context of (NPD) project portfolio selection (PPS). The penultimate section discusses some differences between formal and informal control. The chapter concludes with a summary that provides the basis for the next phase of this study, namely the phase one qualitative interviews.

2.2 Why ambidexterity and what is it?

Innovation '(lies) at the heart of firms' value creation, survival and growth in contemporary environments' (Bisbe & Malagueño, 2015, p. 356). New product development (NPD) represents one vehicle for successful and ongoing innovation in many organisations (Randall, Edelman & Galliers, 2017). Without innovation, a company 'succumbs to competitors or market shifts and eventually disappears' (Davila et al., 2015, p. 240). Furthermore, research contends that building capabilities to employ <u>two</u> types of innovation contributes to an organisation's ability to remain competitive into the long-term (March, 1991; Duncan, 1976). This is termed competence ambidexterity (CA) in the literature and is central to this research. Competence ambidexterity (CA) describes the successful and simultaneous pursuit of *exploration* and *exploitation* sometimes referred to as ex-ante ambidexterity (He & Wong, 2004). Competence ambidexterity leads to outputs (ex-post) of radical and incremental new product innovations, described as innovation ambidexterity (Kortmann, 2015; He & Wong, 2004).

The term ambidexterity referred originally to a person who is equally dextrous in writing using their left or right hand. Exploitation on one hand, builds upon existing assets, knowledge, skills and processes to support a company's everyday survival (Atuahene-Gima, 2005; March, 1991). In terms of new product development (NPD), exploitation describes small advances or improvements to existing products delivering *incremental* new products (Kester et al., 2011; Muller, Martinsuo & Blomquist, 2008; Cooper, Edgett & Kleinschmidt, 2000; Tushman & O' Reilly, 1996). Based on incremental changes, exploitation is therefore associated with greater reliability, stability, efficiency and it facilitates maintenance of a company's status quo. On the other hand, exploration develops new capabilities, seeks new learnings and explores future possibilities (Atuahene-Gima, 2005; March, 1991). If successful, new product exploration delivers fundamentally different, discontinuous or radical new product innovations that offer the greatest potential to support company longevity (Gurtner & Reinhardt, 2016). The aim of the simultaneous pursuit of exploitation and exploration activities (competence ambidexterity) therefore, is to generate incremental and radical innovations (innovation ambidexterity) for superior competitive advantage (Gurtner & Reinhardt, 2016; Lin et al., 2013; He & Wong, 2004; Levinthal & March, 1993). See Figure 2.1 that summarises the characteristics of ambidexterity.

Innovation ambidexterity offers companies the potential to be stable and flexible, to be efficient and adaptable. In other words, innovation ambidexterity is a company's antidote to being rendered irrelevant by changes in their markets and technologies (Birkinshaw & Gupta, 2013; O' Reilly & Tushman, 2013; Andriopoulos & Lewis, 2009; Cao et al., 2009; Baker & Sinkula, 2007; March, 1991). A body of research has grown that links innovation ambidexterity with improved organisational performance, particularly in unstable, dynamic environments akin to today's (Birkinshaw et al., 2016; Gurtner & Reinhardt, 2016; Junni, Sarala, Taras & Tarba, 2013; Lee & Huang, 2012; Andriopoulos & Lewis, 2010; Jansen, Van Den Bosch & Volberda, 2006). So why are competence ambidexterity and innovation ambidexterity not the norm in every organisation?

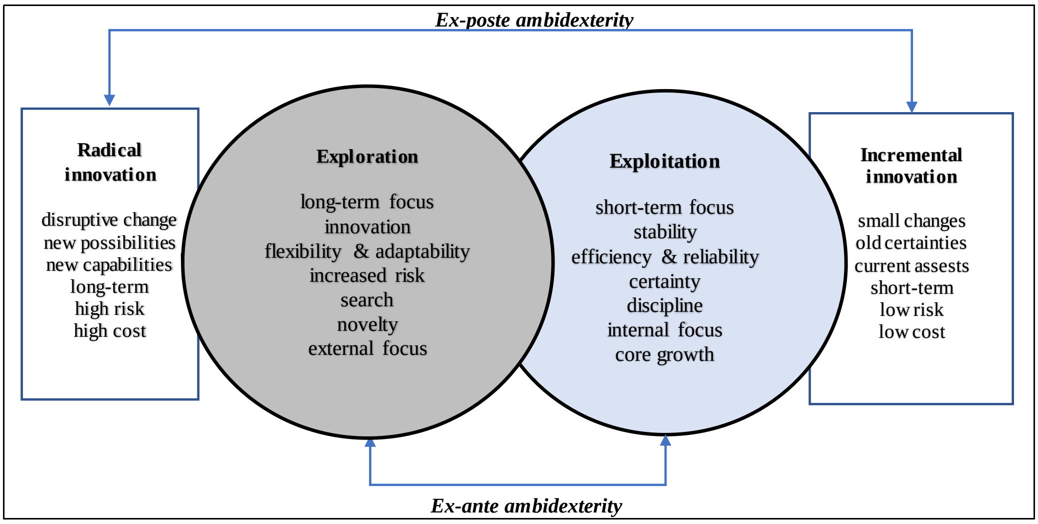


Figure 2.1 The characteristics of ambidexterity following a synthesis of the literature.

2.3 The paradox that is ambidexterity

Exploitation and exploration are polar opposites on the innovation spectrum. Thus achieving innovation ambidexterity through simultaneous exploitation and exploration activities is 'considered one of the toughest managerial challenges in sustaining a firm´s competitive advantage' (Atuahene-Gima, 2005, p. 61). Indeed, the Boston Consulting Group (Haanaes, Reeves & Wurlod, 2018) reported that only 2% of companies successfully manage both exploitation and exploration equally well, leaving a yawning gap to fill for the remaining 98% of companies. The extant literature on organisational ambidexterity, spanning the fields of organisational learning, technological innovation, organisational adaptation, strategic management, organisational design and management accounting, repeatedly expresses the difficulties companies face in managing the contradictory challenges inherent in achieving ambidexterity, as explained next.

Exploration is rife with risk and uncertainty, and it delivers over a longer timeline than is needed for exploitation. Further, exploration demands substantial resources and often is unsuccessful. By stark contrast, exploitation employs existing organisational and individuals' knowledge, systems and processes. It is less demanding of what are usually limited resources and more likely to provide early successes. These oppositional, paradoxical tensions not only make ambidexterity difficult to manage but they create another challenge; they foster a bias or tendency by companies and individuals towards the greater certainty and stability associated with exploitation (Bedford, 2015; Papachroni et al., 2015; Smith & Lewis, 2011). However, too much exploitation, leads to the ‘success trap’ (Lin et al., 2013; March, 1991), that makes companies unprepared for environmental or market changes and thus vulnerable to product redundancies (Figure 2.2).

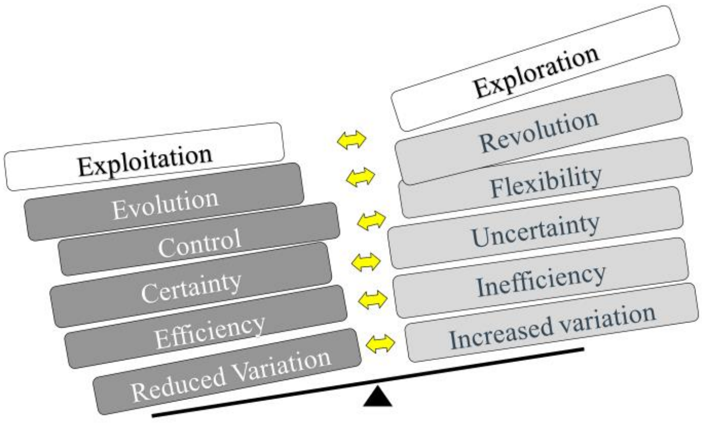


Figure 2.2 The success or competency trap - excessive exploitation versus exploration.

Further, as alluded to earlier, exploration is vital to the discovery of new possibilities and provides answers to new technologies and new challenges faced by firms in the longer term (Baker & Sinkula, 2007; Gibson & Birkinshaw, 2004; Adler, Goldoftas & Levine, 1999; Tushman & O' Reilly, 1996; Levinthal & March, 1993). However, excessive exploration soaks up a company’s slack resources and can leave it bankrupt as it fails to exploit its explorative outputs and this leads to what is termed the ‘failure trap’ (Lin et al., 2013; March, 1991). Organisations must find ways to overcome these inclinations and instead, achieve a *balance* that desists from focusing too heavily on either type of innovation to the extreme (Cao et al., 2009; O’ Reilly & Tushman, 2008; Smith & Tushman, 2005). To this end, research has advanced a series of initiatives employed by companies for achieving ambidexterity. Some of these mechanisms to achieve within-organisation ambidexterity are outlined next to expose the complexities that underlie the struggle faced in achieving competence and innovation ambidexterity. Figure 2.2 provides a simplistic representation of the pull or ‘tug of war’ between opposites that arises when ambidexterity is pursued. In this figure, the see-saw is weighted down on exploitation demonstrating the more common bias towards the lesser challenging road of exploitation.

2.4 Mechanisms to achieve ambidexterity

The earliest research following Duncan's (1976) introduction of the term organisational ambidexterity, considers the achievement of ambidexterity as a *trade-off* process, a choice between exploitation *or* exploration (Levinthal & March, 1993; Duncan, 1976). In this trade-off situation, companies believe it is necessary to sequentially or temporally separate each activity via dual structures because both cannot be conducted at the same time; organic structures (i.e. loose job specialisation, decentralised decision-making, minimum direct supervision) to support early exploratory innovation phases; and mechanistic structures (i.e. specialised functions, centralised decision-making, formal procedures and processes) to support latter phases of exploitation (Venkatraman, Lee & Iyer, 2007; Tushman & O' Reilly, 1996).

As environments and technologies begin to change increasingly rapidly, March (1991) asserts that companies must simultaneously exploit and explore. Ambidexterity is still viewed conceptually as a balancing act but also as one between opposing ends of a *continuum*, such that increasing levels of exploitation mean resources are taken from exploration which consequently suffers. To achieve competence ambidexterity therefore, and advance earlier temporal approaches, another view suggests conducting exploration and exploitation activities concurrently but in physically distinct sub-units (Simsek et al., 2009; Smith & Tushman, 2005; Benner & Tushman, 2003). In this stream of research, emphasis is placed upon the significant role played by senior leadership, excellent communication processes and shared strategic visions to integrate learnings and outputs from the differentiated units and derive combined outcomes of innovation ambidexterity (Turner et al., 2013; Smith, Binns & Tushman, 2010; O' Reilly & Tushman, 2008). Figure 2.3 represents a typology of ambidexterity as created by Simsek et al. (2009). From a synthesis of the various literatures on ambidexterity's conceptualisations, these authors present four main types of ambidexterity based upon two dimensions; the temporal (simultaneous or sequential) and structural (independent or inter-dependent) dimensions. So, for example, if exploitation and exploration are conducted concurrently and within a single organisational unit, ambidexterity is described as harmonic etc.

Gibson & Birkinshaw (2004) suggest the contextual approach to overcome the inherent competition for scarce resources arising in the simultaneous pursuit of ambidexterity. The contextual approach suggests that individuals in companies decide when to switch their time between the conflicting demands of alignment (exploitation) and adaptability (exploration) according to the challenges they face (Simsek et al., 2009; Gibson & Birkinshaw, 2004). The overarching aim is to ensure that exploitation and exploration operate concurrently rather than as sequential activities. The challenge then is to coordinate the oppositional forces leading to ambidexterity, ‘an organisation's capacity to address two organisationally incompatible objectives equally well’ (Birkinshaw & Gupta, 2013, p. 291).

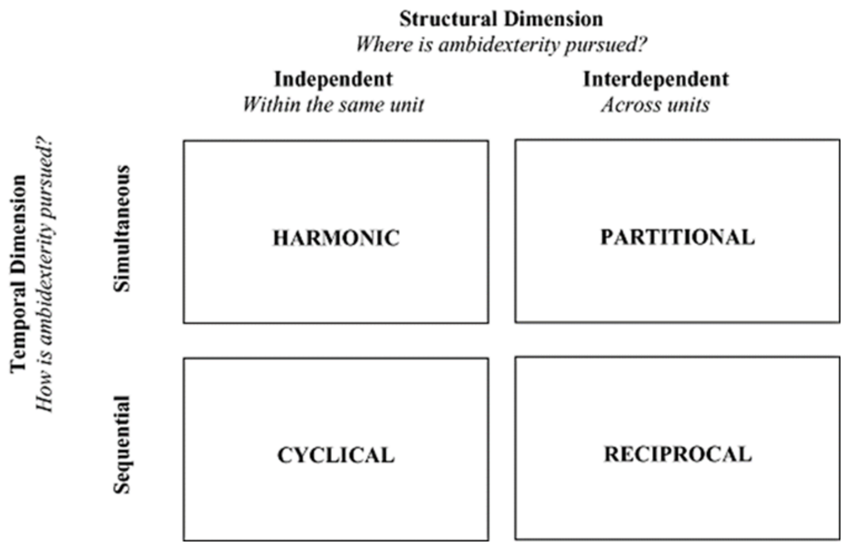


Figure 2.3 A typology of organisational ambidexterity, adapted from Simsek et al. (2009).

Recognising the difficulties in realising ambidexterity within and across organisations, Birkinshaw & Gupta (2013, p. 294) explain that separating exploration from exploitation is not a solution because ‘there is no unit of the organisation (…) that does only one thing.’ Rather, they say, ambidexterity is a ‘blend’ of exploration and exploitation at every organisational level, and organisations should operate in a connected way. The challenge then is to reconcile between alignment and adaptation (Raisch & Birkinshaw, 2008; Gibson & Birkinshaw, 2004; March, 1991), between differentiation and integration (Jansen, Tempelaar, Van Den Bosch & Volberda, 2009; Jansen et al., 2006; Smith &

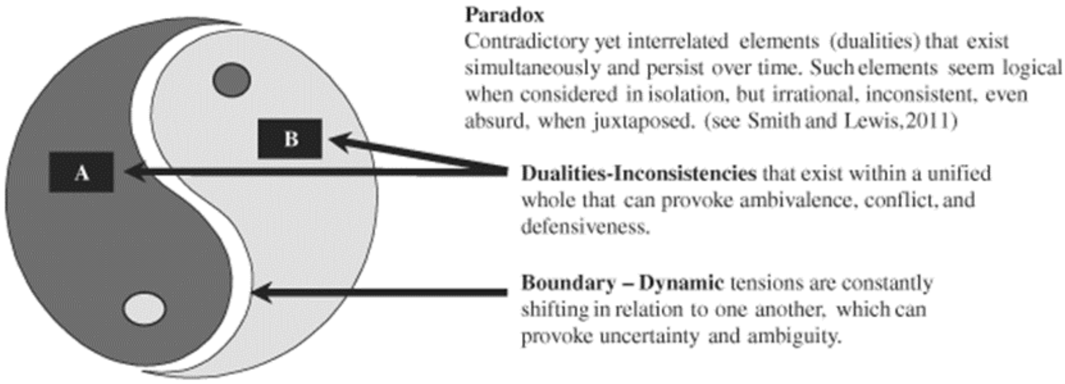
Tushman, 2005) between exploration and exploitation such that an appropriate level of attention is focussed on both.

A turning point arises when Gupta, Smith & Shalley (2006) propose that instead of continuing to consider exploitation and exploration as incompatible and mutually exclusive, they should be viewed as complementary and mutually inclusive. The *orthogonal* approach to ambidexterity is now born. Companies can pursue exploitation independently of exploration and vice versa and more critically, neither at the expense of the other. Later, it is proposed that each activity is beneficial to the other, they are complementary, even reinforcing (Lewis, 2000), or synergistic (Turner et al., 2013) and feed ‘virtuous cycles of ambidexterity’ (Miron-Spektor, Ingram, Keller, Smith & Lewis, 2018; Andriopoulos & Lewis, 2009, p. 6996). Farjoun (2010) puts it nicely when he presents an alternative to the dualism of exploitation and exploration as distinct activities and instead describes ambidexterity as ‘a duality in which stability [proxy for exploitation] and change [proxy for exploration] are fundamentally interdependent, contradictory but also mutually enabling.’

Thus, paradoxical thinking becomes popular as a way of rationalising ambidexterity (Papachroni et al., 2015; Raisch, Birkinshaw, Probst & Tushman, 2009; Lewis, 2000; Eisenhardt, 1989). The challenge is to overcome the ‘capability-rigidity paradox’ (Andriopoulos & Lewis, 2010; Atuahene-Gima, 2005), and cope with the tensions of the paradox, as long-term performance depends on engaging both exploitation and exploration (Smith, 2014; March, 1991; Duncan, 1976). Paradox theory offers useful insights for managing ambidexterity, presented next as it is the ‘way of thinking,’ and it provides the theoretical lens employed in the current study.

2.5 Embracing paradox as a solution to ambidexterity

A paradox denotes ‘tensions that coexist and persist over time, posing competing demands that require ongoing responses rather than one-time solutions’ (Smith, 2014, p. 1592). Paradoxical tensions are viewed as ‘complementary and interwoven’ (Lewis, 2000, p. 764) rather than polarised contradictions. The paradoxical approach moves from decisions based on ‘either/or’ thinking of the trade-off approach, to one that embraces this <u>and</u> that, the ‘both/and’ thinking of the orthogonal approach. Within the paradox frame of thinking then, achieving ambidexterity means that ‘rather than choosing between alternatives, long-term performance depends on engaging them [exploration and exploitation] both’ (Smith, 2014, p. 1592). In other words, managers must opt for short term exploitative ‘and’ long term explorative types of innovation, concurrently, and manage each equally well, to thrive (O’ Reilly & Tushman, 2008; Jansen et al., 2006; Lubatkin, Simsek, Ling & Veiga, 2006). They must ‘move beyond separation-oriented prescriptions toward synthesis or transcendence of paradoxical poles’ (Papachroni et al., 2015, p. 71). Figure 2.4 is a representation of the paradox view adapted from Smith & Lewis (2011) and it reflects the oppositional and contradictory natures inherent in ambidexterity. A and B represent exploration and exploitation as forces of opposition that exist within a unified whole. The internal boundary represents the distinction between exploration and exploitation; managing them as a whole represents ambidexterity and the synergy between exploration and exploitation.



Key: A = exploitation; B = exploration; tensions are represented by the internal boundary; the external boundary encourages synergy by constructing a unified whole.

Figure 2.4 The paradox view of ambidexterity, adapted from Smith & Lewis (2011).

Thus, to be ambidextrous, the paradoxical view is that companies must learn not only to accommodate the contradictions but also to view them as novel synergies; they must not differentiate and integrate but rather view opposites as complementary (Smith & Tracey, 2016; Smith, 2014). The paradox lens offers a rich and more holistic view of ambidexterity. Notwithstanding its benefits, managing the paradoxical tensions of ambidexterity remains ‘a capability that is conceptually ambiguous and difficult to achieve’ (Mc Carthy & Gordon, 2011, p. 250). Further, Lin et al. (2013) advise that in achieving ambidexterity ‘high on both [exploitation and exploration] is better than balanced, and simultaneous is better than sequential' (p.275), indicating the complexity and on-going difficulties for companies, managers and individuals as they grapple with the pursuit of competence ambidexterity.

In response to ongoing calls for clarification and a deeper understanding of how companies manage ambidexterity and its strategic dualities in practice (Birkinshaw et al., 2016), the current study takes place at the centre of a highly paradoxical setting – that of new product selection for a portfolio of new product development (NPD) projects, in companies striving to be ambidextrous. In pursuing portfolio ambidexterity, these companies are forced to choose a small number of new product development (NPD) projects from among a larger number and variety of potential NPD project options spanning from the incremental to the more radical types of product innovations and commit resources towards their development. The group of new products finally selected for development provides the basis on which the potential success of the portfolio depends. Consequently, new product portfolio selection (NPPS) is an imperative phase for performance, but it is also a critical time during which the paradoxical tensions of ambidexterity are made salient and must therefore be managed. This makes new product portfolio selection (NPPS) an ideal context in which to examine paradoxical tensions and how ambidexterity is enacted in practice, and answer calls for this work in the extant literature (Turner, Swart, Maylor & Antonacopoulou, 2015; O' Reilly & Tushman, 2013).

2.6 New product development (NPD) projects

New technologies are being developed at exceptional speeds, and organisations must continuously respond to the 'uncertainties and complexities in [their] business environments' (Jugend & Da Silva, 2014; Martinsuo, 2013, p. 794). One way to do this is through new product innovations (Barczak, Griffin & Kahn, 2009; Cooper & Kleinschmidt, 1995b). Indeed, long-term success 'is contingent upon investing appropriately in on-going product renewal and product line-extensions, as well as investing in products for new market spaces' (Kester et al., 2011, p. 641; Barczak, 1995). Figure 2.5 is a representation of how NPD drives market share value and performance. Incremental new product developments help to satisfy existing customers and grow existing markets. Radical new products help create new markets, and together radical and incremental new products provide the potential to grow market share, market value and overall portfolio / company performance.

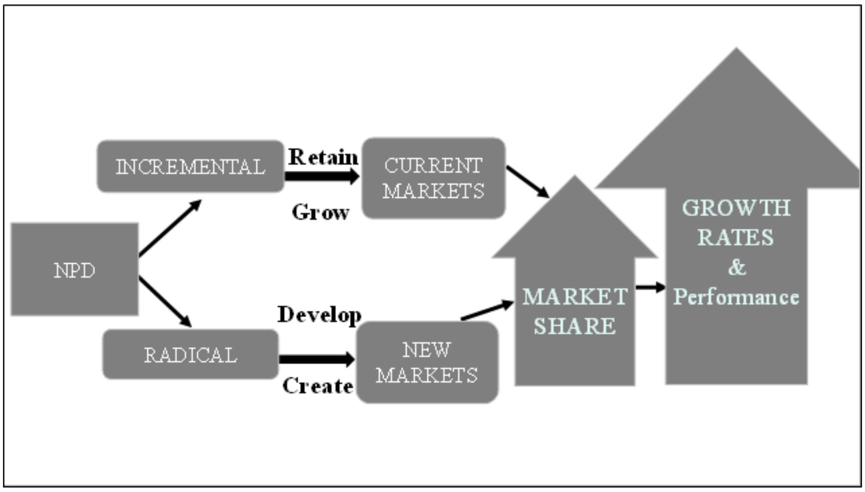


Figure 2.5 Routes and outcomes of new product development (NPD).

Many organisations drive their new product innovations through new product development (NPD) projects (Barczak et al., 2009; Cooper et al., 2001; Song & Parry, 1997). Shenhar, Dvir, Levy & Maltz (2001, p. 699) define projects as 'powerful strategic weapons, initiated to create economic value and competitive advantage.' The earliest research focuses on how best to achieve successful NPD projects. This body of literature introduces broad topics of research including; product life-cycle theory and decision-making at key phases (decision gates) during new product development (Cooper, 1994; Cooper & Kleinschmidt, 1991); the identification of critical success factors in new product development (Griffin, 1997; Song & Parry, 1997; Cooper & Kleinschmidt, 1995a); how to select the best potential new products for development (Calantone, Di Benedetto & Schmidt, 1999; Barczak, 1995); the resource allocation challenge (Cooper & Edgett, 2003); and how to evaluate NPD success (Griffin & Page, 1996; Song & Parry, 1996). In this body of knowledge products are most often considered singularly as sources of technology and performance advancement. Nowadays, recognising that many NPD projects are interrelated and share commonalities and/or are mutually enhancing, research has advanced to studies on groups, packages or portfolios of NPD projects and a new body of literature devoted to project portfolio management (PPM) has ensued.

2.7 The new product development (NPD) project portfolio

The Guide to the Project Management Body of Knowledge (PMBOK, fourth edition) from the Project Management Institute (PMI) Standard, defines the project portfolio as 'a collection of projects and programs and other work that is grouped together to facilitate effective management of that work to meet strategic business objectives' (Petit & Hobbs, 2012; P.M.I., 2008, p. 8). A company's group or portfolio of new product development (NPD) projects (sometimes referred to as the NPD pipeline) represents that company's commitment to the development of that specific combination of NPD projects (Martinsuo, 2013; Blichfeldt & Eskerod, 2008; Cooper et al., 2000). The success of products within the product portfolio impacts portfolio success, and ultimately has a critical bearing on the organisation's overall performance (Benaija & Kjiri, 2015; Jugend & Da Silva, 2014; Chao & Kavadias, 2008; Cooper et al., 1999). Thus, the selection of a group of product development projects that provides an organisation with the most promising NPD portfolio is arguably the most crucial of precursors to an organisation's success.

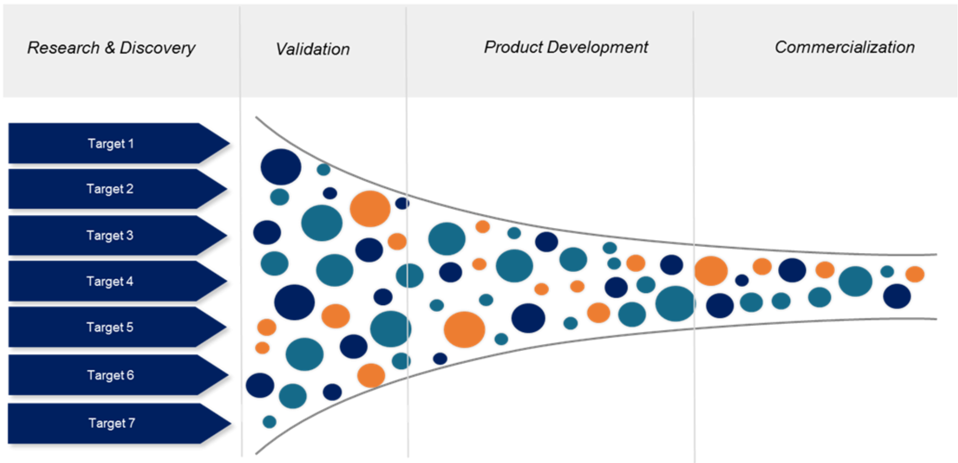


Figure 2.6 The innovation portfolio.

In line with the large body of literature that has accrued on the topic of portfolio management, Kester et al. (2011, p. 641) describe portfolio management as 'the set of activities that allows a firm to select, develop, and commercialise a pipeline of new products aligned with the firm's strategy that will enable it to continue to grow profitably over the long term,' and is represented in Figure 2.6. Thus, new product project selection activities for the portfolio are conceivably the most decisive phase of portfolio management given that only those NPD projects actually selected will be allocated the scarce resources required for their development. These selected projects therefore, have a direct impact on portfolio and subsequently on company success (Mc Nally, Durmusoglu, Calantone & Harmancioglu, 2009).

2.8 Product selection for the NPD project portfolio

Continuing the argument for the criticality of new product selection in portfolio and organisation success, an abundance of research has accrued on methods to identify promising new product ideas and the means by which to select the best group of products for portfolio development. Indeed, the third best practices study in NPD conducted in 2003 by the Product Development and Management Association (PMDA) added two completely new sections to its questionnaire; namely the fuzzy front end (FFE), and portfolio management (Barczak et al., 2009), indicating the increasing interest in viewing NPD more holistically in groups as opposed to individually. Furthermore, Cooper et al. (1998) acknowledge that there are usually vastly more NPD options available than there are the resources to progress them. Therefore, companies must choose wisely and support the 'right' new products for their product development portfolios (Blichfeldt & Eskerod, 2008).

Currently, there are hundreds of publications on project selection, the vast majority of which are based on mathematical programming and statistical models and frameworks based on evaluation and prioritisation assessments (Benaija & Kjiri, 2015; Petit & Hobbs, 2012; Barczak et al., 2009). Project selection techniques include; decision support (Ghasemzadeh & Archer, 2000), scoring techniques (Jugend & Da Silva, 2014), models accounting for interdependencies and risks (Gustafsson & Salo, 2005), the resource allocation problem (Engwall & Jerbrant, 2003), scenario planning, what-if analyses, and using portfolio management indices (Petit & Hobbs, 2012; Chao & Kavadias, 2008). However, much empirical research finds that these models are not used in practice (Jugend & Da Silva, 2014; Blichfeldt & Eskerod, 2008). Some reasons discovered include; (a) the perception that selection models are too difficult to use in practice and that management prefer simpler tools; and (b) the difficulty in accessing reliable data to input into these selection models due to the diversity of projects, the restricted availability of resources and the uncertainty about future markets (Hall et al., 2015; Martinsuo, 2013; Cooper et al., 2000; Ghasemzadeh, Archer & Iyogun, 1999).

Moreover, selection techniques that focus on project assessments at an individual level and project selection in a sequential manner, are outdated (Hall et al., 2015). As the field of project portfolio management (PPM) matures, as project complexities and interdependencies increase, and as future predictions become harder to make, PPM must consider 'multiple factors and the ability to envision alternative future consequences to support and enhance strategic project portfolio decision making' (Killen & Kjaer, 2012, p. 554).

Further complicating project selection, a review of empirical research on PPM conducted by Martinsuo (2013), concludes that it is a mistake to consider project selection as a rational decision-making process that follows fixed procedures. Rather, many organisations exist in fluid contexts, especially those in high technology industries, where changes are ongoing and so rapid that product life cycles are shrinking, managers are continually 'negotiating and bargaining' and resource allocation decisions previously made often change because new strategies emerge (Randall et al., 2017). In response to continually changing and uncertain environments, Martinsuo (2013, p. 799) reports that organisations must deal with 'emergent and unknown issues' and she urges further research in this domain to enable managers deal with real-world contexts and practice.

2.9 Product selection for NPD portfolio ambidexterity

Building on the extant knowledge in new product development (NPD) and portfolio management, and in line with the ambidexterity literature, an increasing literature emphasises that managers must not alone select the 'right projects' but further, they must achieve the 'right mix' or 'balance' of projects within their portfolios for success (Mc Nally et al., 2013; Chao & Kavadias, 2008). In support of these teachings, Cooper, Edgett & Kleinschmidt (1997a, p. 16) identify the three overarching goals of project portfolio management (PPM) as 'maximizing the value of the portfolio, achieving the right balance and mix of projects, and linking the portfolio to the business' strategy.' It can be said that project selection is intimately associated with all three of these goals. To clarify; the choice of projects made will affect portfolio value; project selection decisions will determine the extent to which company strategy is followed; and selection choices will impact the overall balance of project types under development. Balance describes 'the optimal investment mix between risk versus return, maintenance versus growth, and short-term versus long-term new product projects' (Cooper et al., 1997a, p. 16). In other words, new product portfolio selection is potentially very powerful; it must allocate limited resources to a limited yet diverse group of potential NPD projects to meet strategic goals, optimise resource utilisation and enhance company profitability, competitiveness and survival. All of these outcomes of portfolio selection are in line with the concept of ambidexterity.

Continuing with this thinking, and as indicated in earlier passages on ambidexterity, new product innovation and strategy management stress that companies must 'simultaneously develop discontinuous and incremental innovations … for sustainable superior performance' (Kortmann, 2015, p. 666). Project selection decisions for the NPD portfolio must provide a mix of genuinely novel product development projects (associated with exploration and radical innovation outputs) alongside NPD projects that produce product renewals or improvements (associated with exploitation and incremental new products) (Jugend & Da Silva, 2014). This is akin to innovation ambidexterity in the new product portfolio. But what drives the selection decisions towards portfolio innovation ambidexterity? How is competence ambidexterity nurtured as a precursor to innovation ambidexterity?

What becomes clear at this stage is the potential for conflict to arise during new product portfolio selection (NPPS) in achieving the aforementioned portfolio goals. For example, the portfolio that yields the greatest return on invested resources will force conflict between short-term and long-term products, between low-risk projects and high-risk ones, or it will be biased towards more incremental product types (Cooper et al., 2001). Likewise, value maximisation may render a portfolio that is neither strategic nor balanced and a portfolio that is primarily strategic may sacrifice other goals such as short-term profitability. Mismanaging this conflict may partly explain the trending biases towards more incremental product portfolios, as described earlier by Barczak et al. (2009) reporting on the PMDA (2003) study findings and by Cooper and colleagues (1999) ten years earlier. Referring to the latest PMDA best practices survey conducted in 2012, Markham & Lee (2013) report the inclusion of categories relating to radical innovations, more innovative projects, and incremental innovations. This reflects the growing interest and recognised challenges intrinsic to achieving portfolio balance; its strategic contradictions and integral tensions must be recognised and managed to achieve success. This is akin to the ambidexterity challenge.

Despite these challenges, successful project portfolios must align with organisational strategy (Birkinshaw et al., 2016; Kaiser, El Arbi & Ahlemann, 2015; Killen, Jugdev, Drouin & Petit, 2012), maximise value, and optimise use of resources (Jugend & Da Silva, 2014; Petit, 2012; Blichfeldt & Eskerod, 2008; Cooper et al., 2001). Some authors view strategic alignment, risk minimisation and value maximisation (Figure 2.7**)** as the top three success factors of portfolio management (Benaija & Kjiri, 2015) while others emphasise portfolio balance alongside strategy fit and value maximisation (Mc Nally et al., 2013; Chao & Kavadias, 2008). Research in the project portfolio selection context specifically opens new avenues to study 'how (do) leaders manage the fundamental tension between efficiency [incremental innovations] and flexibility [radical innovations]' (Eisenhardt, Furr & Bingham, 2010, p. 1263). And while existing literature expounds the importance of 'a risk-, complexity-, and innovativeness-balanced portfolio' of investments or NPD projects, there is a lack of literature to explain how decisions are made to achieve these oppositional outcomes (Kester et al., 2011, p. 647).

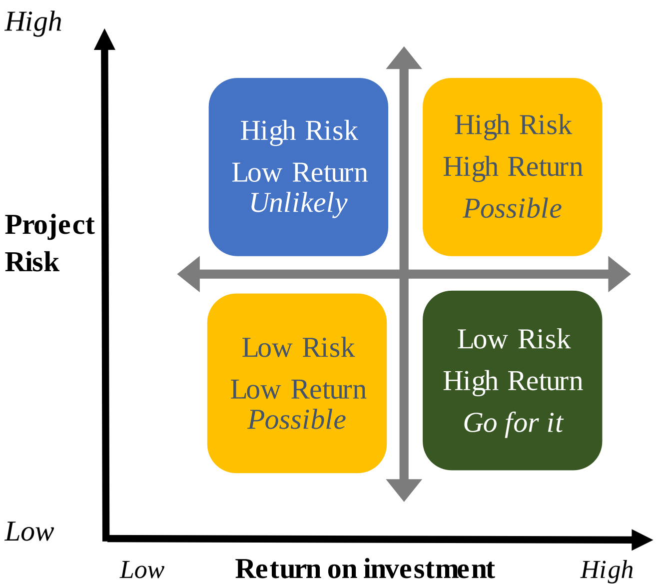


Figure 2.7 Managing risk and value in the project portfolio (adapted from Benaija & Kjiri, 2015).

2.10 Portfolio selection teams; tensions and conflict

Barczak (1995) suggests that multi-functional project teams (and R&D teams for first to market innovations) provide the best avenue through which to enact NPD efforts. Her study is conducted in the high technology telecommunications industry. Barczak (1995) explains that it is in their ability to bring people from different functional areas together, with their varied skills mix and background knowledge, that renders project teams so beneficial to successful new product performance. Her findings are congruent with many empirical and more recent studies that display the pervasiveness and effectiveness of project teams in driving competence ambidexterity generally (Kortmann, 2015; Andriopoulos & Lewis, 2009; Jansen et al., 2009; O' Reilly & Tushman, 2008; Lubatkin et al., 2006; Gibson & Birkinshaw, 2004; Atuahene-Gima & Li, 2002); and a balanced new product portfolio specifically (Markham & Lee, 2013; Mc Nally et al., 2013; Barczak et al., 2009; Cooper et al., 2001).

In his study of new product innovation (NPI) in over 200 electronics companies in China, a location chosen as a rapidly changing and complex market, Atuahene-Gima (2005) explains that it is the interaction between individuals with different functional backgrounds that facilitates an exchange of different views and opinions. This dialogue allows individuals' perspectives to be altered and re-configured. The inter-functional co-ordination, he clarifies, links team members with customer and market knowledge, and this is vital to the realisation in particular of exploration but also of exploitation competencies. Dougherty (1992) indicates that cross-functional meetings lift the barriers to joint interpretation of facts which occur when functional routines and departments proceed independently of each other as their views and understandings are otherwise based on their personal functional priorities. Indeed Atuahene-Gima (2005, p. 61), advocates that without these cross-functional interactions, companies which are proficient at exploiting existing capabilities, will 'falter in simultaneously developing new product innovations' which are necessary to long term survival.

Moreover, Lewis, Welsh & Dehler (2002) acknowledge the paradoxical tensions faced by project teams involved in NPI as they strive to become more technically knowledgeable and innovative (largely through exploration) whilst remaining efficient in terms of new product delivery, scheduling and costing (mainly by exploitation). Lewis and her colleagues (2002, p. 547) identify the importance of neglecting neither. They recommend the 'both/and' approach to achieving a 'balance' between opposing strategies adding 'increasingly, researchers claim that managing tensions is crucial to product development success.'

Tensions are experienced as a pull in opposing directions, similar to a tug of war, and the inability to see how both directions can be achieved simultaneously. This can lead to conflict i.e. disagreement between individuals with opposing views on how to manage the tensions. In her in-depth study on paradox, Lewis (2000) delves into a deeper understanding of various paradoxical tensions and their management. Referring to Amason's (1996) identification of two versions of conflict, Lewis (2000) describes how each has opposing effects on a team. Cognitive conflict denotes 'task-oriented debates that are focused on perceptual differences in how actors perceive a situation and might extend the scope and creativity of decision making.' This type of conflict enhances group outcomes. In contrast, 'affective conflict is emotional and aimed at personal disputes, intensifying actors' defences and tendency to cling to extant frames,' (Lewis, 2000, p. 773). This conflict type is damaging to teams and consequentially damaging to teams' efforts.

Being issue based, cognitive conflict is thought to be the mechanism through which multi-functional project team members can manage the tensions and likely disagreements that arise in a paradoxical setting (such as portfolio selection for ambidexterity) when team members disagree on how to manage those tensions. A body of literature reports that cognitive conflict is associated with improved decisions; better quality decisions, better decision-commitment or buy-in, and better implementation of those decisions (Parayitam & Dooley, 2011; Jehn & Mannix, 2001; Simons & Peterson, 2000; Amason, Thompson, Hochwarter & Harrison, 1995). Lovelace, Shapiro & Weingart (2001) study 43 NPD teams and find that the effect of task disagreement on team outcomes depends on how free members feel to express and share their individually diverse opinions and disagreements. When team members trust each other, relationship conflict is less likely and the benefits of cognitive conflict are effected (Lovelace et al., 2001). Positive collaboration that does not become contentious benefits improved decision-making (Parayitam & Dooley, 2009; Simons & Peterson, 2000).

Some researchers advocate that conflict is desirable to prevent 'groupthink' that arises when members strive towards agreement for agreements sake to please team members as opposed to conducting a thorough analysis of the problem. Groupthink can result in poor decisions (Cosier, Dalton & Taylor Iii, 1991). Others claim that conflict must be embraced to reach a team's full potential but the conflict must be carefully monitored because once aroused it is difficult to control (Amason et al., 1995). Methods such as dialectic enquiry or a devil's advocate approach have been suggested as ways to manage team conflict (Cosier et al., 1991) but are beyond the scope of this study so are no longer discussed.

In their meta-analysis of 116 empirical studies on intra-group conflict, De Wit, Greer & Jehn (2011, p. 573) contend that senior management are likely to be 'more politically savvy and better able to handle complex interpersonal situations, such as conflicts (Lazear & Rosen, 1981).' These authors counter findings from an earlier but smaller meta-analysis study (30 versus 116) by De Dreu & Weingart (2003) that revealed negative effects on performance caused by task conflicts. Instead, with their larger and more in-depth research study, De Wit et al. (2011) conclude that there are conditions favourable to task conflict and positive group performance. They find when task and relationship conflicts are weakly correlated, the conflict is among top management teams rather than teams at lower organisational levels and when performance is measured in terms of financial performance or decision quality rather than overall performance, task or cognitive conflict has positive performance effects.

In summary, whilst the challenges of managing strategic dualities such as competence and innovation ambidexterity are expounded in the literature, and while the product portfolio gains increasing recognition as a fundamental contributor to organisational health, relatively little literature exists that links theory with the practical mechanisms that drive project portfolio selection for ambidexterity. Several authors including Birkinshaw & Gupta (2013) and Turner et al. (2015) call for research into how the competing interfaces or boundary conditions are managed in real contexts. O' Reilly & Tushman (2013) ask for knowledge to learn what distinguishes between 'firms that attempt to be ambidextrous [and] are successful' and those that are not. This research aims to address calls for a better understanding of the mechanisms that drive successful attainment of portfolio ambidexterity.

Considering that management control systems have been shown to contribute toward innovation management, it is likely that performance measurement systems, a form of management control, influence the innovation portfolio (Bedford et al., 2019; Abrantes & Figueiredo, 2015; Korhonen, Laine & Martinsuo, 2014; Petit, 2012). There is a lack of clarity or empirical evidence explaining the performance measurement systems (PMSs) needed to generate NPD portfolio ambidexterity (Jugend & Da Silva, 2014; Martinsuo, 2013; Kester et al., 2011), and so the literature on PMSs pertinent to ambidexterity, ensues.

2.11 Performance measurement systems

At the outset of the current study the criticality of innovation for organisations' on-going success and survival is emphasised. Then the benefits and challenges in the pursuit of competence and innovation ambidexterity are highlighted. Recent publications in management accounting research acknowledge the relevance of performance measurement systems (PMSs) in guiding innovation (Chenhall & Moers, 2015; Davila et al., 2015). In this section a review of the literature on PMSs with a special emphasis on its implications for innovation, is presented.

2.11.1 Performance measurement systems – a definition

Performance measurement (PM) is 'the process of quantifying action, where measurement is the process of quantification and action leads to performance' (Neely et al., 1995, p. 80). Efficiency and effectiveness are two dimensions closely connected to performance. In the context of product innovation for example, the effectiveness of a new product is the measure of how well it satisfies its customers, and the efficiency of the product describes the extent to which developmental resources are used economically. Thus, 'performance measurement can be defined as the process of quantifying the efficiency and effectiveness of action. A performance measure can be defined as a metric used to quantify the efficiency and/or effectiveness of an action, and a performance measurement system can be defined as the set of metrics used to quantify both the efficiency and effectiveness of actions' (Neely et al., 1995, p. 81). The logic is that by measuring performance against particular strategies, the feedback allows for control of future behaviour by an adjustment in the performance measurement system (PMS). Rewards and sanctions may also be used alongside the PMS to reinforce or modify particular behaviour(s).

2.11.2 PMSs and their design

Performance measurement systems (PMSs) influence what people do (Neely et al., 1995; Simons, 1991). The performance measures (PMs) that comprise the PMS are important, as they direct management focus (Bourne et al., 2005). Measurement may be the process of quantification, but its affect is to stimulate action. Kaplan and Norton's (1992) balanced scorecard is one of the best-known and most highly cited examples of a PMS created and used to influence employee behaviour (Kaplan & Norton, 1996). However, because organisations differ in their strategies, their cultures and their priorities, the literature contends that no single PMS design is appropriate for all.

The earliest PMS designs were based on financial costing and budgeting systems because of the pressure to meet mainly financial targets and to measure employees' success at achieving them (Bititci, Garengo, Dörfler & Nudurupati, 2012; Eccles, 1991). However, these PMSs were criticised for encouraging a tendency toward 'short-termism and/or dysfunctional consequences' (Neely, 2005, p. 1271), including the discouragement of new ideas (Merchant, 1990), and of product differentiation strategies (Govindarajan & Fisher, 1990). These early PMSs were judged to be backward looking, internally focused, to lack strategic focus, and to favour minimal variance rather than continuous improvement (Bititci et al., 2012; Chenhall & Langfield-Smith, 2007; Bourne, Mills, Wilcox, Neely & Platts, 2000).

As a result, through the nineties, PMS design progresses towards more multidimensional and forward looking 'frameworks' that include non-financial measures in addition to the financial ones and that attempt to be more outward than inwardly focused, and to pursue business strategy over internal failings (Chenhall & Moers, 2015; Ittner & Larcker, 2000). For example, the Balanced Score Card (BSC) of Kaplan and Norton (1992) fame, is probably the best known of these frameworks and is commended for its emphasis on the need for a balance between measures of short and long-term across a number of business domains including finance, marketing, operations and human resources. Notwithstanding its significant advance on earlier PMS designs, Neely (2005) notes that the BSC omits seeking information on competitors, an essential measure required in NPD. Further, Bourne et al. (2005) argue that 'balanced' performance measurement frameworks provide only a snapshot in time of an existing situation and are unable to cater for a changing world. As environments continually change, as customers' preferences fluctuate, and as technological advances are made, the measures of the PMS must be able to adapt.

Nowadays, the consensus amongst authors is that PMSs must be designed with measures that are derived from an organisation's strategy. Moreover, measures must be continually monitored to ensure the organisation's PMS 'remains integrated, efficient and effective at all times' (Bititci, Turner & Begemann, 2000, p. 693). As research has accrued, two overriding requirements are advocated in designing a PMS; specification of the objectives to be measured (strategy), and selection of the appropriate measures to fulfil that strategy (Cardinal, Kreutzer & Miller, 2017; Bedford, 2015; Chenhall & Moers, 2015; Dekker et al., 2013; Bititci et al., 2012; Cardinal, Sitkin & Long, 2004).

2.11.3 PMSs design and innovation ambidexterity

Since PMS design pertains to the explicit choice of measures incorporated into a firm's PMS to facilitate strategy enactment (Bisbe & Malagueño, 2015, 2012), then companies in pursuit of ambidexterity are expected to design a PMS that incorporates measures to encourage action/behaviour towards innovation ambidexterity's opposing strategies, simultaneously. This means the PMS must incorporate measures that promote exploitation and measures that will not neglect exploration. In line with this thinking, Dekker et al. (2013, p. 72) emphasise the need to 'design (of) more comprehensive and complex PMSs that are aimed at balancing effort and decisions toward the multiple strategies pursued' and avoid the natural bias towards exploitation. Along the same vein, Bedford et al. (2019, p. 24) advocate that the 'PMS must be explicitly designed with a balanced representation of measures to prevent the crowding out of radical innovation efforts.'

In the context of NPD, Davila, Foster & Li (2009) confirm that PMSs are vital for firms engaged in innovation. Davila et al. (2015, p. 147) recommend that the measures used should be tailored towards an innovation 'portfolio's mix of incremental, semi-radical and radical innovation' for successful innovation outcomes. These authors recommend a mix of many measures but urge refrain from using an excessive number of metrics that are both time-consuming to manage and incoherent. Instead, the advice is to include measures that foster short term returns and minimal risk efforts (associated with exploitation and incremental innovations), and to carefully balance them against measures that bring riskier but longer-term activities into view thereby encouraging exploration and more radical product developments (Davila et al., 2015). Key portfolio measures, they suggest, include measures of project 'risk,' 'value,' 'type of innovation,' 'implementation stage' and 'time to value,' comparable to break-even time. All measures provide 'visibility into the development pipeline' (Davila et al., 2015, pp. 165-166). Auh & Menguc (2005a) suggest that measures such as growth in sales, profits, and market share support exploration while measures of return on investment, return on sales, and return on assets encourage exploitation. Lillis & Veen-Dirks (2008, p. 28) explain that in settings where 'low-cost and differentiation strategies are pursued jointly,' the PMS design is 'more complex' than that configured to 'match unidimensional strategic archetypes,' i.e. low cost or differentiation, but not both simultaneously. Indeed, they say, 'the simultaneous pursuit of multiple strategies requires the inclusion of performance measures relating to each strategic priority' (Lillis & Veen-Dirks, 2008, p. 28).

And so, the current consensus and way forward is to 'shift from treating financial figures as the foundation for performance measurement to treating them as one among a broader set of measures' (Eccles, 1991, p. 131). Thus, a holistically designed and balanced PMS is a first step toward ambidexterity.

2.12 The use of PMSs

As the old adage says, 'what gets measured gets done' (Davila et al., 2015, p. 146) or at least it gets attention (Eccles, 1991). Once a PMS has been designed, how it is employed has the potential to drive behaviour and action in desired directions (Bedford et al., 2019; Bedford, 2015; Chenhall & Moers, 2015). Indeed, Hall (2010, p. 303) contends that it is its role as a 'common language' that makes accounting information ideal to 'facilitate communication among managers with different backgrounds, experience and knowledge.' It is the 'interactive nature of the use of the measurement system [that] is important,' and renders the PMS its potential (Bourne et al., 2005, p. 373).

Next are discussed ways in which a PMS designed to facilitate opposing strategies (and referred to as a balanced PMS, namely PMS-bal) can be used.

2.12.1 PMS-bal and dynamic paradoxical tensions

Bedford (2015, p. 12) argues that it is the 'dynamic tension' provided through interactions with a balanced MCS (of which PMSs are a part) that is 'necessary for managing contradictory innovation modes' i.e. ambidexterity. Essentially, the argument is that the contents of the MCSs must operate jointly (also the 'both/and' paradoxical view) to arouse a dynamic tension in organisations that pursue competing strategic priorities (ambidextrous organisations). Without this tension, a single strategic direction will be followed, usually to the exclusion of the other.

In their paper on managing opposing innovation strategies and in helping to describe paradoxical dynamic tensions, Curtis & Sweeney (2017) draw on Robert Simons' 1995 work. Simons (1995) invokes the Chinese philosophy of 'yin' and 'yang' and what he terms the 'four levers' of management control. Two levers promote the 'yin' or negative side and two promote the positive side, the 'yang.' Simons (1995) explains that all four levers must be operated to enact the countervailing or oppositional forces between the yin and the yang and generate the 'dynamic tension' between opposing strategies, such as those in organisations that pursue both exploration and exploitation. Otherwise, the trajectory will most likely pursue exploitation (Curtis & Sweeney, 2017, p. 315).

Similarly, Mundy (2010) explores how organisations balance controlling and enabling uses of management control systems (MCS) so that the benefits of both controls, despite being oppositional controls, can be accrued. Mundy discovers that it is in striving for balance between opposing controls, that the creation of dynamic tensions between enabling and controlling forces is facilitated. Smith & Lewis (2011, p. 392) recommend a need for 'consistent inconsistency' to ensure that attention is simultaneously given to alternative options. And, in line with these teachings, Curtis & Sweeney (2017, p. 314) find a distinction between 'two forms of reinforcement in control systems.' They employ a single case study of a highly innovative medical device company to examine the organisational tension between two forms of innovation. They describe 'consistent reinforcement' as arising from control systems that 'create a push for consistency' and toward a single strategic direction such as exploration or exploitation; and 'countervailing reinforcement' driven by control systems containing 'countervailing forces that generate dynamic tension, thus reducing momentum in one particular direction' (Curtis & Sweeney, 2017, p. 314).

Thus, in ambidextrous settings, a PMS designed using a variety of opposing measures in support of ambidexterity's opposing strategies, and used during NPD portfolio selection, should help generate the dynamic tensions on which an ambidextrous NPD portfolio will depend. The dynamic tension driven by a balanced PMS should help protect against consistent reinforcement wherein one innovation type is pursued at the expense of the other (described as schismogenesis). Instead, a balanced PMS should motivate short- and long-term projects (the ‘both/and’ paradoxical view again), through the countervailing forces of each innovation type. This dynamic tension is important for the pursuit of ambidexterity. So, once the tensions of ambidexterity’s opposing strategies are made salient, what next?

2.12.2 PMS-bal and debate – effects on ambidexterity

Bourne et al. (2005, p. 386) identify ‘the main drive for performance [comes] from continual interaction with the performance data.’ Hall (2010) goes deeper and explains that in companies that pursue opposing strategies, opposing measures prompt intense debate and discussions as individuals grapple with how to meet dual expectations. Bedford et al. (2019, p. 32) contend that this debate arises ‘to address the tensions and trade-offs associated with competing strategic priorities,’ and is vital to the achievement of competence ambidexterity (Smith & Tushman, 2005; Vaivio, 2004).

Moreover, the activities of exploitation and exploration each tend to be ‘self-reinforcing often to the exclusion of one other’ (Bedford et al., 2019, p. 22), and individuals’ ways of thinking, referred to as their mental templates (Smith & Tushman, 2005) tend to favour consistency. These latter authors investigate how firms can develop cognitive frames and processes to accept paradoxical contradictions and therefore enable top management teams to achieve balanced strategic decisions in contradictory contexts (Smith & Tushman, 2005, p. 533). The research thus contends that the debate aroused by PMS-bal is vital to exposing the contradictions and tensions aroused by its contents i.e. measures that favour exploitation combined with those that support exploration. For ambidexterity to be achieved there must be an emphasis on the importance of all measures of mixed and opposing types without favouritism towards the more easily satisfied demands of exploitation (Bedford et al., 2019; Atuahene-Gima, 2005).

Thus, a balanced PMS (PMS-bal) forces discussions between individuals who harbour different interpretations of and views about the importance of conflicting measures and their associated conflicting strategies. During this debate individuals' opinions are shared, and their preferences expressed. Furthermore, this debate encourages the exchange of tacit information that is difficult to share through formal means, and more challenging in complex settings (Dekker et al., 2013; Dekker, 2004). Overall, this open debate and conversation based upon conflicting measures (PMS-bal) and conducted amongst individuals who represent different functions and departments on a portfolio selection team, is especially important in the complex and challenging ambidextrous setting. Indeed Bedford et al. (2019, p. 22) find that 'combining a balanced PMS design and an intensive use of PMS to stimulate debate is pivotal for effectively managing the tensions inherent in attempting to achieve innovation ambidexterity.' Dekker et al. (2013) acknowledge that the PMS information is used more intensively in firms that pursue mixed strategies. And, Bourne et al. (2005) concur with the significance of 'managers interact[ing] much more closely with the data and management system,' and point out from findings of their own empirical study that in high performing business-units 'the main drive for performance [comes] from continual interaction with the performance data' (Bourne et al., 2005, p. 386). What happens when the debate leads to disagreements?

2.12.3 PMS-bal and conflict – effects on ambidexterity

In combining measures that support incremental innovation with measures that encourage more radical innovations, and forcing responses to both, team members from a multiplicity of functional backgrounds are more likely to have differences of opinion or conflicts over their interpretations of the meanings and the implications of those measures, during team-based decision making meetings (Ylinen & Gullkvist, 2014; Jansen et al., 2006). Through the interactive social processes of communication and argumentation, contradictory views and conflicting interpretations are shared, and key issues can be fiercely challenged (Vaivio, 2004). As presented earlier in this chapter, a body of knowledge advocates that as long as these differences and conflicts remains task-focussed (cognitive conflict), there are benefits for decision quality, decision acceptance and decision implementation. However, these benefits are reversed when the conflict becomes personality based referred to as affective conflict (Woods, 2012; Mooney, Holahan & Amason, 2007; Jehn, Northcraft & Neale, 1999; Amason, 1996).

'Ambidextrous organisations create inevitable conflicts' (O' Reilly & Tushman, 2008, p. 199). The short-term, efficiency and control of an existing product is at odds with the uncertainty and inefficiency of experimentation into new products. However, to be ambidextrous, senior leaders must encourage dissent and permit different points of view to be argued as a 'crucial element in the ability of an organisation to simultaneously explore and exploit' (O' Reilly & Tushman, 2008, p. 199).

In line with the value of cognitive conflict in supporting ambidexterity and paradoxical tensions, recent authors have suggested a more direct role for cognitive conflict. Bedford et al. (2019) study top management team (TMT) decision-making in 90 Irish firms that are attempting to be ambidextrous. Bedford et al. (2019) explain that intense debate arises when teams are faced with a diverse and opposing set of performance measures. This debate generates disagreements and cognitive conflict and it is this cognitive conflict 'which in turn drives the realisation of innovation ambidexterity outcomes' (Bedford et al., 2019, p. 21). The essence of the preceding passages is to highlight the importance of PMSs in innovation, and more importantly of PMSs that are balanced in terms of measure diversity and strategic intent, namely PMS-bal, in supporting ambidexterity generally and NPD portfolio ambidexterity specifically. These formal systems are in contrast to informal systems, a review of which follows, as they are both integral to organisational control.

2.13 Formal versus Informal control

Control can be described as 'an evaluation process which is based on the monitoring and evaluation of behaviour or of outputs' (Ouchi, 1977:95 in Cardinal et al., 2017, p. 9). Measuring behaviour refers to what people do; measuring outputs relates to the effects of what people do, namely, their achievements. Management control attempts to direct behaviour towards desired goals and measure the extent to which those goals are accomplished (Chenhall & Moers, 2015; Bourne et al., 2005; Cardinal et al., 2004).

Most of the extant literature in performance management control is based on formal systems (Sitkin, Long & Cardinal, 2020; Tucker, 2019). Management control theory currently advocates that formal and informal controls combine to provide an overall package or framework; the controls unite ‘in different combinations, to different extents, at different times’ depending on the context (Tucker, 2019, p. 221). A number of theories and frameworks used to describe organisational control have emerged over the years. For a good discussion and analysis of these see Cardinal et al. (2017) and Tucker (2019). These authors believe that from being viewed initially as coercive and formal, organisational control requires a more holistic view that incorporates the less formal and enabling aspects of control with the formal.

Formal control represents explicit and codified ‘institutional mechanisms such as written rules, standard operating systems, and procedural directives;’ they are visible and objective forms of control (Cardinal et al., 2004, p. 414). In contrast, informal control embodies ‘unwritten, unofficial values, norms, shared values, and beliefs that guide employee actions and behaviours [and are] less objective, uncodified forms of control’ (Cardinal et al., 2004, p. 414). Table 2.1 below presents the distinction between formal and informal control made by Dekker (2004). He suggests that formal systems represent organisational mechanism of governance while informal governance is a social mechanism that is based upon trust between individuals. In accordance with the definition by Ouchi (1979), the most highly cited author on organisational control, Dekker describes formal control as systems of ‘contractual obligations and formal organisational mechanisms for cooperation [which] can be subdivided into outcome and behaviour control mechanism’ (Dekker, 2004, p. 31; see Table 2.1). Formal systems operate via ex-ante processes to control behaviour (expected actions) or output (expected performance) in advance of actions; and/or by using ex-post processes that monitor achievement of the desired behaviour or outcome of completed actions. Similarly, informal or social control is manifested through ex-ante and ex-post mechanisms (Dekker, 2004; Ouchi, 1979). According to these experts, ex-post control mechanisms serve to monitor the effects of ex-ante control which is often incomplete. And so, as seen in Table 2.1, ex-ante formal control mechanisms include; target setting and the explicit identification of goals to be achieved, clear rewards based on performance (outcome control), expected ways to behave based on e.g. standard operating procedures, rules and regulations etc. namely behaviour control. Ex-post formal control involves; measuring performance achieved against target expectations and rewarding achievements (outcome control), and monitoring behaviour against expectations using checklists and progress reports (behaviour control). Informal ex-ante mechanisms include the selection of individuals deemed capable and approachable (through reputation, known skills, previous social experience), while informal ex-post mechanisms include processes that build towards a stronger inter-personal relationship such as being involved in joint decision-making and problem solving. Formal systems are therefore visible and highly explicit whereas informal systems are neither (Cardinal et al., 2017).

Table 2.1 Formal and informal control mechanisms in organisational relationships (adapted from Dekker, 2004)

Formal mechanisms		Informal mechanisms
Outcome control	**Behavior control**	**Social control**
Ex-ante mechanisms		
Goal setting Incentive systems/reward structures	Structural specifications: • Planning • Procedures • Rules and regulations	Partner selection Trust (goodwill/capability): • Interaction • Reputation • Social networks
Ex-post mechanisms		
Performance monitoring and rewarding	Behavior monitoring and rewarding	Trust building: • Risk taking • Joint decision making • Problem solving

Other examples of mechanisms used in the literature to distinguish between these formal/informal systems include; tight and loose coupling (Merchant 1985 in Merchant & Otley, 2006), mechanistic and organic control (Chenhall and Morris 1995 in Chenhall, Kallunki & Silvola, 2011), and coercive and enabling mechanisms (Adler & Borys, 1996). Other authors describe different practices employed based on the purposes of the control, to differentiate between control mechanisms. Examples include; whether they are designed to affect the input, the process (i.e. throughput), or the output portions of a process (Cardinal, 2001; Merchant, 1985; Ouchi, 1979); or are related to market, bureaucratic, clan controls (Ouchi, 1980); or they distinguish between belief, boundary, diagnostic, and interactive control levers (Simons, 1994); or they effect input, behaviour, and output control (Sitkin et al., 2020; Cardinal et al., 2004; Cardinal, 2001).

The PMSs discussed in this research study represent examples of formal means of control because the measures selected in their design are made explicit and obvious to users. Similarly, NPD project portfolio team meetings are sanctioned between groups of individuals and represent another example of a formal system of control. It is the purpose of control systems 'to ensure that managers and others look past their self-interests to support collective, official goals' (Cardinal et al., 2017, p. 1). However, when meetings take place in an ad-hoc and unplanned manner, which equates with one aspect of informal control, the formal systems of control run the risk of being undermined. Where do informal control systems fit within the control literature?

2.13.1 Attributes of informal control or social control

The Hawthorne studies of the early 1920s demonstrated that an informal social system permeates most work organisations. Nearly a century later, Tucker (2019) gathers findings from five highly cited, review papers published in the management control literature, to provide a summary of conceptualisations made during that time about informal control specifically. Tucker (2019) analyses the evolution of management control research and presents the various conceptualisations as demonstrated in Table 2.2. From this Table can be seen descriptions such as 'unplanned,' 'spontaneous,' 'unwritten,' 'emerging,' 'flexible,' 'responsive,' 'complementing,' 'supplementing,' 'high interdependence' which reflect the informal and emergent nature of these controls that are seen to offer more (complement, supplement) than the formal systems alone. Further, they are understood to derive from an organisation's and individuals' set of values or culture and as such involve higher levels of discretion and individual power during interactions. Named examples include clan control (Ouchi, 1979); social control (Dekker, 2004; Hopwood, 1987) and relational governance (Dekker, 2004).

All these authors describe concepts that are synonymous with the term 'informal control' (Sitkin et al., 2020, p. 352). The thread that binds these conceptualisations is the social context of informal control systems, i.e., they rely heavily on person to person communication. Furthermore, they depend most heavily on levels of trust.

Table 2.2 Characteristics of informal control as identified in management control reviews (adapted from Tucker, 2019)

Review Paper	*Conceptualization of Informal Control*
Otley et al. (1995)	Unplanned and spontaneous processes, with organically emerging informal structures, supplementing or subduing rational design frameworks.
Langfield-Smith (1997)	Not consciously designed. Include the unwritten policies of the organisation and often derive from the shared values and norms or are an artefact of the culture of the organisation. Parallels with clan controls (Ouchi 1979), and social controls (Hopwood 1974).
Chenhall (2003)	Flexible, responsive, involve fewer rules and standardised procedures, tend to be richer in data, involve higher discretion and power, and facilitate coordination by mutual adjustment and high interdependence. Based on informal processes, a free flow of information throughout the organisation, and flexibility to encourage adaptive decision making and to foster interactions (Chenhall & Morris 1995). Similar to clan controls (Ouchi 1979) and social controls (Hopwood 1974).
Malmi and Brown (2008)	Embedded in culture: the values, beliefs, and social norms that are established influence employees' behaviour (Birnberg & Snodgrass 1988; Dent 1991; Pratt & Beaulieu 1992). Analogous to clan controls in that they work by establishing values and beliefs through the ceremonies and rituals of the clan (Ouchi 1979).
Berry et al. (2009)	Include group norms, socialisation, and culture (Collier 2005), and the development of trusting relationships that are traditionally found in hierarchies (Dekker 2004). Also referred to as social control and relational governance and includes informal cultures and systems influencing members, and essentially relates to mechanisms encouraging self-regulation (Dekker 2004) Characterised by socialisation, informal communication processes, and informal social interaction beyond their functional boundaries (Dent 1987; Frow et al. 2005). Exemplified by social control, and self-controls (Hopwood 1974).

2.13.2 Informal control and trust

The current understanding of trust and its tight coupling with informal control, is built upon the research of Rousseau, Sitkin, Burt & Camerer (1998). These authors describe trust as a psychological state wherein an individual holds positive expectations about the intentions or behaviour of another. They explain that trust is conditional upon two factors; interdependence and risk. Interdependence is 'where the interests of one party cannot be achieved without reliance upon another' and 'risk is the perceived probability of loss, as interpreted by a decision maker'

(Rousseau et al., 1998, p. 395). Thus, interdependence emphasises the importance of a two-way interaction and of reciprocity; and the element of risk introduces uncertainty as there would be no need for trust if there was no risk. These authors add that while risk and interdependency are prerequisites of trust, the relative requirements of each depend upon context. Previous research associates high trust, built on previous interactive experience for example, with decisions to cooperate; and there is evidence that trust is a predictor of successful negotiations and conflict resolution (Rousseau et al., 1998). It would appear therefore, that trust inherent to informal control systems is likely to play a role in NPD project portfolio decision-making.

Hinging on these latter researchers' work, the extant literature distinguishes between three origins of trust; *relational trust* which develops based upon repeated interactions between individuals through joint decision-making and problem solving; *institutional-trust* which derives from standards and expectations associated within an institution; and *calculus-based trust* which depends upon credible information about an individual's trustworthiness such as gained from their qualifications, reputation and/or feedback from self or others with whom they may have previously worked (Sitkin et al., 2020; Dekker, 2004). Once again, these characteristics of informal control are likely associated with portfolio selection team members and reflective of their inter-functional relationships.

Taken altogether, the literature contends that informal control evolves and is 'shaped and influenced by common values, beliefs, culture, group norms, and traditions that guide the behaviour of group members' (Tucker, 2019, p. 220). Davila et al. (2015, p. 166) further elevate informal control as they equate it with judgement saying, 'nothing can replace good judgement.' However, Sitkin et al. (2020, p. 352) suggest that 'control researchers have focused primarily on the perspectives of controllers while often ignoring the role that controlees play in how controls are developed, deployed, and enacted in organisations.'

By employing Simons' (1995) levers of control framework in a case study setting, Mundy (2010, p. 500) cautions against the 'suppression' of informal control systems over the other three levers of control saying; 'an organisation's inability to balance different uses of MCS is associated with slower decision-making, wasted resources, instability and, ultimately, lower performance.' This lack of balance and consequential failure to generate a dynamic tension between opposing types of control, as explained by Curtis & Sweeney (2017, p. 318) may lead to a situation in which 'informal systems may be used to support agreed plans and stifle [or suppress] further discussion.' It could be said perhaps that informal means of control are perennially available to individuals, to be put into action whenever conditions allow, for better or for worse depending on how they are managed.

2.13.3 Informal control and innovation

Early research viewed control mechanisms as the means to avoid and prevent problems by directing behaviours toward specific ends. As such they were regarded as being coercive, and constraining (Davila et al., 2009; Ouchi, 1979) and especially in relation to innovation (Henri & Wouters, 2019; Damanpour, 1991). Further, the traditional view of control considers formal and informal control as 'substitutes for each other, with one *or* the other being more appropriate depending on the tasks performed' (Kreutzer, Cardinal, Walter & Lechner, 2016, p. 237). Bedford (2015) finds that a combined and balanced use of controls favours performance in firms where ambidexterity is pursued. As explained by Mundy (2010) and Curtis & Sweeney (2017), the combined and balanced use of formal and informal systems of control creates a dynamic tension that encourages decision makers to concomitantly address the demands for both opposing strategies associated with ambidexterity. In this way, the 'both/and' perspective is encouraged (Henri, 2006), countervailing forces are aroused (Curtis & Sweeney, 2017) and dual types of innovation thus supported. Indeed, Chenhall & Moers (2015) provide a description of the evolution of MCS to facilitate innovation and conclude that the combined use of both formal and informal systems are complementary and crucial to innovation performance. They advise that 'organic systems [proxy for informal control] provide a supportive culture to develop innovation and flexibility to identify opportunities from uncertain settings and formal systems curb excessive attention to potentially unviable innovations' (Chenhall & Moers, 2015, p. 6; Chenhall & Langfield-Smith, 2007; Chenhall, 2003). From their synthesis of the recent literature, Kreutzer et al. (2016, p. 238) advance three purposes for the combined use of formal and informal control systems amongst strategic teams; one, they foster debate between team members; two, they encourage cooperation between individuals; and three, their complementary use offers 'opportunities to mitigate limitations and deficiencies inherent in relying on only one or the other type of control.'

2.14 Summary

This chapter has presented the literature pertinent to understanding the research domain and the theoretical underpinnings of the research. Relevant literature relating to ambidexterity, project portfolio management (PPM), performance measurement systems (PMSs), and conflict, was critically assessed. The chapter then discussed paradox theory in terms of its 'both/and' approach to managing strategic opposites and established it as a suitable theoretical base for the study. In employing this lens throughout the literature review, the paradoxical tensions that describes ambidexterity and an ambidextrous project portfolio, was explained. Similarly, the paradoxical tensions aroused by a balanced PMS, a balanced project portfolio and the balance between formal and informal means of control were highlighted. At the end of this literature review two overarching gaps in knowledge emerged; one, there is little known about how to manage ambidexterity in NPPS (NPD project portfolio selection); and two, there is a dearth of information about the role played by performance measurement systems and other organisational factors in this paradoxical context.

This literature thus forms the basis for the study's research question, namely; '*What role do performance measurement systems (PMSs) and related organisational factors (tensions, debate, conflict, functional diversity) play during NPPS in the achievement and outcome of an ambidextrous portfolio?*' Further, it is clear that a paradoxical lens is likely to support a better understanding of ambidexterity in the context of NPPS. Therefore, paradoxical thinking is incorporated into the development of an interview schedule employed in phase one exploratory interviews and paradox guides the development of the conceptual models and survey instrument employed in research phase two. The next two chapters present the methods used and findings gathered from phase one, field-based interviews conducted with professionals working in NPPS in the ambidextrous setting of the high technology industry in Ireland.

Chapter:3 **Phase I Methodology**

Qualitative Interviews

"There is no burden of proof. There is only the world to experience and understand. Shed the burden of proof to lighten the load for the journey of experience"

"Qualitative inquiry cultivates the most useful of all human capacities – the capacity to learn from others"

Halcolm's Evaluation Laws

Patton (1990, p. 460)

3.1 Introduction

A research methodology refers to the overall approach of the research process from theory through to analysis (Collis & Hussey, 2013; Saunders, 2012). This chapter describes the methodology used for collecting and analysing the empirical data required to address this study's research question and research objectives (the steps taken in the current study are illustrated in Figure 3.1 and discussed in greater detail later in the chapter), with an emphasis on the first research phase. The chapter opens with an introduction to research philosophy and it outlines the philosophical position of the current study as a positivist/functionalist work. The chapter continues with an explanation and justification for the mixed methods and sequential, two-phase, design of the current research. Herein, it includes a discussion on qualitative and quantitative research methods. Next, it reiterates the study's research question and its objectives before it details the research methodology and data collection methods associated with phase one of the field research; this includes development of an interview schedule and sample selection methods. Phase one concerns the qualitative, exploratory interviews conducted with 12 senior professionals working in the high technology medical devices industry. Phase one findings are presented in the next chapter and they provide the basis upon which the quantitative research phase two (presented in ensuing chapters) of this study, is built. The chapter concludes with a summary.

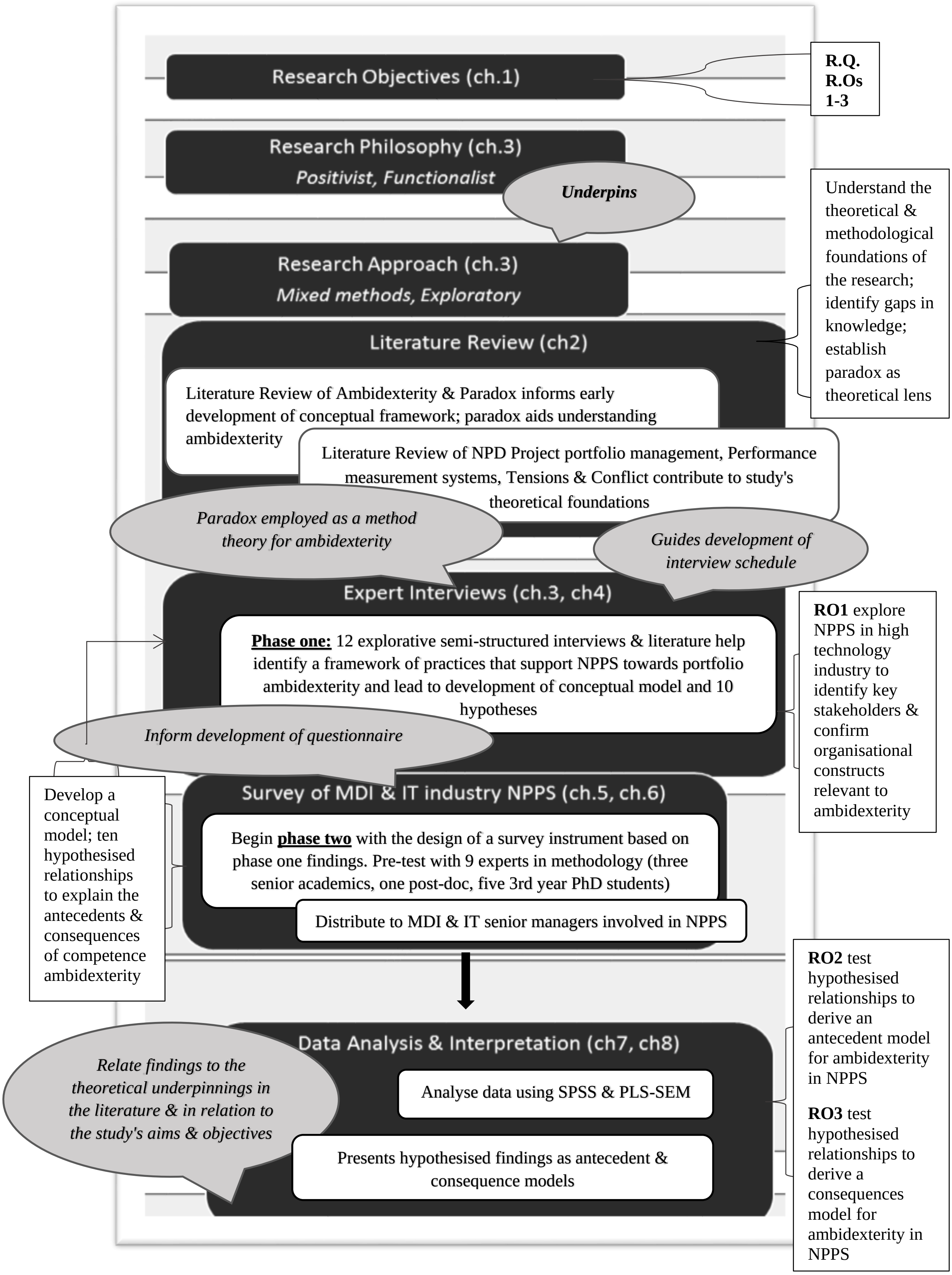


Figure 3.1 Methodological approach of the study

3.2 Research philosophy

Research philosophy describes a set of beliefs about the world or the nature of knowledge, reality and existence. A research paradigm is a philosophical framework that guides how scientific research should be conducted (Collis & Hussey, 2013, p. 43). An understanding of research philosophy and its paradigms is important to a researcher's ability to choose the research design and methods appropriate for his/her study (Saunders, 2012). A philosophical position is made up of axiolytic, ontological, and epistemological assumptions (Figure 3.2).

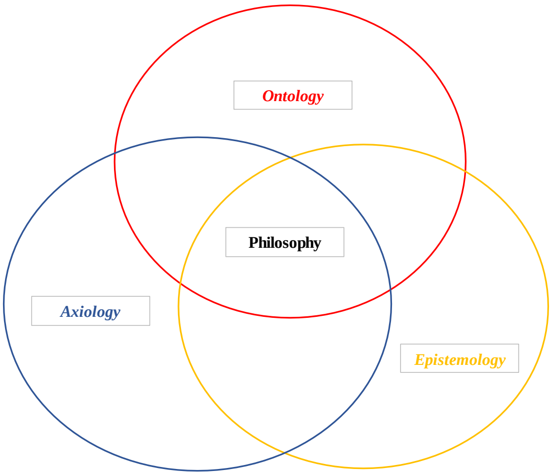


Figure 3.2 A diagrammatic representation of research philosophy

3.2.1 <u>The research paradigm including its ontology and epistemology</u>

Axiology relates to assumptions that are based on personal values. Ontology represents the assumptions made about the nature of reality, and epistemology is a general set of assumptions about the best ways of inquiring into the nature of that reality (Brown & Dueñas, 2020; Easterby-Smith, 1991). Accordingly, a researcher's paradigm and philosophical assumptions impact the research methodological choices that are made (Figure 3.3). A well thought out and consistent set of assumptions constitutes a credible research philosophy (Saunders, Lewis & Thornhill, 2015, p. 124). According to Johnson & Clark (2006), it is important that business and management researchers are aware of their philosophical assumptions in order to make coherent and meaningful research strategy choices because these choices will affect the interpretation of the findings.

The philosophical position of the current study is described as a positivist, functionalist one, explained in the following passages.

Figure 3.3 The building blocks forming a piece of work's research paradigm, how they interrelate & affect research methods (Brown & Dueñas, 2020).

A paradigm therefore represents a viewpoint or a perspective. There are many paradigms (Figure 3.4) and no single best business and management philosophy (Levers, 2013). Indeed, organisational studies are increasingly characterised by a plurality of research paradigms, and their associated research methods (Saunders et al., 2015; Mingers, 2001). Due to the diversity of philosophies that are recognised in the discipline of business and management, they can be distinguished based on their position on a number of continua between extremes (Figure 3.4).

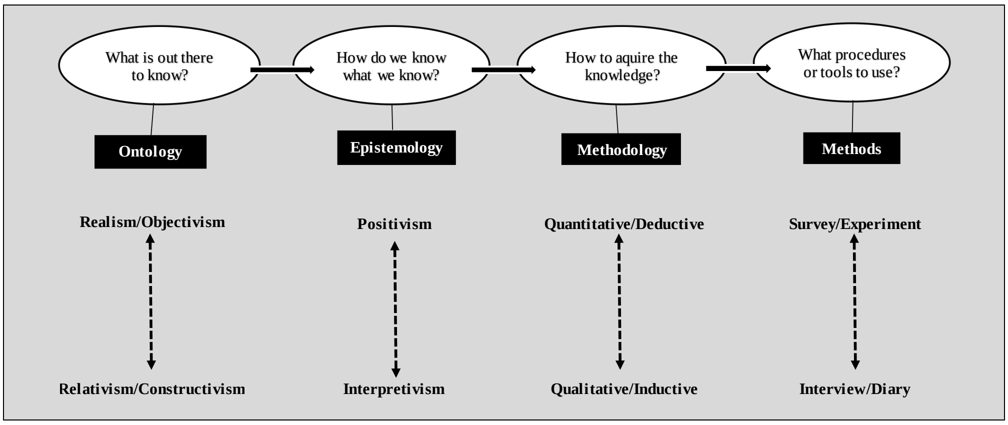


Figure 3.4 Research philosophy & associated continua.

3.2.2 The objectivism - subjectivism continuum

Objectivism (Table 3.1) assumes that social reality is external to individuals. Ontologically, objectivism embraces realism and sees the world and its people (social actors) as independent physical entities of the natural world. Being independent, social actors cannot influence the existence of the social world which therefore remains relatively enduring and stable and consequently amenable to scientific examination. Epistemologically, objectivists seek to learn about the real social world by observing measurable facts which can be generalised to the whole world. Axiologically, since social actors and social entities are independent of each other, objectivists believe they can remain detached and objective with their data (Saunders et al., 2015).

Subjectivists (Table 3.1) by contrast, view the world as socially constructed. Ontologically, the subjectivists social world is dependent upon its social actors and the interactions and perceptions of these actors. Accordingly, since individuals hold differing perceptions and will interact in different ways, subjectivists believe that the social world is in constant flux and exhibits multiple realities. Epistemologically, subjectivists study verbal narratives and individuals' opinions to attribute meaning to the varied reality. Subjectivists believe that they are integral to the social world they study and cannot completely detach. They therefore acknowledge and reflect upon their own values when conducting research.

Table 3.1 The objectivism-subjectivism continuum (adapted from Saunders 2015)

Objectivism	<=>	**Subjectivism**
Reality is ... Real	<=>	Decided by convention/Nominal
The world is ...External		Socially constructed
There is/are … One true reality	<=>	Multiple realites
The world is .. Granular, made of things		Flowing, made of processes
There is … Order	<=>	Chaos
Adopts assumtions of the… Natural scientist		Arts & Humanities
Acceptable knowledge … Facts	<=>	Opinions
Good quality data … Numbers		Narratives
Types of contribution … Observable phenomena	<=>	Attributed meanings
Types of contribution … Law-like generalisations		Individuals and context-specifics
Research should be … Free of researcher values	<=>	Value-bound
Researcher should remain … Detached		Integral & Reflexive

3.2.3 The functionalist paradigm

Burrell & Morgan (2001) combine the objectivist-subjectivist continuum with their regulation-radical change continuum and present four distinct paradigms of the social and organisational world represented in the four quadrants of Figure 3.5. To guide the reader in interpreting this model, the two paradigms to the left are associated with the subjectivist view (left-right arrow); those to the right with objectivism. Also in this representation, the two paradigms at the bottom are aligned with the regulation dimension (up-down arrow), indicating an interest in understanding the status quo, those on the top are more concerned with what impacts changes within organisational life. The functionalist paradigm located on the objectivist-regulation dimensions represents the paradigm within which most business and management research operate (Saunders et al., 2015; Burrell & Morgan, 2001). Functionalists are concerned with rational explanations and developing recommendations within current structures. Functionalists are interested in organisational problems in terms of the functions performed. Burrell & Morgan (2001) and Banville & Landry (1989), differentiate functionalists (whom they describe as main-stream navigators and unity advocates) from non-functionalists (interpretivist, radical humanist and radical structuralist). Functionalists study key business processes and create management models which they believe are generalisable. A key assumption of functionalists is that organisations are rational entities with rational problems that can be rationally resolved (Saunders et al., 2015). The current research adapts a mainly functionalist approach whereby organisations and some of their key functional personnel and the organisational process of new project portfolio selection are studied. The research hopes to contribute knowledge about the empirical nature of organisations (with useful perspectives, conceptual models and detailed research findings) to help improve organisation efficiency and effectiveness (Burrell & Morgan, 2001).

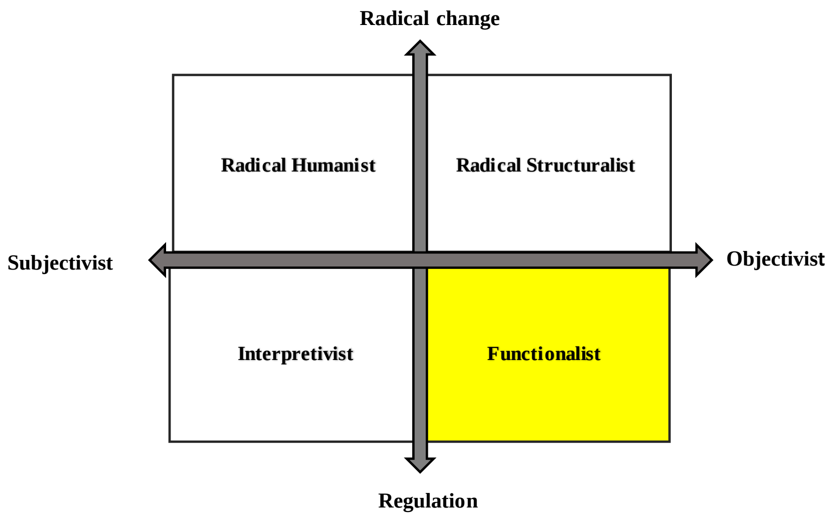


Figure 3.5 The four paradigms of organisational research based on (Burrell & Morgan, 2001).

3.2.4 Positivism

Positivism tends to dominate in many areas of business research (Chen & Hirschheim, 2004) and is associated ontologically with realism and epistemologically with objectivity (Figure 3.4, Table 3.2). Positivism originates in the natural sciences and it assumes that reality exists objectively and independently from human experiences (Burrell & Morgan, 2001). Reality is a combination of objects and phenomena that create an observable social reality. Since the world of the positivist is regular rather than random, positivists believe that people are rational and predictable (Rubin & Rubin, 2012). Positivists believe that objective investigation will bring us closer to the truth. From an epistemological perspective, positivism is concerned with testing propositions, model formation, and quantifiable measures of variables. It conducts empirical testing of theories (Easterby-Smith, Thorpe & Jackson, 2008) such as in the examination of the hypothesised relationships of the current research. In other words, positivists are concerned with the hypothetic-deductive testability of theories. Positivists believe that scientific knowledge should allow for verification or falsification of theories and it should seek generalisable results (Chen & Hirschheim, 2004). Further, positivists believe that they are impartial observers and thus can objectively evaluate and predict processes whilst remaining unaffected by the subject of the research (Chen & Hirschheim, 2004; Orlikowski & Baroudi, 1991). The current study is dominated by a positivist/functionalist paradigm; it empirically tests hypotheses, it emphasises the importance of rigour, precision, logical reasoning and attention to evidence, all toward the study of some organisational realities.

3.2.5 Positivist qualitative & interpretive qualitative research

Interpretivism is conceptualised as having a relativist/constructivist ontology with a subjectivist epistemology (Figure 3.4, Table 3.2) in direct contrast to positivism. Interpretivists assume that scientific knowledge is obtained through the understanding of human and social interaction by which the subjective meaning of the reality is constructed (Chen & Hirschheim, 2004; Burrell & Morgan, 2001). Interpretivism emphasises that human beings and their interactions create meaning and are therefore distinct from physical objects and phenomena. Interpretivist researchers seek to build richer, deeper understandings of organisational realities through their study of social relations (Saunders et al., 2015; Chen & Hirschheim, 2004). The current study's first phase employed qualitative interviews which examined human interactions such as debate, and conflict. The qualitative interview is used in qualitative research of all kinds, whether positivist, interpretive or critical

(Myers & Newman, 2007). Guided by Grandy, Cassell & Cunliffe (2018, p. 19), the phase one interviews employ a positivist view as they focus on 'searching for, through non-statistical means, regularities and causal relationships between different elements of the reality, to summarise identified patterns into generalised findings.' (Grandy et al., 2018). In this way, the qualitative methods in the current study extend the depth of the positivist functionalist enquiry of the current study.

Table 3.2 A comparison of two main paradigms (adapted from (Brown & Dueñas, 2020).

Paradigm	Positivist	Interpretevist
Reason for doing the research	To discover laws that are generalisable & govern the universe	To understand & describe human nature
Ontological assumptions	There is a single, objective reality that can be observed through science	There are multiple subjective realities, each of which is socially constructed by between individuals
Epistemological assumptions	Neutral knowledge can be obtained through the use of reliable & valid measurement tools	Knowledge is subjective & formed at an individual level
Methodological	Tests hypotheses and controls for confounders, e.g.surveys, experiments	Knowledge creation through interaction, e.g. case studies, phenomenology, grounded theory
Methods	Structured interviews, structured questionnaires, measurements, observations	Usually qualitative data collection through use of open-ended questions, resordings of observations, interpretations
Data source	Pre-post test, scores on exams, rating scales	Audio data from interviews, textual data from transcribed audio, fireld notes, open-ended survey responses

3.3 The mixed methods approach

Mixed methods research brings two or more approaches to a single research activity (Teddlie & Tashakkori, 2009). Researchers such as Mingers (2001, p. p. 241) contend that 'research results will be richer and more reliable if different research methods, preferably from different (existing) paradigms, are routinely combined together.' Mixing different modes of enquiry such as qualitative and quantitative methods into the research design, allows for the benefits of each method to be combined and for the possibility that potential weaknesses of any single method used alone, may be overcome or at least balanced by the strengths of the alternative method. Moreover, employing mixed methods provides scope for a richer set of data and interpretations (Saunders, 2012; Creswell, 2009); richer because the data are more comprehensive and potentially better because mixed methods can yield highly reliable, valid, and useful findings. Chen & Hirschheim (2004) determine that alternatives to the more commonly and singularly employed positivist approach using survey methods, should be welcomed. They say that interpretivism and qualitative methods should be encouraged because they provide ‘different dimensions for research investigation that the positivist paradigm and survey methods would not be able to accomplish alone’ (Chen & Hirschheim, 2004, p. 199). While positivist research might serve the purpose of generalisability, interpretivist studies aim to understand the meaning embedded by individuals in the phenomena investigated (Orlikowski & Baroudi, 1991). Mixed methods provide an alternative dimension for scientific inquiries and ‘should supplement rather than exclude each other’ (Chen & Hirschheim, 2004, p. 226).

Some scholars are against employing mixed methods. They argue, for example, that mixing two methods of incongruent paradigms is impossible (Tashakkori & Teddlie, 2003), may be divisive (Benbasat & Weber, 1996), or that the combination is unable to render valuable results (Denzin & Lincoln, 2005; Mingers, 2001). On the other hand, proponents of mixed methods approaches suggest that ‘a peaceful coexistence of multiple methodologies is possible’ (Venkatesh, Brown & Bala, 2013, p. 22), and indeed desirable. Mingers (2001, p. 243) proposes that multimethod research is actually essential to grasping ‘the full richness of the real world.’ For those who advocate mixed methods, they say that the facility to triangulate findings from a combination of the different research methods used, has the potential to offer complementary advantages and greater validity to findings over the use of any single methodology alone (Tashakkori & Teddlie, 2003; Patton, 1990).

According to Patton (1990, p. p.13), ‘any given design is necessarily an interplay of resources, possibilities, creativity and personal judgements’ of the people conducting the research. Given that the current study combines exploratory, explanatory, descriptive and correlational activities, the mixed methods approach was considered the most appropriate strategy for investigation. Furthermore, the multidisciplinary nature of the context under study where groups of individuals from different functions make NPPS decisions, coupled with the complexities inherent in conducting NPD project selection to achieve portfolio ambidexterity, lent well to the employment of both research paradigms. Finally, calls for using mixed methods research to help understand and explain complex organisational and social phenomena, further reinforced the decision to employ mixed methods in this study (Venkatesh et al., 2013; Modell, 2005; Mingers, 2001).

Figure 3.6 on the following page, summarises the design of the current study which uses a mixed methods approach that combines qualitative and quantitative research methods carried out in two research phases. This figure aligns with Figure 1.1 and Figure 3.1 Methodological approach of the study presented earlier. Research phase one is largely qualitative while research phase two takes a quantitative approach. The figure shows that phase one (Phase I) includes a literature review and a series of semi-structured interviews followed by an analysis of the transcribed interview scripts assisted by the NVivo software package. Research phase two (Phase II) begins with the development of a theoretical model and supporting hypotheses based upon phase one findings. Phase two continues with the development of an instrument to capture data using the survey method. Phase two concludes with the statistical analysis of the data gathered using SPSS (Statistical Package for Social Scientists) and partial least squares-structural equation modelling (PLS-SEM) to validate antecedent and consequence models of ambidexterity.

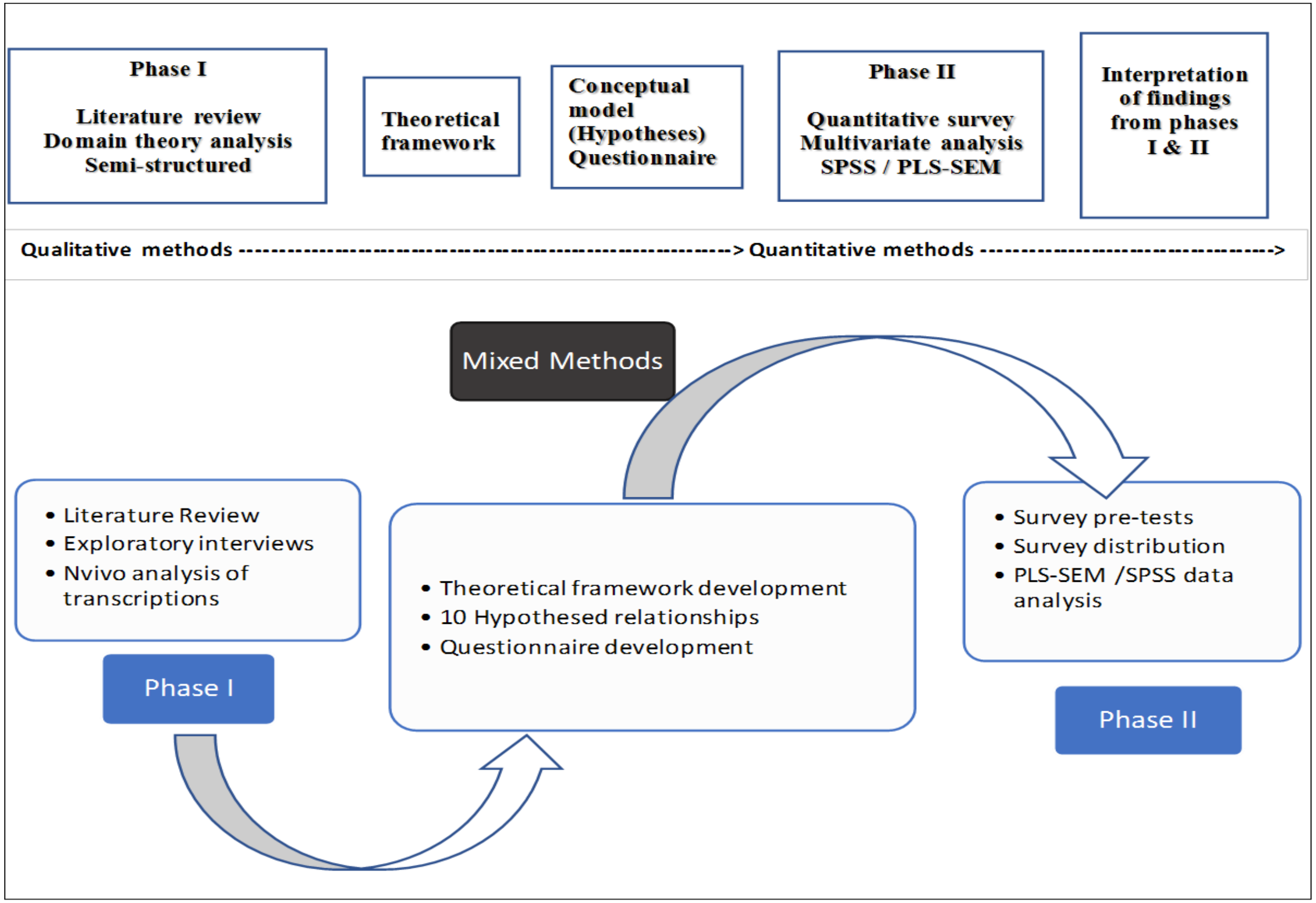


Figure 3.6 The mixed methods design of the current study.

3.3.1 Justification for qualitative, exploratory interviews

The qualitative approach is traditionally associated with non-positivist (e.g. interpretivist) forms of research. However, the qualitative interview as an example of qualitative enquiry, has been used in qualitative research of all kinds, whether positivist, interpretive or critical (Myers & Newman, 2007). In the current study, qualitative interviews were judged to enhance the value of the research that uses primarily quantitative measurement techniques. These interviews offered the opportunity for a deeper understanding of phenomena linked to NPPS that were to be further studied by quantitative means (Miles & Huberman, 1994). As indicated in chapter two, PPM generally and NPPS specifically are enacted by people of varying functional backgrounds and effected in a dynamic and challenging real-world context. Therefore, the qualitative, semi-structured interview was deemed the best way to; grasp a deeper understanding of the unique social setting of NPPS, to identify its key stakeholders, to glean a fuller appreciation of organisational constructs thought relevant to ambidexterity and NPPS, and to prepare for phase two enquiry. Since exploratory research seeks to understand the status quo, to find new insights, and to ask questions to assess phenomena in a new light (Robson, 2016), exploratory interviews were deemed particularly suitable to the study of NPPS and ambidexterity, where few previous studies have been conducted, and little is known about the associated organisational phenomena (Patton, 1990). Further, exploratory research is advantageous where it focuses on gaining familiarity with an area to facilitate more rigorous study later (Collis & Hussey, 2013). In the current study, the qualitative findings alongside the literature, led to theory development by induction. Induction is a *bottom-up* approach, where theory is developed from observation; i.e. general inferences or theories are induced or built upon from specific inferences. Knowledge moves from the specific to the general by induction (Collis and Hussey, 2013). The conclusion of inductive reasoning is therefore a hypothesis, or a proposition based on the evidence presented (Cooper & Schindler, 2003). In the current study, ten hypotheses were developed (chapter 5) based on findings derived from its phase one exploratory interviews (next chapter, chapter 4). These hypothesised relationships formed the basis for the phase two quantitative survey methods.

3.3.2 Justification for quantitative survey methods

The quantitative approach has its roots in the natural sciences and is associated with positivist research. This approach is widely used in the social sciences and dominates organisation and management research (Saunders et al., 2015; Chen & Hirschheim, 2004; Miles & Huberman, 1994). Numbers and measurement are central to this approach which relies on formality, mathematics, and statistics to establish correlations between variables. Examples of quantitative methods include surveys, lab experiments and numerical methods (Myers & Newman, 2007). However, some argue that it lacks suitability to study complex, socio-technical systems such as NPPS, where phenomena emerge during the interactions of multiple individuals, or agents, which is why it is strengthened in the current study by combining its use with preliminary qualitative methods. The findings from using quantitative methods are often used to test theories and then to make deductions, as in this study (Saunders et al., 2015). Deduction is a *top-down* method of reasoning. In other words, a conceptual and theoretical structure is developed (the 10 hypotheses in this study) and tested by experimental observation (surveyed questionnaire and analysis), allowing the deduction of particular instances (antecedent and consequent models) from general observation. Hence, deduction is described as moving from the general to the particular (Collis & Hussey, 2013).

3.4 The overarching research question and research objectives

Subsequent to the extensive literature reported in chapter two, the research question guiding this study asks (see section 1.3): *What role do performance measurement systems (PMSs) and related organisational factors (tensions, debate, conflict, functional diversity) play during NPPS in the achievement and outcome of an ambidextrous portfolio?* Three research objectives are set out to answer this question and are reiterated next (also see section 1.4).

3.4.1 Research Objectives

The study's three research objectives are reiterated next. The first phase of study addresses the first objective.

Research objective 1. Analyse NPPS in high technology industry (HTI) to identify key stakeholders and explore organisational constructs relevant to ambidexterity.

Research objective 2. Test hypothesised relationships to derive an antecedent model for competence ambidexterity in NPPS.

Research objective 3. Test hypothesised relationships to derive a consequences model for competence ambidexterity in NPPS.

To explore NPPS and ambidexterity in high technology industry, research Phase I embarks upon key informant interviews. Exploratory, semi-structured interviews with professionals working in an ambidextrous setting are employed as the preliminary means to achieve this objective. Four key themes of the research; namely ambidexterity, NPD (new product development) project portfolio selection (NPPS), performance measurement systems (PMSs), and the management of conflict and paradoxical tensions, guide these interviews (Figure 3.7). Rubin and Rubin (2005) state that qualitative interviews are like night goggles, 'permitting us to see that which is not ordinarily on view and examine that which is looked at but seldom seen'(Myers & Newman, 2007, p. 3). These interviews offer an appropriate early phase research method for the current study.

3.5 Interview schedule or protocol

The interview schedule as presented in Figure 3.7**,** is prepared to pose relevant questions, prompt discussions based on the aforementioned key themes, and understand important background details. Publicly available data covering each company's size, mission statement etc. and some internal documents that were offered during interviews were used to triangulate data. These background searches mainly assisted in finding profile information on potential interviewees. The interview schedule was used to guide identification of key stakeholders and discuss key organisational constructs relevant to ambidexterity and NPPS.

Interview schedule and probe questions

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1. Background questions

- How many individuals are involved in portfolio selection?
- What functional areas do they represent?
- How often do they meet? Are meetings face to face?
- What's the usual duration of each meeting?
- How many projects are under consideration at each meeting?

2. KPIs (key performance indicators) or performance measures, financial and non-financial

- What criteria (KPIs) are used to select individual projects for the portfolio?
- Are the criteria/measures weighted in any way?/ How are they weighted?
- Are projects categorised in any way using KPIs? (relative to e.g. risk, cost, value, time to market)
- How useful are the measures in making decisions?
- Are some measures more useful than others in assessing particular types of products?
- Are some measures more dominant than others? Explain
- Have any changes taken place in the use of performance measures over the last few years?
- Do different functions prefer certain KPIs? Explain
- What role do performance measures play in the final selection decision?
- What are the greatest obstacles to making final decisions?

3. The final Portfolio -balance

- How important is it for the portfolio to comprise different types of projects in terms of value, risk, time to market etc?
- How is this achieved? Specific KPIs?
- How is this measured?
- Define a 'balanced' portfolio.
- Do you try to have a balance of projects in the portfolio?
- Can you show me the typical portfolio makeup / diversity?
- How easy is it to predict in advance of PPS meetings which projects will be selected?
- How much influence do different portfolio selection team members have in decision-making?

4. Managing differences of opinion between decision-makers for project portfolio selection

- Do different points of view emerge in discussing project selection?
- Are there any particular factors that are likely to lead to differences of opinion? E.g. Functional background of members? /Types of projects?
- How acceptable is it to voice contradictory views?
- To what extent are performance metrics referred to in discussions?
    - Which measures generate the most discussion/debate?
    - To what extent is there debate around the meaning/implications of particular metrics?
    - To what extent are metrics related to differences of opinion?
- Do discussions get heated?
- How are differences of opinion managed?
- In your experience, are there factors that are likely to escalate or de-escalate differences of opinion?

5. Dynamism

- How does technological dynamism affect your decision making?
- In your experience, are environmental or competitive dynamism influencing factors?

Figure 3.7 Interview schedule to guide the semi-structured interviews.

Table 3.2 Themes explored in the semi-structured interviews, link to questions & the literature

Theme	*Questions*	*Author*
Key Performance Indicators (KPIs) or Performance Measurement Systems (PMSs)	Questions are posed to determine types of measures used during NPPS as some are known to favour exploitation & incremental innovations over exploration & radical innovations	Bedford et al. (2019); Severgnini, Vieira & Cardoza Galdamez (2018); Davila, Shelton & Epstein (2015);Dekker, Groote & Schoute (2013); Kester et al. (2013); Ahrens & Chapman (2007); Simons (1995).
A balanced Portfolio (Ambidexterity/Paradox)	Questions are posed to enquire if balance is considered during NPPS & how balance is achieved	Raisch, Hargrave & van de Ven (2018); Meifort (2016); Papachroni et al. (2015); Jugend & Da Silva (2014); McNally et al. (2013); Petit & Hobbs (2012); Smith & Lewis, (2011); Andriopoulos & Lewis (2010); Barczak (2009); Perez-freije & Enkel (2007).
Debate (lively discussions)	These questions are asked to assess if paradoxical tensions are felt during NPPS based on use of opposing measures directing project selection between opposing types of product innovation	Bedford et al. (2019); Bedford (2015); Dekker Groote & Schoute (2013); Kester et al. (2011); Hall (2010); Ahrens & Chapman (2007); Henri, (2006); Bisbe & Otley(2004); Simons (1995).
Conflict (disagreements)	These questions are aimed at understanding how disagreements are managed; to determine if they are issue (cognitive) or personality (affective) based	Parayitam & Dooley (2009); McNally et al. (2009); Lovelace, Shapiro & Weingart (2001); Amason (1996); Jehn (1995).

Table 3.3 Respondent interviewee demographics

Interviewee (I) Number	**Respondent Role**	**Company size**	**Duration interview (minutes)**	**Frequency of portfolio selection meetings**
I. 1	Chief Executive Officer	Medium	27.19	Quarterly
I. 2	Research & Innovation Senior Leader	Large	22.41	Monthly
I. 3	New Product Innovation Director	Large	63.45*	Quarterly
I. 4	Director Marketing & Research	Medium	31.42	Weekly
I. 5	Operations Vice President	Large	25.28	Quarterly
I. 6	Director Program Management	Large	23.72	Quarterly
I. 7	Director Research and Development	Small	21.37	All the time
I. 8	Director of Operations	Small	47.34	Monthly
I. 9	Chief Executive Officer	Small	14.09	As needed
I. 10	Finance Director	Large	10.2	Quarterly
I. 11	Director Research and Development	Large	48.42	Quarterly
I. 12	Senior Project Manager	Large	34.28	Quarterly
		Average	27.79	

* This includes a subsequent telephone conversation of 18.22 min duration
Company size key: Small (<50); Medium (51-249); Large (>250) employees

3.6 Target population

Interviews were targeted at the high technology medical devices organisations operating in current-day dynamic and intensely competitive environments. As knowledge and technologies rapidly advance, product obsolescence is an ongoing threat for these companies (Wang & Rafiq, 2014). They must therefore protect themselves against over-dependency on existing successful products which leads to product redundancy vulnerabilities. Biotech and IT companies are considered to be models of ambidexterity (Andriopoulos & Lewis, 2009; Tushman & O' Reilly, 1996), renowned for their excellence in exploitative and exploratory innovations within intensely competitive new product development (NPD) industries. Since Galway City and the West of Ireland is a recognised hub for the medical devices industry, professionals in this industry were targeted for the early phase one exploratory interviews to identify key stakeholders and confirm key organisational constructs relevant to ambidexterity and NPPS.

3.7 Sample selection

Over a three-month period, an e-mail was sent to the CEO of 10 medical device companies based in Ireland. The CEOs were purposefully selected to reach companies of small, medium and large size. In most instances, names were garnered from the company’s profile on the internet. The e-mail conveyed the study’s research area and general purpose and it asked the CEO or another company employee to meet with the researcher for a discussion about NPD project portfolio selection decisions (email sample Figure 3.8). It was anticipated that the CEO or an employee nominated by him/her would possess the holistic knowledge and expertise to provide an information-rich source for the exploratory purposes of the current study. Anonymity and confidentiality of the company and the potential interviewee were assured in the e-mail. In total, 12 senior managers accepted an invitation to interview (Table 3.3). Respondents came from multiple disciplines (e.g., marketing, R&D, operations, finance) which benefits the research with multiple individual perspectives and likely therefore to reduce informant bias (Kaplan & Maxwell, 2005; Miles & Huberman, 1994). Interviews were mutually arranged on a suitable date and time and were held at each interviewee’s place of work.

Dear XX

The reason I am emailing you is that I am doing a study looking at what factors influence new product development project selection decisions and how organisations balance their portfolio of projects between incremental and radical type projects. I will be meeting with a number of companies in the medical device industry to look at how decisions are made, the extent to which KPIs are used in making decisions etc. The names of companies participating in the study will be completely confidential and findings will be reported on an aggregate basis.

Would you or someone else in COMPANYNAME involved in NPD project selection meetings be willing to meet with me? The meeting would take no longer than 1 hour, and I am happy to meet at any time convenient.

I look forward to hearing from you and really appreciate your support for our research.

Figure 3.8 Sample e-mail request to conduct exploratory interviews.

3.8 Semi-structured interviews

Interviews were conducted at individuals' places of work (except for a single case), and each lasted 30 minutes on average. Interviewees spanned all company size categories from small through to medium and large and a included a wide range of senior management disciplines (Table 3.3) The flexibility of semi-structured interviews can lend itself to the emergence of unexpected and previously unknown information. Consequently, valuable insights can be captured. Additionally, semi-structured interviews permit a two-way discussion that proves useful in clarifying misunderstandings in real-time. The intent of the research was to increase understanding of the phenomenon or key organisational constructs of NPPS, within its contextual setting; 'where the phenomen[a] of interest [were] examined in [their] natural setting and from the perspective of the participants; and where researchers did not impose their out siders 'a priori understanding on the situation' as prescribed by Orlikowski & Baroudi (1991, p. 5).

3.8.1 Ethical issues during phase I

According to best practice and due diligence, ethical issues were considered in phase one. First, requests to potential interviewees were made formally through university e-mail. Interviews were conducted on a one-to-one basis and participants were reminded that their participation was voluntary, and they could leave the process at any time. Further, they were reminded that the discussion would remain anonymous and confidential and that future reports would be made in the aggregate. Permission to record was requested before interviews were commenced and interviews were recorded using a digital device. Recordings were transcribed by a professional transcribing agency, into pdf files. This proved useful for listening back as insights came to light that were not picked up during the interview. Recordings were allocated a reference code instead of a personal identifier, to strengthen anonymity and confidentiality. Anonymity was sustained during transcribing as the agency typist was requested to replace any company name or individual's name inadvertently used during recordings, with a generic term e.g. COMPANYNAME, PRODUCTNAME or NAME etc. These transcripts provided the data for interview analyses. All transcribed material was kept under lock and key and the recording on the digital device were subsequently erased.

3.9 Data analysis

Data was analysed using the 'relational database' tool called NVivo (Bazeley & Jackson, 2013, p. 50). NVivo is a software package that assists researchers in the interpretation of non-numeric qualitative data using a systematic process that is less laborious than earlier approaches to qualitative data analysis. For example, hand-written pieces of paper laid on the floor like a jig-saw puzzle that get shuffled around during the analysis phase are a thing of the past with NVivo. Instead, this software program can upload textual data in the form of interview transcriptions, which are then coded by the researcher. Data can be easily copied and pasted into several categories as the researcher sees fit. The editing facilities, alongside the graphical and pictorial representations available, facilitate identification of themes and patterns in the data as the analysis advances.

In NVivo, 'cases' act as containers that centrally store all data pertaining to each case (e.g. interviewee). The data remains accessible at all times. In this study, cases pertain to individual members (I) of NPD portfolio selection teams (I1, I2, I3 etc.) of whom each represent a key functional role within their organisation/team. 'Attributes' (gender, age, functional role, tenure etc.) and 'attribute values' (male, female; age categories e.g. 30s, 40s, 50s; functions or disciplines e.g. R&D, Commercial, Operations, Financial etc.) are case specific. Once allocated to their relevant case, attribute values remain as permanent case identifiers for future comparator work. Further, as part of the graphical representations available, NVivo can present textual data in visually attractive displays such as concept maps, matrices, and models (e.g. Figure 3.9) that assist researchers in data interpretation by making it easier to see and make links between concepts while reflecting on data, during analysis. These displays also serve the function of data reduction by facilitating its storage and its movement into sub-categories as sub-themes by simply selecting and dragging (Bazeley & Jackson, 2013; Miles & Huberman, 1994)). These characteristics render NVivo highly attractive for interview data management and interpretation which explains its choice as the preferred tool for data analysis in this research. Interview data analysis was conducted in stages as follows;

3.9.1 Stage 1 – Familiarity with the data

Within an hour following each interview its digital recording was played and preliminary notes were taken while the conversation was still fresh and easy to recall. Subsequently, every recording was re-played whilst simultaneously reading the corresponding transcript. This action familiarises the researcher with interview content and leads to a better understanding of the material as individual inflexions and specific emphases on words and phrases can be heard and noted. Use was made of the editing functions within NVivo where words emphasised in recordings were emboldened in the transcripts to convey respondent expressions of significance, and points for critical attention were underlined. Unintentional typographical errors and mistakes of omission were also corrected in the transcribed documents, during this stage.

3.9.2 Stage 2 – Initial coding

When satisfied that the transcriptions were correct, audio and PDFs (portable document files) were uploaded into NVivo. A process called open coding (Strauss & Corbin, 1990) began wherein the transcripts were broken down sentence by sentence and allocated or coded (highlight text, drag and drop) into a number of themes or codes entitled ‘nodes’ (represented as oval shapes) in the NVivo system. As recommended by Patton (1990), an initial set of themes was developed in the current study before (a priori) the interviews commenced. Some of these themes were specifically relevant to the research having been garnered from the literature prior to the interviews taking place. Accordingly, (see Table 3.4), this initial set of nodes was mainly based around pre-determined theoretical categories such as innovation (e.g. exploitation, incremental etc.), ambidexterity (balance), PMSs (e.g. financial, non-financial), etc. while others emerged from the analysis. Coding continued until saturation was reached, i.e. no sections of the transcripts remained un-coded and no further themes were being identified. As recommended in Bazeley & Jackson (2013, p. 89), 'coding can be applied to a word, phrase, sentence, paragraph, long passage, or a whole document … you need to include a sufficient length of passage for the coded segment to 'make sense' when you retrieve it.' By coding longer passages time can also be saved as the data does not become excessively disjointed. The data remains linked to NVivo's graphics which further assists in rapid data retrieval during the iterative cycles of analysis, reflection and interpretation (Klein & Myers, 1999).

Table 3.4 Initial coding of interview data

Node number	Node name	Node number	Node name
1	Balance	10	Functional role
2	Conflict and Tensions	11	Irrelevant
3	Culture	12	Leadership
4	Customer	13	Market
5	Decision-making	14	Organisation
6	To be decided	15	Performance management
7	Dynamism	16	Portfolio
8	Exploitative innovation	17	Strategy
9	Explorative innovation	18	Uncertainty

3.9.3 Stage 3 – Refinement

As data analysis progressed, the initial codes were refined based on a re-examination of the literature and the data. Using NVivo software, some of the large number of codes were categorised into a smaller number of broad themes through merging and movement of sub-categories, seen visually as tree nodes and sub-nodes like that of Figure 3.9, a pictorial example of a coding 'tree' in NVivo related to the broad theme of performance measurement systems (PMSs). In this figure, (Figure 3.9), the PMSs form the central or adult node of the tree (yellow oval shape) akin to a tree trunk. Other themes, ideas, concepts etc. that were coded to the PMSs during open coding, are linked as child nodes (blue in Figure 3.9) to the adult node by lines or 'branches' to the trunk. Colours and shapes can be edited. All parts can be moved easily during analysis as different perceptions are examined and compared. As such, the coding tree is a visual aid in the interpretation of findings. In combination with existing theory and researcher experience, knowledge and intuition, coding trees help the researcher to expedite an appreciation and interpretation of qualitative data.

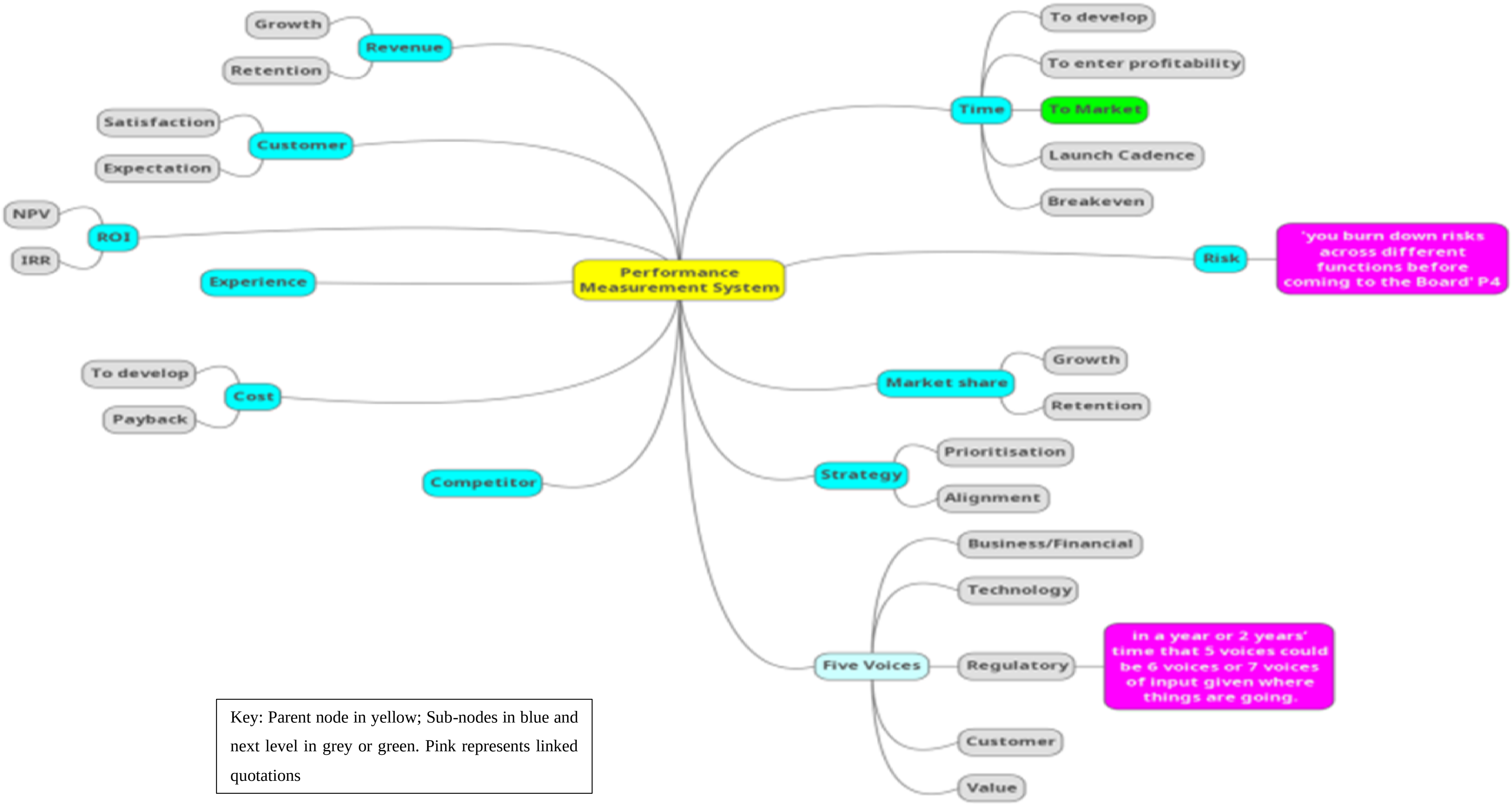
3.9.4 Stage 4 – Axial coding

Axial coding involves linking themes to contexts, themes to consequences, themes to patterns of interaction and themes to causes (Strauss & Corbin, 1990). This linking process facilitates the examination of interrelationships between themes and is helped by a return to the literature. The red dashed lines in Figure 3.10, represent axial coding. The current study's qualitative analysis was also guided by the approach to coding followed by Papachroni, Heracleous & Paroutis (2016), because similar to the current study, they focused their analysis on predetermined themes, some of which are also relevant to this study, i.e. they examined 'how actors interpreted and managed tensions of innovation and efficiency' (Papachroni et al., 2016, p. 1797). Thus, the current study uncovered relationships within and between the predetermined key themes of interest such as actors' interpretation of the tensions between opposing strategies (e.g. defending current business, exploring new opportunities for growth). Through NVivo, themes and relationships identified in the literature were examined in the context of NPD portfolio selection, they were validated in this context and categories that needed further refinement and development (ambidexterity; PMSs, cognitive conflict) were addressed (Bazeley & Jackson, 2013). Findings were then compared again with pre-existing theory creating a more theoretically informed analysis.

3.10 Summary

This chapter opened with a discussion based on research philosophy and identified the current study as a positivist, functionalist work. The chapter then outlined and justified the mixed methods two-phase research design. After restating the research question and research objectives, the first field-based data collection phase, namely the phase one semi-structured interviews, were presented in detail. The chapter concluded with a discussion based on the data analysis methods used. In summary, the chapter justified the choice of expert interviews to identify a framework of organisational factors important to ambidexterity and NPPS.

The next chapter presents the findings from this first phase study, findings that prove most beneficial toward directing the second, quantitative phase of the study.



Key: Parent node in yellow; Sub-nodes in blue and next level in grey or green. Pink represents linked quotations

Figure 3.9 Analysing interviews using NVivo; a coding tree sample for a PMS (performance measurement system).

Key: Overarching theme dark blue; sub-themes orange; next level pale blue then grey ; interrelationships red hatched lines.

Figure 3.10 A coding tree for tensions of opposites and testing for interrelationships.

Chapter:4 **Phase I Findings**

Qualitative Interviews

"When you first came to me you said you wanted to

learn 'how to interpret' what you see as you travel through the world.

Your confusion is simple.

To interpret and to state Truths are two quite different things"

From Halcolm's Evaluation Parables

Patton (1990, p. 460)

4.1 Introduction

This chapter presents the synthesised findings gathered from the phase one, semi-structured interviews and their analysis using NVivo methods that were reported in the last chapter. These findings are gathered toward answering the overarching research question arrived at following the literature review, namely; '*What role do performance measurement systems (PMSs) and related organisational factors (tensions, debate, conflict, functional diversity) play during NPPS in the achievement and outcome of an ambidextrous portfolio?'*

After a re-iteration of this study's three research objectives, the chapter reports on the findings relevant to research objective one in preparation for the phase two research phase, which addresses research objectives three and four. Findings include the identification of key stakeholders who enact NPPS demonstrating the functional diversity of the individuals involved. This has implications during the decision-making process. Then, findings concerning the types of PMSs employed, and other organisational factors relevant to NPPS, are reported. More specifically, a role for the PMS in generating tensions, debate and conflict during NPPS, is examined. Consideration is then given to new findings revealed about informal controls, and their possible effects on ambidexterity. The chapter concludes with a summary of phase one findings; findings which provide the basis for a conceptual model and associated hypotheses to direct the second research study phase.

4.2 Research objectives

<u>Research objective 1.</u> Analyse NPPS in high technology industry (HTI) to identify key stakeholders and explore organisational constructs relevant to ambidexterity.

<u>Research objective 2</u>. Test hypothesised relationships to derive a model of specific organisational antecedents of competence ambidexterity in NPPS.

<u>Research objective 3</u>. Test hypothesised relationships to derive a model of specific consequences of competence ambidexterity in NPPS.

4.3 Functional diversity in new product portfolio selection

The study finds that new product portfolio selection (NPPS) decisions are made by a number of individuals each with a different functional background, demonstrating that functional diversity (FD) is associated with NPPS. Three functions are found to dominate in NPPS; commercial/marketing/sales, research and development (R&D), quality and/or regulatory functions. Gathering individuals from a variety of functional backgrounds to make important decisions such as NPPS, provides the broad spectrum of specialist knowledge deemed essential to HTIs that market products for human use (Tobin & Walsh, 2011; Atuahene-Gima, 2005). R&D expertise is critical to exploratory activities. Skills in marketing and commercial roles are essential to the achievement of customer satisfaction and market value. The quality and regulatory roles are requisites for meeting the strict quality and regulatory standards faced by HTI. Findings show that in the larger companies, individuals from other functional roles including operations, clinical and finance also partake in NPPS (Auh & Menguc, 2005b). In the small and some medium-sized companies, interviewees report that their company CEO fulfils the finance function at NPPS meetings. In most cases, NPPS meetings are reported to take place on a quarterly or monthly basis. Smaller organisations conduct face-to-face NPPS meetings. Larger companies say they hold virtual, web-based meetings with some individuals located in another country.

4.4 Types of performance measures for portfolio selection

Findings confirm that performance measurement systems (PMSs) are important in guiding NPPS. All interviewees report a broad range of performance measures (PMs) to which they refer when making NPPS decisions (Table 4.1). Findings indicate that interviewees from small companies quote a narrower PMS dominated by measures of revenue, costs and time in NPPS decision-making, compared with those working in larger companies. As companies grow in size, findings show that their PMS grows in breadth and diversity.

For example, the following quote from an interviewee based in a large company illustrates the range and variety of information underlying the PMS used for NPPS decisions in that company:

"we have what's called a Project Investment Proposal (PIP), so in other words somebody would create this proposal and I think there's 16 sections and it's everything from market to value to customers to ... we do what's called the 5 voices, the voice of the customer, the voice of business, the voice of technology, the voice of regulatory … and voice of value ... So someone has to do all that and create a whole proposal and bring that to the business plan meeting."

(Director of Program Management >250 employees).

In contrast, interviewees in smaller companies report a narrower and less diverse PMS focused to a greater extent on financial measures:

"it's very bottom-line focused, I mean it's very sales and marketing focused because it has to be. I mean the different factors, how quickly can it get into manufacturing, what capital is required, what's the likely adoption, sometimes, once you've got your core technology the next bits are reasonably straight forward, do you want big ones, smaller ones, fatter ones, thinner ones? ... There's a bit of that about it, it's just widening out the portfolio. So, we're not taking any big bets. The initial one was the big bet but now that we've got out there, it's about trying to entrench it and being a slightly broader portfolio."

(CEO <50 employees).

The most frequently quoted measures used in NPPS (Table 4.1) fall roughly into three categories; namely financial (4.4.1); non-financial (4.4.2); and portfolio-type or 'balancing' measures (4.4.3). Findings corresponding to each category are presented next with an emphasis on PMs most often discussed.

Table 4.1 Categorisation of the performance measurement system employed during NPPS

Financial Measures	Non-financial Measures	Portfolio-Type Measures
Revenue (retention; growth)	Time (to develop; to market)	Launch cadence
Profitability	Risk	New/Existing market
Costs	Market-share	Low/Medium /High risk
Net present value (NPV)	Regulatory compliance	Radical/Incremental product
Return on investment (ROI)	Reimbursement	New/Existing customer
Pay-back time	Competitor activity	Value
Value	Customer satisfaction	

4.4.1 Financial measures

All financial measures included in Table 4.1 (above) are important in NPPS meetings. The first three listed, revenue (income generated from sales), profitability (revenue in excess of expenses), and costs (expenses attributable to production and commercialisation), are reported to be critical. Furthermore, all financial measures are afforded the greatest level of significance in decision-making compared with non-financial measures and portfolio-balancing measures. It comes as no great surprise that financial measures are reported as very important during NPPS. What is surprising is the finding that financial metrics have such a prominent role in NPPS decisions given that the literature suggests that they tend to bias decisions toward the short-term rather than the longer-term.

Emphasising this dominance, an interviewee says (emboldened words reflects vocal stress on the word by interviewee):

"financials rule everything, financials rule ***everything****."*

(Director of Program Management, >250 employees).

and another respondent adds:

"It's around the project justification both in terms of technical need and finance, ***<u>all</u> the finances****, what the project is going to cost, the duration, what the NPV and the IRR are ... whether a project pays for itself within one year or 2 years, 5 years, whatever, the shorter the better the more attractive the project is ... probably NPV and Pay Back would be the two things that are most important."*

(Senior Project Manager, >250 employees).

One interviewee equates financial measures with 'hard facts' suggesting that they provide solid and credible evidence in support of specific product candidates:

"some of the reasons we pick projects are for ***hard, cold facts*** *-so we work out NPV for projects-are you familiar with the term NPV? Net Present Value, so we work out NPV for projects and that's hard facts, if you have two projects of equal risk and one has double the NPV of the other, which project would you pick?"*

(Research & Innovation Director, >250 employees).

In addition to reporting profitability and cost measures as central in NPPS, all interviewees emphasise the limitations in resources available for product development. This, they say, means that it is critical to pick the 'right' products to develop. Otherwise, they say, the implications of product failure include loss of competitive advantage and loss of revenue. Two examples follow;

"In this early phase [pointing to pre-initiation projects on a graphical representation of the portfolio, from which selections are made for development] *it's all about prioritisation of projects- are we doing the* ***right*** *projects ... resources are always our number one issue after money* [revenue]."

(Director of Research and Innovation, >250 employees).

"how much money it takes to develop, which is a lot, and then how much can you make back, which is obviously a function of how much you can sell it for versus how much it costs to make, which is all kind of very simple stuff, but that's a ***big*** *one that comes into our thoughts as well because I've worked for companies* [*>5,000 employees*] *where we started to develop a product and we were saying, okay, this is getting a bit complicated now, we're not going to even make a profit on this so why are we even bothering."*

(Director of Research and Development, <50 employees).

Interestingly, two interviewees report that the ‘value’ a new product can offer is gaining increasing importance in NPPS. For example, one interviewee says that the ‘voice of value’ has superseded the ‘voice of the customer’ in terms of importance as follows:

*“Voice of customer **was** one and actually at the moment **voice of value** is the one that’s come from nowhere in the last 2 years, again because of where the market is gone, because if you can’t prove now that you’re bringing value and value can vary between clinical value or you know longevity of life or you know those kind of things … that’s become a really, **really important** one.*”

(Director of Program Management, >250 employees).

4.4.2 Non-financial measures

The complexities involved in NPPS decision making are evidenced in the range of non-financial measures reported in Table 4.1. Since the interview conversations focus on the non-financial measures most frequently reported as significant in NPPS, namely time-related measures, market-share, and measures of risk, the other measures are listed and briefly presented next because they are also important in decision making.

Regulatory compliance and reimbursement considerations are highly critical issues to industries working with high technology products that involve humans use (Tobin & Walsh, 2011). When products are used by people (e.g. arterial stents) or are handled by people (e.g. diagnostic kits), the manufacturing companies must comply with strict quality and safety regulatory standards to protect human lives. Regulatory compliance is essential for market access and indeed it must continue to be monitored post-market launch. This is a huge expense for HTIs. The achievement of regulatory compliance status for any product by a company is not guaranteed. Further, due to higher uncertainty attaching to increasingly novel products, regulatory compliance considerations are important during NPPS. Reimbursement related to medical devices refers to the facility of reimbursement or compensation to an organisation or individual that uses the medical device(s) and is provided under the GMS (Medical Card) or DPS (Drugs Payment Scheme) schemes. Possessing reimbursement status is very important in giving a medical device company access to hospitals. Increasingly, achieving reimbursement status is more difficult than in the past. Interviewees report that, as part of the negotiations for reimbursement status upon which an order is dependent, companies are obliged to document the ways in which their product provides value over the status quo.

All interviewees report that they must always be aware of competitor activity. Competitor activity is linked with market-share as seen below in quotes. Interviewees say they aim to stay ahead of the competition, and one says they may even change direction in research activities depending on competitor activity. Customer satisfaction is also reported as important and is linked also to market share. It is spoken of as an important contributor to retention of market share.

All interviewees report a reliance on **time** related measures in NPPS discussions. The length of time a potential product is predicted to take for its development (development-time) is reported as important from three perspectives; one, its effect on product launch-date - the longer it takes to develop a product, the later its launch date (time-to-market); two, its effect on financial returns - the longer the time-to-market, the longer the period required to recoup investment costs and to return profits; and three, the longer the time-to-market - the greater the pressure to fill the intervening time with new incremental product selections for the portfolio. How all of these factors are interrelated can be seen in the following quote from a senior manager:

"So we're talking 2020, 2022 before we're going to see the real return. So for certain parts of the organisation that's too far away, there's a lot of smaller value pieces to do at the moment and we may have to do multiple ones of those with multiple different customers to make sure we're ... no one knows the winner and we're definitely not going to be the ones to make the bet in deciding one or the other but we have to keep a certain amount of the options open."

(Director of Marketing & Research, 51-249 employees).

Market-share is a metric that describes the share a company/product has in a market relative to the size or potential of the entire market. Market share is calculated by taking the company's sales over a certain period of time and dividing them by the total sales of the industry over the same time period. Interviewees explain that companies must continue to satisfy their existing customers from month to month just to retain current market-share. Otherwise, they say, customers could move to competitor products which puts a company's current business in jeopardy. The following quotation is an example of the pull that respondents feel between the need to retain current market share and the fear of losing a potentially larger market share to a competitor's radical new technology:

*"What you keep needing to do is improve your product to **hold** your market share because your competitive analysis is looking at, for us it would be CompanyName and CompanyName and CompanyName, right, so where are they investing? Is their product going to be better than our product in a year's time or 2 years' time? If it is, we need to invest to make sure we stay ahead of them from a technology perspective."*

(Director of Program Management, 51-250 employees)

However, the literature indicates that improving existing products (through exploitation and incremental product innovations) to retain current market share is merely a short-term practice (Lin et al., 2013). To grow market share substantially, a successful new or radical product is needed. This requires attention to market-share growth during NPPS, despite the very strong pull toward market share retention. If allowed, the natural tendency toward exploitation and incremental new product innovation choices will dominate.

Notwithstanding these facts, a Director of Research and Innovation described the difficulty in using market-share as an indicator for NPPS because of the degree of uncertainty in trying to make predictions about the future. Notice also that the use of market share measures is tightly coupled with financial metrics:

"market-share it's a guess but financially, if you get 10% market share versus 12%, that financially makes a big difference but how do you know if you're going to get 10% or 12% market-share? So that's a good example of, so market- share is generally one that's very hard to know."

(Director of Research and Innovation, >250 employees).

Nevertheless, market-share comprises an essential element of the performance measurement package for NPPS as reported by all interviewees. Market-share measures are consistently reported as important indicators of a potential product's desirability for portfolio selection and development.

Risk describes the probability of loss. The term is added to Table 4.1 as another non-financial measure given prominence during NPPS. Risk refers to the likelihood of unexpected outcomes and is thus strongly linked to levels of uncertainty. As uncertainty increases, risk levels rise. Likewise, as product complexity increases, risk increases accordingly. Respondents expressed awareness that successful radically new products are likely bring better returns than do successful incremental products (*"it's a risk-return"*), but if the risk associated with a particular product is deemed too high, its introduction into the product portfolio becomes delayed or even suspended:

> *"So if the project is great and you can make it ... it's a great idea* ***but*** *if it's going to cost a hundred million, Supply Chain and Engineering will go away and say 'Well that's going to cost a hundred million to ... it's a lot of capital and we're only going to sell 200 million in the first year. Are we prepared to take the risk on the return on investment?' So all of that will come into play ... as I said the idea is* ***kill them early****, do* ***not*** *have people working on things that you don't believe are ever going to materialise into a commercial product.*"
>
> (Director of Research and Development, >250 employees).

Other interviewees report different ways of dealing with high risk product development categories. Some talk about having to "kill them early" if they are considered high risk (Director of R&D, >250 employees). Others talk about filtering out very high-risk but potentially profitable projects to do further examinations on them before considering their introduction into the NPD portfolio e.g. by doing a formal "Project Development Plan" upfront before further consideration (Senior Project Manager, medium-sized company) or performing "skunk works" on potential new products (CEO, medium-sized company). Others report that the highest risk NPD projects are bought or acquired by larger companies from smaller companies when the latter companies have already dealt with the greatest risks (R&D Director, 50-249 employees).

The development of a totally new radical innovation (as an example), requires new systems, new processes, new knowledge, with all the associated monetary costs and time. Further, it necessitates seeking quality systems approval and regulatory compliance assurances, usually lengthy and costly processes, and with uncertain outcome. Radical product innovation often entails securing reimbursement approval i.e. that the Health Boards will cover the costs of the product if hospitals purchase it. And, after these aforementioned requirements are met, there is no guarantee of product success. Moreover, markets and customer preferences change over time. So, while interviewees say that the development of radically new products is desirable for the preferential benefits ("*it's a risk-return"*), they are also very cognisant of the higher associated risks and the fact that these risks make delivery of radical new products less likely and their selection into the NPD portfolio very challenging.

This reality is evidenced in a discussion with another interviewee who explicitly reports the value of using both financial and non-financial measures in combination for NPPS. This individual says that it is important not to rely entirely on financial measures if new innovations are desired and adds that non-financial measures "force" the consideration of explorative solutions needed for a longer-term portfolio. The literature describes this as making explorative activities and radical-type innovations 'visible' (Bedford et al., 2019; Davila et al., 2015; Anthony, Johnson, Sinfield & Altman, 2008). This finding is significant because it demonstrates evidence for the use of a broad PMS that incorporates financial and non-financial measures. A broad PMS facilitates explorative activities and radical innovations, rather than limiting innovation activities to exploitative, incremental ones. It also offers an example of the tensions that arise between the short-term and the long-term; between current markets and new ones:

"if you do it [prioritisation] purely on a financial basis, only certain types of projects will get through and this company are very much a blue ocean company,… if you're looking at creating new market opportunities, in creating new market space, you haven't got that percentage of existing market you can analyse, so the thing I do is try and avoid it being a pure financial computation … I just use forty years of experience of product development. Strategically, when I think of where the company is evolving to, in five, ten years' time, so I'm looking at what type products will fit that portfolio, what sort of markets do we need to be in for the future that isn't necessarily going to give us any short-term pay back but we need to position ourselves there."

(CEO, 50-249 employees).

4.4.3 Portfolio-type measures for a balanced portfolio

When questions were asked about how a balance is achieved between e.g. short-term and long-term development projects (i.e. taking a *portfolio* approach) to manage the tendency towards the shorter-term project, interviewees describe their portfolio holistically. Some discuss a "launch-cadence," the ability to have products in development that can launch in the short-term and others available to launch in the longer-term. Others describe portfolio balance in terms of balancing overall portfolio risk, overall portfolio value, and/or by balancing the types of products under development. Critically, they report that NPPS decisions are not taken without consideration of the portfolio. This indicates a *portfolio perspective* (Jugend & Da Silva, 2014; Blichfeldt & Eskerod, 2008), and that these companies are attempting to be ambidextrous. Striving for a “launch cadence” or a “phasing-in-pipeline” are approaches reported to create a balanced portfolio. Some companies report using visual graphics that show the composition of the existing NPD portfolio and expected launch timelines for its constituent products. This assessment during NPPS enables the selection team to identify gaps that could be filled by the product(s) they ultimately select for the portfolio.

An example of this is given in an interview extract from a New Product Innovation Director who reports the need to plan ahead for a ‘launch cadence’ of products to ensure there are no extended periods of time during which some new product is not being introduced into the market from the product portfolio, as follows:

“you always want a cadence; you can’t have a gap in your portfolio so that one year you’re not launching anything. You need to have new products on the market because that’s what the customers’ expectations are, plus new products generate most of our revenue, so that’s what you call a launch cadence, that’s pretty standard in most companies, you want a launch cadence.”

(Director New Product Innovation, >250 employees).

Indeed, all interviewees report the importance of having products in the portfolio that allow for on-going product launches. One respondent describes it as having to maintain a ‘*pipeline’* of products to permit timely “*phasing in”* of new products:

“you’ve got to maintain that R&D pipeline and have stuff phasing in, so we would have like a graphic representation of what products, new products would phase in over the next number of years so that we ***continually*** *are feeding new products into that pipeline but you have to put money into them now for maybe two to three years’ time.”*

(CEO, >250 employees).

The essence of this time-scheduling is to try and maintain a balance within the NPD portfolio, a balance between the number of incremental and radical products that are under development so that new product launches are on-going, which will keep customers satisfied. Similarly, an examination of the portfolio’s existing product-type content gives a picture of whether or not the portfolio is balanced in terms of the mix of incremental and radical projects. Measuring the cumulative risks associated with the portfolio of products, is another means of balancing the NPD portfolio. If most products are associated with low risk, the lack of investment for the longer term is made visible.

In summary, this section (4.4) has presented evidence on the range of financial and non-financial metrics used during NPPS; the dominance of financial metrics (particularly in smaller companies) during NPPS; and the use of portfolio metrics to aim for a balanced portfolio across product type, launch schedules and risk. The next section sets out other important issues associated with PMSs in NPPS.

4.5 A role for PMSs in generating tensions, debate, and conflict

This section provides evidence that the composition of PMSs that simultaneously make opposing demands, creates dynamic tensions. These tensions are experienced by individuals as they try to respond to simultaneously opposing demands. Consequently, debate is aroused. Debate can lead to disagreements or conflict.

4.5.1 Individuals' experiences of tensions underlying the PMS

As described in the last section, PMSs are employed during NPPS. An examination of these metrics reveals that they comprise measures which direct opposing strategies simultaneously. In one example, interviewees express the tensions imposed by these opposing demands in describing the pull they feel between market-share retention and market-share growth. Radical new products respond to the demand for market share growth. To maintain current market share, incremental new products will suffice. The quotation below is an example that reveals the paradoxical nature of PMSs that comprise opposing measures. For example:

> *"what you* ***keep needing to do*** *is improve your product to hold your market share […] but* ***we also have to*** *balance the show and be part of these growth areas. One of the growth areas is structural heart and mitral […] so if you've got a share of whatever, 30 per cent of the product, you have to keep investing in that product to make it better, to keep that market share, but you also need to bring in new products and it's that trade-off decisions*
>
> (Director of Marketing and Innovation, 50-249 employees).

This respondent above describes the need to hold onto existing market-share by improving existing products (i.e. pursuing exploitative strategies) in coronary diseases and, at the same time, develop new market-share (i.e. through explorative strategies) to enter into the new market of mitral structural heart disease (non-coronary). These opposing measures require responses through opposing activities thus making explorative as well as exploitative innovation activities relevant (making exploration visible). Incremental new product portfolio choices support exploitative activities and provide incrementally improved products that serve to “hold market share.” New product selections on the other hand, “bring in new products” and respond to “new growth areas.” Furthermore, the use of language such as “keep needing to” alongside “but also have to” (above) shows the persistence of these demands and their inherent challenge (Smith, 2014).

Another example of individuals’ perception of tensions arising from opposing measures is portrayed in the following statement from a senior project manager. In this case two sets of opposing measures were cited to which individuals in NPPS must respond simultaneously - one related to market-share growth (growing revenue) versus market-share maintenance (maintaining revenue) as heretofore; Once again, the words “trying to” suggest the challenge and “all the time” reflect the persisting nature of the experienced paradoxical tensions (underlined by author to highlight paradoxical tensions and their persistence):

“You’re trying to i<u>nch up all the time</u> and <u>trying to maintain</u> <u>your business, trying to</u> <u>maintain your revenue</u>, because <u>if you didn’t</u> work at it your customers would stop buying product and jump onto something else. So it’s about, it’s really around <u>either growing market share or maintaining market share</u> and <u>maintaining revenue or growing revenue</u>. So that’s really the basis on which our product selection or project selection is made.”

(Senior Project Manager, >250 employees).

4.5.2 <u>Role of metrics in promoting debate</u>

As described in the last section, contrasting measures (e.g. retain/create market-share; maintain/grow revenue; invest in current products/new product areas) within the PMS help make the tensions between opposing strategies explicit to individuals. These tensions are felt by individuals as they attempt to respond to opposing measures during NNPS.

Individuals tasked with NPPS bring several different functional backgrounds together. Accordingly, these individuals are likely to have differences of opinion about the order of priority they give to the various measures and therefore over the NPD selection choices they would prefer for the NPD portfolio. The exchange of different opinions between groups of individuals is termed debate and is considered valuable in decision-making, it provides opportunities for individual assumptions to be aired and new understandings to be developed (Lunenburg, 2012; Hall, 2010).

In the following quotation, an expert in research and innovation reports how market-share is the metric that drives the most debate during NPPS because of the uncertainty and the assumptions that are inherent in its calculation. Note also the differences in opinions between two functional roles; marketing who emphasise time-based metrics and R&D who favour measures related to the technical functionality of the new product:

"I think the ones [measures] that mostly get debated are market share, what kind of market share can we achieve on a project?... It's a guess, it's a guess but financially, if you get 10% market share versus 12%, that financially makes a big difference but how do you know if you're going to get 10% or 12% market share? So that's a good example of, so market share is generally one that's very hard to know…I think you will get debate, I think it's important, we're talking about projects now to decide to go into the portfolio, they do get debate because some of it is-you're trying to foretell the future and therefore there is always uncertainty associated with that. You try to use real measures to get rid of the debate but there are certain aspects that are always going to be up for debate, you know 'what kind of feature set does it want'? marketing always want something quicker, so there will always be those challenges eh so, is there debate? Absolutely. Yes, but debate is healthy."

(Director New Product Innovation, >250 employees).

The underlying uncertainty of market-share measures is seen to stimulate the debate where "real measures" are used to try to "get rid of the debate." Perhaps this suggests that market-share measures are considered to be strong ("real") despite being clouded in uncertainty or perhaps it suggests that alternative more certain financial ("real") measures are used alongside market-share to persuade a decision one way or another and "get rid of the debate." Further, the findings suggest that the attempts to "get rid of the debate" imply that debate is not desired, and efforts are made to deflate debate by introducing measures that are considered to bring greater certainty. This may promote measures that favour incremental product selections over radical product type selections.

4.5.3 Role of metrics in promoting cognitive conflict

When disagreement arises it is termed conflict. Task-based conflict, termed cognitive conflict is known as healthy conflict and can lead to improved decision-making. However, when conflict is focussed on personal issues, it is considered unhealthy, and termed affective conflict (Jehn, 1995). Indeed, this research finds that interviewees report what appears to be cognitive conflict in saying that disagreements arise most often between individuals from R&D and those from Engineering for example:

*"You'll **always** have it (conflict) between engineering and R&D people. Obviously, the manufacturing side of engineering wants to keep the numbers driven and so would finance and so would the commercial team. R&D is obviously keen to bring new products through, so there is a bias."*

(CEO, 50-249 employees).

And,

"where you get conflict then is that you're dealing with two very different beasts, R&D like to change things all the time (laughter) and operations people don't."

(Operations Director, <50 employees).

These quotes demonstrate disagreements arising between different functional roles; manufacturing engineers, marketing and finance versus R&D specialists. The former set of functions tend to be "numbers-driven," and prefer increased efficiency, reduced variability, increased throughput, shorter time frames, reduced risk; all measures that promote exploitation and incremental product developments. On the other hand, R&D experts are said to favour "change" and "new products," that supports exploration and radical product innovations. Consequently, conflict over specific new product selection decisions does arise during NPPS. This indicates a role for PMSs in generating conflict between individuals during NPPS.

In summary, this section presents evidence that PMSs are designed to include metrics that are in opposition to each other (such as market-share or revenue 'retention' **and** market-share or revenue 'growth'). In so doing, PMSs make the tensions between opposing strategic intent evident to individuals, i.e. it makes exploitative and explorative options visible. Furthermore, by placing on-going and conflicting demands on individuals during NPPS, PMSs are shown to promote debate and are shown to arouse conflict between individuals during NPPS. When conflict is issue-based, termed cognitive conflict, it has been shown to support better decision-making, better decision acceptance and implementation (Jehn et al., 1999; Amason, 1996). The next section describes findings in regard to PMSs and innovation ambidexterity in the research sample.

4.6 A role for PMS in supporting ambidexterity

Choices made in selecting exploitative strategies that lead to incremental product innovations and/or explorative strategies that lead to radical product selections, have bearings on portfolio ambidexterity. So far, findings demonstrate that companies in high technology industries employ PMSs to guide NPPS decisions. Furthermore, in their design that accommodates opposing types of measures, these PMSs are found to have roles in making the tensions between exploitation and exploration salient. This leads to debate and cognitive conflict during NPPS. Whether these PMSs are effective in driving innovation ambidexterity is examined next.

Evidence that these companies strive to be ambidextrous is observed in the way interviewees speak about trying to manage their company's current business and simultaneously prepare for future changing demands through their NPD portfolio (Andriopoulos & Lewis, 2009; He & Wong, 2004). Interviewees describe the NPD portfolio as the vehicle to support current and future business based on the combination of the product types that they select for the portfolio. This aligns with innovation portfolio scholars Chao & Kavadias (2008) and Cooper et al. (2001) who advocate for a portfolio comprising incremental and radical new products. Portfolio product mix and performance measures are thus intimately entwined. The following quotation demonstrates attempts to be ambidextrous. The interviewee reports that NPPS decisions are based on how potential new products match up against the measures of time (short-term, long-term), product-type (iterative, disruptive) and risk (low, high) as the selection team endeavour to achieve what is described as a *balanced* portfolio:

"every year we want to be launching products, that's number one, and then, second of all we would try and have products which are iterative products, which are just next generation products which you would probably describe as low risk. And then we would describe products which are just adjacent markets that we're not presently in or new markets and they are more, higher risk, and so we try and have a balanced portfolio between high risk and low risk projects."

(Research & Innovation Director, >250 employees).

Iterative, next-generation products referred to in the last quote, describe the results of exploitation that render incremental or small modifications to existing products. These are associated with the lowest risk. Adjacent markets (sometimes also referred to as 'new') are markets or customers currently untapped by an existing product. While harder to win over new customers (therefore higher risk), adjacent markets offer new opportunities for growth for already proven products. By comparison, new markets are served by exploration and radical new products and are thus associated with the greatest risk. Seeking to achieve a 'balance' between these product types and markets reflect ambidexterity tendencies (Kortmann, 2015; Lin et al., 2013).

Similarly, another interviewee referred to the application of measures of revenue and market-share when describing his/her company's NPPS strategy. This interviewee talked about protecting the existing market by making investments that improve an existing product. This represents product exploitation. This same interviewee added that 'disruptive play' may also be considered to enable access to new markets. This indicates radical innovations. Once again, in striving toward NPD projects of both incremental and radical types simultaneously, efforts toward ambidexterity are evidenced in these innovative companies:

"*you have to keep investing in that product to make it better, to keep that market share ... protect current market … and then you need to try and grow your market share and then you might have a disruptive play as well."*

(Director Program Management, >250 employees).

In the quote above, the tensions experienced in supporting what are opposing strategies are reflected in the words "try" and "have to" used by the interviewee. On the one hand, this interviewee speaks about having to invest in existing products, known as a short-term strategy, one that protects current revenues and existing markets. This same interviewee reports on the other hand, the tension of an opposing pull expressed in the "need to try" and "maintain that R&D pipeline." This requires the simultaneous pursuit of a longer-term focus "having stuff phasing in" and "disruptive play," through radical new products.

Three short quotes below, describe the portfolio as the means to achieve a 'balance' between short-term and long-term products, between "regular run of the mill" current products and new products for the future "down the road." The term 'balance' was not expressed as a specific measure, but more by way of describing a portfolio containing a mix of constituent products that facilitates an overall balanced product portfolio that match a broad range of metrics related to (a) time; (b) product type; and (c) risk; in turn below:

(a) "*portfolio is kind of, it captures a lot of things, it captures projects which are close to launch and projects that are nowhere close to launch, that's when people talk about portfolio, and what we try to do is have a balance on that."*

(Research & Innovation Director, >250 employees).

(b) Seeking an 80:20 ratio between extreme product types:

"it goes back to like 80 per cent of our business probably is on regular run of the mill (incremental products)*... but we still have to ... that 20 per cent is going to be the feeders into ... down the road* (radical products)*."*

(Director of Marketing & Research, >250 employees)

(c) Achieving a 'balance' in terms of spreading portfolio product risk:

"If you have 20 projects in a portfolio, balance would probably mean that you will have, I would say, let's say 7 projects which are low risk, 7 projects which are medium risk and 7 projects which are higher-end risk … it's risk/reward. Again, it will come back to your business unit and what are the market drivers."

(Research & Innovation Lead, >250 employees).

Overall, findings suggest that PMSs have a role in supporting portfolio ambidexterity. Findings demonstrate that metrics determine the portfolio launch schedule by examining product development timelines. Metrics are used to ensure a portfolio that includes a mix of product-types; portfolio risk-level metrics are used in striving toward a 'balanced' portfolio that supports short-term and long-term products simultaneously and thus aims for an ambidextrous product development portfolio. In summary, evidence suggests that companies strive toward ambidexterity and that PMSs have a role in its support.

4.7 The relationship between PMS and informal controls

Up to this point, findings presented have been associated with formal measurement control (Cardinal et al., 2004). PMSs align with the definition of formal control as 'officially sanctioned [usually codified] institutional mechanisms, such as written rules, standard operating systems, and procedural directives … visible, objective forms of control.' (Cardinal et al., 2004, p. 415).

During interviews, an unexpected finding reveals itself in what the literature describes as 'informal controls.' Cardinal et al. (2004, p. 415) define informal controls as 'unwritten, unofficial values, norms, shared values, and beliefs that guide employee actions and behaviours … less objective, uncodified forms of control.' Interviewees spoke of unplanned, impromptu meetings that take place in advance of the scheduled NPPS meetings. These informal meetings are reported as one-to-one, ad-hoc meetings between individuals who partake in NPPS decisions. Their purpose appears to be to persuade an individual towards specific product choices. Such meetings are considered informal control.

One interviewee reports the occurrence of these types of meetings as "*impromptu"* and even suggests that these types of meetings are a part of the culture in Ireland "*We're experts at impromptu in Ireland."* (Director of Operations, <50 employees).

Another interviewee explains the importance of informal meetings to garner a more holistic understanding of others' views and even for "managing" them:

"before you go into the meeting you've managed all the stakeholders and you kind of know which way the wind is blowing so, generally speaking I would say, generally, you would know what projects are going to be successful in a portfolio and what are not … and you know what's in the zeitgeist."

(Research & Innovation Director, >250 employees).

In describing how informal meetings exert their influence, apart from 'managing the stakeholder' (as quoted above) others explained that:

"certain things you would socialise ***before*** *it gets to a meeting, so you might put it out there, … you might talk to the people who are going to be there beforehand and go 'Here, I'm putting this forward* [pointing to the computer screen to a document he had shown me as an example of indicators of importance in making decisions] *this is my reason, this is why I want to try and do it' and you'll have your backing before you even go in, it's a rubber stamping."*

(Director of Marketing & Research, >250 employees).

These findings suggest that informal controls may be instrumental in reducing the level of debate and/or cognitive conflict that might otherwise be expected to arise during formal NPPS between individuals from different functions and based on a PMSs containing opposing measures. Thus, if certain individuals have succeeded in persuading others to their way of thinking via informal pre-meeting sessions as described above, this may have the effect of reducing debate and especially of reducing disagreements (cognitive conflict) during formal NPPS meetings. However, the literature contends that cognitive conflict is particularly beneficial in supporting paradoxical challenges (Smith et al., 2010), and thus ambidexterity, and the literature says that formal group debate and conflict are essential to explorative innovation (Chenhall & Moers, 2015; Dekker et al., 2013; O' Reilly & Tushman, 2008; Lewis et al., 2002). Thus, if informal controls suppress debate and cognitive conflict at NPPS meetings, informal meetings may have negative repercussions for organisational ambidexterity. For example, informal sessions may persuade a greater emphasis on more immediate financial metrics and influence more reliable product selection choices for the portfolio at NPPS meetings. The potential consequences of these findings are tested in phase two of this research.

Finally, another informal control, namely individual intuition is found to be particularly useful in managing uncertainty during NPPS. One interviewee provides an example of this in the next quotation. He reports that uncertainty is recognised as playing its most significant role in the earliest stages of product development (where product portfolio selection takes place), because the future of potential new products is most doubtful at this stage. This uncertainty combined with the lack of a complete dataset at such an early product development stage further fuels the use of informal means of control through personal judgement based on an individual's past experiences in making product selection decisions, as follows:

*"So we're trying to make a decision and it's 'oh I think this is a good thing to do,' And it's based on a personal perception of how it's going to go, ... but there's no better way to do it because you're making a decision about a product and you're looking at it and saying well I **think** that's going to work but we won't know until we do our clinical trial or when we do our studies ... I think the performance indicators are good sometimes to make the judgement but they're not perfect. I think a lot of the time it comes down to personal judgement, and that's where the disagreement and making decisions becomes key. I don't think there's any magic formula."* (Director of R&D, >250 employees).

4.8 Chapter summary

This chapter has presented findings from the phase one, preliminary semi-structured interviews. It has addressed the first research objective and identified key stakeholders involved in NPPS in the high technology sector and confirmed organisational constructs relevant to ambidexterity and NPPS. These findings provide evidence that PMSs are important in NPPS. A wide range of PMs guide NPPS which is critical in selecting the *right* products to develop, that will sustain current and future company successes. Findings indicated import roles for PMSs during NPPS. First, their arrangement into measures of opposing types to promote opposing product strategies simultaneously, arouses paradoxical tensions felt by individuals during NPPS. These tensions make exploration and radical new product choices visible. The tensions provide the basis for debate based on those performance measures, between individuals from different functional backgrounds, as they express differing opinions on the importance of different PMs, and therefore on their preferred NPD project for selection. Second, PMSs designed in this way to comprise opposing metrics, can lead to disagreements and stimulate cognitive conflict. Cognitive conflict has been shown to be associated with better decision-making. Furthermore, PMSs designed with opposing metrics and used to guide NPPS were found to support NPD portfolio ambidexterity by directing a 'balanced' NPD portfolio in terms of its constituent product types, overall portfolio value, portfolio launch schedule and overall portfolio risk. Finally, findings revealed interesting and unexpected new findings in the context of ambidexterity and NPPS – the existence of impromptu, informal meetings which arise before formal NPPS meetings and appear to influence NPD portfolio selection decisions. The findings of this qualitative analysis inform the development of a conceptual model and associated hypotheses that are presented in the next chapter. Thus, phase one findings form the basis for further study of NPPS during a second phase of research. Table 4.2 provides a summary of the findings from the qualitative semi-structured interviews, and how they are linked with the literature and the themes addressed during the second quantitative research phase.

Table 4.2 Link between phase one findings, phase two research themes & the associated literature

Interview findings	→	**Suvey themes**	**References**
NPPS teams display diversity in functional role	→	Explore NPPS team functional roles & their total numbers per team	Tobin & Walsh (2011); Atuahene-Gima (2005); Auh & Menguc (2005).
A variety, breadth & mix of PMs are employed during NPPS. Tensions are felt by NPPS teams as they strive to maintain & grow revenue; retain & increase market share	→	Examine types & importance of PMSs employed during NPPS (PM-inc and PM-rad)	Bedford et al. (2019); Davila et al. (2015); Smith (2014); McNally et al. (2013); Lin et al. (2013); Cooper & Edgett (2012); Kester et al. (2011); Lavie et al. (2010); Anthony et al. (2008); Auh & Menguc (2005).
Debate arises due to functional differences in opinions towards contradictory PMs, especially where there is uncertainty	→	Examine if PM-debate arises i.e. debate focused on performance measures as debate is important to exploratory innovations in particular	Bedford et al. (2019); Bedford (2015); Dekker et al. (2013); Lunenberg (2012); Kester et al. (2011); Hall (2010); Ahrens & Chapman (2007); Henri (2006).
Companies strive to manage within constantly changing environment & this is where ambidexterity is especially useful	→	Measure levels of environmental dynamism	Lin et al. (2013); Atuahene-Gima (2005); Jaworski & Kohli (1993); March (1991).
Disagreements arise due to functional differences in attitudes towards contradictory strategies	→	Determine if disagreements are of the cognitive conflict or affective conflict variety	Smith (2010); Parayitam & Dooley (2009); McNally et al. (2009); Lovelace et al. (2001); Amason (1996); Jehn (1995).
Companies strive toward achieving competence ambidexterity (CA); preparing for future change while taking care of the present	→	Determine tendency to exploit & tendency to explore & operationalise competence ambidexterity by formula later	Kortman (2015); Lin et al. (2013); Andriopoulis & Lewis (2009); Cao et al. (2009); Chao & Kavidias (2008); Lubatkin et al. (2006); He & Wong (2004).
Companies strive for a balanced NPD portfolio (IA); as they try to balance the NPD portfolio in terms of risk, value, launch schedule & product types	→	Assess for levels of incremental innovation & assess for levels of radical innovation. Operationalise later for innovation ambidexterity	Raisch et al. (2018); Meifort (2016); Papachroni et al. (2015); Jugend & Da Silva (2014); McNally et al. (2013); Petit & Hobbs (2012); Smith & Lewis (2011); Andriopoulis & Lewis (2010); Barczak et al. (2009); Blichfeldt & Eskerod (2008); Perez & Enkel (2007); Cooper et al. (2001).
Ad-hoc meetings occur in advance of formal NPPS meetings	→	Examine informal & formal meetings	Kyriazis et al. (2017); Eling et al. (2016); Smith (2010); Cardinal (2004); Fischer et al. (1997).
These companies are successful in terms of profitibility and longevity	→	Measure performance of the business unit / organisation compared with expectations in terms of market share, profitibility, revenue and new product success rate	Eling et al. (2016); Lin et al. (2013); Jansen et al. (2012); Kester et al. (2011); Salomo et al. (2010); Cao et al. (2009); Atuahene-Gima (2005); He & Womg (2004); Gupta et al. (1986).
Resources are under constant demand & threat of redirection	→	Measure resources munificence for new product innovation	Atuahene-Gima (2005); Cooper et al. (2001).

Key: PM-inc = Performance measures that encourage more incremental than radical innovation; PM-rad = Performance measures that increase the visibility of radical innovation.

Chapter:5 **Hypotheses and Conceptual Model**

"A hypothesis may be simply defined as a guess. A scientific hypothesis is an intelligent guess"

Issac Asimov's Book of Science and Nature Quotations

(Asimov & Shulman, 1988, p. 114)

5.1 Introduction

This chapter addresses research objectives two and three; to develop two conceptual models derived from a series of hypothesised relationships to explain the antecedents and consequences of competence ambidexterity in the context of NPPS. The models are based on the research question; '*What role do performance measurement systems (PMSs) and related organisational factors (tensions, debate, conflict, functional diversity) play during NPPS in the achievement and outcome of an ambidextrous portfolio?'*

Hypothesised relationships are proposed and built upon findings presented in the previous chapter and summarised in Table 4.2. The first group of hypotheses (1-6) is focused on drivers or **a**ntecedents of competence ambidexterity and presented as an *antecedent* model namely, Model A, where A stands for antecedent. Figure 5.1, represents the originally hypothesised antecedent model, namely Model A_1 that is based on the literature and the field-based interviews reported in the previous chapter. (An alternative and improved antecedent model, namely Model A_2, emerges from data analysis of the ensuing quantitative survey findings, and is discussed in following chapters). The second group of hypotheses (7-10) is focused on the outcomes or **c**onsequences of competence ambidexterity represented as the *consequence* Model C (Figure 5.2), where C stands for consequence. Following a reiteration of this study's research objectives next, sections 5.4 to 5.7 inclusive present each of the hypothesised relationships attaching to the antecedent Model A_1; while sections 5.10 to 5.14 present the hypothesised consequence Model C.

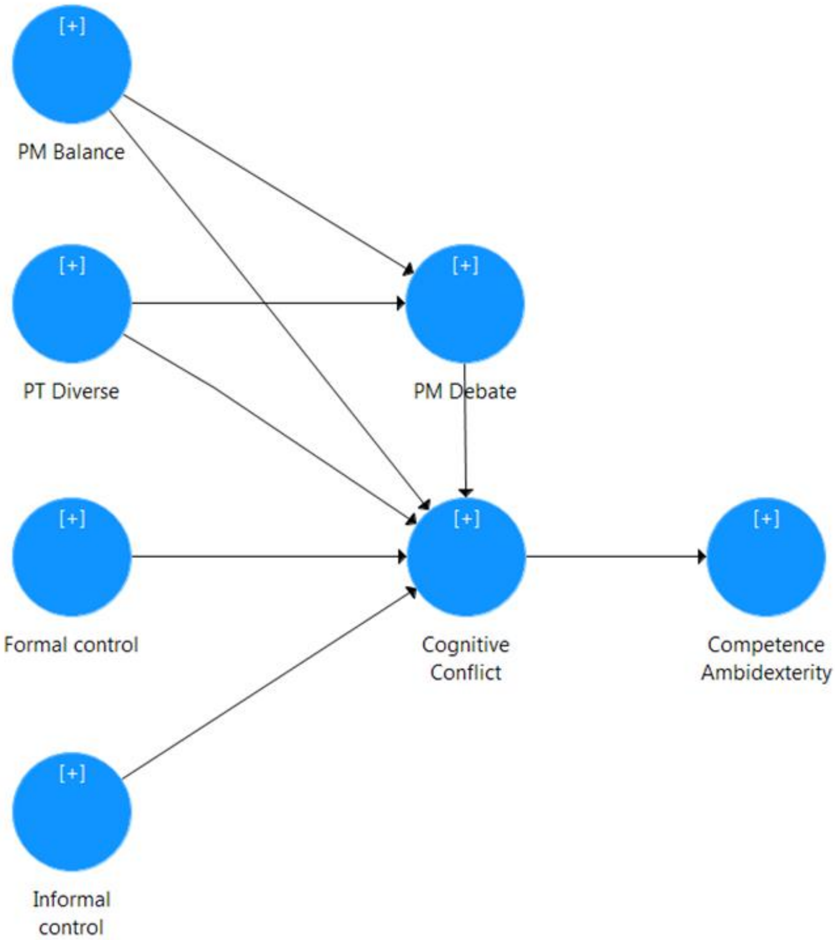
5.2 Research objectives

<u>Research objective 1.</u> Analyse NPPS in high technology industry (HTI) to identify key stakeholders and explore organisational constructs relevant to ambidexterity.

<u>Research objective 2</u>. Test hypothesised relationships to derive a model of specific organisational antecedents of competence ambidexterity in NPPS.

<u>Research objective 3</u>. Test hypothesised relationships to derive a model of specific consequences of competence ambidexterity in NPPS.

5.3 Model A1 Antecedents of competence ambidexterity



Key: PM = performance measure; PT = portfolio team

Figure 5.1 Original Antecedent Model A1 for competence ambidexterity.

5.4 The effects of a balanced PMS (PM-balance)

5.4.1 PM-balance and PM-debate

PM-balance is derived from the study of Bedford et al. (2019) and it describes a PMS comprising measures that focus on the short-term **and** measures that have a longer-term focus. More specifically, PM-balance combines measures that incentivise exploitation and incremental innovations with measures that make exploration and radical innovations visible. Previous literature has shown that PMS design is important in guiding behaviour in a desired direction (Chenhall & Langfield-Smith, 2007; Perez-Freije & Enkel, 2007; Chenhall, 2003; Simons, 1991). Past literature has emphasised the need to incorporate a diverse set of measures (Lillis & Veen-Dirks, 2008), that are comprehensive in content (Dekker et al., 2013), and forward looking (Chenhall & Moers, 2015) to facilitate multiple and mixed strategy objectives. However, recently emerging literature contends that when competing strategies are required simultaneously, such as when in pursuit of competence ambidexterity, a balance in the diversity of measures is most important to avoid the increasing trend towards short-termism (Neely, 2005; Eccles, 1991)**.**

Thus, a PMS that incorporates measures which simultaneously support opposing strategies, places the PMS at the centre of a dynamic tension; this tension is created through the countervailing forces that are generated by the contradictory demands of that PMS (Curtis & Sweeney, 2017; Bedford & Malmi, 2015). The paradoxical nature of PM-balance forces decisions that consider 'both/and' choices rather than 'either/or' options (Papachroni et al., 2015; Lewis, 2000) and this generates forces debate based on those demands. PM-balance therefore becomes the focus for discussions and debate (Hall, 2010). In challenging users to respond to opposing strategies, PM-balance stimulates debate in the interpersonal discussions that arise, based on those opposing measures. This is termed PM-debate (Bedford et al., 2019).

In the current research, respondents to the first phase interviews that were conducted with senior managers who partake in NPPS, describe the performance measures which guide NPD selection decisions. In most cases, the measures reported are multiple and varied, some are oppositional, and all are reported to influence NPPS decisions. After examining the measures it seems that these companies design their PMS to include measures known to facilitate incremental NPD projects with measures that make radical NPD projects visible. Furthermore, and according to interviewees, the measures that direct NPPS arouse "lively debate" (CEO; Research and Innovation Director) because of their contradictory measures. And so, the first hypothesis (Hypoth.) proposed in the current study is;

Hypoth. 1a ***A positive relationship exists between PM-balance & PM-debate.***

5.4.2 PM-balance and Cognitive conflict

According to Bedford et al. (2019, p. 12), 'PM-balance will help ambidextrous firms to support paradoxical cognitive frames that embrace opposing views.' Accordingly, in the context of NPPS, PM-balance is likely to encourage decisions that include incremental and radical NPD project choices for the development portfolio. However, PM-balance is also likely to arouse conflict or disagreements between individuals who are likely to harbour differences of opinion on the priority they bestow on different performance measures and consequently on different project selection preferences. Indeed, Bedford et al. (2019) find that a PMS which has been designed to demand high levels of exploitation and high levels of exploration, drives conflict. They find that the equal emphasis placed on opposing metrics in a balanced PMS is important in making the distinction between opposing strategic choices evident and in allowing disagreements to be aired. These issue-based conflicts describe cognitive conflict (Smith, 2014; Smith & Tushman, 2005; Amason et al., 1995), and lead to the next hypothesis;

Hypoth. 1b ***A positive relationship exists between PM-balance & cognitive conflict.***

5.5 The effects of a diverse portfolio selection team (diverse-PT)

5.5.1 PT-diversity and PM-debate

Following phase one interviews, the current study finds that a group of individual senior professionals from diverse functional backgrounds, gathers to deliberate over NPPS. Diversity refers to 'the differences between individuals on personal attributes, such as age, race, or values, or on job related attributes, such as tenure or functions' (Olson, Bao & Parayitam, 2007, p. 36). As presented in the previous chapter, this NPPS team comprises members representing at least four different functional specialties and individuals who have in excess of fifteen years' professional experience. As such, the NPPS team is considered diverse (Olson et al., 2007) and offers the advantage that 'teams will have more problem-solving capabilities than individuals alone' (Parayitam & Dooley, 2011, p. 343). Phase one interviews also indicate that diversity among NPPS teams is associated with "robust discussions" and that these are "expected" between such senior professionals based on the importance of the project selection decisions being made (R & I Director, employees > 250). In this study, interviewees report that NPPS team members are mature and well able to express their differences of opinions and indeed are expected to do so to arrive at decisions that are in the best interests of that organisation. Given that a diverse team (diverse- PT) is tasked with deciding which of the potential NPD projects should be allocated some of the typically scarce resources for further development and commercialisation through the NPD portfolio, intense debate is likely to arise. Interactions between individuals with different functional and educational backgrounds have been shown to facilitate the exchange of different views and opinions (Atuahene-Gima, 2005). This rich dialogue allows individuals' different perspectives to be aired, shared, altered and re-configured which is important for better decision-making (Bedford et al., 2019; Lewis et al., 2002). PM-debate is vital to the exchange of ideas across functional boundaries (Simons, 1991). It is considered even more helpful when the setting for exploratory research is challenging due to high levels of uncertainty and low levels of knowledge (Chenhall & Moers, 2015). In the presence of a diverse team therefore, the dialogue instigated (PM-debate) is likely to help protect against a bias for consistency and instead to promote a more robust discussion because members from different functional backgrounds are likely to place different emphases on various measures (Dekker et al., 2013). The expectation, therefore, is that an increasingly diverse portfolio team is associated with greater debate based on a balanced set of contradictory performance measures. Therefore, the next hypothesis is as follows;

Hypoth. 2a ***A positive relationship exists between a diverse- PT & PM-debate.***

5.5.2 PT-diversity and Cognitive conflict

A diverse team makes the decisions regarding NPPS. Thus, many individuals' feelings, values and basic beliefs are in the mix during decision-making. Due to this PT-diversity, different views are likely and the more diverse the group, the more likely that differences of opinion will lead to disagreements (conflict) between one or more individuals (Lovelace et al., 2001; Simons & Peterson, 2000). Issue-based conflict (cognitive conflict) is likely to arise during NPPS communications (Ylinen & Gullkvist, 2014) as individuals from diverse functional backgrounds are likely to disagree about the relevance of certain NPD project choices. The expectation is that an increasingly diverse portfolio team is likely associated with increasing levels of disagreement about certain NPD project choices during NPPS. Therefore, the next hypothesis is as follows;

Hypoth.2b ***A positive relationship exists between a diverse-PT & cognitive conflict.***

5.6 PM-debate and Cognitive conflict

PM-debate describes the conversation that arises when two or more people openly share their opinions and interpretations. Based on years of experience and the maturity associated with senior roles, the debate during NPPS is likely to be lively and involve an exchange of a rich variety of ideas, opinions, and perspectives (De Wit et al., 2011). Similarly likely, is that disagreements will arise over the different NPD project options available. These disagreements are likely to be conducted in a mutually respectful manner due to the maturity and experience associated with individuals involved in NPPS. Disagreements that are issue-based describe what is termed task conflict or cognitive conflict in the literature (Amason, 1996) During NPPS meetings therefore, it is anticipated that the greater the levels of intragroup PM-debate, the higher the levels of cognitive conflict so that;

Hypoth. 3 ***A positive relationship exists between PM-debate & cognitive conflict.***

5.7 Cognitive conflict and Competence ambidexterity

Task or cognitive conflict is generally associated with positive outcomes for group decisions (Simons & Peterson, 2000). Cognitive conflict is especially useful in innovative settings (Lewis et al., 2002; Lewis, 2000) as it may ‘extend the scope and creativity of decision making’ (Lewis, 2000, p. 773). Dissent is especially relevant to complex and ambiguous strategic decisions such as the ability of an organisation to concomitantly explore and exploit (Parayitam & Dooley, 2011; O’ Reilly & Tushman, 2008) and therefore dissent is desirable in achieving a balanced portfolio.

Cognitive conflict is lauded to improve decision-making, and especially ‘for teams facing complex and non-routine decisions’ (Bedford et al., 2019; Amason, 1996). Although findings have been mixed, most of the extant literature links cognitive conflict with improved decision quality and improved decision buy-in or commitment (Parayitam & Dooley, 2011, 2009). In an ambidextrous setting such as the NPPS meetings of the current study, cognitive conflict permits the airing of individuals’ dissent. Issue-based disagreements facilitate the exchange of alternative perceptions and of opposing attitudes on decision-making and on actions to take (De Wit et al., 2011). Cognitive conflict that arises during strategic decision-making, based on for example decisions about which NPD projects should be allocated resources for development, permits a synthesis of 'contesting diverse perspectives [which are] generally superior to the individual perspectives' (Parayitam & Dooley, 2011, p. 345). Authors in praise of cognitive conflict during team meetings suggest that it may help prevent premature consensus and stimulate more critical thinking among members that leads to deeper and more holistic understandings of the problems and issues faced by the group (Jehn, 1995; Cosier et al., 1991). In their study of 43 teams, Lovelace et al. (2001, p. 779) found that 'the effect of task disagreement on team outcomes depended on how free members felt to express task-related doubts and how collaboratively or contentiously these doubts were expressed.' Consequently, it is expected that during NPPS meetings in ambidextrous organisations, cognitive conflict will be inevitable (O' Reilly & Tushman, 2008). This cognitive conflict is expected to make the different strategic options between exploitation and exploration ever more salient. It is expected to lead to the NPPS team making choices to configure and reconfigure organisational resources to capture existing as well as new opportunities (O' Reilly & Tushman, 2011). From this expectation the next hypothesis follows;

Hypoth. 4 ***A positive relationship exists between cognitive conflict & competence ambidexterity.***

5.8 Formal control and Cognitive conflict

Formal controls refer to pre-planned and explicit mechanisms of control employed by organisations and made known to employees (Cardinal et al., 2004). Examples in this study include the documented PMS that formally directs NPPS, namely PM-balance; and the project portfolio selection team meetings that are scheduled on a regular basis and at known times. The objective of these formal controls is to manage behaviour and outcomes of the behaviour of those under control (Dekker, 2004; Ouchi, 1979).

Evidence from this study's preliminary interviews reveals that a multifunctional team presides over NPPS meetings, and that these meetings are held monthly in the majority of cases. The meetings provide an opportunity for individuals to air their differences of opinion which are likely to exist as they are dealing with a complicated strategy. Due to individual team members having different functional backgrounds, high levels of debate are expected, and disagreements are likely to arise in the setting where project selection choices must be made. Evidence from the literature is that in these situations, cognitive conflict is good for decision making and is expected to be encouraged during formal meetings. Consequently, the following hypothesis follows;

Hypoth. 5 ***A positive relationship exists between formal meetings & cognitive conflict.***

5.9 Informal control and Cognitive conflict

In contrast to formal control, informal control describes non-explicit and unplanned mechanisms. As such, while organisations may be aware that informal meetings take place, they do not formally schedule, conduct or monitor them. Informal meetings are therefore not planned and have been described in the literature as ad-hoc, unplanned, non-scheduled, undocumented, face to face meetings between individuals (Dekker et al., 2013; Dekker, 2004); meetings that take place in offices corridors or even by the photocopier (for example). Informal meetings may take place for the exchange of tacit information that is difficult to share through formal means and made more challenging in complex settings such as formal NPPS meetings. Martinsuo, Korhonen & Laine (2014); and Martinsuo (2013, p. 794) suggest that uncertainty and complexity during project portfolio management prompt behaviours of negotiation and bargaining over what they call 'rational decision processes.' Interviewees from semi-structured discussions revealed that informal, one-to-one meetings take place regularly and in advance of NPPS meetings to resolve known or potential conflicts that might arise and lead to managers failing to reach agreement on NPPS decisions. Based on this feedback and the literature, this study predicts therefore that informal meetings are held between NPPS meetings to reduce cognitive conflict arising during the formal NPPS meetings, which leads to the next hypothesis;

Hypoth. 6 ***A negative relationship exists between informal meetings & cognitive conflict.***

5.10 Model C Consequences of competence ambidexterity

Figure 5.2 represents the hypothesised consequence model, Model C. In sections 5.11 to 5.14 inclusive, each of the associated hypothesised relationships is presented.

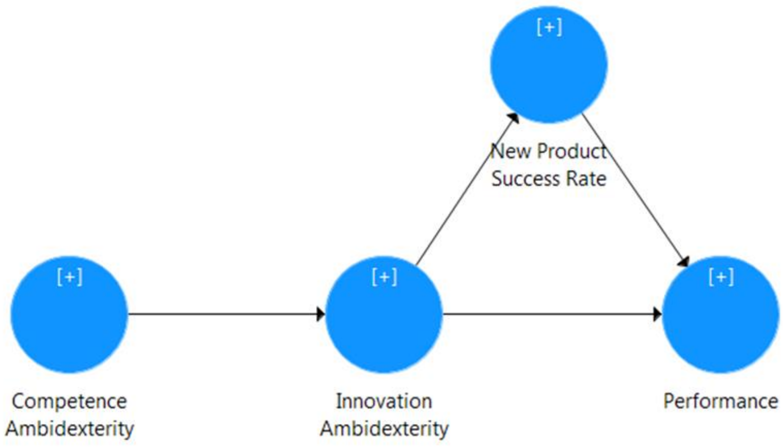


Figure 5.2 Conceptual Model C; Consequences of competence ambidexterity.

5.11 Competence ambidexterity and Innovation ambidexterity

Competence ambidexterity refers to an organisation's ability to simultaneously explore and to exploit (O' Reilly & Tushman, 2013; Jansen et al., 2009). When competence ambidexterity is realised successfully, it drives innovation ambidexterity characterised by outcomes of radical and incremental innovations (Bedford et al., 2019; Andriopoulos & Lewis, 2009). In NPD this equates to incremental and radical new product outputs (Kortmann, 2015; Atuahene-Gima, 2005). This in turn describes the outputs of an ambidextrous NPD portfolio, a portfolio that consists of a mix of discontinuous and incremental project types for development and subsequent commercialisation. The new product and portfolio literature rarely uses the terms competence ambidexterity or innovation ambidexterity. Instead it refers to the ability to make balanced decisions (competence ambidexterity) that select a mix of different product development projects so that a balanced portfolio is achieved (Martinsuo, 2013; Mc Nally et al., 2013; Barczak et al., 2009; Muller et al., 2008; Cooper et al., 2001).

Similar to the challenges in achieving competence ambidexterity, it is extremely difficult to achieve innovation ambidexterity (Bedford et al., 2019; Jansen et al., 2012; March, 1991). Some of the reasons for this difficulty suggested in the literature include the cognitive biases towards consistency over inconsistency during decision-making (Curtis & Sweeney, 2017; Birkinshaw & Gupta, 2013; Lin et al., 2013); favouring short-term incremental products over longer-term radical ones because of the latter's greater propensity for failure, higher associated costs and risks (O' Reilly & Tushman, 2013; Levinthal & March, 1993); the scarcity of resources (Birkinshaw & Gupta, 2013; Cooper et al., 1998) and excessive use of informal over formal processes (Mc Nally et al., 2013; Barczak et al., 2009). There is relatively little research that directly examines the link between competence ambidexterity and innovation ambidexterity (Bedford et al., 2019). Two exceptions include the study by Kortmann (2015) who analyses and finds a direct relationship between ambidexterity-oriented decisions and innovation ambidexterity; and that of Wang & Rafiq (2014) who find that an ambidextrous culture develops competence ambidexterity which enables innovation ambidexterity, especially important they say, in high technology industries. In the current study, the decision-making context faced by NPPS teams contains significant complexity and uncertainty where competence ambidexterity is lauded to provide successful outcomes. Furthermore, to achieve innovation ambidexterity, these individuals must also embrace paradoxical tensions inherent in choosing incremental and radical new product innovations simultaneously (Smith, 2014). Moreover, Mc Nally et al. (2013); and Chao & Kavadias (2008) urge managers to select a ‘balance’ and mix of product types for their NPD portfolio. The ambidexterity literature indicates that this is vital to enabling organisations to respond to current day needs whilst also protecting organisations’ future. This leads to the next hypothesised relationship;

Hypoth. 7 ***A positive relationship exists between competence ambidexterity (CompAmb) & innovation ambidexterity (InnAmb).***

5.12 Innovation ambidexterity and Performance

Many studies have documented the effects of ambidexterity at the organisational, business unit, project, and individual levels (Birkinshaw & Gupta, 2013; O' Reilly & Tushman, 2013). The empirical evidence suggests that particularly in uncertain markets that also experience rapidly changing technologies, ambidexterity typically has a positive effect on firm performance (Wang & Rafiq, 2014; Junni et al., 2013), and the results are considered robust. As examples, studies have shown positive growth in sales (Venkatraman et al., 2007; He & Wong, 2004); in subjective performance ratings (Cao et al., 2009; Lubatkin et al., 2006; Gibson & Birkinshaw, 2004); and in innovation (Davila et al., 2015; Birkinshaw & Gupta, 2013; Adler et al., 1999). This leads to the next hypothesis;

<u>Hypoth. 8</u> ***A positive relationship exists between innovation ambidexterity & business unit perceived performance*.**

5.13 Innovation ambidexterity and new product success rate

The NPD portfolio describes a group of new product projects for development and eventual commercialisation (Kester et al., 2011) An ambidextrous portfolio describes a portfolio that comprises a mix of radical and incremental products that are appropriately balanced between each product type (Kortmann, 2015; Jugend & Da Silva, 2014). Radical products have a longer time frame associated with their development. Accordingly, it is anticipated that a better-balanced, ambidextrous portfolio will develop a higher proportion of radical products to incremental ones compared with the average NPD portfolio that is often biased toward incremental products (Cooper et al., 1999; Barczak, 1995). Radical products take more time to develop and so the completion rate of successful new product innovations will be reduced. Consequently the next hypothesis follows;

<u>Hypoth. 9</u> ***A negative relationship exists between innovation ambidexterity & the rate of new product success (NPSR).***

5.14 NPS (new product success) rate and Performance

New product developments can lead to small (incremental) or entirely novel (radical) innovation outputs. At one extreme the new product provides small improvements to an existing product; at the other extreme are products described as *blue ocean* or new to the world (Christensen, 2013). Products that are associated with greater levels of novelty are generally associated with higher value. As a result, an ambidextrous portfolio will be associated with greater levels of novelty. Consequently, the next hypothesis follows;

<u>Hypoth. 10</u> ***A positive relationship exists between the rate of new product success (NPS) & performance.***

5.15 Chapter summary

In the context of NPPS, this chapter has presented two conceptual models (an antecedent and a consequence model) derived from an analysis of the findings from phase one study in combination with the extant relevant literature. Model A_1 described an originally hypothesised antecedent model for competence ambidexterity that was derived towards more fully addressing research objective two; Model C described a consequence model for competence ambidexterity that was derived towards more fully addressing research objective three.

These models are used to guide the development of the survey instrument that is employed in the second study phase to test the hypothesised relationships and answer the overarching research question The methods used are described in Chapter:6, Phase II Methodology (next).

Chapter:6 **Phase II Methodology**

Quantitative Survey

"Because almost all data collection methods have some biases associated with them,

collecting data through multi-sources lends rigor to research"

(Sekaran, 1992)

6.1 Introduction

This chapter presents the survey methods employed in testing the proposed hypotheses to help answer the research question; '*What role do performance measurement systems (PMSs) and related organisational factors (tensions, debate, conflict, functional diversity) play during NPPS in the achievement and outcome of an ambidextrous portfolio?'*

Following a reiteration of the research objectives, the methods chapter is presented under six main headings. First, sample selection methods are described. Second, survey implementation methods, including pre-tests, piloting, and survey distribution methods are described. Third, the questionnaire design including the arrangement of its research themes, variable selection, and variable measurement methods, are presented. Fourth, the process of construct operationalisations are examined, and fifth, supporting construct statistics (reliability and validity) for these operationalisations are presented. Sixth, survey data analysis methods are explained. The chapter concludes with a summary.

6.2 Research objectives

This chapter sets out to address research objectives two and three below;

<u>Research objective 1.</u> Analyse NPPS in high technology industry (HTI) to identify key stakeholders and explore organisational constructs relevant to ambidexterity.

<u>Research objective 2</u>. Test hypothesised relationships to derive a model of specific organisational antecedents of competence ambidexterity in NPPS.

<u>Research objective 3</u>. Test hypothesised relationships to derive a model of specific consequences of competence ambidexterity in NPPS.

6.3 Sample selection

Following the semi-structured interviews, the target population for this survey was confirmed as the individuals who make new product development (NPD) portfolio selection (NPPS) decisions within the medical devices and information technology industries. These high technology firms are surveyed for two reasons: Lin et al. (2013) contend that ambidexterity is relevant in the highly innovative medical devices and IT industries; and both industries face the imposition of strict regulatory demands, coupled with dynamic, highly competitive markets to which they must respond through successful NPD portfolio selection.

Phase two respondents were identified from phase one interviewees as senior managers who were knowledgeable in the firm's formal performance measurement system (PMS) and were employed in organisations with more than 40 employees to ensure they were large enough to manage a portfolio of NPD projects. The unit of analysis was the strategic business unit (SBU); those within a company or one represented by a medium-sized company that operates as a single strategic business unit. The SBU is appropriate 'because that is the level within organisations at which portfolio decisions are made' (Kester et al., 2011, p. 644). A strategic business unit is defined in the literature as an independent business unit operating within a parent company (Smith, Erez, Jarvenpaa, Lewis, Tracey, Knight & Paroutis, 2017, p. 405).

Target respondents were required to actively participate in product portfolio selection decisions in their respective organisation/business unit. Respondents targeted included heads of research and development (R&D), marketing, finance, operations, etc. with a minimum one years' experience in that role. This is deemed adequate to be familiar with the PMS and selection strategy employed within their firm (Bedford et al., 2019). Only a single respondent per team could participate in the study to ensure statistical validity and response anonymity. Therefore, participants were invited to distribute the questionnaire to another portfolio selection team member if they could not themselves complete a survey. Additionally, invitees were requested to forward a survey to other business units, if any existed within their firm (Appendix A, Figure 1).

Target firms were defined as Ireland-based, legal entities operating independently or as sub-units of a larger organisation and included for-profit, product manufacturing companies, operating in the highly innovative medical device industry (MDI) and the information technology (IT) industry where ambidexterity is relevant (Lin et al., 2013).

Appropriate firms were initially identified from the FAME (Financial Analysis Made Easy) listing obtained from the library website at NUI, Galway. FAME contains detailed information for more than four million UK and Irish companies. Using the FAME-directed search strategy (presented below by FAME in Figure

6.1), and the search to identify target IT firms as an example, relevant firms were found by conducting several search steps.

Product name	**Fame**		
Update number	**350**		
Software version	**54.00**		
Data update	**09/11/2018 (n° 8792)**		
Username	**University of Galway-4872**		
Export date	**12/11/2018**		
Cut-off date	**31/03**		
		Step result	**Search result**
1.	**All active companies (not in receivership nor dormant) and companies with unknown situation**	**4,126,991**	**4,126,991**
2.	**NACE Rev. 2: All codes: 26 - Manufacture of computer, electronic and optical products**	**28,686**	**10,188**
3.	**Number of Employees, using estimates: Last available year, min=40**	**116,215**	**864**
4.	**Country: Prim. trading address, R/O address: Republic of Ireland**	**628,197**	**108**
	Boolean search : 1 And 2 And 3 And 4		
		TOTAL	**108**

Figure 6.1 FAME database search strategy for IT businesses.

Step one selected all active companies (not in receivership or dormant) and companies with 'unknown situation.' Step two provided the best match returned in response to the company description entered to align with survey needs i.e. including manufacturers of computer, electronic and optical products. Step three further refined the target by allowing elimination of companies with fewer than 40 employees. Step four restricted the selection to Irish-based firms to provide comparable environmental and economic conditions for the sample. The search yielded 108 companies. Duplications were noted and excluded manually (some medical devices companies were also registered as IT firms). Supplementary sources were used that included an on-line listing of 'IT firms in Ireland' (35 recorded), the membership list of the Irish Medical Device Association (IMDA), (117), the Irish Times Top 1000 companies and an on-line database *Kompass*, from which 100 senior management names were gleaned.

6.4 Survey implementation

The aim during this part of the research was to maximise survey participation and the return of fully completed surveys. Procedural methods were employed in this instance. These included careful preparation of the survey tool and subsequently, careful attention to survey distribution. Two versions of the survey were prepared, a hardcopy version (Appendix C Survey Questionnaire), and an on-line version through the QuestionPro software tool to facilitate those who might prefer one version over another.

6.4.1 Pre-tests and piloting

Following best practice standards, pre-tests and piloting of the survey were conducted before survey distribution to ameliorate against common-method bias (CMB), and to confirm the clarity and validity of the survey instrument (Dillman, 2009; Podsakoff, Mackenzie, Jeong-Yeon & Podsakoff, 2003). First, the instrument was extensively and iteratively pre-tested with nine experts in methodology to assess consistency in interpretation and to remove potential ambiguity. Three senior academics, one post-doctorate and five 3rd year PhD colleagues, two of whom were experienced in industry, assisted with survey pre-testing.

Further, feedback was captured from six professionals, each of whom was timed completing the survey. These individuals were all employed in the high technology industry (MDI) where ambidexterity is relevant (Lin et al., 2013). Each professional industry representative completed the survey separately and in the presence of the researcher. Each discussed their impressions of the survey contents with the researcher immediately following the pilot test. Response times ranged from 9 to 14 minutes. All professionals complimented the questionnaire saying it was easy to complete, very comprehensible and interesting. Alterations were made based on feedback, and the alterations assisted in improving the usability of the questionnaire.

6.4.2 Response rate augmentation efforts

Further led by recommendations from Dillman (2009); and Podsakoff et al. (2003), several suggestions were activated to encourage a good response. These included assuring potential respondents of response confidentiality and anonymity. Further, potential survey participants were offered summarised findings at a later date, if they desired (Appendix A, Figure 1).

An option to complete a hardcopy version was also provided. For this purpose, a mail-out package was prepared that included a personalised cover letter, the survey questionnaire and a prepaid, return-to-sender addressed envelope for the response.

To increase visibility of the survey in busy executives' mail inboxes, invitations to partake in the survey were personalised where possible. To augment researcher credibility, invites were sent on NUIG headed mail showing that the research was bona fide and supported by the IRC (Irish Research Council). Also, the survey was embedded in invitees e-mail message using the professional software *QuestionPro* tool. Respondents were reminded that only a single company/business unit team response was sought in the research so if unable to complete the survey themselves, they were urged to forward the link to an appropriate respondent in their firm. It was hoped that direct mailing would encourage a sense of responsibility to respond or find someone who would. On-line reminders were sent two weeks following initial mailings, third and fourth reminders every subsequent fortnight to those who had yet to reply. The survey was shut down at the end of March 2019.

6.4.3 GDPR

Due to the new European general data protection regulation (GDPR), most attempts to access e-mail addresses over the telephone, even with researcher identity provided, failed. This proved a significant challenge to overcome; many invitations remained impersonal; others e-mail addresses could not be confirmed. Google and LinkedIn were used to help identify some respondents by name (e.g. CEO, R&D Director, Marketing Director), but more often than not, the names were outdated or non-existent. Hard copy surveys were sent where no on-line access could be found. GDPR was a significant challenge to the final response rate.

6.4.4 Ethical issues during phase II

With the emergence of the World Wide Web and the facility to readily connect online, the interest in and prevalence of survey research has grown dramatically in the last decades. Alongside this popularity in employing survey methods is an increasing concern in regard to issues of potential respondents' 'consent, risk, privacy, anonymity, confidentiality, autonomy, and … complexities surrounding data storage, security, sampling, and survey design' (Buchanan & Hvizdak, 2009, p. 37). Ethical issues are tightly linked to methodological issues (Markham, 2006) and were taken seriously in research phase two of this study as follows;

All communications to partake in the survey were respectful, informative and transparent. All respondents were advised that the study had the support of NUIG, the IRC (Irish Research Council) and was guided by two, named, highly esteemed academic supervisors. All potential respondents were advised that their participation would be anonymous and voluntary and that they were free to opt out of the survey at any time. To enhance trust with respondents, they were provided with an explanation of the purpose of the study, and reassurances that their response would be kept private and confidential, and that all results would be reported in the aggregate. During the survey, great attention was given to the wording and clarity of instructions and questions to assist understanding for respondents, and to facilitate their progress through the survey. Respondents were informed that they had been selected for the study because of their expertise in NPPS, and they were reminded of the unique value their complete response would make to the study findings. Furthermore, the professional survey software tool *QuestionPro*, was employed, as it is deemed to lessen security risks associated with e-mailing surveys as attachments (Evans & Mathur, 2018, 2005). To ameliorate further concerns with on-line security issues, all potential respondents were offered the choice to request a hardcopy version of the survey if they wished. Finally, participants were advised that they could include/add their identity and contact details if they wished, and later receive a copy of the findings. All invitees were provided with full contact details of the researcher and encouraged to make contact if further clarification or explanations were needed. Following the survey shut-down, data are currently stored in password protected files on the researcher’s personal laptop. Hard copy questionnaires remain stored in a secured and locked filing cabinet, its single key being in the sole possession of the researcher. All data coding for data analysis purposes was anonymised; respondents’ names were encrypted in numerals, with the connection known singularly to the researcher and also filed safely in the locked filing cabinet.

6.5 Questionnaire design

Guided by best practice methods in survey design and implementation (De Vellis, 2017; Dillman, 2009), the survey tool was designed to gather important information that reflects the extant literature and findings from the semi-structured interviews (see Table 4.2, chapter four). It was also used to collect respondent and portfolio selection team demographics. Questions were distributed carefully within six sections (A-F). To minimise common method bias (CMB), procedural (before despatch) and statistical (after despatch) methods were employed (Menguc & Auh, 2008). In designing the survey tool, questions were carefully worded and carefully sequenced. Some questions were reversed (i.e. the question posed was in the negative compared with preceding questions which were posed positively), and sensitive questions were dispersed within the survey and not too near the beginning of the survey tool as to cause respondents to leave the survey prematurely. Statistical methods are described in section 6.10 and 6.11.

6.5.1 Research themes and demographics

Research themes included; new product innovation, performance measurement systems, formal and informal controls, team debate (its focus), team disagreements (their nature), portfolio performance (innovation ambidexterity, market and financial aspects), during NPPS (Table 6.1). Demographic questions completed the survey tool design.

Table 6.1 Survey tool design

Survey topics/themes	Sections	Questions	Total No. statements
Respondent demographics	A, F	1-7, 27	8
Selection team demographics	B	8,9,12	10
New product innovation and competence ambidexterity	C	13, 14	16
Performance measures	D	15, 16	16
Informal and formal meetings	B, D	10, 11, 19	11
Cognitive conflict and debate	D	17, 18, 20	12
Market and Innovation ambidexterity performance	E	21-26	14

6.5.1.1 New product innovation and competence ambidexterity

To gather information about new product innovation, questions were posed about the levels of resources made available for NPD and about the innovation intentions of respondent companies. These questions sought to measure how innovative the company was, whether its focus was on exploitation and incremental innovation, on exploration and radical innovation or on a combination of both. Answers to these questions helped measure competence and innovation ambidexterity.

6.5.1.2 ***Performance measures, formal and informal meetings***

To gather information on formal and informal controls guiding NPPS, a two-part approach was taken. The first was based on metrics, the second was based on meeting type. More specifically, the interviews revealed that certain measures are favoured over others and the extant literature links different measures with different innovation outcomes; therefore some questions posed in the survey focused on the type and others on the relative importance placed upon specific PMs used during NPPS. Also, since the earlier interviews identified informal meetings as persuasive and even pervasive in NPPS, survey questions focused on the frequency of formal, scheduled meetings and of informal, non-scheduled meetings related to NPPS.

6.5.1.3 ***Team debate and cognitive conflict***

Since groups of individuals are involved in NPPS, team debate and individual disagreements among team members were considered inevitable. Interviewees reported that intense debate arises between individuals of certain functional backgrounds who place different emphases on different metrics depending on respective functional role. Furthermore, the literature has shown that when a broad and balanced-PMS guides team behaviour, debate is aroused in the presence of a diverse team driven by the competing contents of the PMS. It is this debate based on those measures (PM-debate) that drives performance. Consequently, this survey posed questions about the focus of team debate during NPPS and enquired about the influence of certain PMs in this context.

Disagreements were thought likely to arise in the context of NPPS where opposing types of innovation strategy (exploit, explore) were simultaneously demanded, where resources are limited, and where different priorities were likely amongst team members from different functions. Much of the literature reports that issue based disagreements, termed cognitive conflict, is critical in successful decision-making. In this survey therefore, questions were posed about the type of disagreements, whether they were issue-based (cognitive conflict) or became personality clashes (affective conflict).

*6.5.1.4 **Innovation ambidexterity and business unit performance***

There is a dearth of empirical evidence of performance outcomes associated with single studies that compare competence and innovation ambidexterity. This survey tool posed questions about portfolio performance within the overall business unit or firm and included questions about new product innovation outcomes. These questions were designed to measure the impact of competence ambidexterity in terms of the less commonly measured innovation ambidexterity (InnAmb) and new product success rate (NPSR) outcomes, with the more commonly measured financial and market-share performance (Perf) outcomes.

*6.5.1.5 **Demographic variables and control variables***

Respondent demographics were gathered using background descriptive statistics questions covering current employment role (title), duration of tenure (years), professional experience (years), age (range), gender, industry (medical device, information technology) and the dynamic nature of the environment in which the respondent worked. Product portfolio selection team demographics were gathered from questions about team size (also a control), team members' functional role (a choice of eight functional roles) and the frequency and duration of portfolio selection meetings.

6.6 Construct Operationalisation

Operationalisation is the process of defining how to measure a phenomenon that is not directly measurable, in order to make it measurable (Huber, Van Vliet, Giezenberg, Winkens, Heerkens, Dagnelie & Knottnerus, 2016). The phenomenon is an abstract or latent concept such as health, gravity, happiness, or satisfaction which cannot be directly observed and measured. Operationalisation helps infer the existence of the phenomenon of interest by means of some observable and measurable effects it possesses. In other words, operationalisation attempts to make unobservable phenomena distinguishable, understandable and measurable by empirical observation (Hair et al., 2017; Pallant, 2016). More specifically, operationalisation refers to the process of developing indicators or items to measure unobserved research themes or constructs. These are presented formally in a survey instrument as the questions posed to respondents, and their associated measurement scales.

Given the high level of subjectivity and imprecision inherent in defining social science constructs, most are measured using multiple indicators (in the form of statements) in an attempt to reduce subjectivity and determine a more comprehensive and more reliable view of the constructs being examined (Hair et al., 2017). Generally, two approaches are possible, namely reflective and formative measurement. Both reflective and formative constructs were employed in this research. A distinction between types of construct is important in how they are analysed, an explanation of which follows (Figure 6.2).

6.6.1 Reflective constructs

Reflective constructs are measured by reflective indicators, so called because changes in reflective indicators are assumed to be caused by the latent construct they represent. This also explains the arrows pointing away from the construct towards indicators in the reflective measurement model representation (Figure 6.2). Thus, reflective indicators represent the effects or manifestations of their underlying construct (Hair et al., 2017). Removal of any of the reflective variable items is not expected to have a major impact on the measurement score as reflective indicators are highly correlated and interchangeable (Diamantopoulos & Siguaw, 2006; Jarvis, Mackenzie & Podsakoff, 2003; Diamantopoulos & Winklhofer, 2001). An example in this study includes Cognitive conflict (Figure 6.2).

6.6.2 Formative constructs

By contrast, formative indicators explain or contribute to the variation in a formative construct. More specifically, each formative indicator contributes a small part towards the whole and so the arrows point from formative indicators toward the underlying construct. Thus, formative indicators predict different aspects or dimensions of their associated construct making them not interchangeable. Consequently, formative indicators are not expected to correlate (making such tests redundant) and removal of any formative indicator would be expected therefore to diminish the meaning of the underlying formative construct. Examples in this study include PMinc and PMrad (performance measures (PMs) that encourage incremental innovation and those that make radical innovations visible, respectively), and the balance (PM-bal) between PMinc and PMrad (Figure 6.2).

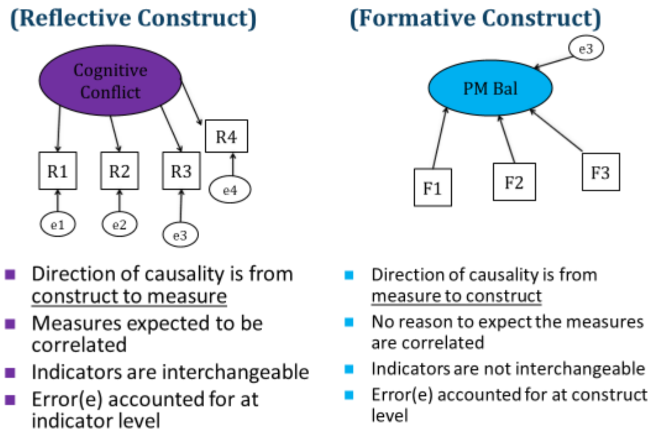


Figure 6.2. Representation of reflective and formative constructs (based on 2 study constructs) (adapted from Jarvis et al. 2003 and Hair et al. 2017).

6.7 Variable selection

The sources of variable selection for this study's survey tool are reported in Table 6.2, and presented in more detail in the next section. Where possible, existing, proven instruments derived from extant literature, were used. Refinements and adaptations to the research context of NPPS were made carefully and according to the guidelines found in Rossiter (2002) and Jarvis et al. (2003). Furthermore, the study favoured Likert rating scales to allow for a more finely tuned, granular response than yes/no or male/female (binary) items allow. Respondents were requested to rate for example their level of agreement or disagreement with a statement by using either a 5-point or a 7-point scale. Odd 'anchor' numbers were used to permit a neutral response. Although Likert scales are ordinal scales because the anchors are not necessarily equidistant, like many researchers this research treated them as interval scales to enable analyses (correlations and regression tests) which would otherwise have been inaccessible (Norman, 2010).

6.8 Survey constructs and variables; their identity, reliability and validity

The constructs employed in this survey, how their variables are operationalised and the reliability and validity of those operationalisations, are presented in detail next (Table 6.2 & Table 6.3). First, the literature source/sources are confirmed, and any adaptations made for the study context are reported. Next, the number of items (questions) per construct, their type (whether reflective or formative), and a description of their associated measurement scale is given. Items presented in the reverse order (to minimise CMB), are disclosed (Table 6.2). Then factor analysis using SPSS principal component analysis (PCA) techniques is reported to further validate the operationalisations in the study context, because 'PCA can be used as an initial step in common factor analysis because it provides information regarding the maximum number and nature of factors'(Kim, 2008, p. 17). The final results of statistical tests of reliability (Cronbach's Alpha) and validity (AVE, item loadings and/or weights) complete the section and include the following Tables; Table 6.2, Table 6.3, Table 6.4, Table 6.5, Table 6.6 & Table 6.7. The overall reliability and validity findings presented in tables are examined against recommended statistical boundaries (Table 6.8). Results are highlighted and explained, consideration is given to decisions regarding retention of specific items (Hair, Risher, Sarstedt & Ringle, 2018; Papachroni et al., 2016; Diamantopoulos & Siguaw, 2006; Jarvis et al., 2003; Diamantopoulos & Winklhofer, 2001). Supplementary tests are included in Appendix A, at the rear of the thesis.

6.8.1 Intention to exploit (Ext)

This study adapted and condensed instruments employed by Cao et al. (2009); Lubatkin et al. (2006); He & Wong (2004), to measure a company's or business unit's propensity to exploit in product innovation, and included 6 reflective items to measure exploitative tendencies. Respondents were asked to indicate (on a Likert scale anchored at 1=strongly disagree to 7-strongly agree) the extent to which they agreed with each statement. Guided by the literature on reliability and validity in scale development, principal component analysis (PCA) extracted a single component for the 6-item construct (De Vellis, 2017; Pallant, 2016; Diamantopoulos & Siguaw, 2006). Exploit (Ext) returned acceptable reliability scores (Cronbach's alpha = 0.86; Composite Reliability (CR) = 0.89). The 6-item scale showed good convergent validity and discriminant validity (Table 6.2 & Table 6.3)

6.8.2 Intention to explore (Exr)

This study adapted and condensed instruments employed by Cao et al. (2009); Lubatkin et al. (2006); He & Wong (2004), to measure a company's or business unit's propensity to explore in product innovation, and included 6 reflective items to measure explorative tendencies. Instrument adaptations were made to reflect technological and product type innovations. Respondents were asked to indicate (on a Likert scale anchored at 1=strongly disagree to 7-strongly agree) the extent to which they agreed with each statement. The 6-item Explore scale loaded onto a single component and returned reliability scores for Cronbach's alpha (0.8) and Composite Reliability (0.85) that compared favourably with values returned by Cao et al. (2009) equal to 0.82 and 0.82 respectively. Notwithstanding that item loadings of 3 items were close to the 0.7 limit, removal of any item from the scale had little bearing on the Cronbach's alpha score and only minimally improved the Composite Reliability (CR) and average variance extracted (AVE) validity scores. Since the cut-off for convergent validity is an AVE of 0.5 (Pallant, 2016; Tabachnick & Fidell, 2013), an AVE of 0.49 for the complete 6-item scale was considered acceptable. Furthermore, discriminant validity tests indicated that within-construct item correlations were greater than correlations with other items, and the square root of AVE (0.7) for Explore was larger than the correlations between any construct pair, findings that make a strong case for construct discriminant validity and the retention of the full 6-item scale to measure Explore as derived in the literature (Table 6.2 & Table 6.3).

6.8.3 Resources munificence (Res)

To measure resources munificence or the availability of uncommitted resources for investment into NPD, a 4-item scale was derived from Atuahene-Gima (2005). Respondents were asked to indicate (on a Likert scale anchored at 1=strongly disagree to 7-strongly agree) the extent to which they agreed with each statement. The third item was reversed scored as a method to help manage common method bias. PCA extracted a single component. However, one item loaded at 0.61 with an indicator reliability score of 0.37, both below the preferred levels of 0.7 and 0.5 respectively. With otherwise robust scale reliability and validity scores returned, the 4-item scale was retained (Table 6.2 & Table 6.3).

6.8.4 Frequency of informal, non-scheduled, one-to-one meetings (IF)

The frequency of informal meetings was measured using 3 items derived from the scale of Fisher, Maltz & Jaworski (1997) who adapted the scale from Maltz & Kohli (1996). The 3 items loaded on a single factor that returned a Cronbach's alpha of 0.699. Respondents were asked to rate the frequency (on a Likert scale anchored at

1=never to 7-daily) of meetings of each type. Although IF3 asked respondents how often they communicate with team members about new product selection decisions by ‘informal, one-to-one, face-to-face conversations in a non-work setting’ to which almost 60% said ‘Never,’ the removal of IF3 increased Cronbach’s alpha only to 0.752, but had very little effect on Composite Reliability (0.856). Additionally, since its AVE (0.702) score exceeded the minimum 0.5 threshold (Pallant, 2016; Tabachnick & Fidell, 2013), the full 3-item scale was therefore retained (Table 6.2 & Table 6.3).

6.8.5 Frequency of formal, scheduled meetings (F)

This construct was measured using 3 items derived from the scale of Fisher et al. (1997) who adapted the scale from Maltz & Kohli (1996). Respondents were asked to rate the frequency (on a Likert scale anchored at 1=never to 7-daily) of meetings of each type. The 3 items loaded on a single factor, demonstrating good internal consistency, with a Cronbach’s alpha of 0.75. All items were retained. Removal of any reduced the reliability score and other reliability scores. Discriminant validity checks returned acceptable scores (Table 6.2 & Table 6.3).

6.8.6 Opportunities to conduct informal meetings (IFOp)

Efforts failed to find an existing measure of the extent to which opportunities arise for informal meetings to take place in advance of NPPS meetings. A new instrument made of a 2-item scale was developed. Respondents were asked to rate their level of agreement (on a Likert scale anchored at 1=strongly disagree to 7=strongly agree) on opportunities arising for certain informal decision-making. While a Cronbach’s alpha was low at 0.61, Nunnally (1967 in Nunnally & Bernstein, 1994) suggests that a Cronbach’s α from 0.50 to 0.60 is adequate for measures in the preliminary stages of development. Since other reliability and validity tests returned scores above acceptable levels, the new scale was retained (Table 6.2 & Table 6.3).

Table 6.2 Survey constructs, total number of items (N), measurement scale & literature source

Construct & label in brackets	N	Measurement scale (Likert)	Literature source
Intention to Exploit (Ext)	6	Agreement 1-5; from Strongly Disagree to Strongly Agree	(Cao et al., 2009; Lubatkin et al., 2006; He & Wong, 2004)
Intention to Explore (Exr)	6	Agreement 1-5; from Strongly Disagree to Strongly Agree	(Cao et al., 2009; Lubatkin et al., 2006; He & Wong, 2004)
Resources munificence (Res)	4	Agreement 1-5; from Strongly Disagree to Strongly Agree	(Atuahene-Gima, 2005)
Frequency of informal, non-scheduled one-to-one meetings (IF)	3	Frequency 1-7; from Never to Daily	(Kyriazis, Massey, Couchman & Johnson, 2017; Fisher, Maltz & Jaworski, 1997)
Frequency of formal scheduled meetings (F)	3	Frequency 1-7;from Never to Daily	(Kyriazis et al., 2017; Fisher et al., 1997)
Opportunities to conduct informal meetings (IFOp)	2	Agreement 1-5; from Strongly Disagree to Strongly Agree	New
Prediction of project selection following IF meetings (IFPred)	2	Agreement 1-5; from Strongly Disagree to Strongly Agree	New
Debate based on Performance measures (PM-deb)	4	Agreement 1-7; from Strongly Disagree to Strongly Agree	(Bedford et al., 2019)
Cognitive conflict (CogCon)	4	Agreement 1-5; from Never to a Very Great Deal	(Lubatkin et al., 2006; Jehn et al., 1999; Amason, 1996)
Affective conflict (AffCon)	4	Agreement 1-5; from Never to a Very Great Deal	(Jehn et al., 1999; Amason, 1996)
Incremental innovation (Inc)	3	Agreement 1-5; from Strongly Disagree to Strongly Agree	(Lin et al., 2013; Atuahene-Gima, 2005; Cooper et al., 2000)
Radical innovation (Rad)	3	Agreement 1-5; from Strongly Disagree to Strongly Agree	(Lin et al., 2013; Atuahene-Gima, 2005; Cooper et al., 2000)
Company or Business unit performance (Perf)	4	Expectation 1-5 scale; from Significantly Lower to Significantly Higher	(Lin et al., 2013; Jansen et al., 2012; Kester et al., 2011; Salomo, Keinschmidt & De Brentani, 2010; Cao et al., 2009; Atuahene-Gima, 2005; He & Wong, 2004; Gupta & Govindarajan, 1986)
New Product Success Rate (NPSR)	4	In 20 percent blocks 1-5; progresses from 1% to 100%	(Eling, Griffin & Langerak, 2016)
Environmental dynamism (EnvDyn)	5	Agreement 1-5; Strongly Disagree to Strongly Agree	(Atuahene-Gima, 2005; Jaworski & Kohli, 1993)
Performance measures that favour incremental innovation (PM-inc)	6	Importance 1-7; from Not Important to Critically Important	(Bedford et al., 2019; Davila et al., 2015; Mc Nally et al., 2013; Cooper & Edgett, 2012; Kester et al., 2011; Lavie et al., 2010; Anthony et al., 2008)
Performance measures that make radical innovation visible (PM-rad)	6	Importance 1-7; from Not Important to Critically Important	(Bedford et al., 2019; Davila et al., 2015; Mc Nally et al., 2013; Cooper & Edgett, 2012; Kester et al., 2011; Lavie et al., 2010; Anthony et al., 2008; Auh & Menguc, 2005a)

Table 6.3 SPSS Reliability & Validity statistics of survey constructs

Latent Variable (Abbreviation)	Indicators	Convergent Validity			Internal Consistency Reliability		Discriminant Validity
		Initial Loadings	Indicator Reliability	AVE	Cronbach's Alpha	Composite Reliability	√AVE
		>0.7	>0.5	>0.5	0.6-0.9	0.6-0.9	
Intention to Exploit (Ext)	Exploit1	0.726	0.527	0.53	0.79	0.9	0.73
	Exploit2	0.776	0.602				
	Exploit3	0.684	0.468				
	Exploit4	0.712	0.507				
	Exploit5	0.713	0.508				
	Exploit6	0.998	0.996				
Intention to Explore (Exr)	Explore1	0.75	0.563	0.54	0.79	0.85	0.74
	Explore2	0.602	0.362				
	Explore3	0.799	0.638				
	Explore4	0.778	0.605				
	Explore5	0.633	0.401				
	Explore6	0.646	0.417				
Resources (Res)	Res 1	0.822	0.676	0.59	0.76	0.85	0.77
	Res 2	0.882	0.778				
	Res 3	0.611	0.373				
	Res 4	0.726	0.527				
Frequency informal, non-scheduled, one-to-one meetings (IF)	IF1	0.798	0.637	0.62	0.7	0.83	0.79
	IF2	0.888	0.789				
	IF3	0.671	0.45				
Frequency of formal, scheduled meetings (F)	F1	0.824	0.679	0.67	0.75	0.86	0.82
	F2	0.765	0.585				
	F3	0.859	0.738				
Opportunity to conduct IF meetings (IFOp)	IFOP1	0.847	0.717	0.72	0.61	0.84	0.85
	IFOP2	0.847	0.717				
Prediction of project selection following IF meeting (IFPred)	IFPred1	0.843	0.711	0.71	0.59	0.83	0.84
	IFPred2	0.843	0.711				
Debate based on performance measures (PM-deb)	PMdeb_1	0.921	0.848	0.69	0.83	0.91	0.83
	PMdeb_2	0.941	0.885				
	PMdeb_3	0.458	0.210				
	PMdeb_4	0.9	0.810				
Cognitive conflict (CogCon)	CogCon_1	0.825	0.681	0.53	0.69	0.81	0.73
	CogCon_2	0.728	0.53				
	CogCon_3	0.62	0.384				
	CogCon_4	0.713	0.508				
Affective Conflict (AffCon)	AffCon1	0.918	0.843	0.82	0.912	0.94	0.91
	AffCon2	0.914	0.835				
	AffCon3	0.884	0.781				
	AffCon4	0.841	0.707				
Incremental (Inc)	Inc1	0.707	0.5	0.7	0.78	0.87	0.84
	Inc2	0.887	0.787				
	Inc3	0.905	0.819				
Radical (Rad)	Rad1	0.911	0.83	0.81	0.88	0.93	0.9
	Rad2	0.915	0.837				
	Rad3	0.878	0.771				
Company or Business unit Performance (Perf)	Perf1	0.859	0.738	0.83	0.93	0.95	0.91
	Perf2	0.881	0.776				
	Perf3	0.938	0.88				
	Perf4	0.955	0.912				
New Product Success Rate (NPSR)	NP1_Scr	0.722	0.521	0.58	0.76	0.85	0.76
	NP2_Sel	0.818	0.669				
	NP3_Com	0.793	0.629				
	NP4_Suc	0.714	0.51				
Environmental Dynamism (Dyn)	Dyn1	0.721	0.52	0.64	0.86	0.9374	0.8
	Dyn2	0.813	0.661				
	Dyn3	0.869	0.755				
	Dyn4	0.758	0.575				
	Dyn5	0.832	0.692				

6.8.7 Predictability of project selection following informal meetings (IFPred)

Efforts failed to find an existing measure of the degree to which product selection predictability arises out of informal meetings held in advance of formal product selection meetings. A new instrument made of a 2-item scale was therefore developed. Respondents were asked to rate their level of agreement (on a Likert scale anchored at 1=strongly disagree to 7=strongly agree) on predictability for certain informal decision-making. This scale returned a Cronbach's alpha at 0.59, but following Nunnally's (1967) guidelines for new measures and backed by other acceptable reliability and validity test scores returned, this 2-item scale was retained (Table 6.2 & Table 6.3).

Principal component analysis (PCA) on the amalgamated scales (IFOp + IFPred), extracted two components (Table 6.4). However, while IFPred1 and IFPred2 distinctly reflected one of these factors, IFOp1 and IFOp2 appeared to measure both factors and were therefore dropped from the final model analysis (Table 6.4).

Table 6.4 Principal component analysis test

Component Matrix

	Component	
Construct	**1**	**2**
IFOP1	0.756	0.385
IFOP2	0.537	0.709
IFPred1	0.633	-0.491
IFPred2	0.690	-0.523
Extraction Method: Principal Component		
2 components are extracted.		

6.8.8 Debate based on performance measures (PM-deb)

PM-deb refers to the debate dimension that has performance measures at the centre of the debate. To measure PM-deb during new product portfolio selection meetings, a 4-item scale developed by Bedford et al. (2019) was employed. This scale identified items used specifically in debate and discussions among top management teams. Respondents were asked to rate their level of agreement (on a Likert scale anchored at 1=strongly disagree to 7=strongly agree) with each of the 4 statements. The 4-item scale returned a low loading (0.46) on item PM-deb3, (reverse coded), and a very low indicator reliability score (squared loading) of 0.21, well below the preferred 0.4 threshold (Table 6.2 & Table 6.3). Good practice was followed and the PM-deb3 item was deleted. Improved reliability and validity scores were associated with the reduced 3-item scale (Appendix A, Table 3).

6.8.9 Cognitive conflict (CogCon)

Cognitive conflict was represented by the latent construct CogCon. It was assessed using the 4-item scale developed by Jehn et al. (1999) and adapted for use in a portfolio meeting context based on evidence from Amason (1996) and Lubatkin et al. (2006). Respondents were asked to rate their level of agreement (on a Likert scale anchored at 1=strongly disagree to 7=strongly agree) on each of the statements. The third item was reverse scored as a means to ameliorate against common method bias. PCA revealed that all items loaded on a single component and returned an AVE score of 0.53. Despite item CogCon_3 loading just below the cut-off of 0.7 (at 0.62) and its indicator reliability score was just below the 0.4 limit (at 0.38), removal of the items only minimally reduced Cronbach's alpha and Composite Reliability scores (Table 6.2 & Table 6.3; Appendix A, Table 3). All items of the scale were therefore retained (Pallant, 2016; Tabachnick & Fidell, 2013).

6.8.10 Affective conflict (AffCon)

AffCon represented the latent construct affective conflict that describes more personality-based conflict. It was assessed using the 4-item scale developed by Jehn et al. (1999) and adapted for use in a portfolio meeting context, based on evidence from Amason (1996) and Lubatkin et al. (2006). Respondents were asked to rate their level of agreement (on a Likert scale anchored at 1=strongly disagree to 7=strongly agree) on each of the statements. Employing PCA, all items loaded on a single component. Relevant reliability and validity tests returned were within acceptable ranges (Table 6.2 & Table 6.3).

6.8.11 Incremental innovation (Inc)

Inc refers to the construct representing incremental innovation, an output measure of exploitative innovation. To measure incremental innovation, this study used a 3-item measure derived from Lin et al. (2013), Atuahene-Gima (2005), and Cooper et al. (2000). Respondents were asked to rate their level of agreement (on a Likert scale anchored at 1=strongly disagree to 7=strongly agree) on each of the 3 statements. All items loaded on a single component and the scale returned robust reliability and validity scores (Table 6.2 & Table 6.3).

6.8.12 Radical innovation (Rad)

Radical innovation is an output measure of explorative innovation and this study used a 3-item measure (named Rad), derived from Lin et al. (2013), Atuahene-Gima (2005), and Cooper et al. (2000) to measure radical innovation. Respondents were asked to rate their level of agreement (on a Likert scale anchored at 1=strongly disagree to 7=strongly agree) on each of the statements. All items loaded on a single component and the scale returned solid reliability and validity scores (Table 6.2 & Table 6.3).

6.8.13 Company or Business Unit Performance (Perf)

Business Unit Performance was measured by asking respondents how they rated the performance of their business unit over the previous year compared with their expectations, using a 4-item scale adapted from the works of Lin et al. (2013); Jansen et al. (2012); Kester et al. (2011); Cao et al. (2009); He & Wong (2004); and Gupta & Govindarajan (1986). Respondents were asked to rate their level of agreement (on a Likert scale anchored at 1=strongly disagree to 5=strongly agree) with expectations of their firm's performance over the previous 12 months (Cao et al., 2009) in terms of sales growth, profit growth, market share growth, and overall performance. Since company performance can be and has been measured by a single or many outcome items, it was felt that restricting to one or two indicators would 'run the risk of producing biased estimations of organisational ambidexterity's contributions to the firm's overall success' (Raisch & Birkinshaw, 2008, p. 400). Thus, the advice of Lin et al. (2013) was taken in the choice of metrics used to render a broader perspective on firm performance (Lin et al., 2013). Results established internal consistency with a Cronbach's alpha co-efficient of 0.93, and a Composite Reliability score of 0.95. A mean inter-item correlation value 0.77 suggested a strong relationship among the scale items. Validity tests, namely AVE at 0.83 and square root of AVE at 0.91 suggested convergent and discriminant validity of acceptable values (Table 6.2 & Table 6.3).

6.8.14 New Product Success Rate (NPSR)

New product success was measured using a 4-item scale derived from the research of Eling et al. (2016) and adapted to include the phases of new product selection. Respondents were asked (based on a Likert scale anchored at 1=1-20% to 5=80-100%) to choose a percentage band matching their judgement in terms of NPDs that pass through certain product development phases. PCA extracted a single component and all scale items loaded above 0.7. Reliability and validity scores returned were consistent with accepted standards (Table 6.2 & Table 6.3).

6.8.15 Environmental dynamism (Dyn)

Environmental dynamism refers to ‘the turbulence within markets that is driven by technological, economic, and competitive changes’ (Davila et al., 2015, p. 229). The greater the pace of such changes, the greater the need to invest in NPD. To measure the extent of these environmental and market changes, a 5-item scale developed by Jaworski & Kohli (1993) and validated by Atuahene-Gima (2005) was employed. Respondents were asked to rate their level of agreement (on a Likert scale anchored at 1=strongly disagree to 7=strongly agree) on each of the statements. PCA extracted a single component from the 5-item scale. Reliability tests including Cronbach’s alpha (0.86) and Composite Reliability (0.94) suggested internal scale consistency. Validity scores also supported scale validity (Table 6.2 & Table 6.3).

6.8.16 Measures that favour incremental innovation (PM-inc)

A list of measures considered to be more strongly associated with short termism and a response via incremental NPD, was derived from the literature of performance measurement in innovation contexts (Bedford et al., 2019; Davila et al., 2015; Cooper & Edgett, 2012; Kester et al., 2011; Lavie et al., 2010; Hardenbrook, 2009; Anthony et al., 2008). In this study, 8 of these measures were grouped and labelled PM-inc (Table 6.5 & Table 6.6). Respondents were asked to rate the importance (on a Likert scale anchored at 1=not important to 7-critically important) given to each measure when selecting a new product for their business unit product portfolio. The 8 measures listed in (Table 6.5 & Table 6.6), are as follows; potential revenue (M3Rev), meeting customer targets (M6MCT), product development resources (M7Res), potential return on investment (M8Ret), expected time-to-market

(M9T2M), break-even time (M10BE), competitor activity (M11Comp), and customer satisfaction (M12Cust). Since all measures contributed independently of each other towards the formative construct, PM-inc employed in this study, and all ‘weighted' comparably important as contributors to the business unit’s PMS (Table 6.5 & Table 6.6), no item was dropped as this would have altered the meaning of the construct (Diamantopoulos & Siguaw, 2006; Jarvis et al., 2003).

6.8.17 Measures that favour radical innovation (PM-rad)

Measures that make radical innovations more acceptable or more ‘visible’ are associated with the longer term and can foster exploration through more radical innovations (Bedford et al., 2019; Davila et al., 2015; Kester et al., 2011; Anthony et al., 2008; Auh & Menguc, 2005a; Cooper et al., 2001). Measures such as timeframe and overall risk, also encourage the pursuit of a balanced product portfolio based on a portfolio product mix and they are considered to ‘even out multiple concerns’ (McNally et al. 2013, p.249). This study derived 8 such measures from the literature of performance measurement in innovation contexts, which are labelled PM-rad and listed in Table 6.5 & Table 6.6. Respondents were asked to rate the importance (on a Likert scale anchored at 1=not important to 7-critically important) given to each measure when selecting a new product for their business unit product portfolio. Measures employed were; seeking a balance in the portfolio in terms of product launch schedule (Bal1Time), overall portfolio risk (Bal2Risk), constituent product type (existing or entirely new) (Bal3Type), profitability (Bal4Profit), using individual intuition and professional experience (M1Exp), matching company strategy (M2Strat), seeking growth in market share (M4MSG) and opening of new markets (M5ONM). Since all measures contributed independently of each other towards the formative construct PM-rad employed in this study, (Table 6.5 & Table 6.6), no item was dropped as this would have altered the meaning of the construct (Diamantopoulos & Siguaw, 2006; Jarvis et al., 2003).

Table 6.5 Outer loadings and weights (relative importance) of each factor towards the formative construct

Construct PM Rad	Outer loadings	Outer weights	Construct PM Inc	Outer loading	Outer weights
Bal1_Time	0.47	0.1	Meas10_BE	0.26	-0.39
Bal2_Risk	0.65	0.28	Meas11_Comp	0.81	0.51
Bal3_Type	0.42	0.07	Meas12_Customer	0.42	0.14
Bal4_Profit	0.44	-0.05	Meas3_Revenue	0.37	-0.07
Meas1_Experience	0.24	0.01	Meas6_MCT	0.24	0.13
Meas2_Strategy	0.68	0.09	Meas7_FRes	0.24	-0.37
Meas4_MSG	0.92	0.68	Meas8_Ret	0.73	0.83
Meas5_ONM	0.52	0.15	Meas9_T2M	0.5	0.2

Key: PMrad = measures that make radical innovations visible; MSG = market share growth; ONM = open new markets; PMinc = performance measures that encourage incremental innovations. BE = break-even time; Comp = competitor; MCT = meeting customer targets; FRes = financial resources; T2M = time to market

Table 6.6 Average importance of performance measures (PMs) employed during product portfolio selection

Construct PMrad	Average importance	Construct PMinc	Average importance
Bal1_Time	4.13	M3_Revenue	6.25
Bal2_Risk	4.18	M6_MCT	5.36
Bal3_Type	4.78	M7_FRes	5.03
Bal4_Profit	4.86	M8_Return	5.7
M1Experience	4.44	M9_T2M	5.14
M2_Strategy	6.12	M10_BE time	4.73
M4_MSG	5.87	M11_Competitor	5.31
M5_ONM	5.62	M12_Customer	6.14

Key: PMrad = measures that make radical innovations visible; MSG = market share growth; ONM = open new markets; PMinc = performance measures that encourage incremental innovations. BE = break-even time; MCT = meeting customer targets; FRes = financial resources; T2M = time to market

Note: The average overall importance of PM-inc is greater than that of PM-rad

6.9 Survey composite constructs; identity, reliability and validity

Competence ambidexterity (CompAmb in models and tables), innovation ambidexterity (InnAmb) in models and tables; and a performance measurement system that is 'balanced' between measures that favour incremental innovation and those that make radical innovations visible (PM-bal), are three composite, multidimensional, formative constructs key to this research. Measuring multidimensional constructs is more complicated than measuring those of single dimensions. Consequently there is greater potential for error or misspecification, (Klarner, Sarstedt, Hoeck & Ringle, 2013; Jarvis et al., 2003). Care was taken in 'operationalising' these constructs, i.e. in rendering the unobservable construct phenomena measurable (Table 6.2 & Table 6.3). Findings from the unidimensional constructs were combined to render the multidimensional composite constructs described next (Table 6.7).

Table 6.7 Composite constructs, operationalisation and literature source

Construct and Operationalisation explanation	**Literature source**
Competence Ambidexterity (CompAmb) The multiplication of explore and exploit scores = multiplicative combined dimension (mCD) The addition of explore and exploit scores = additive combined dimension (aCD) The reverse score of absolute difference between exploit and explore scores = balance dimension (BD) The multiplication of combined (mCD) and balance dimensions formed the multiplicative composite mCompAmb* The multiplication of combined (aCD) and balance dimensions formed the additive composite aCompAmb construct	Lin et al. (2013); Jansen et al. (2012); Cao et al. (2009); Simsek et al. (2009); Menguc & Auh (2008); Gibson & Birkinshaw (2004); He & Wong (2004)
Innovation Ambidexterity (InnAmb) The multiplication of incremental and radical scores = multiplicative combined dimension (mCD) The addition of incremental and radical scores = additive combined dimension (aCD) The reverse score of the absolute difference between incremental and radical scores = balance dimension (BD) The multiplication of combined (mCD) and balance dimensions formed the multiplicative composite mInnAmb construct* The multiplication of combined (aCD) and balance dimensions formed the additive composite construct aInnAmb	Bedford et al. (2019); (Lin et al.); Jansen et al. (2012); Cao et al. (2009); Simsek et al. (2009); Menguc & Auh (2008); Gibson & Birkinshaw (2004); He & Wong (2004)
A balanced set of portfolio selection measures (PM-bal) A combination of portfolio selection (formative) measures that promote exploitation and incremental innovations (PM-inc) with those that increase the visibility of exploration and radical innovations (PM-rad) = combined dimension The reverse score of the differences between each PM type rendered the construct = balance dimension	Davila et al. (2015); Mc Nally et al. (2013); Kester et al. (2011); Lavie et al. (2010); Anthony et al. (2008); Auh & Menguc (2005a); Cooper et al. (2001)

*The multiplicative approach has been the most frequently employed measure to date

6.9.1 Competence Ambidexterity (CompAmb)

Ambidexterity scholars have provided different arguments about the operationalisation of ambidexterity. Most studies utilise either the absolute difference between exploration and exploitation or the product of the two strategies. A few studies use their sum score (Birkinshaw & Gupta, 2013). 'We find that over and above their independent effects, concurrent high levels of BD [the balance dimension] and CD [the combined dimension] yield synergistic benefit' (Cao et al., 2009, p. 781). Accordingly, this research conceptualised ambidexterity as an aggregate multidimensional construct comprising the interaction (multiplication) of two dimensions (Cao et al., 2009; Simsek et al., 2009), namely the balance dimension (BD) and combined dimension (CD), thus overcoming or minimising drawbacks based on more restrictive operationalisations as suggested in the literature (Rosing & Zacher, 2017; Cao et al., 2009), (Table 6.7).

6.9.1.1 ***Balance dimension of exploitation and exploration (BD)***

The balance dimension of exploitation and exploration (EEBD) concerns the *relative balance* of exploitation with exploration. This was measured as the absolute difference between their total scores (since 'the difference score only captures the degree of imbalance, but not the level of (im)balance' (Rosing & Zacher, 2017, p. 697). To facilitate interpretation, this measure was flipped by subtracting the absolute difference calculations from 7 (the size of the Likert scale) so that higher values indicated greater balance (Cao et al., 2009).

6.9.1.2 ***Combined dimension of exploitation with exploration (CD)***

The second dimension (CD) refers to the combination of activities of exploration and exploitation (EE). The combined dimension (EECD) therefore reflects a firm's *combined magnitude* of exploration and exploitation. This is in line with the theoretical treatment of this dimension which proposes that 'high levels of exploration and exploitation can complement and augment the performance-enhancing effect of the other' (Cao et al., 2009, p. 788). The calculation of CD has been enacted in two different ways by different authors, one is by multiplication (mCD), one by addition (aCD). Both were performed in this study.

The most frequently referenced approach is the multiplicative approach, used by Jansen et al. (2012); He & Wong (2004) for example. It was calculated in this study by the multiplication of Explore and Exploit scores (mCD). The second or additive approach e.g. (Lubatkin et al., 2006), summated Explore and Exploit innovation scores (aCD).

6.9.1.3 ***The aggregate construct competence ambidexterity (mCompAmb; aCompAmb)***

The aggregate, multidimensional or composite construct CompAmb was calculated as the multiplication of the balance dimension (BD) and a combined dimension (CD). This operationalisation recognises that competence ambidexterity is attributable to balancing high levels of both exploitation and exploration rather than by attaining balance at any level of emphasis (Bedford, 2015). Thus, a high CompAmb score indicates that both exploitation and exploration operate at high levels (Bedford & Sandelin, 2015; He & Wong, 2004). Due to two approaches in the literature in the operationalisation of the combined dimension (multiplicative and additive), two operationalisations for competence ambidexterity were calculated, namely mCompAmb and aCompAmb. The first of these, **m**CompAmb, uses the multiplicative approach (mCompAmb = multiplicative combined dimension times the balance dimension), min. (15.84), max. (340.48) yielding a range of 324.64. This operationalisation is employed in the current study. The second operationalisation **a**CompAmb uses the additive approach (aCompAmb = additive combined dimension times the balance dimension), min. (20.24), max (93.84) and yields a range of 73.60, (Table 6.7).

6.9.2 Innovation Ambidexterity (InnAmb)

Similar to CompAmb, innovation ambidexterity (InnAmb) is conceptualised as an aggregate, multidimensional or composite construct comprising the interaction of two dimensions, a balanced dimension (BD) and a combination dimension (CD), of two innovation output types, radical and incremental innovation (Bedford et al., 2019). Innovation ambidexterity is a measure of ex-post exploitation and exploration activity through a measure that reflects both incremental and radical innovations (He & Wong, 2004).

6.9.2.1 ***Balance dimension of incremental and radical innovation (BD)***

The balance dimension of incremental and radical innovation (IRBD) concerns the *relative balance* of incremental innovations and radical innovations. This is measured as the absolute difference between their total scores (Bedford et al., 2019). To facilitate interpretation, this measure was 'flipped' by subtracting the absolute difference calculations from 7 so that higher values would indicate greater balance.

6.9.2.2 ***Combined dimension of incremental and radical innovations (CD)***

The second dimension refers to the *combination* of incremental and radical innovations. This is calculated in two different ways by different authors. The first, called the multiplicative approach used by e.g. (Jansen et al., 2012; Jansen et al., 2006; He & Wong, 2004), was calculated as the multiplication of incremental (Inc) and radical (Rad) innovation scores (mCD). The second or additive approach e.g. (Lubatkin et al., 2006) summated incremental and radical innovation scores (aCD). Reflecting the theoretical treatment of the combined dimension of competence ambidexterity by Cao et al. (2009) and Lin et al. (2013), it is similarly proposed that high levels each of incremental and radical innovations complement and augment the performance-enhancing effects of the other.

6.9.2.3 ***The aggregate or composite construct innovation ambidexterity (mInnAmb; aInnAmb)***

The aggregate composite construct InnAmb representing innovation ambidexterity was calculated similarly to the construct representing competence ambidexterity, by the multiplication of the InnAmb balance dimension and each of its combined dimension(s). This operationalisation recognises that innovation ambidexterity is attributable to balancing high levels of both radical and incremental innovation rather than by attaining balance at any level of emphasis. Thus, a high InnAmb score would indicate that both innovation outcomes are at high levels (Bedford et al., 2019). Using the multiplicative approach yielded a range of (103), and the additive approach yielded a range of (40), (Table 6.7).

6.9.3 A balanced set of performance measures (PM-bal)

Answers to survey questions about the type of and relative importance placed upon 16 specific performance measures employed during product portfolio selection (PM-inc and PM-rad) contributed toward measuring the formative construct PM-bal, namely, a balanced set of performance measures. This construct is a central study construct (Table 6.7).

*6.9.3.1 **Composite construct PM-bal as a formative multidimensional construct***

The portfolio performance measurement system (PMS) guiding new product portfolio selection was represented as a formative construct composed of PM-inc and PM-rad constructs. To operationalise the construct PM-bal, an approach similar to that taken in operationalising the balance dimension (BD) of aforementioned composite constructs, was taken. The reverse score of the absolute difference between PM-inc and PM-rad rendered the balance dimension employed, with a value range of 21 (Table 6.7).

6.10 Data analysis using SPSS

Data analysis was performed in two main parts. The first part aligned with the preliminary tests required to prove that the data instrument used, (i.e. its variables and constructs), and data collected (responses) were reliable and valid as sources for an examination of the hypothesised relationships (Pallant, 2016; Podsakoff, Mackenzie & Podsakoff, 2012; Podsakoff et al., 2003). These initial analyses were conducted using the Statistical Package for Social Sciences(SPSS) version 25 software package and are reported in this chapter. The second part of data analysis focussed on testing the hypothesised models and used Partial Least Squares (PLS) structural equation modelling (SEM) methods employing the software package SmartPLS version 3. Findings from SmartPLS-SEM are reported in the next chapter, Chapter 7.

6.10.1 Data cleansing

Data analysis began by ‘cleaning the data’ (Pallant, 2016, p. 44; Tabachnick & Fidell, 2013). Using SPSS, frequency and exploratory tests were run on all variables checking the data for errors of omission, out of range readings (mistakes or outliers), inconsistencies and suspicious patterns of response including straight-lining (consistently marking the same level response to a high proportion of answers), diagonal-lining and alternating extreme poles in sequenced questions. Tests to identify outliers were run by SPSS-explore which produced stem and leaf plots clearly identifying outliers by respondent number (Sarstedt, Ringle, Smith, Reams & Hair, 2014b). These proved minimal. Fewer than 5% of values were missing on any single question so missing values were accounted for by mean value replacement (Hair et al., 2017, p. 57). Nonresponse bias (when respondents differ in meaningful ways from non-responders) was examined using the 'extrapolation method' (Armstrong & Overton, 1977, p. 397), where late responders are assumed to behave like non-responders. Here, a comparison was made between the first and last 20 percent (30 responses) of surveys received. The two-tailed (at 0.05 significance), Mann-Whitney U and Kruskal-Wallis tests of differences between the two independent groups, showed no meaningful differences between them.

6.10.2 Tests for data normality

Lack of normality in variable distributions can distort multivariate analysis output (Sarstedt et al., 2014b). Normality of the study data was examined using the SPSS Kolmogorov-Smirnov test for skewness and the Shapiro-Wilks test measured data 'peakedness' or kurtosis. Appendix A, Table 6 shows that the majority of study variables displayed normal distribution. Of more than 60 variables examined, skewedness was present in only two. Gender had a Kolmogorov-Smirnov value of -2.43 explained by the 'non-normal,' low numbers of females to males still evident in senior management positions, and the other deviation was not extreme at 1.75 for IF3. Kurtosis was normal in most instances but for 11 variables with the highest Shapiro-Wilks = 4 for gender as explained above, followed by Shapiro-Wilks = 1.9 for IF3. All other values were close to -1 or 1. Minor deviations are not a problem for PLS-SEM (Hair et al., 2017), and that is one of the benefits in employing PLS-SEM in later analyses.

6.10.3 Common method bias (CMB)

The Harman's single factor test was employed to check for common method bias. Using principal component analysis (PCA), 24 distinct items were found to account for 81.7% of the total variance in the data (Appendix A, Table 5). Further, the first unrotated factor captured only 14% of the variance suggesting that CBM was not an issue in this study (Pallant, 2016; Podsakoff et al., 2012; Menguc & Auh, 2008).

6.10.4 Tests of reliability and validity using SPSS

All survey constructs were analysed initially for reliability and validity using SPSS exploratory factor analysis techniques as reported in the earlier sections of this chapter (6.8; 6.9). The literature is rich with guidance on outer statistical limits for constructs and their items to show reliability and validity (Table 6.8). These guidelines were followed closely, and any deviations were reported. Tests used in this study and their statistical limits are presented briefly next.

6.10.4.1 ***Cronbach's alpha (α)***

The Cronbach's alpha coefficient describes the average correlation or consistency between all items making up a measurement scale. Nunnally & Bernstein (1994), and De Vellis (2017) recommend a minimum value of Cronbach's α at 0.7, as an acceptable measure of internal consistency or scale reliability.

6.10.4.2 ***Composite Reliability***

Composite Reliability is considered to be a more rigorous test of internal construct reliability. Composite reliability attempts to measure the shared variance among observed items or variables being used to measure the underlying latent construct (Fornell & Bookstein, 1982). Scores are derived from the item loadings (r) and loadings above 0.7 indicate that the construct explains over 50% of the indicator's variance (Sarstedt, Ringle, Henseler & Hair, 2014a).

'Values between 0.60 and 0.70 are considered ''acceptable in exploratory research'', whereas values between 0.70 and 0.95 are considered ''satisfactory to good'' (Hair et al., 2017, p. 102). Values higher than 0.95 are considered 'problematic,' as they may indicate that the item is 'redundant,' leading to issues such as undesirable response patterns (e.g., straight lining), and inflated correlations among indicator error terms (Sarstedt et al., 2014b, p. 108).

6.10.4.3 ***Inter-item correlation tests***

The mean inter-item correlation measures are recommended when Likert scales have fewer than 10 items (Briggs and Cheek, (1986) in Pallant, 2016). These measures should ideally range from 0.2 to 0.4 suggesting a strong relationship amongst items comprising the measurement scale (Hair et al., 2017). Low values (<0.3) indicate that the item is measuring something different from the scale as a whole (Tabachnick & Fidell, 2013) and can be considered for removal from the scale if by so doing the composite reliability and validity values (AVE) improve (Hair et al., 2017).

6.10.4.4 ***Average variance explained***

AVE measures the convergent validity of latent constructs**.** AVE describes the 'extent to which a construct converges in its indicators by explaining the items' variance' (Sarstedt et al., 2014b, p. 108), which is the reason it is not suitable for testing formative items. AVE values greater than 0.5 suggest convergent validity (Fornell & Bookstein, 1982).

6.11 Data analysis using SmartPLS-SEM version 3 methods

The second stage of data analysis focussed on the two main hypothesized relationships models; namely Model A reflecting the ***a****ntecedents* of competence ambidexterity and Model C, representing the ***c****onsequences* of competence ambidexterity. Methods of analysis are presented next while the detailed findings are presented in Chapter 7.

6.11.1 Introduction to SmartPLS-SEM

This study employed partial least squares (PLS) structural equation modelling (SEM), software package SmartPLS version 3 (referred to as PLS-SEM from now on), for a number of reasons: (i) it favours complex path models that include many constructs (Chin, Peterson & Brown, 2008); (ii) models inclusive of reflective and formative constructs (Hair et al., 2018); (iii) it integrates measurement and structural model assessments simultaneously (Gefen, Rigdon & Straub, 2011); (iv) it tolerates minor elements of non-normality (Wong, 2013); it uses the bootstrap procedure in PLS-SEM that (v) handles relatively small sample sizes (77 in this case). Moreover, (vi) PLS path modelling is recommended in early stages of theoretical development in order to test and validate exploratory models (Henseler & Chin, 2010), thus matching well with conditions of the current study. Finally, (vii) the graphics in SmartPLS-SEM made it easier to use than SPSS and its AMOS technique that would have otherwise needed to be employed (Kock, 2015).

As stated, this study examines what are named antecedent Model A and consequence Model C. They must not be confused with the 'model' nomenclature used within SmartPLS-SEM. More specifically, structural equation modelling (SEM) examines data in the form of two 'models;' namely an outer model or measurement model that explains the relationships between latent constructs and their observed indicators; and an inner model or structural model that specifies the relationships or paths between independent and dependent latent constructs. Appropriate analyses conducted in the current study were guided by expert recommendations (Figure 6.3) and threshold guidelines (Table 6.8) next.

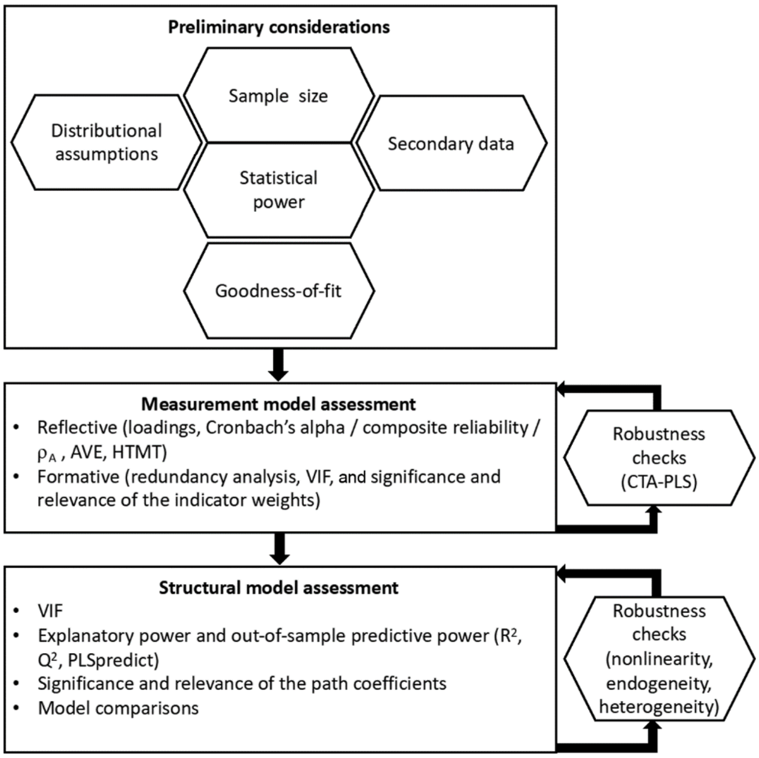


Figure 6.3 Tests to consider during SEM analysis (Adapted from Hair et al. 2018, p.4).

Table 6.8 Guidelines when using PLS-SEM (Adapted from Hair et al. 2018, p.15)

Reflective measurement models	
Indicator loadings	≥0.708
Internal consistency reliability	Cronbach's alpha is the lower bound, the composite reliability is the upper bound for internal consistency reliability. ρ_A usually lies between these bounds and may serve as a good representation of a construct's internal consistency reliability, assuming that the factor model is correct Minimum 0.70 (or 0.60 in exploratory research) Maximum of 0.95 to avoid indicator redundancy, which would compromise content validity Recommended 0.70-0.90 Test if the internal consistency reliability is significantly higher (lower) than the recommended minimum (maximum) thresholds. Use the percentile method to construct the bootstrap-based confidence interval; in case of a skewed bootstrap distribution, use the BCa method
Convergent validity	AVE ≥ 0.50

Discriminant validity	For conceptually similar constructs: HTMT < 0.90 For conceptually different constructs: HTMT < 0.85 Test if the HTMT is significantly lower than the threshold value
Formative measurement models	
Convergent validity	≥0.70 correlation
Collinearity (VIF)	Probable (i.e. critical) collinearity issues when VIF ≥ 5 Possible collinearity issues when VIF ≥ 3-5 Ideally show that VIF < 3
Statistical significance of weights	p-value < 0.05 or the 95% confidence interval (based on the percentile method or, in case of a skewed bootstrap distribution, the BCa method) does not include zero
Relevance of indicators *with a significant weight*	Larger significant weights are more relevant (contribute more)
with a non-significant weight	Loadings of ≥0.50 that are statistically significant are considered relevant
Structural model	
Collinearity (VIF)	Probable (i.e. critical) collinearity issues when VIF ≥ 5 Possible collinearity issues when VIF ≥ 3-5 Ideally show that VIF < 3
R2 value	R2 values of 0.75, 0.50 and 0.25 are considered substantial, moderate and weak. R2 values of 0.90 and higher are typical indicative of overfit
Q2 value	Values larger than zero are meaningful Values higher than 0, 0.25 and 0.50 depict small, medium and large predictive accuracy of the PLS path model
PLSpredict	Set k = 10, assuming each subgroup meets the minimum required sample size Use ten repetitions, assuming the sample size is large enough Qpredict2 values > 0 indicate that the model outperforms the most naïve benchmark (i.e. the indicator means from the analysis sample) Compare the MAE (or the RMSE) value with the LM value of each indicator. Check if the PLS-SEM analysis (compared to the LM) yields higher prediction errors in terms of RMSE (or MAE) for all (no predictive power), the majority (low predictive power), the minority or the same number (medium predictive power) or none of the indicators (high predictive power)
Model comparisons	Select the model that minimizes the value in BIC or GM compared to the other models in the set
Robustness checks	
Measurement models	CTA-PLS
Structural model	Nonlinear effects Endogeneity Unobserved heterogeneity

6.11.2 PLS-SEM measurement model analysis

While initial data analyses were based on the survey instrument and used SPSS as reported above, subsequent study employed Smartpls-SEM for the reasons reported in section 6.11.1, and focussed on the hypothesised relationship models, antecedent Model A and competence Model C. According to PLS-SEM, these models each comprise a measurement model (incorporating reflective and formative (composite) constructs) and a structural model (representing the hypothesised relationships). Measurement model analysis preceded structural model analysis, and both are reported next. Consequently, measurement model analysis incorporated appropriate tests for reflective and formative constructs (Table 6.8 & Figure 6.3). Tests that have not been presented earlier are briefly reported next as fuller details are readily available in several methods books and journal articles.

6.11.2.1 ***Outer item cross-loadings***

Outer item cross-loadings were compared. All item loadings should be larger on the construct being measured compared with the cross-loadings to other constructs (Hair et al., 2017). This indicates discriminant validity between constructs (Sarstedt et al., 2014b).

6.11.2.2 ***Fornell-Larker Criterion***

The Fornell-Larker Criterion is considered a more rigorous discriminant validity test. Its guideline states that a construct should not exhibit shared variance with any other construct that is greater than its AVE value. This measure can only be derived during structural model analysis but is reported in hypothesised model findings in the next chapter.

6.11.2.3 ***Heterotrait-Monotrait (HTMT) ratio***

Lately, the validity of the Fornell-Larker criterion and the cross-loadings measures in determining discriminant validity have been questioned (Hair et al., 2017; Henseler, Ringle & Sarstedt, 2015b). An alternative measure, the heterotrait-monotrait criterion, (HTMT), compares correlations between indicators and their latent constructs and compares the indicator correlations with all other constructs. A value close to 1 suggests a problem of discriminant validity issues. Values less than 0.85 are preferred while values less than 0.9 may be considered where constructs are conceptually very similar (Hair et al., 2017). There were no HTMT issues found in the current study.

6.11.2.4 ***Value inflation factor (VIF)***

Value inflation factor (VIF) is a measure of collinearity (high correlation) used to assess formative indicators in measurement models and constructs to determine convergent validity issues. Following best practice and as advised by Hair et al.

(2017), values for VIF above 5 suggest collinearity. Collinearity was not an issue in this study as all inner model and relevant outer model VIF values were less than 1.5 (Table 7.10 & Table 7.11 in Chapter 7).

*6.11.2.5 **Indicator weights (w)***

Indicator weights (*w*) are delivered by PLS-SEM as well as indicator loadings (*l*). The weights were important in assessing the formative measures used in this study comprising PM-rad and PM-inc. The statistical significance of the item weights in combination with item loadings led to the decision to retain all indicators (Hair et al., 2017).

6.11.3 PLS-SEM structural model analysis

The structural model is the term allocated to the hypothesised relationships between model constructs that can be represented graphically as lines or paths connecting the constructs. Structural model analysis examines these path relationships. The appropriate tests are explained next. The numerical findings derived from the actual analyses of the current survey data are presented next in Chapter 7.

*6.11.3.1 **Path coefficient (ß)***

The strength and direction of the proposed paths are presented in chapter 7 after using SmartPLS-SEM. Its algorithm (set at 300) converged in fewer than 20 cycles and returned *ß* values as presented in chapter 7. Using the PLS-SEM Bootstrap procedure that draws a large number of subsamples (i.e. 5,000) iteratively and randomly from the original sample with replacement (to approximate normality), significance values (*T*-statistics and *p*-statistics) were generated for all paths in the entire model and reported in Chapter 7.

*6.11.3.2 **Coefficient of determination (R^2 value)***

This measure represents the combined effects of exogenous latent variables on the endogenous variables to which they are linked. As such, R^2 measures the contributory effect of certain constructs on the construct into which they feed. It is therefore a measure of a model's explanatory power and represents a measure of in-sample predictive power (Sarstedt et al., 2014a; Rigdon, 2012). R^2 ranges from 0 to 1, with higher values indicating a greater explanatory power (Hair, Sarstedt & Ringle, 2019). R^2 values of 0.75, 0.50 and 0.25 are considered substantial, moderate and weak (Hair, Ringle & Sarstedt, 2011; Henseler & Chin, 2010) although acceptable values are based on the context. In some disciplines an R^2 value as low as 0.10 is considered satisfactory. R^2 findings are reported in Chapter 7.

*6.11.3.3 **Effect size (f^2)***

The effect size assesses the magnitude or strength of the relationship between latent variables. Effect size of 0.02, 0.15, and 0.35 indicates small, medium, and large effect sizes respectively (Gefen et al., 2011; Cohen, 1988).

*6.11.3.4 **Robustness tests***

To account for possible influence from extraneous factors, controls were included in the models to enable quantification of their influence and add robustness to the study. Control constructs *Environmental dynamism* (Dyn) and team size (number of individuals) were added to each model to assess any changes due to their presence. The controls were found not to substantially affect the results of the hypotheses examined.

*6.11.3.5 **PLS-Predict***

As PLS models lack an index for goodness of fit statistics, Tenenhaus, Vinzi, Chatelin & Lauro (2005) argue that besides the reliability and validity of constructs, the significance of variance explained and positive Q2s for all but one of the constructs provide sufficient evidence of model fit. The results in Appendix B, Table 5 suggest that the current model has predictive relevance (Ylinen & Gullkvist, 2014).

6.12 Chapter summary

This chapter has presented the methods and statistical analysis procedures conducted as part of Phase II methodology. SPSS and PLS-SEM statistical tools were used. The chapter described sample selection methods, and detailed survey development and distribution. It provided a description of the research themes, variable selection, and operationalisation of constructs. Using SPSS, the reliability and validity of the survey tool were established. An introduction to PLS-SEM was made. This technique was used to analyse the hypothesised models. The findings from this analysis are presented next in Chapter 7.

Chapter:7 Phase II Findings

Evaluating hypotheses

7.1 Introduction

This chapter presents the findings from this study's quantitative research phase two. The chapter opens with a reiteration of the research question and research objectives. It proceeds with respondent sample descriptive statistics (response rate, team characteristics etc). Next, findings based on the hypothesised relationships are presented in the form of antecedent model and consequence model for competence ambidexterity. First, an original **a**ntecedent Model **A**1 that represents the initially hypothesised antecedent model derived from phase one findings and the literature, is followed by an alternative, better fitting **a**ntecedent Model **A**2 that emerges during the analysis of phase two survey results. Then, a **c**onsequence model for competence ambidexterity, consequence Model **C**, is presented. Guided by the literature on structural equation modelling (SEM), and the detailed explanation in the previous chapter, each model is assessed in two stages; the first stage analyses the measurement model components (constructs and their variables) and the second stage probes the structural model (relationships between constructs). The chapter concludes with a summary of findings associated with each of the hypothesised relationships.

7.2 Research question and research objectives

The overarching research question asks: '*What role do performance measurement systems (PMSs) and related organisational factors (tensions, debate, conflict, functional diversity) play during NPPS in the achievement and outcome of an ambidextrous portfolio?'*

As in previous chapters, the research objectives addressed in the current chapter are reiterated next.

Research objective 1. Analyse NPPS in high technology industry (HTI) to identify key stakeholders and explore organisational constructs relevant to ambidexterity.

Research objective 2. Test hypothesised relationships to derive a model of specific organisational antecedents of competence ambidexterity in NPPS.

Research objective 3. Test hypothesised relationships to derive a model of specific consequences of competence ambidexterity in NPPS.

7.3 Sample size

Authors argue over how many respondents are adequate for specific tests. Using SmartPLS-SEM, the 10:1 ratio rule proposed by Nunnally (1978) was followed. This rule says that ten times the maximum number of arrows (paths) pointing at any single construct (which is 7 times 10, see below) denotes the minimum sample required. With 77 respondents, this study exceeds the minimum sample size threshold.

7.4 Response rate

A total of 115 responses were returned. When incomplete questionnaires were removed a final usable sample of 77 was yielded. Since 490 survey invitations were dispatched. This represents a response rate of 15.7%. This response rate is in accordance with the average response rate in the broader social sciences field at '35.7% percent with a standard deviation of 18.8' as quoted by Baruch & Holtom (2008 p.1139), who analysed more than 1600 studies published between 2000 and 2005, and similar to that in accounting research literature (Bedford et al., 2019). It is also in line with recent research that reports response rates below 10% as not uncommon and especially in more recent years where survey 'fatigue' has increased due to the increasing demands on the time of senior managers in particular (Van Mol, 2017; Van Der Stede, Young & Chen, 2005). Also, the targeted sample is very specific, historically secretive and difficult to engage, which likely impacted the response rate.

7.5 Respondent characteristics

Responses are split between Medical Device (60%), and Information Technology (36%) companies (Table 7.1). While the majority of respondent companies (48%) are large (>250), significant numbers (33%) represent medium (51-249) and small (40-50 employees) companies (20%). This means that all company sizes are well represented in this study and all 77 respondents are from high technology companies that face constantly changing and increasingly more technologically advanced markets where ambidexterity is lauded to be particularly relevant (Birkinshaw et al., 2016; Gurtner & Reinhardt, 2016; Wang & Rafiq, 2014; Birkinshaw & Gupta, 2013; Junni et al., 2013; Lin et al., 2013; Jansen et al., 2012; Andriopoulos & Lewis, 2009).

Respondents are highly experienced in industry and in their respective roles; 90% have more than 10 years' professional experience, 55% have worked more than 4 years in their current role; 76 of 77 respondents are over 30 years of age, 88% are male. With these levels of experience, the respondents have likely accrued valuable skills, knowledge and insights from which they can draw in responding to this survey. Further, the majority of respondents work in the specialty of R&D (53%) or Marketing /Commercial (27%). As such, the respondent sample is highly experienced and knowledgeable in innovation management and in their markets.

Table 7.1 Descriptive statistics of respondent population

Construct	Description	% (No.)	Construct	Description	% (No.)
Total	Respondents	100 (77)	***Professional***	1-10	9 (7)
Industry	MDI	60 (46)	***Experience***	11-20	14 (11)
	IT	36 (28)	***(years)***	21-30	53 (41)
	Other	4 (3)		31+	23 (18)
Co. Size	Small (40-50)	20 (15)	***Age***	20-29	1 (1)
	Medium (51-249)	32 (25)	***(years)***	30-39	13 (10)
	Large (>250)	48 (37)		40-49	53 (40)
Professional Role	R&D	53 (41)		50+	33 (25)
	Business	27 (21)	***Role Tenure***	1-3	45 (35)
	Other Role	20 (15)	***(years)***	4-6	14 (11)
Gender	Male	88 (68)		7-9	16 (12)
	Female	12 (9)		10-12	12 (9)
				13+	13 (10)

Table 7.2 Companies surveyed, number, industry & source of their details

Industry	**Numbers**	**Sources of company details**
Medical Devices	46	FAME Financial Analysis Made Easy
Information Technology	28	IMDA (Irish Medical Devices Association) Membership List
Other	3	IT Firms in Ireland List
Total	77	Irish Times Top 1,000 Companies
		Kompass List of Senior Company Managers Names (subscription required)
		LinkedIn & Google searches

7.6 Product portfolio selection (PPS) teams

Most (82%) new product portfolio selection (PPS) teams comprise between 4 and 12 team members. Over half of respondent companies (52%) reported a team size of between 4 and 9 members whilst (32%) of all teams comprised between 4 and 6 members. Meetings were scheduled quarterly in 25% of cases, monthly in almost 25% and more frequently in the remainder (Table 7.3). Therefore, these groups are multi-functional which makes them suitable for examining conflict and decision-making in a complex environment. Meetings were scheduled quarterly in 25% of cases, monthly in almost 25% and more frequently in the remainder. Further, the meetings lasted between 30 mins and 3 hours in 75% of cases indicating that substantial time is devoted to these meetings where important decisions are made (Table 7.3).

Table 7.3 Descriptive statistics for product portfolio selection teams

	Description	Percent (No.)	Company size (%) Small (30-49)	Medium (51-249)	Large (>251)
Team size	4-6	32 (25)	12	13	8
	7-9	20 (15)	4	6	9
	10-12	30 (23)	1	9	19
	13-15	10 (8)	1	3	6
	>16	8 (6)	1	1	5
Median = 7-9	**IQR:** (4-6; 10-12)				
Frequency of scheduled team meetings	Never	9 (7)	3	3	4
	Quarterly	25 (19)	4	5	16
	Monthly	23 (18)	4	10	9
	2-4 a month	10 (8)	4	3	4
	Weekly	19 (15)	4	6	9
	2-4 per week	9 (7)	1	3	5
	Daily	4 (3)	0	3	1
Median = Monthly	**IQR:** (Quarterly; Weekly)				
Duration of scheduled team meetings	<30 min	10 (8)	0	3	8
	30-60 min	34 (26)	6	16	12
	1-3 hours	40 (31)	9	10	21
	3-5 hours	6 (5)	3	1	3
	6-8 hours	9 (7)	1	3	5
Median = 1-3 hours	**IQR:** (30-60min;1-3 hours)				

Key: IRQ = interquartile range (25%;75%). Median = the point above and below which 50% lie.

Product portfolio selection teams are found to be cross-functional in composition (Table 7.4). Thus, the portfolio selection team represents a diverse group in terms of specialist roles. This renders the sample ideal for an examination of the management of contradictory tensions, decision-making and conflict, in the paradoxical setting of project portfolio selection that aims for ambidexterity. Most teams (>80%) had a minimum of 3 senior management roles represented on their product portfolio selection team, namely R&D (91%), Marketing/Sales (84%), and a CEO (82%). The Operations role was present in 75% of cases. Up to 60% of teams included Finance, Quality/Regulation and a Program Manager. Indeed, the information gleaned from phase one interviews supported these findings where it was disclosed that the top 3 management roles in product portfolio selection (PPS) are Research & Development (R&D), Commercial (i.e. Marketing and Sales) and a Senior Manager such as the Chief Executive Officer.

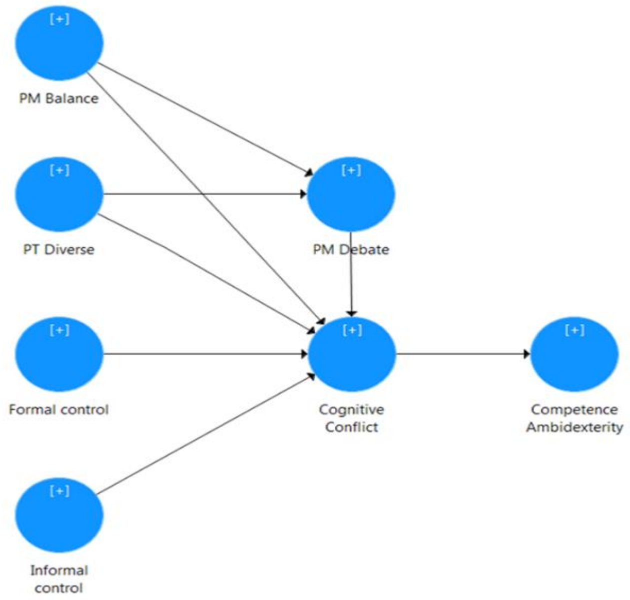
Table 7.4 Functional roles represented on project portfolio selection teams

	Percent	
Functional Role	**Yes**	**No**
Research & Development	91	9
Marketing or Sales	84	16
Finance	64	36
Operations	75	25
Quality / Regulation	60	38
Clinical	38	62
Program Manager	60	40
BU General Manager/CEO	82	18

Key: BU = Business Unit; CEO = Chief Executive Officer.

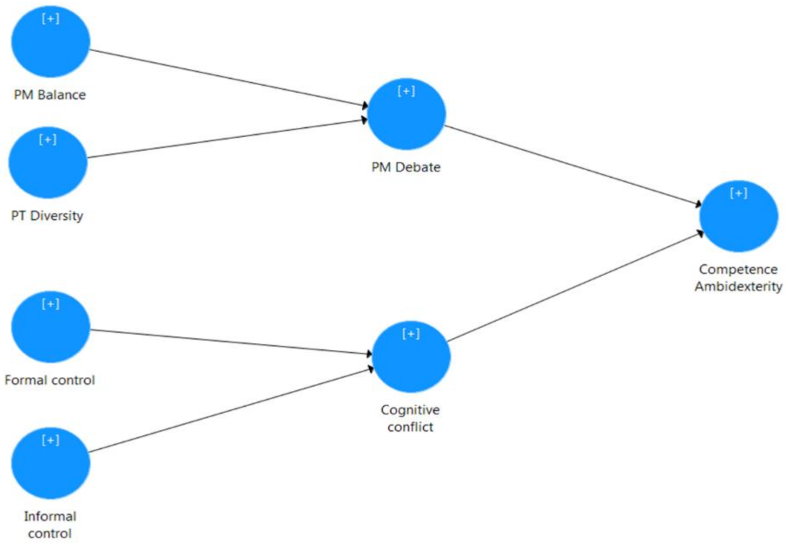
7.7 Findings related to antecedent models; Model A_1 & Model A_2

The original antecedent model (Figure 5.1, Figure 7.1), Model A_1 including its 6 hypothesised relationships listed below, is generated following an analysis of the literature (Ylinen & Gullkvist, 2014; Chin et al., 2008) and feedback from the semi-structured interviews with experts in innovation and product development (Chapter:5). This model represents specific organisational factors and their hypothesised antecedent relationships with competence ambidexterity. Guided by findings that follow an extensive survey data analysis, an improved antecedent model, Model A_2 (Figure 7.2) is generated. This alternative antecedent model is presented *after* the relevant data from the original antecedent Model A_1 has been presented to explain the evolution of the alternative antecedent Model A_2. Taking a preliminary comparison of both models below, it is clear that in the transition from the original antecedent model to the alternative antecedent model, two negligible paths are dropped, and one path is redirected; the full explanation and details for these changes follow.



Key: PM = performance measures, PT = portfolio team.

Figure 7.1 Originally hypothesised antecedent Model A1.



Key: PM = performance measures, PT = portfolio team.

Figure 7.2 Improved, alternative antecedent Model A2.

7.7.1 From the originally hypothesised antecedent model, Model A1 to the improved antecedent model, Model A2

Findings are first presented based on the originally hypothesised competence ambidexterity antecedent Model A1 as shown in Figure 5.1 in Chapter 5. This antecedent model is presented again below (Figure 7.1). Then, findings based on the improved or amended competence ambidexterity antecedent Model A_2 (Figure 7.2), developed during analysis of survey findings, are presented. Presenting both aims to help guide the reader from the original through to the improved antecedent Model A_2. In summary, after analysis of Model A_1, two negligible (i.e. the strength of the path is tiny) effect paths are dropped, and the path PM debate to cognitive conflict is redirected rendering an originally non-hypothesised path (i.e. PM debate to competence ambidexterity), which is added and this represents the improved antecedent Model A_2. This process of discovery is provided in great detail below. First, a summary list of the hypotheses associated with antecedent models and their outcome, based on the statistical analyses, is presented.

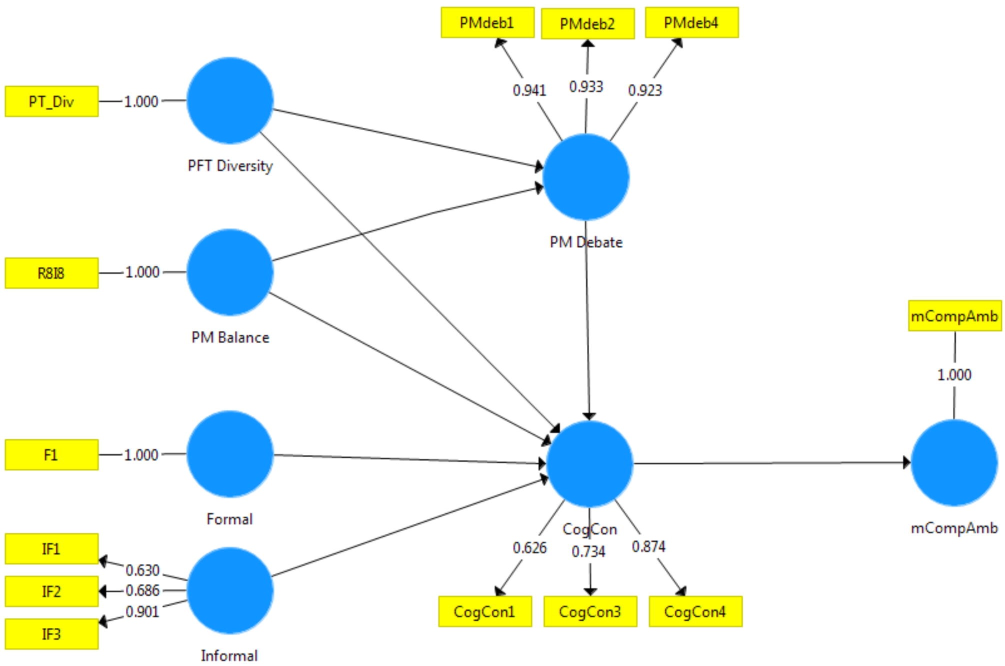
7.7.2 Summary list of hypotheses associated with antecedent models

- H1a+ PM-balance is positively and significantly associated with PM-debate.
    - *Supported*.
- H1b+ PM-balance is positively and significantly associated with cognitive conflict.
    - *Rejected and the path is of negligible size.* (This path is dropped in Model A_2).
- H2a+ PT-diversity is positively and significantly associated with PM-debate.
    - *Supported*.
- H2b+ PT-diversity is positively and significantly associated with cognitive conflict.
    - *Rejected and the path is of negligible size.* (This path is dropped in Model A_2).
- H3+ PM-debate is positively and significantly associated with cognitive conflict.
    - *Rejected as weak and not significant.* (It is later replaced by alternative hypothesis 3).
- H3+(**alternative** redirected path) PM-debate is positively and significantly associated with competence ambidexterity. (This path is added in Model A_2).
    - *Supported*.
- H4+ Cognitive conflict is positively and significantly associated with competence ambidexterity.
    - *Rejected because a significant negative relationship is found.*
- H5+ Formal meetings are positively and significantly associated with cognitive conflict.
    - *Rejected because a negative relationship is found*.
- H6- Informal meetings are negatively and significantly associated with cognitive conflict.
    - *Rejected because a positive relationship is found*.

Detailed statistical results related to these hypotheses and associated models follow.

7.8 The originally hypothesised antecedent Model A1

The figure below shows the organisational factors (constructs represented by blue circles) and their hypothesised antecedent relationships with competence ambidexterity. These hypothesised paths form what is referred to as the 'structural model' in structural equation modelling. What is referred to as the 'measurement model' shows the relationships between constructs and the variables (yellow rectangles) employed to measure the constructs. The figure below (Figure 7.3) represents the originally hypothesised antecedent Model A1 on which the first set of statistical analyses are performed.



Key to figure: CogCon = cognitive conflict; PM performance measures; PT = portfolio team; CompAmb = competence ambidexterity. Constructs represented by blue circles; Indicators as yellow rectangles. Numbers represent reflective variable indicator loadings.

Figure 7.3 Measurement model of original hypothesised antecedent model, Model A1, and its indicator loadings.

7.8.1 Measurement model assessment, Model A1

Models were estimated using the SmartPLS structural equation modelling (PLS-SEM) technique as explained in the methods chapter. In accordance, the models were assessed in two stages (Hair et al., 2017; Hulland, 1999). The first measurement model stage, calculated by running the PLS-algorithm, assesses the reliability and validity statistics associated with model constructs and the variables used to measure them. PLS-SEM usually causes small, non-significant changes to model results for each iteration, but when structural models (model paths) are altered in any way these changes become more significant (Hair et al., 2017). So, while tests on all endogenous and exogenous constructs were presented in the last chapter, some must be presented again hereunder when examining specific models by PLS-SEM.

First, findings revealed that loadings on 4 indicators previously accepted, were weak (PM-deb_3, CogCon_2, F2, and F3), (Table 7.5). Indicator reliability scores (squared loadings) fell outside the acceptable range. However, in some cases scores near the lower boundary of 0.4 are acceptable, especially when constructs are early in their development (Hulland, 1999) as is the case for Informal Meetings. Consequently, 3 of the 4 variables were removed from the model. Removal of any of the reflective variable items is not expected to have a major impact on the measurement score (Jarvis et al., 2003; Diamantopoulos & Winklhofer, 2001; Fornell & Bookstein, 1982). Acceptable loadings were returned after their removal (Figure 7.3 & Table 7.6).

Table 7.5 PLS findings on 4 model constructs (antecedent Model A_1)

Construct label	**Indicator label**	**Indicator loading >0.7**	**Squared loading 0.4 - 0.7**	**Indicator weight**
CogCon	**CogCon_1**	0.681	0.464	0.248
	CogCon_2	**0.505**	**0.255**	**0.129**
	CogCon_3	0.786	0.618	0.5
	CogCon_4	0.794	0.630	0.47
PM-deb	**PM-deb_1**	0.935	0.874	0.365
	PM-deb_2	0.937	0.878	0.299
	PM-deb_3	**0.358**	**0.128**	**0.056**
	PM-deb_4	0.922	0.850	0.39
Formal Meetings	**F1**	0.998	0.996	1.022
	F2	**0.435**	**0.189**	**0.041**
	F3	**0.552**	**0.305**	**-0.07**
Informal Meetings	**IF1**	0.69	**0.476**	0.382
	IF2	0.763	0.582	0.248
	IF3	0.848	0.719	0.644

Key to table: CogCon = cognitive conflict; PM-deb = debate based on performance measures.

Table 7.6 presents reliability (Cronbach's alpha, Composite Reliability, and average variance extracted (AVE)) statistics associated with the original antecedent Model A_1. Convergent reliability was indicted by Cronbach's alpha and Composite Reliability (CR) scores greater than 0.7 (Nunnally & Bernstein, 1994) and by AVE measures greater than 0.5 (Hulland, 1999; Chin, 1998) which indicate that more variance is associated with indicator changes than due to error.

Table 7.6 Measurement model descriptive and reliability findings; antecedent Model A1

Indicators	loadings (>0.7)	loadings² (>0.4)	Indicator weights	Mean	Stnd Dev	Min.	Max.	Theoretical range	Cronbach's α (>0.7)	Composite R (>0.7)	AVE (>0.5)
CogCon1	0.63	0.40	0.24	3.53	0.82	1.00	5.00	1 to 5	0.64	0.79	0.56
CogCon3	0.73	0.53	0.41	3.38	1.01	1.00	5.00				
CogCon4	0.87	0.76	0.63	2.62	0.93	1.00	5.00				
F1	1	1	1	3.49	1.64	1.00	7.00	1 to 7	-	-	-
IF1	0.63	0.40	0.36	4.01	2.07	1.00	7.00	1 to 7	0.69	0.79	0.56
IF2	0.69	0.48	0.13	3.6	2.09	1.00	7.00				
IF3	0.9	0.81	0.75	2.08	1.76	1.00	7.00				
PMdeb1	0.94	0.88	0.38	5.01	1.36	1.00	7.00	1 to 7	0.93	0.95	0.87
PMdeb2	0.93	0.86	0.3	4.84	1.41	1.00	7.00				
PMdeb4	0.92	0.85	0.39	4.77	1.36	1.00	7.00				
PT_Div	1	1	1	5.56	1.57	2.00	8.00	1 to 8	-	-	-
R8I8	1	1	1	4.29	0.54	2.38	5.00	1 to 5	1	1	1
mCompAm	1	1	1	183.35	66.45	15.84	340.48	36 to 8,820	-	-	-

Key: Loadings of indictors on latent constructs, 0.7 or above indicates good indicator reliability. Squared loadings over 0.4 reflect acceptable reliability. Cronbach's alpha (α) and Composite R **(**reliability), 0.7 or above on both indicates good convergent reliability. AVE: average variance extracted, 0.5 or above indicates good convergent reliability.

Discriminant validity was supported with results of three tests; the Fornell-Larker assessment (Table 7.7) compared the AVE of each construct (emboldened and on the diagonal) with the variance shared between each construct and other model constructs. Diagonal values were all greater than the off-diagonal loadings in corresponding rows and columns, supporting construct discriminant validity; the Cross-loadings matrix (Table 7.8) reports discriminant validity tested at the item level. All items demonstrated higher loadings on their associated construct (emboldened) than were the cross-loadings onto a different construct's items; and HTMT values (Table 7.9) were well below the critical cut-off value of 0.85 (Hair et al., 2017) further in support of discriminant validity. This concludes measurement model analysis of the antecedent Model A1.

Table 7.7 Fornell-Larker Criterion correlation matrix for discriminant validity; antecedent Model A1

Construct	CogCon	Formal	Informal	PM Balance	PM Debate	PT Diversity	mCompAmb
CogCon	**0.75**						
Formal	-0.07	**1**					
Informal	0.18	0.49	**0.75**				
PM Balance	-0.06	0.13	0.24	**1**			
PM Debate	-0.17	0.22	0.14	0.36	**0.93**		
PT Diversity	0.02	0.15	0.1	0.16	0.41	**1**	
mCompAmb	-0.21	0.19	-0.06	0.03	0.38	0.25	**1**

Key: Numbers on the diagonal (emboldened) report the square-root of the average variance extracted for reflective constructs. Off-diagonal elements represent correlations between constructs.

Table 7.8 Cross-loadings analysis; antecedent Model A1

Construct	CogCon	Formal	Informal	PM Balance	PM Debate	PT Diversity	mCompAmb
Indicator							
CogCon1	**0.63**	-0.03	0.11	0.03	-0.04	0.03	-0.04
CogCon3	**0.73**	-0.1	0.05	-0.1	-0.2	0.04	-0.08
CogCon4	**0.87**	-0.04	0.22	-0.04	-0.12	-0.01	-0.26
F1	-0.07	**1**	0.49	0.13	0.22	0.15	0.19
IF1	0.09	0.49	**0.63**	0.16	0.06	0.08	0.18
IF2	0.03	0.41	**0.69**	0.16	0.07	0.17	0.04
IF3	0.19	0.34	**0.9**	0.22	0.14	0.07	-0.18
PMdeb1	-0.11	0.19	0.17	0.35	**0.94**	0.43	0.33
PMdeb2	-0.14	0.14	0.09	0.24	**0.93**	0.34	0.36
PMdeb4	-0.21	0.27	0.12	0.41	**0.92**	0.36	0.36
PT_Div	0.02	0.15	0.1	0.16	0.41	**1**	0.25
R8I8	-0.06	0.13	0.24	**1**	0.36	0.16	0.03
mCompAmb	-0.21	0.19	-0.06	0.03	0.38	0.25	**1**

Key: Emboldened values represent highest factor item loadings. All are greater than loadings with any other factor items providing support for construct discriminant validity (Hair et al. 2017).

Table 7.9 Results of Heterotrait Monotrait (HTMT) test; antecedent Model A1

Construct	CogCon	Formal	Informal	PM Balance	PM Debate	PT Diversity	mCompAmb
CogCon							
Formal	0.09						
Informal	0.23	0.63					
PM Balance	0.09	0.13	0.27				
PM Debate	0.2	0.23	0.14	0.37			
PT Diversity	0.04	0.15	0.16	0.16	0.42		
mCompAmb	0.21	0.19	0.2	0.03	0.39	0.25	

Key: CogCon=cognitive conflict; PFT=portfolio team; PM=performance measures; CompAmb=competence ambidexterity using multiplicative approach (m). All values are well below the critical cut-off value of 0.85 (Hair et al. 2017; Henseler 2015).

7.8.2 Structural model assessment, antecedent Model A1

In summary, the originally hypothesised antecedent model's structural or inner paths are tested to examine the hypothesized relationships between its constructs (Figure 7.4). Guided by best practice (Hair et al., 2017), analysis begins with tests to ensure multi-collinearity is not present (value inflation factor (VIF) analysis; Table 7.10 & Table 7.11). Analysis proceeds with assessment of the coefficients of determination (R^2) and effect sizes (f^2) to measure model significance (Table 7.12). Investigation of path coefficients (*ß*) (Table 7.13, Appendix B, Table 2 & Appendix B, Table 3) and model fit statistics (Appendix B, Table 4 & Appendix B, Table 5) complete the analysis of antecedent Model A1 and leads to 3 negligible, non-significant paths being eliminated and 1 previously non-hypothesised path being added to derive an alternative antecedent Model A2. Findings of this process are presented next.

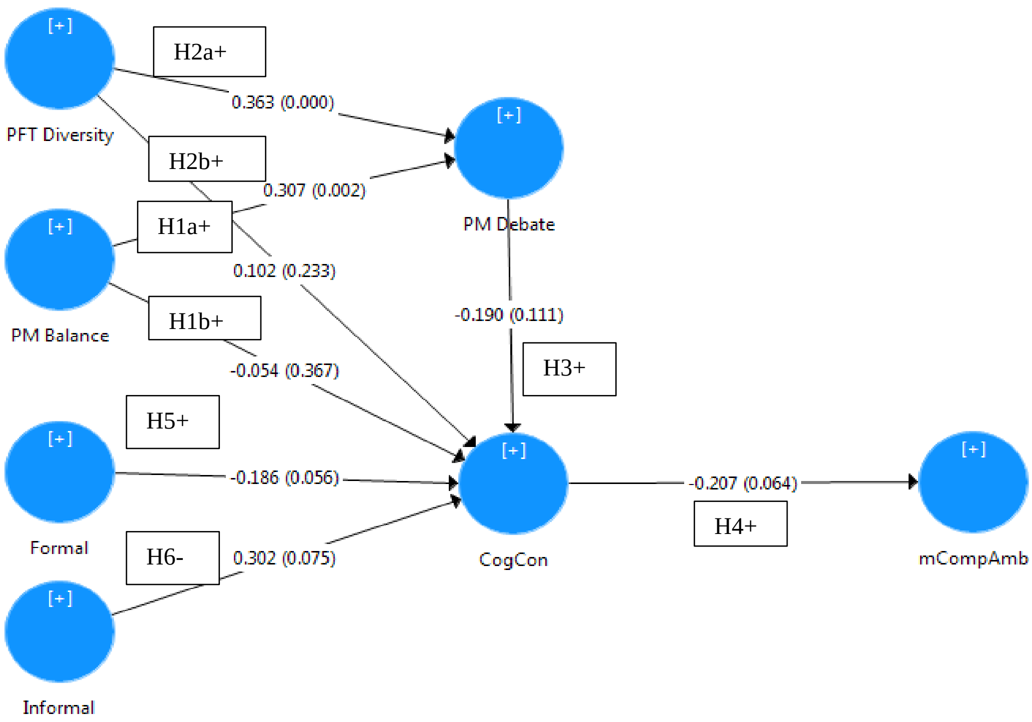


Figure 7.4 Structural model of the original hypothesised antecedent Model A1.

Key: Blue circles represent consructs. Numbers on the line represent path co-efficient (β). Numbers in brackets give the significance score (ρ). PFT = Project portfolio team. PM = Performance measure. CogCon = cognitive conflict. mCompAmb=competence ambidexterity, multiplicative approach. * ρ<0.10, ** ρ<0.05, *** ρ<0.01 (One-tailed bootstrap for hypothesised associations).

7.8.2.1 *Smartpls-SEM quality findings relevant to original Model A1*

Value inflation factor (VIF) analysis confirms that collinearity is not an issue for this model (Table 7.10 & Table 7.11), as all values are less than 1.5 and VIF should be 5 or less (Hair et al., 2018).

Table 7.10 Collinearity statistics (value inflation factor) for antecedent Model A1

Indicator	Outer VIF
CogCon1	1.25
CogCon3	1.24
CogCon4	1.27
F1	1
IF1	1.57
IF2	1.83
IF3	1.24
PMdeb1	4.16
PMdeb2	4.33
PMdeb4	2.9
PT_Div	1
R8I8	1
mCompAm	1

Key: Indicator numbers represent individual indicators. CogCon=cognitive conflict; F=formal meetings; IF=informal meetings; PM-deb=debate based upon performance measures; PT-Div=portfolio team diversity; R8I8=a balanced performance measurement system; PM=performance measures; CompAmb=competence ambidexterity using the multiplicative approach (m).

Table 7.11 Collinearity statistics (inner VIF) associated with antecedent Model A1

Construct	**Inner VIF**						
	CogCon	**Formal**	**Informal**	**PFT Divers**	**PM Balanc**	**PM Debate**	**mCompAml**
CogCon							1
Formal	1.36						
Informal	1.37						
PT Diversit	1.21					1.02	
PM Balanc	1.21					1.02	
PM Debate	1.39						
mCompAmb							

Key: Indicator numbers represent individual indicators. CogCon=cognitive conflict; F=formal meetings; IF=informal meetings; PM-deb=debate based upon performance measures; PT-div=portfolio team diversity; R8I8=a balanced performance measurement system; PM=performance measures; CompAmb=competence ambidexterity using the multiplicative approach (m).

R^2 and f^2 statistics help measure the explanatory quality of a model. R^2 is an indicator of whether an individual factor has explanatory power or not. F^2 is an indicator of whether or not the whole model has explanatory power. The coefficient of determination (R^2) represents the contribution of preceding construct(s) toward a particular construct and findings are presented in the first column of Table 7.12. R^2 values of 0.25, 0.50 and 0.75 are considered weak, moderate and substantial (Hair et al., 2017; Henseler & Chin, 2010). Acceptable values are based on the context and in some disciplines an R^2 value as low as 0.10 is considered satisfactory (Hair et al., 2019). More importantly, the 'R^2 is a function of the number of predictor constructs, the greater the number of predictor constructs, the higher the R^2. Therefore, the R^2 should always be interpreted in relation to the context of the study, based on the R^2 values from related studies and models of similar complexity' (Hair et al., 2017, p. 11). In the current study, the highest R^2 value returned is for PM-debate at a value of 0.26, suggesting that its predictor constructs, namely a balanced set of measures (PM-bal) and a diverse portfolio selection team (PT-div), explain 26% of the construct PM-debate in Model A1. An R^2 = 0.11 for cognitive conflict and R^2 = 0.04 for competence ambidexterity suggest that this model accounts for 11% and 4% of the variance in these constructs, respectively.

Table 7.12 Coefficient of determination (R^2) and effect size (f^2) statistics; Model A1

	R Square	**f square**						
Construct		**CogCon**	**Formal**	**Informal**	**PT Diversit**	**PM Balanc**	**PM Debate**	**mCompAml**
CogCon	0.11							0.04
Formal		0.03						
Informal		0.07						
PT Diversity		0.01					0.17	
PM Balance		0					0.12	
PM Debate	0.26	0.03						
mCompAmb	0.04							

Key: CogCon=cognitive conflict; PT=portfolio team; PM=performance measures; mCompAmb=competence ambidexterity using multiplicative approach (m).

A model's effect size (f^2) demonstrates how much an exogenous latent variable contributes to an endogenous latent variable's R^2 value. Guidelines on assessing f^2 report that values of f^2 at 0.02, 0.15 and 0.35 represent weak, medium and large effects respectively (Cohen, 1988). Values smaller than 0.02 represent no effect. Chin et al. (2008) advise that it is remiss of researchers not to include f^2 outcomes when reporting model findings. Consequently, referring to Table 7.12 above, this study finds that 2 constructs, namely PM-balance and PT-diversity show a medium effect size on PM-debate. The 3 constructs, formal meetings, informal meetings and PM-debate show weak effect sizes on cognitive conflict (Table 7.12).

7.8.2.2 Structural path findings by hypothesis relevant to original antecedent Model A1

Results from assessment of the size and strength of path coefficients (*ß*) are reported in Table 7.13 based on the hypotheses listed earlier in section 7.7.2 and Figure 7.4. Bootstrapping (repeated random selection of subsamples from the total sample, with replacement) was performed with 5,000 subsamples to test the statistical significance of path coefficients. As per best practice, one-tailed significance tests (ρ<0.05) were run for hypotheses analyses. Findings are reported in sequence based on the hypothesised relationships, H1 to H6 inclusive, next.

Table 7.13 Hypotheses with associated structural path coefficients & significance statistics; antecedent Model A1

Original Hypothesis	**Model Paths**	**Original Sample**	**Sample Mean**	**Standard Deviation**	**T Statistics**	***P* Values**	**Bias**	**Confidence Interval 5.00%**	**95.00%**
H4+	CogCon -> mCompAmb	-0.21	-0.2	0.14	1.52	0.06	0.01	-0.39	0.06
H5+	Formal -> CogCon	-0.19	-0.16	0.12	1.59	0.06	0.03	-0.38	-0.01
H6-	Informal -> CogCon	0.3	0.27	0.21	1.44	0.07	-0.03	-0.33	0.46
H2b+	PT Diversity -> CogCon	0.1	0.09	0.14	0.73	0.23	-0.02	-0.12	0.34
H2a+	PT Diversity -> PM Debate	0.36	0.36	0.1	3.66	0	-0.01	0.19	0.52
H1b+	PM Balance -> CogCon	-0.05	-0.03	0.16	0.34	0.37	0.02	-0.29	0.22
H1a+	PM Balance -> PM Debate	0.31	0.3	0.11	2.83	0	-0.01	0.12	0.47
H3+	PM Debate -> CogCon	-0.19	-0.21	0.16	1.22	0.11	-0.02	-0.38	0.19

Key: H=Hypothesis. CogCon=cognitive conflict; mCompAmb=competence ambidexterity derived by the multiplicative (m) method. PT = portfolio team. PM=performance measures; **p*<0.10, ***p*<0.05, ****p*<0.01 (One-tailed bootstrap for hypothesised associations).

<u>*Hypothesis 1a*</u> predicts a positive and significant relationship between PM-balance and PM-debate. Table 7.13 shows that the structural path coefficient for this path is positive and highly significant ($ß$ = 0.31, $p < 0.01$) ***supporting H1a+.*** This finding suggests that debate centred on performance measures is encouraged when diverse measures with

competing demands comprise the package of performance measures driving portfolio new product selection.

Hypothesis1b predicts a positive and significant relationship between PM-balance and cognitive conflict. However, the structural path coefficient for this path is negligible, negative and non-significant ($ß$ = -0.05; $p > 0.3$). This finding suggests that a balanced package of performance measures of opposing demands does not by itself, promote cognitive conflict and so ***H1b+ is rejected***.

Hypothesis 2a predicts a positive and significant relationship between PT-diversity and PM-debate. *Support for H2a+ is shown* with a positive and significant path coefficient for this relationship ($ß$ = 0.36; $p < 0.01$). This result supports the expectation that an increasingly diverse portfolio team is associated with greater debate based on a balanced set of contradictory performance measures.

Hypothesis 2b predicts a positive and significant relationship between PT-diversity and Cognitive Conflict. While a positive association is found for this relationship, it is of negligible size and is non-significant ($ß$ (original sample) = 0.1; $ß$ (sample mean) = 0.09; $p > 0.2$), and so **H2b+ is rejected**.

Hypothesis 3 predicts a positive and significant association between PM-debate and cognitive conflict. Surprisingly, as Table 7.13 reveals, the path coefficient for this relationship is in a negative direction and is non-significant ($ß$ = -0.19; $p > 0.1$). This study shows that as debate based on a balanced package of performance measures increases, cognitive conflict decreases**. *H3a+ is therefore rejected (and an alternative H3 path is later proposed)*.**

Hypothesis 4 predicts that cognitive conflict is positively and significantly associated with competence ambidexterity. However, and contrary to the hypothesised relationship, the corresponding path coefficient for CogCon to CompAmb while marginally significant, is negative ($ß$ = -0.21; $p = 0.06$). It therefore seems that cognitive conflict has a negative influence on the achievement of competence ambidexterity. A test to see if cognitive conflict might have a role in supporting PM-debate to drive competence ambidexterity was performed, but the path coefficient from CogCon to PM-deb was negligible, negative and non-significant ($ß$ = -0.05; $p > 0.1$). ***H4+ is therefore rejected***.

Hypothesis 5 predicts a positive and significant relationship between formal meetings and cognitive conflict. However, and unexpectedly, the corresponding path coefficient while marginally significant, is found to be negative ($ß = -0.19$; $p = 0.06$). These findings imply that the more frequently scheduled group meetings are arranged to discuss product portfolio selection decisions, the less cognitive conflict that arises. Contrary to expectations, formal group meetings are associated with reduced levels of cognitive conflict. Therefore ***H5+ is rejected***.

Hypothesis 6 predicts a negative and significant association between informal meetings and cognitive conflict, based largely on interview findings. Data analysis shows that the path coefficient corresponding to this relationship, Informal to CogCon, is positive and marginally significant ($ß = 0.30$; $p < 0.1$). Surprisingly, rather than informal, one-to-one meetings leading to less cognitive conflict due to the potential influence of a dominant character, cognitive conflict increases in association with informal meetings. This insinuates that disagreements are openly and actively conducted during one-to-one informal meetings. *Therefore* ***H6a- is rejected***.

7.8.2.3 Final statistical tests on this antecedent model, Model A_1

On further analysis of Model A_1, all indirect paths associated with this model are found to be of negligible size (all *ß* values are between 0.01 and 0.07) and non-significant (all *p* values are >0.12 in Appendix B, Table 2). This implies that there are no mediating paths overlooked. An examination of the total effects model statistics (Appendix B, Table 3) supports these findings confirming that no other relationships are uncovered by this antecedent model, Model A_1. As a final test, model fit statistics are reported in Appendix B, Table 4 and Table 5. While close to the saturated antecedent model, the estimated antecedent Model 1 SRMR statistics are found to be 0.11 (SRMR preferred <0.08).

7.9 From the originally hypothesised antecedent Model A_1 to the alternative antecedent Model A_2

Since the path PM-debate to cognitive conflict (already reported above as H3+), is unexpectedly found to be small, negative and non-significant, an alternative relationship is hypothesised to examine if PM-debate might have a direct and significant role in driving competence ambidexterity as an alternative to operating through cognitive conflict. Thus an alternative hypothesis (AltH3+) proposes a positive and significant relationship exists between PM-debate and competence ambidexterity. Consequently, an advanced antecedent Model A_2 is derived (Figure 7.2, Figure 7.5) from the original antecedent Model A1 (Figure 7.1, Figure 7.4). The advanced, amended antecedent Model A2 adds the redirected path PM-debate to CompAmb. This corresponds to the alternative(Alt) hypothesis, H3+ by replacing the small and non-significant path PM-debate to cognitive conflict. It also removes the 2 formerly reported paths of negligible effect, namely PM-balance to cognitive conflict and PT-diversity to cognitive conflict. Model fit statistics for this alternative antecedent Model A2, are improved over the original antecedent Model A1. The detailed findings related to this alternative Model A2 are reported next. The report follows the same rigorous set of analyses that were performed on antecedent Model A1 and as advised by academic experts (Hair et al., 2017; Chin et al., 2008; Chin, Marcolin & Newsted, 2003).

Table 7.14 Model fit summary statistics for alternative antecedent Model A2

	Saturated Model	Estimated Model
SRMR	0.08	0.11
d_ULS	0.59	1.04
d_G	0.29	0.34
Chi-Square	138.53	156.02
NFI	0.66	0.62
	rms Theta	0.22

Key: See the key below Table 7.15, for fuller key relevant details. SRMR=Standardised Root Mean Square Residual, values <0.08 considered good fit (Hu and Bentler, 1999; Henseler et al. 2014).

Table 7.15 Model fit significance statistics for alternative antecedent Model A2

			Significance Interval	
SRMR	Original Sample	Sample Mean	95%	99%
Saturated Model	0.08	0.08	0.13	0.16
Estimated Model	0.09	0.09	0.13	0.16
d_ULS				
Saturated Model	0.58	0.57	1.44	2.31
Estimated Model	0.8	0.82	1.61	2.47
d_G				
Saturated Model	0.28	0.26	0.42	0.54
Estimated Model	0.31	0.29	0.45	0.59

Key: SRMR=Standardised Root Mean Square Residual, values <0.08 considered good fit (Henseler, Hubona & Ray, 2015a); d_ULS=the squared Euclidean distance; d_G=the Geodesic distance; NFI=Normed Fit Index, values 0.9 preferred (Lohmöller, 1989); Rms_theta=Root mean squared residual covariance matrix of the outer model residuals (Lohmöller, 1989), values<0.12 preferred (Henseler et al., 2015a).

*Note: Researchers should be very cautious to report and use model fit in PLS-SEM. The proposed criteria are in their early stage of research, are not fully understood … SmartPLS provides them but believes that there is much more research necessary to apply them appropriately (Hair et al., 2017).

*'Another popular prediction metric is the root mean squared error (RMSE), [also called SRMR] which is defined as the square root of the average of the squared differences between the predictions and the actual observations. As the RMSE squares the errors before averaging, the statistic assigns a greater weight to larger errors, which makes it particularly useful when large errors are undesirable – as is typically the case in business research applications' (Hair et al. 2019).

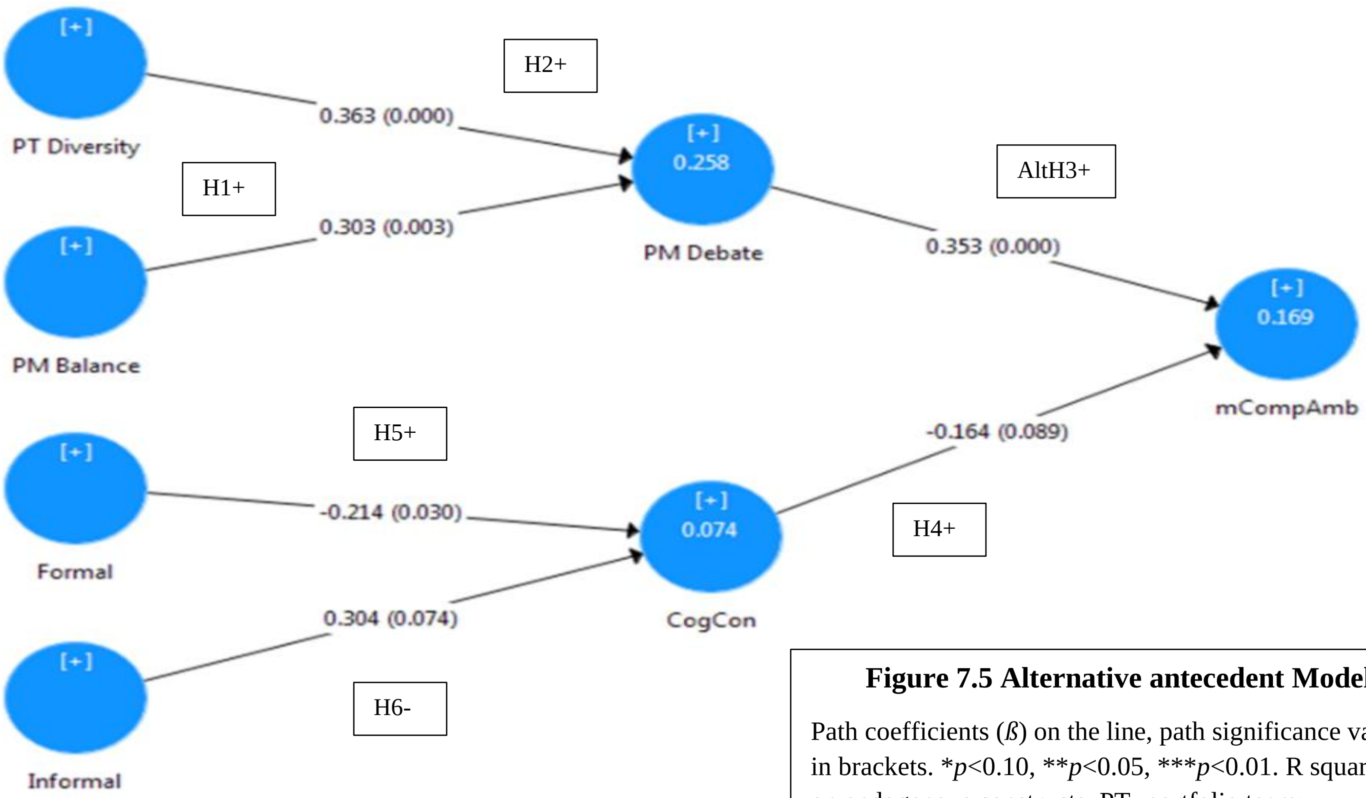


Figure 7.5 Alternative antecedent Model A2.

Path coefficients (ß) on the line, path significance values (*p*) in brackets. **p*<0.10, ***p*<0.05, ****p*<0.01. R square values on endogenous constructs. PT=portfolio team; PM=performance measures; CogCon=cognitive conflict; mCompAmb=competence ambidexterity derived by the most commonly used operationalisation multiplicative method (m).

7.9.1 Measurement model assessment; Alternative antecedent Model A2

As before, the first measurement model assessment stage assesses the reliability and validity statistics associated with the survey model constructs and the variables used to measure them. Table 7.16 to Table 7.19 inclusive demonstrate that the alternative antecedent Model A2 components meet all reliability, convergent validity (Cronbach's alpha, Composite Reliability, and average variance extracted (AVE)) and discriminant validity statistics (Fornell-Larker criterion, Cross-loadings, HTMT and Collinearity (VIF) tests) required (Hulland, 1999; Chin, 1998; Nunnally & Bernstein, 1994). Any differences between the original antecedent Model A1 and the alternative antecedent Model A2 are minor and insignificant as all the Tables confirm (Hair et al., 2019; Hair et al., 2017).

Table 7.16 Measurement model descriptive and reliability statistics, alternative antecedent Model A2

Indicators	loadings (>0.7)	loadings^2 (>0.4)	Indicator weights	Mean	Stnd Dev	Min.	Max.	Theoretical range	Cronbach's α (>0.7)	Composite R (>0.7)	AVE (>0.5)
CogCon1	0.64	0.41	0.27	3.53	0.82	1.00	5.00				
CogCon3	0.65	0.42	0.29	3.38	1.01	1.00	5.00	1 to 5	0.64	0.78	0.55
CogCon4	0.91	0.83	0.7	2.62	0.93	1.00	5.00				
F1	1	1	1	3.49	1.64	1.00	7.00	1 to 7	-	-	-
IF1	0.64	0.41	0.4	4.01	2.07	1.00	7.00				
IF2	0.67	0.45	0.1	3.6	2.09	1.00	7.00	1 to 7	0.69	0.79	0.56
IF3	0.9	0.81	0.76	2.08	1.76	1.00	7.00				
PMdeb1	0.94	0.88	0.37	5.01	1.36	1.00	7.00				
PMdeb2	0.94	0.88	0.32	4.84	1.41	1.00	7.00	1 to 7	0.93	0.95	0.87
PMdeb4	0.92	0.85	0.38	4.77	1.36	1.00	7.00				
PT_Div	1	1	1	5.56	1.57	2.00	8.00	1 to 8	-	-	-
R8I8	1	1	1	4.29	0.54	2.38	5.00	1 to 5	1	1	1
mCompAm	1	1	1	183.35	66.45	15.84	340.48	5 to 245	-	-	-

Key: Loadings of indictors on latent constructs, 0.7 or above indicates good indicator reliability. Squared loadings over 0.4 reflect acceptable reliability. Cronbach's alpha (α) and Composite R (reliability), 0.7 or above on both indicates good convergent reliability. AVE: average variance extracted, 0.5 or above indicates good convergent reliability. Indicator numbers represent individual indicators. CogCon=cognitive conflict; F=formal meeting; IF=informal meeting; PM-deb=debate centred on performance measures; PT-div=portfolio team diversity; R8I8=measures representing performance measurement system; mCompAmb=competence ambidexterity using multiplicative approach (m).

Table 7.17 Fornell-Larker Criterion correlation matrix, alternative antecedent Model A2

Construct	CogCon	Formal	Informal	PM Balanc	PM Debate	PT Diversi	mCompAm
CogCon	**0.74**						
Formal	-0.06	**1**					
Informal	0.2	0.49	**0.75**				
PM Balance	-0.05	0.13	0.24	**1**			
PM Debate	-0.15	0.22	0.14	0.36	**0.93**		
PT Diversity	0.01	0.15	0.1	0.16	0.41	**1**	
mCompAmb	-0.22	0.19	-0.06	0.03	0.38	0.25	**n.a.**

Key: Numbers on the diagonal (emboldened) report the square-root of the average variance extracted for reflective constructs. Off-diagonal elements represent correlations between constructs. CogCon=cognitive conflict; PM=performance measures; PT=portfolio team; mCompAmb=competence ambidexterity using multiplicative approach (m).

Table 7.18 Results of Heterotrait Monotrait (HTMT) test, alternative antecedent Model A2

Constructs	CogCon	Formal	Informal	PM Balanc	PM Debate	PT Diversit	mCompAml
CogCon							
Formal	0.09						
Informal	0.23	0.63					
PM Balance	0.09	0.13	0.27				
PM Debate	0.2	0.23	0.14	0.37			
PT Diversity	0.04	0.15	0.16	0.16	0.42		
mCompAmb	0.21	0.19	0.2	0.03	0.39	0.25	

Key: CogCon=cognitive conflict; PM=performance measures; PT=portfolio team; mCompAmb=competence ambidexterity using multiplicative approach (m). All values are well below the critical cut-off value of 0.85 (Hair, 2017; Henseler et al., 2015a).

Table 7.19 Cross-loadings analysis, alternative antecedent Model A2

Indicators	CogCon	Formal	Informal	PM Balanc	PM Debate	PT Diversity	mCompAml
CogCon1	**0.64**	-0.03	0.11	0.03	-0.04	0.03	-0.04
CogCon3	**0.65**	-0.1	0.05	-0.1	-0.2	0.04	-0.08
CogCon4	**0.91**	-0.04	0.22	-0.04	-0.12	-0.01	-0.26
F1	-0.06	**1**	0.49	0.13	0.22	0.15	0.19
IF1	0.11	0.49	**0.64**	0.16	0.06	0.08	0.18
IF2	0.03	0.41	**0.67**	0.16	0.07	0.17	0.04
IF3	0.2	0.34	**0.9**	0.22	0.14	0.07	-0.18
PMdeb1	-0.1	0.19	0.16	0.35	**0.94**	0.43	0.33
PMdeb2	-0.12	0.14	0.1	0.24	**0.94**	0.34	0.36
PMdeb4	-0.2	0.27	0.12	0.41	**0.92**	0.36	0.36
PT_Div	0.01	0.15	0.1	0.16	0.41	**1**	0.25
R8I8	-0.05	0.13	0.24	**1**	0.36	0.16	0.03
mCompAm	-0.22	0.19	-0.06	0.03	0.38	0.25	**1**

Key: Emboldened values represent highest factor item loadings. All are greater than loadings with any other factor items providing support for construct discriminant validity (Hair et al. 2017). Indicator numbers represent individual indicators. CogCon=cognitive conflict; F=formal meeting; IF=informal meeting; PM-deb=debate centred on performance measures; PT-div=portfolio team diversity; R8I8=measures representing performance measurement system; mCompAmb=competence ambidexterity using multiplicative approach (m).

7.9.2 Structural model assessment; Alternative antecedent Model A2

Continuing to be guided by best practice (Hair et al., 2017), analysis of the structural model first presents findings of model 'quality' (nomenclature used in SmartPls-SEM) followed by those linked to its structural path coefficients (hypothesised relationships between constructs), including any mediating effects.

7.9.2.1 Quality findings relevant to alternative antecedent Model A2

Results from value inflation factor (VIF) analysis confirm the absence of collinearity issues for this model where all VIF values returned are less than 5 (Hair et al., 2017), (Table 7.20). Coefficients of determination (R^2) and effect sizes (f^2) are presented in Table 7.21 and Table 7.22 respectively.

Table 7.20 Collinearity statistics (VIF) associated with inner (structural model) and outer (measurement model) alternative antecedent Model A2

Indicators	*Outer VIF*
CogCon1	1.25
CogCon3	1.24
CogCon4	1.27
F1	1
IF1	1.57
IF2	1.83
IF3	1.24
PMdeb1	4.16
PMdeb2	4.33
PMdeb4	2.9
PT_Div	1
R8I8	1
mCompAm	1

Inner VIF	CogCon	Formal	Informal	PM Balanc	PM Debate	PT Diversit	mCompAm
CogCon							1.02
Formal	1.32						
Informal	1.32						
PM Balance					1.02		
PM Debate							1.02
PT Diversity					1.02		
mCompAmb							

Key: Indicator numbers represent individual indicators. CogCon=cognitive conflict; F=formal meeting; IF=informal meeting; PM-deb=debate centred on performance measures; PT_div=portfolio team diversity; R8I8=measures representing performance measurement system; mCompAmb=competence ambidexterity using multiplicative approach (m).

Table 7.21 Coefficient of determination (R^2) statistics, alternative antecedent Model A2

Construct	Original Sample	Sample Mean	Standard Deviation	T Statistics	*P* Values	Bias	Confidence Interval 5.00%	95.00%
CogCon	0.07	0.12	0.05	1.57	0.06	0.05	0	0.1
PM Debate	0.26	0.27	0.1	2.68	0	0.01	0.1	0.41
mCompAml	0.17	0.19	0.09	1.99	0.02	0.02	0.05	0.31

Key: CogCon=cognitive conflict; PM=performance measures; mCompAmb=competence ambidexterity using multiplicative approach (m). All values are significant. **p*<0.10, ***p*<0.05, ****p*<0.01.

R^2 values of 0.25, 0.50 and 0.75 are normally considered small, medium and large although acceptable values vary with context (Hair et al., 2019; Hair et al., 2017). Furthermore, R^2 is a function of the number of predictor constructs, increasing with higher number of predictor constructs. Examining the sample mean R^2 values returned in Table 7.21 above, all are in the small range from PM-debate at $R^2 = 0.27$, followed by CompAmb with an $R^2 = 0.19$ and CogCon where $R^2 = 0.12$. This means that preceding constructs account for 27%, 19% and 12% of the variance in each of the constructs respectively. While there are likely other factors not being examined in this study that also contribute towards the model constructs, all R^2

values in this antecedent Model A2 are significant (all p = 0.06 or less) and contribute towards explanation of this model.

Guidelines for assessing f^2 report that values of 0.02, 0.15 and 0.35 represent weak, medium and large effect size respectively, while values $f^2 < 0.02$ represent no effect (Chin et al., 2003; Cohen, 1988). Looking at sample mean f^2 values returned in Table 7.22 below, two paths show weak effect sizes of f^2 = 0.05. All other effect sizes are of moderate size. Results indicate that formal meetings have a weaker impact on cognitive conflict than do informal meetings (f^2 =0.05 *v* f^2 =0.12). Likewise, since the path PM-debate to competence ambidexterity shows an effect size f^2=0.16, PM-debate has a bigger influence on competence ambidexterity than does cognitive conflict, where f^2=0.05. Interestingly, a diverse team has a slightly greater effect size on PM-debate (f^2=0.19) that does a balanced set of performance measures (f^2 =0.14).

Table 7.22 Effect size (f^2) statistics; Alternative antecedent Model A2

Model Paths	Original Sample	Sample Mean	Standard Deviation	T Statistics	*P* Values	Bias	Confidence Interval	
							5.00%	95.00%
CogCon -> mCompAmb	0.03	0.05	0.05	0.69	0.24	-0.18	-0.01	0.41
Formal -> CogCon	0.04	0.05	0.04	0.97	0.17	-0.23	0.09	0.43
Informal -> CogCon	0.08	0.12	0.07	1.14	0.13	0.21	-0.56	0.27
PM Balance -> PM Deb	0.12	0.14	0.1	1.16	0.12	0.18	-0.28	0.12
PM Debate -> mCompA	0.15	0.16	0.1	1.5	0.07	0.2	-0.06	0.1
PT Diversity -> PM Deb	0.17	0.19	0.12	1.47	0.07	0.18	-0.26	0.17

Key: CogCon=cognitive conflict; mCompAmb=competence ambidexterity using multiplicative approach (m); PM=performance measures; PT=portfolio team. *p<0.10, **p<0.05, ***p<0.01 (One-tailed bootstrap for hypothesised associations).

7.9.2.2 Structural path coefficient (ß) results and associated hypotheses findings; Alternative antecedent Model A2

As explained previously, 2 non-significant and negligible paths are removed, and a single path added that represents a new hypothesised relationship. More specifically, the alternative H3+ predicts a positive and significant relationship between PM-debate and competence ambidexterity. Statistical analysis demonstrates an improved and alternative antecedent Model A2 (Figure 7.5). The alternative Hypothesis 3+ is linked to the added model path in Model A2 and it replaces Hypothesis 3 in the original antecedent Model A1. The results of model path coefficient (*ß*) analyses are presented in the next sequence of tables (Table 7.23 to Table 7.26).These findings are shown in Figure 7.5 above and correspond to an earlier pictorial representation of the alternative antecedent Model A2 (Figure 7.4).

The difference between the figures is that Figure 7.5 shows the antecedent Model A2 superimposed with its associated hypothesised relationships (which were included in the list in section 7.9).

Table 7.23 Alternative antecedent Model A2; Hypotheses, path coefficients (*ß*), their strength, direction and significance values

Hypothesis	Model Paths	Original Sample	Sample Mean	Standard Deviation	T Statistic	*P* Value	Bias	Confidence Interval 5%	Confidence Interval 95%
H4+	CogCon -> mCompAmb	-0.16	-0.15	0.12	1.35	0.09	0.01	-0.31	0.09
H5+	Formal -> CogCon	-0.21	-0.19	0.11	1.88	0.03	0.02	-0.39	-0.04
H6-	Informal -> CogCon	0.3	0.29	0.21	1.44	0.07	-0.02	-0.4	0.42
H1	PM Balance -> PM Debate	0.3	0.3	0.11	2.77	0	0	0.12	0.47
Alt H3+	PM Debate -> mCompAmb	0.35	0.35	0.09	3.76	0	0	0.18	0.5
H2	PT Diversity -> PM Debate	0.36	0.36	0.1	3.52	0	0	0.19	0.52

Key: CogCon=cognitive conflict; mCompAmb=competence ambidexterity using multiplicative approach (m); PM=performance measures; PT=portfolio team. Tests are one-tailed *p<0.10, **p<0.05, ***p<0.01.

Table 2.3 presents the results from assessing the size and strength of path coefficients (*ß*) that reflect the hypotheses findings associated with the alternative antecedent Model A2. The algorithm converges after 15 iterations. As before, bootstrapping (repeated random selection of 5,000 subsamples from the total sample, with replacement) is performed to test the statistical significance of path coefficients. As per best practice, one-tailed significance tests (p<0.05) are run for hypotheses analyses. All 6 paths are found to be significant and are reported next;

Hypothesis 1 predicts a positive and significant relationship between PM-balance and PM-debate. The path PM-balance to PM-debate is found to be positive and highly significant (*ß* = 0.30, p < 0.01) in line with ***H1+ which is accepted***. This finding continues to support the finding reported earlier that debate centred on a group of balanced performance measures is encouraged when diverse measures with competing demands comprise the package of performance measures and this is demonstrated to occur during portfolio new product selection.

Hypothesis 2 predicts a positive and significant relationship between PT-diversity and PM-debate. ***Support for H2+** is shown* with a positive and significant path coefficient for this relationship (*ß* = 0.36; p < 0.01). This result supports the expectation that an increasingly diverse portfolio team is associated with greater debate based on a balanced set of contradictory performance measures.

Hypothesis 3 is ***an alternative hypothesis*** to that predicted in the earlier studied antecedent Model A_1. For Model A_2, H3+ proposes a positive and significant relationship between PM-debate and competence ambidexterity. The path PM-debate to competence ambidexterity is found to be positive and highly significant ($ß = 0.35$; $p < 0.01$) in line with the hypothesised new relationship under examination in the amended antecedent Model A_2, namely the ***Alternative H3+*** *which* ***is accepted***. Together these relationships demonstrate that a balanced performance measurement system and a diverse portfolio team both encourage debate among team members based on the performance measurement system. This debate is found to drive or support competence ambidexterity.

Hypothesis 4 predicts a positive and significant relationship between cognitive conflict and competence ambidexterity. However, and contrary to the hypothesised relationship, the corresponding path coefficient in the alternative antecedent Model A_2, while marginally significant, is in the negative direction and significant ($ß = -0.16$; $p = 0.09$). In this study therefore, cognitive conflict is found to be negatively associated with competence ambidexterity. ***H4+ is rejected.***

Hypothesis 5 predicts a positive and significant relationship between formal meetings and cognitive conflict. However, and unexpectedly, the path F (formal meetings) to CogCon (cognitive conflict) is found to be negative and significant ($ß = -0.19$; $p < 0.05$). This study finds that formal meetings are associated with lower levels of cognitive conflict. These findings imply that the more frequently scheduled group meetings are arranged to discuss product portfolio selection decisions, the less cognitive conflict that arises. Contrary to expectations, formal group meetings are associated with reduced levels of cognitive conflict. Therefore ***H5+ is rejected***.

Hypothesis 6 predicts a negative and significant association between informal meetings and cognitive conflict, based largely on interview findings. However, and also contrary to expectations, the path IF (informal meetings) to CogCon is found to be positive and significant ($ß = 0.29$; $p < 0.1$). This insinuates that disagreements are openly and actively conducted during one-to-one informal meetings. Rather than informal, one-to-one meetings leading to less cognitive conflict due to the potential influence of a dominant character, this study finds that informal meetings are linked with increases in cognitive conflict leading to the ***rejection of H6-.***

7.9.2.3 Mediation and the Alternative Model 1, namely (Model A2)

Table 7.24 presents all paths (total effects table) associated with this alternative model and reveals that there are ten. Since six were predicted, the extra four paths (of which two are significant), represent the *indirect effect* paths that are singled out in Table 7.25. Significant indirect paths identify mediation (Hair et al., 2017; Nitzl, Roldan & Cepeda, 2016; Zhao, Lynch Jr & Chen, 2010), as seen in Figure 7.6 and Figure 7.7. Referring to these figures, the 2 significant indirect paths in the alternative antecedent Model A2 are PM-balance ---> mCompAmb (*ß* = 0.11; $p < 0.05$); and PT-diversity ---> mCompAmb (*ß* = 0.13; $p < 0.05$). The specific indirect effects Table (Table 7.26) reveals that the 2 independent exogenous constructs PM-balance and PT-diversity act through the endogenous construct PM-debate in affecting mCompAmb. When direct and indirect effects are significant and in the same direction, it demonstrates partial, complementary mediation (Zhao et al., 2010), (Figure 7.7). These findings provide empirical support for the complementary mediating role of debate based on performance measures (PM-deb). More specifically, debate based on performance measures is shown to underpin the relationship between a balanced set of performance measures (PM-bal) and competence ambidexterity; and it underpins the relationship between portfolio team diversity and competence ambidexterity. These findings suggest that without PM-debate, none of these early predictor constructs would have as strong an effect on competence ambidexterity (CompAmb).

Table 7.24 Total Effects statistics for antecedent Model A2

Model Paths	Original Sample	Sample Mean	Standard Deviation	T Statistics	*P* Values	Bias	Confidence Interval 5.00%	95.00%
CogCon -> mCompAmb	-0.16	-0.15	0.12	1.35	0.09	0.01	-0.32	0.09
Formal -> CogCon	-0.21	-0.19	0.11	1.88	0.03	0.02	-0.39	-0.04
Formal -> mCompAmb	0.03	0.03	0.03	1.15	0.12	-0.01	0	0.1
Informal -> CogCon	0.3	0.29	0.21	1.44	0.07	-0.02	-0.4	0.42
Informal -> mCompAmb	-0.05	-0.04	0.05	0.96	0.17	0.01	-0.11	0.06
PM Balance -> PM Deb	0.3	0.3	0.11	2.77	0	-0.01	0.12	0.48
PM Balance -> mComp	0.11	0.1	0.05	2.26	0.01	0	0.04	0.2
PM Debate -> mCompA	0.35	0.35	0.09	3.76	0	0	0.19	0.5
PT Diversity -> PM Det	0.36	0.36	0.1	3.52	0	-0.01	0.19	0.52
PT Diversity -> mComp	0.13	0.13	0.05	2.38	0.01	0	0.05	0.23

Key: CogCon=cognitive conflict; mCompAmb=competence ambidexterity using multiplicative approach (m); PM=performance measures; PT=portfolio team. *p<0.10, **p<0.05, ***p<0.01 (One-tailed bootstrap for hypothesised associations).

Table 7.25 Alternative antecedent Model A2; Total indirect effects statistics, and significance values

Model Paths	Original Sample	Sample Mean	Standard Deviation	T Statistics	*P* Values	Bias	Confidence Interval 5.00%	95.00%
CogCon -> mCompAmb								
Formal -> CogCon								
Formal -> mCompAmb	0.03	0.03	0.03	1.15	0.12	-0.01	0	0.1
Informal -> CogCon								
Informal -> mCompAmb	-0.05	-0.04	0.05	0.96	0.17	0.01	-0.11	0.06
PM Balance -> PM Debate								
PM Balance -> mComp/	0.11	0.1	0.05	2.26	0.01	0	0.04	0.2
PM Debate -> mCompAmb								
PT Diversity -> PM Debate								
PT Diversity -> mComp	0.13	0.13	0.05	2.38	0.01	0	0.05	0.23

Key: CogCon=cognitive conflict; mCompAmb=competence ambidexterity using multiplicative approach (m); PM=performance measures; PT=portfolio team. *p<0.10, **p<0.05, ***p<0.01 (One-tailed bootstrap for hypothesised associations).

Table 7.26 Alternative antecedent Model A2; Specific indirect effects statistics and significance values

Model Paths	Original Sample	Sample Mean	Standard Deviation	T Statistics	*P* Values	Bias	Confidence Interval 5.00%	95.00%
Formal -> CogCon -> mCompAmb	0.03	0.03	0.03	1.15	0.12	-0.01	0	0.1
Informal -> CogCon -> mCompAmb	-0.05	-0.04	0.05	0.96	0.17	0.01	-0.11	0.06
PM Balance -> PM Debate -> mCom	0.11	0.1	0.05	2.26	0.01	0	0.04	0.2
PT Diversity -> PM Debate -> mCor	0.13	0.13	0.05	2.38	0.01	0	0.05	0.23

Key: CogCon=cognitive conflict; mCompAmb=competence ambidexterity using multiplicative approach (m); PM=performance measures; PT=portfolio team. *p<0.10, **p<0.05, ***p<0.01 (One-tailed bootstrap for hypothesised associations).

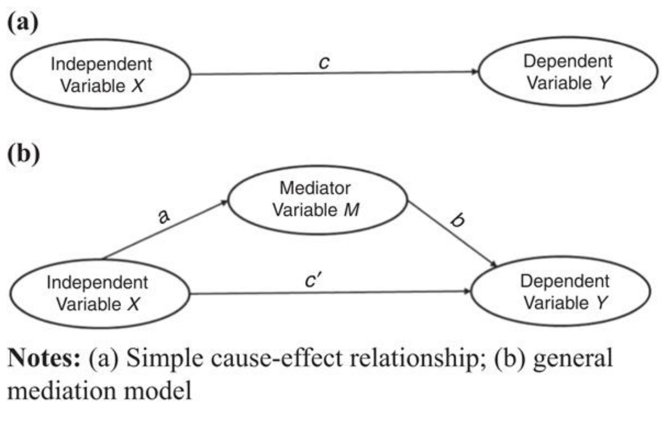


Figure 7.6 Direct effect and mediation models (Nitzl et al., 2016,p.1851).

Moreover, on further examination of Table 7.25 and Table 7.26, no other mediation effects are observed. This confirms that there is no evidence that cognitive conflict (CogCon) acts as a mediator in this model.

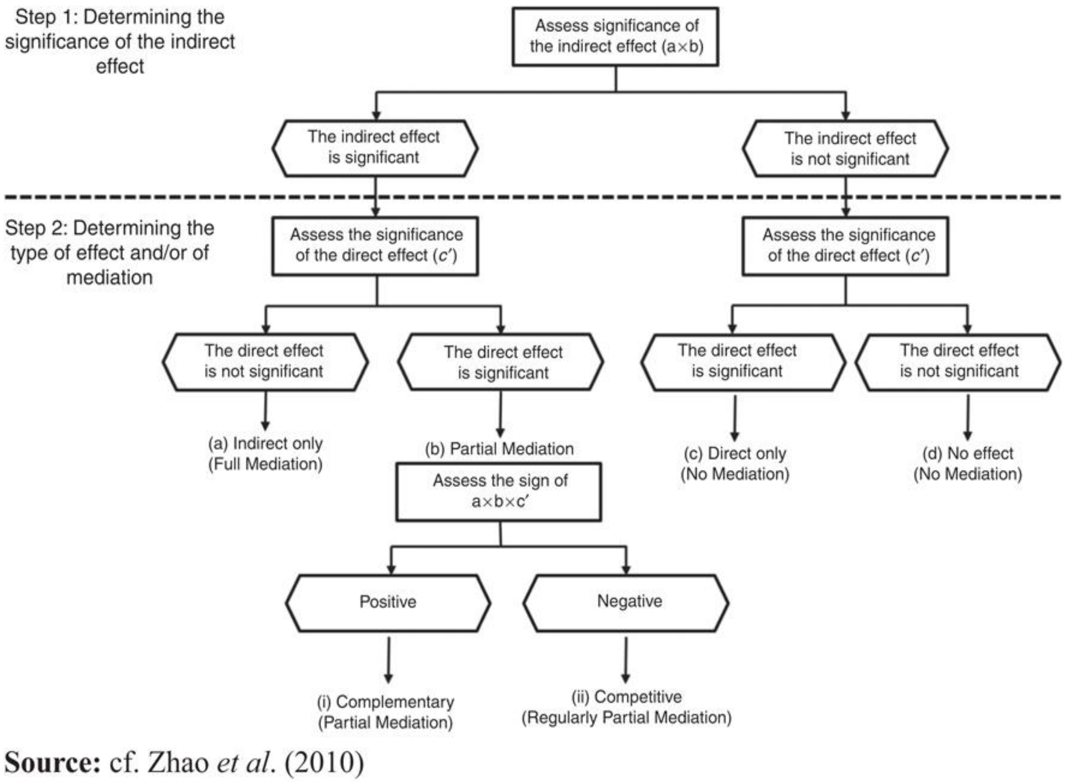


Figure 7.7 Significance tests of mediation models (Nitzl et al., 2016,p.1853).

7.9.3 Summary results linked to alternative antecedent Model A2

In summary, the alternative antecedent Model A2 indicates that debate based upon a mixed but balanced set of performance measures in conjunction with a diverse team plays a central role in driving competence ambidexterity. The balanced set of performance measures and a diverse team behave as antecedents of competence ambidexterity whose effects are driven through debate. This debate plays the more important role as it acts as a mediator of the effects of its preceding two latent constructs. Furthermore, this antecedent Model A2 shows that formal meetings discourage cognitive conflict, informal ones drive it, and according to effect sizes, the effect of informal meetings is greater. Overall, the impact on cognitive conflict is that it reduces competence ambidexterity. Further research is merited to uncover the micro-foundations of the formal/informal/cognitive conflict relations.

7.10 Model C, consequences of competence ambidexterity

In this part of the chapter, findings are related to the **c**onsequences of competence ambidexterity. Model C (Figure 7.8) displays 4 hypothesised paths based on the extant literature and phase one interviews. Following previous model assessments, the analysis begins with a reiteration of the associated hypotheses followed by an assessment of the measurement model before the structural model findings are examined. Structural path findings statistics are then presented in relation to the 4 hypothesised relationships.

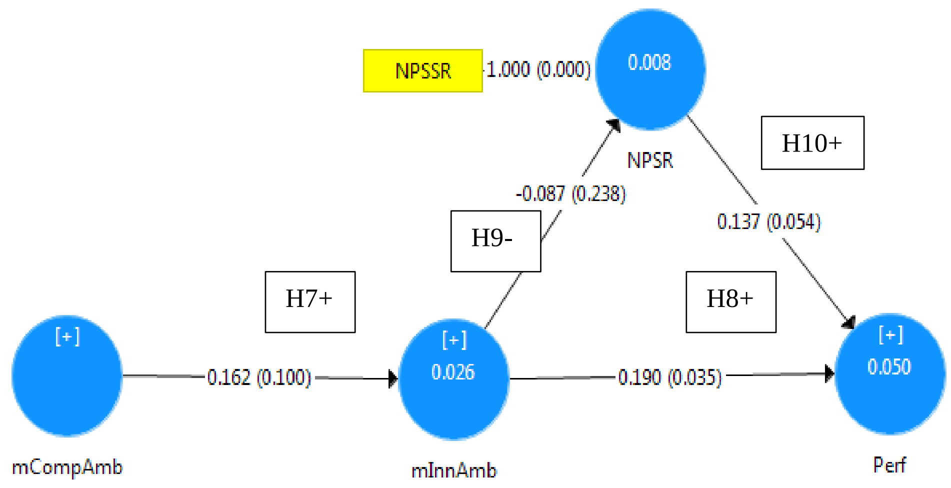


Figure 7.8 Consequences of competence ambidexterity; Model C.

Key: Path coefficients *(ß)* on the line, path significance values (*p*) in brackets. *$p<0.10$, **$p<0.05$, ***$p<0.01$ (One-tailed bootstrap for hypothesised associations). R square values on endogenous constructs. mCompAmb=competence ambidexterity derived by the most commonly used operationalisation multiplicative method (m); mInnAmb=innovation ambidexterity operationalised by the multiplicative method (m); NPSR=new product selection success rate; Perf=performance.

*Note: NPSR=NPSSR = New product selection success rate is operationalised as (NPcom*NPsuc)/NPsel where NPcom represents the percentage of selected new products that were commercialised; NPsuc represents the percentage of commercialised new products that were successful and NPsel represents the percentage of all screened new products that were selected for development in the new product portfolio adapted from Eling et al. (2016).

7.10.1 Summary list of hypotheses associated with consequence model; Model C

- H7+ Competence ambidexterity (mCompAmb) is positively and significantly associated with innovation ambidexterity (mInnAmb).
    - *H7+ is supported.*
- H8+ Innovation ambidexterity (mInnAmb) is positively and significantly associated with performance (Perf).
    - *H8+ is supported.*
- H9- Innovation ambidexterity (mInnAmb) is negatively and significantly associated with new product success rate (NPSR).
    - *H9- is rejected* as the relationship is non-significant.

- H10+ New product success rate (NPSR) is positively and significantly associated with performance (Perf).
    - *Hypothesis 10+ is supported.*

7.10.2 Measurement model findings; consequence Model C

As in previous model analyses, the SmartPLS-SEM algorithm is run. It converges after 4 iterations. Reliability and validity checks ensue, and relevant Tables from Table 7.27 to Table 7.30 are presented next.

Table 7.27 Measurement model descriptive and reliability statistics, consequence Model C

Indicators	loadings (>0.7)	loadings^2 (>0.4)	Indicator weights	Mean	Stnd Dev	Min.	Max.	Theoretical range	Cronbach's α (>0.7)	Composite R (>0.7)	AVE (>0.5)
NPSSR	1.00	1.00	1.00	1.45	2.08	0.02	8.10	1-5	1	1	1
Perf1_MSG	0.85	0.72	0.25	3.3	0.87	1.00	5.00	1-5	0.93	0.95	0.83
Perf2_Profit	0.89	0.79	0.29	3.42	0.93	1.00	0.93	1-5			
Perf3_SG	0.94	0.88	0.33	3.42	1.02	1.00	5.00	1-5			
Perf4_Ovr	0.95	0.90	0.23	3.45	0.95	1.00	5.00	1-5			
mCompAmb	1.00	1.00	1.00	183.35	66.45	15.84	340.48	36 to 8,820	1	1	1
mInnovAmb	1.00	1.00	1.00	57.97	26.64	8.89	112.00	9 to 1,125	1	1	1

Key: Loadings of indictors on latent constructs, 0.7 or above indicates good indicator reliability. Squared loadings over 0.4 reflect acceptable reliability. Cronbach's alpha (α) and Composite R (reliability), 0.7 or above on both indicates good convergent reliability. AVE: (average variance extracted), 0.5 or above indicates good convergent reliability. NPSSR=new product selection success rate; Perf=performance; mCompAmb=competence ambidexterity using multiplicative approach (m); mInnAmb=innovation ambidexterity operationalised by the multiplicative method (m).

Table 7.28 Fornell-Larker Criterion correlation matrix, consequence Model C

Construct	NPSSR	Perf	mCompAm	mInnAmb
NPSR	**1**			
Perf	0.12	**0.91**		
mCompAm	0.14	0.16	**1**	
mInnAmb	-0.09	0.18	0.16	**1**

Key: Numbers on the diagonal (emboldened) report the square-root of the average variance extracted for reflective constructs. Off-diagonal elements represent correlations between constructs. NPSR/NPSSR= new product selection success rate; Perf=performance; mCompAmb=competence ambidexterity using multiplicative approach (m); mInnAmb=innovation ambidexterity operationalised by the multiplicative method (m).

Table 7.29 Results of Heterotrait Monotrait (HTMT) test, consequence Model C

Construct	NPSSR	Perf	mCompAm	mInnAmb
NPSR				
Perf	0.12			
mCompAm	0.14	0.17		
mInnAmb	0.09	0.18	0.16	

Key: NPSR/NPSSR=new product selection success rate; Perf=performance; mCompAmb=competence ambidexterity using multiplicative approach (m); mInnAmb=innovation ambidexterity operationalised by the multiplicative method (m). All values are well below the critical cut-off value of 0.85 (Hair et al. 2017; Henseler 2015).

Table 7.30 Cross-loadings matrix, consequence Model C

Construct	NPSSR	Perf	mCompAm	mInnAmb
NPSSR	**1**	0.12	0.14	-0.09
Perf1_MSG	0.09	**0.85**	0.21	0.15
Perf2_ProfitG	0.1	**0.89**	0.12	0.19
Perf3_SG	0.13	**0.94**	0.11	0.15
Perf4_Ovr	0.12	**0.95**	0.15	0.15
mCompAmb	0.14	0.16	**1**	0.16
mInnovAmb	-0.09	0.18	0.16	**1**

Key: Emboldened values represent highest factor item loadings. All are greater than loadings with any other factor items providing support for construct discriminant validity (Hair et al. 2017). NPSSR=new product selection success rate; Perf=performance; mCompAmb=competence ambidexterity using multiplicative approach (m); mInnovAmb=innovation ambidexterity operationalised by the multiplicative method (m).

Consequence Model C adequately meets all reliability and validity statistics standards allowing assessment of the structural model findings to proceed (Hair et al., 2017; Hulland, 1999; Nunnally & Bernstein, 1994).

7.10.3 Structural model findings; consequence Model C

As depicted in Figure 7.8, the consequence Model C is associated with 4 hypotheses. These hypotheses predict the consequences of competence ambidexterity on innovation ambidexterity, on new product success and on performance through new product portfolio selection. Continuing model statistical analyses as previously, structural model assessment first presents model quality findings including significance tests of collinearity (VIF tests), coefficients of determination (R^2) and effect sizes (f^2), in Table 7.31, Table 7.32 and Table 7.33 respectively. These tests are followed by structural model path (*B* coefficient) analyses (Table 7.34 to Table 7.37). As previously, the bootstrap procedure is applied through SmartPLS-SEM using 5000 subsamples, one-tailed tests at 0.05 level of significance, and bias corrected scores).

7.10.3.1 SmartPLS Quality (nomenclature of SmartPLS) findings relevant to Model C

Results from value inflation factor (VIF) analysis confirm no collinearity issues for this model (Table 7.31). All VIF values returned, (except 1; Perf 4 indictor = 6.04) are less than 5 (Hair et al., 2018; Hair et al., 2017). Some authors suggest an upper limit of VIF=10 and since Perf4 VIF value returned is closer to 5 than to 10, the Perf4 variable is retained as dropping it to improve VIF 'may do more harm than good' (O' Brien, 2007, p.683).

Table 7.31 Collinearity statistics (VIF) associated with inner and outer consequence Model C

	Inner VIF
NPSSR	1
Perf1_MS(	2.91
Perf2_Prof	3.32
Perf3_SG	4.71
Perf4_Ovr	6.04
mCompAm	1
mInnovAml	1

Outer VIF	NPSR	Perf	mCompAm	mInnAmb
NPSSR		1.01		
Perf				
mCompAmb				1
mInnAmb	1	1.01		

Key: NPSSR/NPSR=new product selection success rate; Perf=performance; MSG=market-share growth; SG=sales growth; Ovr=overall business unit performance; mCompAmb=competence ambidexterity using multiplicative approach (m); mInnAmb/mInnovAmb=innovation ambidexterity operationalised by the multiplicative method (m).

Table 7.32 Coefficient of determination (R^2) statistics, consequence Model C

	Original S:	Sample Me:	Standard D	T Statistics	*P* Values	Bias	5.00%	95.00%
NPSSR	0.01	0.02	0.03	0.27	0.39	0.01	0	0.05
Perf	0.05	0.07	0.05	1.11	0.13	0.02	0.01	0.12
mInnAmb	0.03	0.04	0.05	0.57	0.28	0.02	0	0.13

Key: Tests are one-tailed. *p<0.10, **p<0.05, ***p<0.01. NPSSR/NPSR=new product selection success rate; Perf=performance; mInnAmb=innovation ambidexterity operationalised by the multiplicative method (m).

Table 7.33 Path Effects (f^2) statistics, consequence Model C

Structural path	Original S:	Sample Me:	Standard D	T Statistics	*P* Values	Bias	5.00%	95.00%
NPSR -> Perf	0.02	0.03	0.03	0.75	0.23	0.12	-0.42	0.05
mCompAmb -> mInnAml	0.03	0.05	0.05	0.49	0.31	0.14	-0.26	0.1
mInnAmb -> NPSR	0.01	0.02	0.03	0.24	0.4	-0.09	-0.11	0.33
mInnAmb -> Perf	0.04	0.06	0.05	0.75	0.23	0.17	-0.3	0.05

Key: Tests are one-tailed. *p<0.10, **p<0.05, ***p<0.01. NPSR=new product selection success rate; Perf=performance; mCompAmb=competence ambidexterity using multiplicative approach (m); mInnAmb=innovation ambidexterity operationalised by the multiplicative method (m).

R^2 values returned for consequence Model C are small and f^2 values are weak although acceptable values can vary depending on the research context (Hair et al., 2019; Hair et al., 2017). Small R^2 values associated with this model are understandable as first they each include only a single predictor construct, and secondly, they suggest that other non-examined constructs also contribute towards remaining independent constructs, namely, innovation ambidexterity, new product selection success and performance outcomes. Furthermore, 'R^2 is a function of the number of predictor constructs, the greater the number of predictor constructs, the higher the R^2 (Hair et al., 2017,p.11). Consequently, lower R^2 are not unexpected in the consequence Model C where a single construct predicts both innovation ambidexterity (namely competence ambidexterity) and new product selection success rate (namely innovation ambidexterity). Furthermore, 'a small f^2 does not necessarily imply an unimportant effect' (Chin et al., 2003, p.211). Thus, with acceptable measurement model parameter findings presented, analysis continues with an examination of the structural path findings linked to the hypothesised paths in consequence Model C (from Table 7.34 to Table 7.37).

7.10.3.2 ***Structural path findings for consequence Model C***

Table 7.34 and Figure 7.8 present the path coefficients (*ß*), their strength, direction and the significance associated with the hypothesised paths of consequence Model C. Findings are presented next, linked to the hypothesised relationships.

Table 7.34 Direct hypothesised paths associated with consequence Model C

Hypothesis	**Structural path**	**Original Sample**	**Sample Mean**	**Standard Deviation**	**T Stat. |O/STDEV|**	***P* Values**	**Bias**	**5%**	**95%**
H10+	**NPSR -> Perf**	0.14	0.14	0.09	1.61	0.05	0	-0.03	0.26
H7+	**mCompAmb -> mInnAmb**	0.16	0.16	0.13	1.28	0.1	0	-0.05	0.36
H9-	**mInnAmb -> NPSR**	-0.10	-0.08	0.12	0.71	0.24	0.01	-0.28	0.12
H8+	**mInnAmb -> Perf**	0.19	0.2	0.1	1.82	0.03	0.01	-0.03	0.34

Key: NPSR=new product selection success rate; Perf=performance; mCompAmb=competence ambidexterity using multiplicative approach (m); mInnAmb=innovation ambidexterity operationalised by the multiplicative method (m). One-tailed bootstrap for hypothesised associations, *p<0.10, **p<0.05, ***p<0.01.

<u>*Hypothesis 7*</u> predicts a positive and significant association between competence ambidexterity (CompAmb) and innovation ambidexterity (InnAmb). The effect is shown to be positive although marginally significant (*ß* = 0.16; p = 0.10). ***H7+ is supported***. The positive path findings indicate a positive trend that suggests that increasing competence ambidexterity is associated with innovation ambidexterity. Findings suggest that it takes more than ambidexterity competence to support innovation ambidexterity.

<u>*Hypothesis 8*</u> predicts a positive and significant association between innovation ambidexterity and business unit perceived performance. Performance is measured as a combination of market share, sales growth and financial metrics. Data analysis reveals a positive and significant result for this path (*ß* = 0.19; p < 0.05) that links increasing innovation ambidexterity with increasing performance. ***H8+ is supported.***

<u>*Hypothesis 9*</u> predicts a negative and significant association between innovation ambidexterity and the output rate of successful selected new products. The corresponding path coefficient is shown to be negative, ($ß$ = -0.1; $p > 1$) but non-significant. The negative path coefficient reflects the expected trend that as innovation ambidexterity rises, fewer products will be launched. This is because an increasingly ambidextrous product portfolio will comprise a greater proportion of long-term to short-term development projects and therefore the rate of products developed will diminish, hence the negative path. However, while the corresponding path coefficient is shown to be negative, the path is not found to be significant ($ß$ = -0.1; $p > 1$). Thus ***H9- is rejected***.

<u>*Hypothesis 10*</u> predicts a positive and significant association between the rate of success at new product selection (NPSR) and performance. This path is shown to be both positive and significant ($ß$ = 0.14; $p = 0.05$). ***H10+ is supported***. It indicates that increasing success in selection for an ambidextrous product portfolio is associated with increasing business unit performance.

7.10.3.3 Mediation findings, consequence Model C

An examination of the total effects (Table 7.35) and indirect effects (Table 7.36 & Table 7.37). Tables associated with the consequence Model C reveal no significant indirect paths. This confirms that no mediating effects are suggested by this model (Hair et al., 2017; Nitzl et al., 2016). For example, the indirect path from competence ambidexterity to performance is negligible ($ß$ = 0.03; $p = 0.22$). Therefore, innovation ambidexterity is shown to directly and positively impact overall performance, in this model. The direct, positive and significant effect by innovation ambidexterity on performance (Perf) is thus confirmed to be directed specifically by the balance of radical and incremental new products developed through an ambidextrous new product development portfolio.

Table 7.35 Total effects, consequence Model C

Structural path	Original Sa	Sample Me	Standard D	T Statistics	*P* Values	Bias	5.00%	95.00%
NPSR -> Perf	0.14	0.14	0.09	1.61	0.05	0	-0.03	0.26
mCompAmb -> NPSR	-0.01	-0.01	0.03	0.53	0.3	0	-0.08	0.01
mCompAmb -> Perf	0.03	0.03	0.03	0.85	0.2	0	-0.01	0.1
mCompAmb -> mInnAn	0.16	0.16	0.13	1.28	0.1	0	-0.05	0.36
mInnAmb -> NPSR	-0.10	-0.08	0.12	0.71	0.24	0.01	-0.28	0.12
mInnAmb -> Perf	0.18	0.19	0.1	1.7	0.04	0.01	-0.03	0.33

Key: NPSR=new product selection success rate; Perf=performance; mCompAmb=competence ambidexterity using multiplicative approach (m); mInnAmb=innovation ambidexterity operationalised by the multiplicative method (m). *p<0.10, **p<0.05, ***p<0.01 (One-tailed bootstrap for hypothesised associations).

Table 7.36 Indirect effects, consequence Model C

Structural path	Original S	Sample Me	Standard D	T Statistics	*P* Values	Bias	5.00%	95.00%
NPSR -> Perf								
mCompAmb -> NPSR	-0.01	-0.01	0.03	0.53	0.3	0	-0.08	0.01
mCompAmb -> Perf	0.03	0.03	0.03	0.85	0.2	0	-0.01	0.1
mCompAmb -> mInnAmb								
mInnAmb -> NPSR								
mInnAmb -> Perf	-0.01	-0.02	0.02	0.5	0.31	0	-0.07	0.01

Key: NPSR=new product selection success rate; Perf=performance; mCompAmb= competence ambidexterity using multiplicative approach (m); mInnAmb=innovation ambidexterity also operationalised by the multiplicative method (m). *p<0.10, **p<0.05, ***p<0.01 (One-tailed bootstrap for hypothesised associations).

Table 7.37 Specific indirect effects, consequence Model C

Structural path	Original S	Sample Me	Standard D	T Statistics	*P* Values	Bias	5.00%	95.00%
mCompAmb -> mInnAmb -> NPSR	-0.01	-0.01	0.03	0.53	0.3	0	-0.08	0.01
mInnAmb -> NPSR -> Perf	-0.01	-0.02	0.02	0.5	0.31	0	-0.07	0.01
mCompAmb -> mInnAmb -> NPSR -> Perf	0	0	0	0.39	0.35	0	-0.02	0
mCompAmb -> mInnAmb -> Perf	0.03	0.04	0.03	0.88	0.19	0	-0.01	0.1

Key: NPSR=new product selection success rate; Perf=performance; mCompAmb= competence ambidexterity using multiplicative approach (m); mInnAmb=innovation ambidexterity also operationalised by the multiplicative method (m). *p<0.10, **p<0.05, ***p<0.01 (One-tailed bootstrap for hypothesised associations).

7.10.3.4 Moderation findings; consequences Model C

Finally, based on findings from the antecedent model, Model A2 regarding the new construct informal meeting forum, the consequence Model C is tested for a potential moderation effect by informal control on the path from competence ambidexterity to innovation ambidexterity. Following guidance by Hair et al. (2017), the moderating variable is operationalised through SmartPLS as the product of informal control and competence ambidexterity. Figure 7.9 below shows what is called the moderation model as it appears in SmartPLS. Table 7.38 presents the path coefficients (*ß*), associated with this model. Analysis finds a significant moderating effect that is also in the negative direction ($ß = -0.21$; $p < 0.05$). This finding shows that with increasing levels of informal meetings, there is a negative influence on the otherwise positive and significant competence ambidexterity - innovation ambidexterity relationship. Informally held meetings show a negative impact on the realisation of innovation ambidexterity.

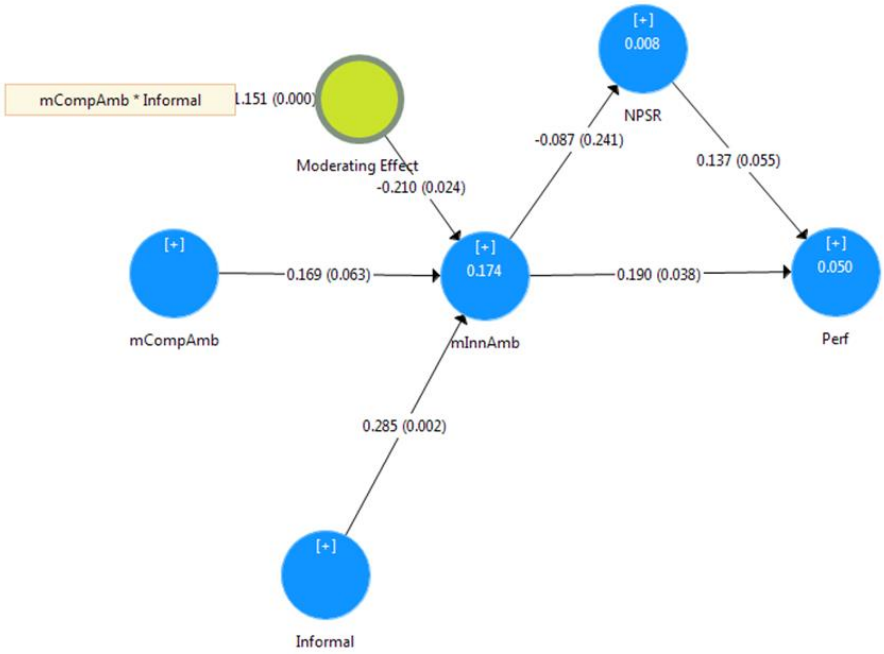


Figure 7.9 The moderation model (Informal*Competence ambidexterity) in the consequence Model C.

Key: Path coefficient values (*ß*) are on the line, significance *P*-values are bracketed. *P<0.10, **P<0.05, ***P<0.01 NPSR=new product selection success rate; Perf=performance; mCompAmb= competence ambidexterity using multiplicative approach (m); mInnAmb=innovation ambidexterity also operationalised by the multiplicative method (m). Moderating effect shown by yellow coloured circle.

Table 7.38 Path coefficients *(ß)* associated with the moderation consequence Model C2

Model paths	Original Sa	Sample Me	Standard D	T Statistics	*P* Values	Bias	5.00%	95.00%
Informal -> mInnAmb	0.29	0.3	0.1	2.9	0	0.01	0.11	0.41
Moderating Effect -> mInnAmb	-0.21	-0.2	0.11	1.98	0.02	0.02	-0.37	-0.03
NPSR -> Perf	0.14	0.14	0.09	1.6	0.06	0	-0.03	0.26
mCompAmb -> mInnAmb	0.17	0.17	0.11	1.53	0.06	0	-0.02	0.34
mInnAmb -> NPSR	-0.09	-0.08	0.12	0.7	0.24	0.01	-0.29	0.12
mInnAmb -> Perf	0.19	0.2	0.11	1.78	0.04	0.01	-0.02	0.34

Key: mInnAmb=innovation ambidexterity also operationalised by the multiplicative method (m). NPSR=new product selection success rate; Moderating effect=informal*competence ambidexterity; Perf=performance; mCompAmb= competence ambidexterity using multiplicative approach (m); *p<0.10, **p<0.05, ***p<0.01.

Figure 7.10 presents the simple slope graph that visually explains the moderation effect. At average levels (in red) of informal control, the red slope rises from left to right indicating a positive relationship between competence ambidexterity (x-axis) and innovation ambidexterity (y-axis). Figure 7.10 and Table 7.38 both support this significant relationship (*ß* = 0.169; p = 0.063). Returning to Figure 7.10, a reduction in informal control by one standard deviation, results in a steeper upward incline (blue slope) as the moderating path effect (*ß* = -0.21) is subtracted from the path coefficient between competence ambidexterity and innovation ambidexterity; i.e. 0.169 – (-0.21) = 0.169+0.21 = *ß* = 0.379. This reflects a stronger positive path relationship between competence and innovation ambidexterity, in association with lower levels of informal control. Conversely, a single unit, standard deviation rise in informal control (green line) shows that the direction of the slope reverses into a downward direction. This is because the impact of the moderator on the path coefficient (*ß* = 0.169) is to increase it by the moderating effect (*ß* = -0.21) which in effect reduces the path coefficient to *ß* = -0.04. These findings reveal the moderating negative influence of informal control on the translation of competence ambidexterity to innovation ambidexterity. Increases in levels of informal control reduce the positive influence of competence ambidexterity on innovation ambidexterity. An examination of the effect sizes Table 7.39 shows that the sample mean effect size of f^2=0.08 for the moderating path effect is in the small effect size (Chin et al., 2003; Cohen, 1988) but 'does not necessarily imply an unimportant effect' (Chin et al., 2003, p.211). These findings merit further investigation in future research.

Table 7.39 Effect sizes (f^2), moderation consequence Model C

Model paths	Original S:	Sample Me	Standard D	T Statistics	*P* Values	Bias	5.00%	95.00%
Informal -> mInnAmb	0.1	0.12	0.08	1.3	0.1	0.2	-0.46	-0.21
Moderating Effect -> mInnAmb	0.07	0.08	0.07	1.03	0.15	-0.27	0.14	0.19
NPSR -> Perf	0.02	0.03	0.03	0.73	0.23	0.12	-0.3	0.05
mCompAmb -> mInnAmb	0.03	0.05	0.05	0.66	0.25	0.13	-0.24	0.08
mInnAmb -> NPSR	0.01	0.02	0.03	0.25	0.4	-0.09	-0.11	0.28
mInnAmb -> Perf	0.04	0.06	0.05	0.73	0.23	0.17	-0.3	0.05

Key: mInnAmb=innovation ambidexterity operationalised by the multiplicative method (m). NPSR=new product selection success rate; Moderating effect=informal*competence ambidexterity; Perf=performance; mCompAmb= competence ambidexterity using multiplicative approach (m); *p<0.10, **p<0.05, ***p<0.01

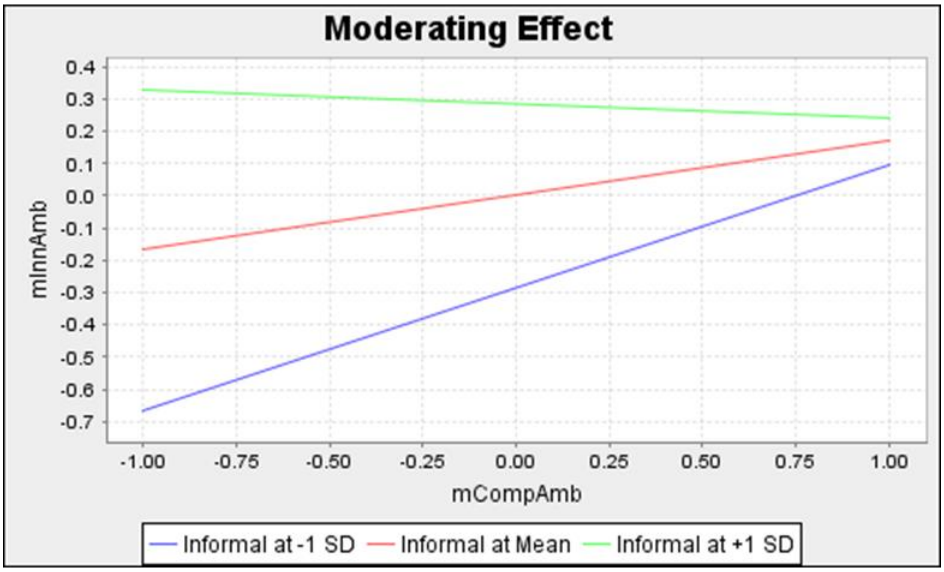


Figure 7.10 Simple slope analysis of the moderating effects of informal control in the consequence Model C.

Key: Informal is represented at 3 levels; an average level (red line), average level plus one standard deviation (green line) and average level minus one standard deviation (blue line).

7.11 Controls tests on antecedent and consequence models; Model A2 and Model C

To control for context, and to consider literature that suggests environmental dynamism and company size can influence innovation and how performance measures are used, models are examined with direct paths from EnvDyn (Appendix B, Figure 1 & Appendix B, Figure 2) and Team size (Appendix B, Figure 3 & Appendix B, Figure 4) to all model constructs. The models compare favourably (and as anticipated) with non-controlled models, indicating that there is no significant impact made by controls, (see Appendix B, for details).

7.12 Robustness test findings on antecedent and consequence models; Model A2 and Model C associated with the ambidexterity construct

As described in the methods chapter, ambidexterity (including competence ambidexterity and innovation ambidexterity) has been operationalised in the extant literature by a number of different approaches. Following good practice, the models derived in the current study, (which use the composite multiplicative 3 dimensions approach as explained in chapter 6 section 6.9.1) are examined for robustness of the ambidexterity measures employed. This is done by examining and comparing the models using alternative operationalisations. Four alternative operationalisations of ambidexterity are examined. These operationalisations include the composite additive (3 dimensions) approach (Figure 7.11 & Figure 7.12); the multiplicative combined dimension (2 dimensions) approach (Figure 7.13 & Figure 7.14); the additive combined dimension (2 dimensions) approach (Figure 7.15 & Figure 7.16) and the single dimension balance approach (Figure 7.17 & Figure 7.18). The graphical representations, corresponding to each operationalisation, applied to both antecedent and consequence models (Model A2 and Model C) respectively, and these are presented next (Figure 7.11 to Figure 7.18).

7.12.1 Additive composite ambidexterity approach (3 dimensions)

aCompAmb = (Exploit+Explore)*(Balance dimension) = competence ambidexterity additive, composite approach

aInnAmb = (Incremental+Radical)*(Balance dimension) = innovation ambidexterity additive composite approach

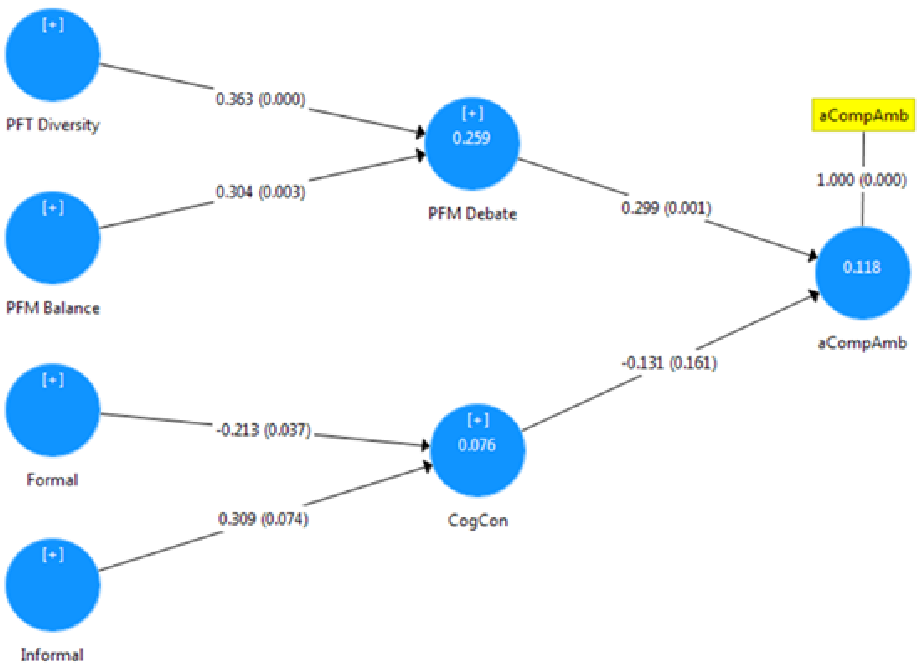


Figure 7.11 Robust test using aCompAmb, alternative antecedent Model A2.

Using aCompAmb to measure competence ambidexterity gives highly comparable results to the findings of the mCompAmb model of the current study. except for the loss of significance in the path from cognitive conflict to competence ambidexterity.

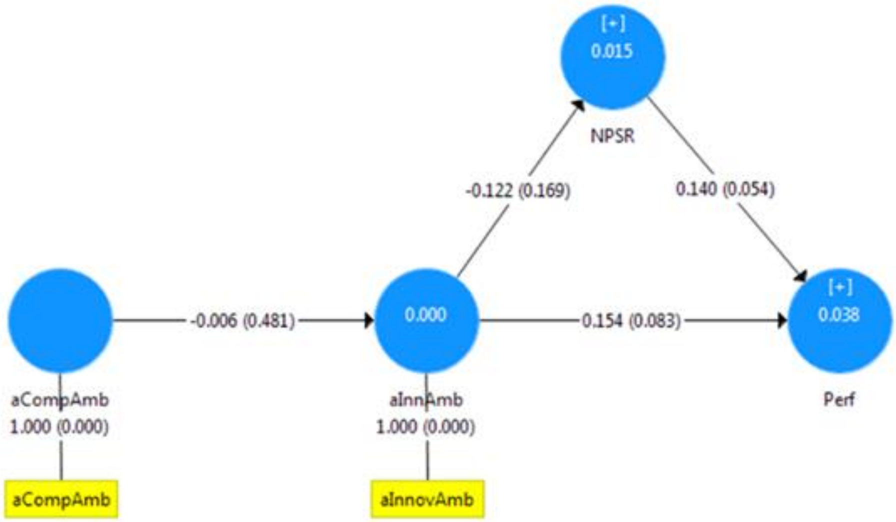


Figure 7.12 Robust test using aCompAmb, and aInnAmb consequence Model C.

Using the additive composite competence and innovation ambidexterity constructs, aCompAmb and aInnAmb respectively, changes the path from competence ambidexterity to innovation ambidexterity to one of negligible effect and non-significance. Remaining paths are comparable to those associated with the multiplicative composite approach rendering both consequence models highly correlated.

Overall, antecedent Model A2 and consequence Model C that employ the additive composite ambidexterity approach are highly correlated with the Models A2 and C of the current study that employ the multiplicative ambidexterity approach.

7.12.2 Multiplicative combined dimension ambidexterity approach (2 dimensions)

mEE = (Exploit*Explore) = multiplicative combined dimension

mIR = (Incremental*Radical) = multiplicative combined dimension

Using the Exploit*Explore combined dimension is often referred to as the multiplicative approach in the literature, but often it does not include a balance dimension. Here it is referred to as the two-dimensional mEECD for competence ambidexterity and mIRCD for innovation ambidexterity.

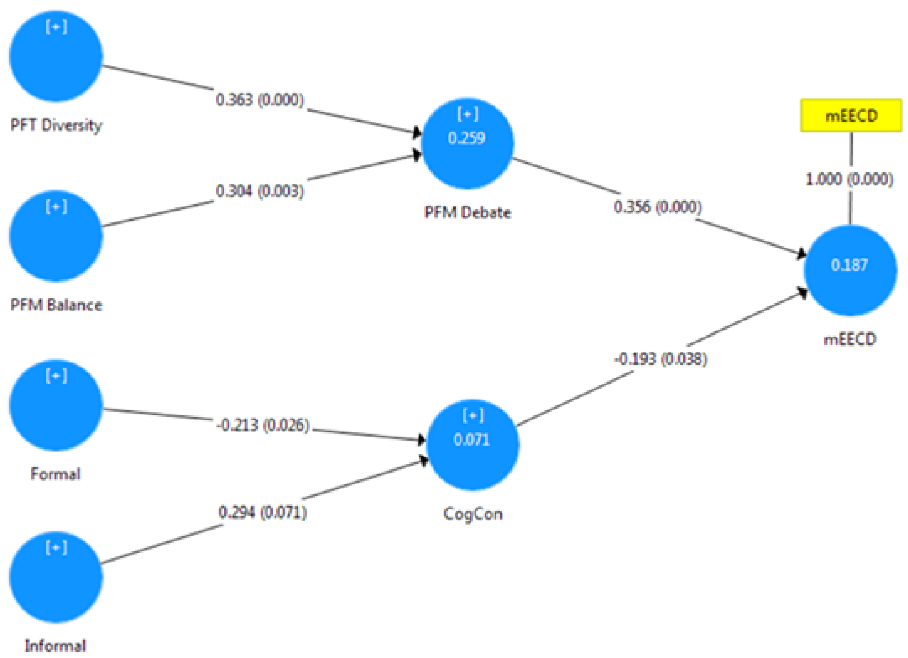


Figure 7.13 Robust test using multiplicative combined dimension (mCD), in the alternative antecedent Model A2

Replacing the ambidexterity construct with the Exploit*Explore combined dimension gives highly comparable results to the mCompAmb model findings except that some path coefficients (ß) are at stronger and significance levels are higher.

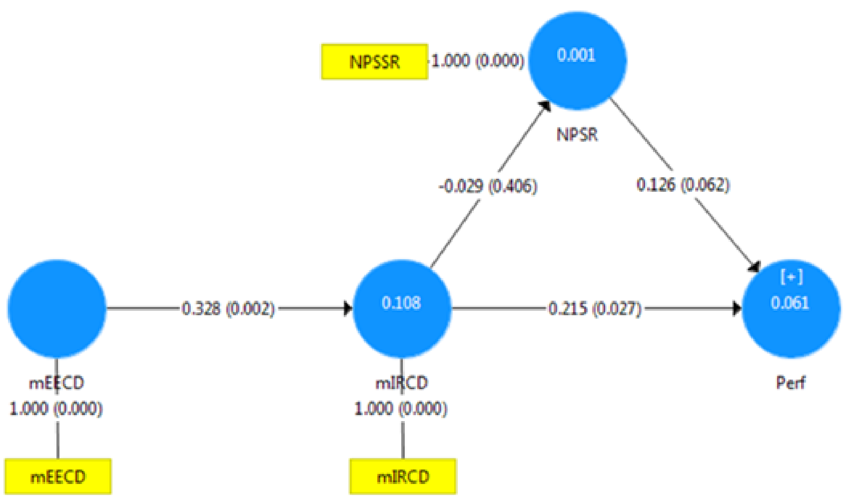


Figure 7.14 Robust test using multiplicative combined dimensions (mEECD & mIRCD), in the consequence Model .C

Findings are attractive as all path coefficients are higher and 3 show higher levels of significance. This may be misleading as it lacks consideration of the balance dimension that is demonstrated in the literature as highly relevant to ambidexterity.

7.12.3 Additive combined dimension approach (2 dimensions)

aEE = (Exploit+Explore) = additive combined dimension

aIR = (Incremental+Radical) = additive combined dimension

Some studies in the literature use the Exploit+Explore combined dimension is referred to as the additive approach in the literature, but again, it may not include a balance dimension. Here it is referred to as the two-dimensional aEECD for competence ambidexterity and aIRCD for innovation ambidexterity.

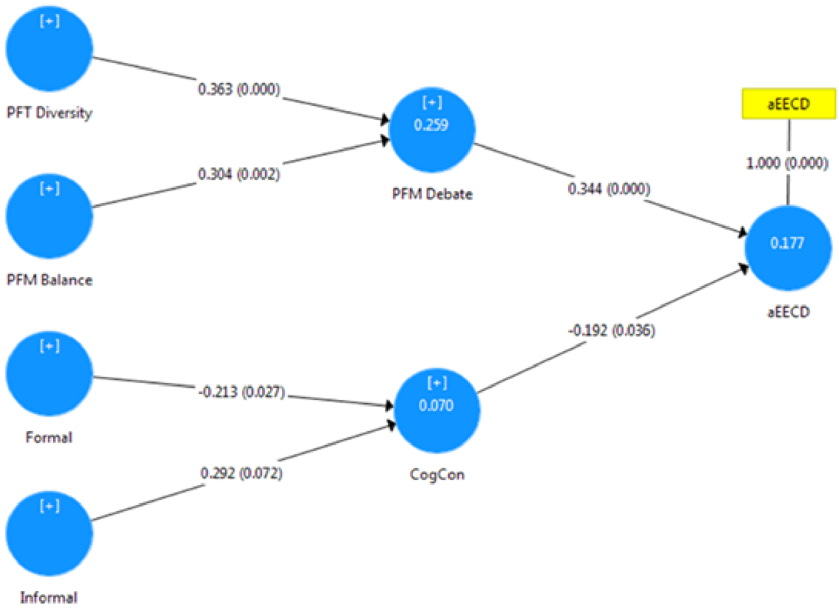


Figure 7.15 Robust test using additive combined dimension (aEECD), in the *alternative* antecedent Model A2.

Similarly to the previous use of the two dimensions combined construct to measure ambidexterity, the Exploit+Explore combined dimension gives highly comparable results to mCompAmb model findings except that many path coefficients (ß) are at higher values and significance levels are stronger.

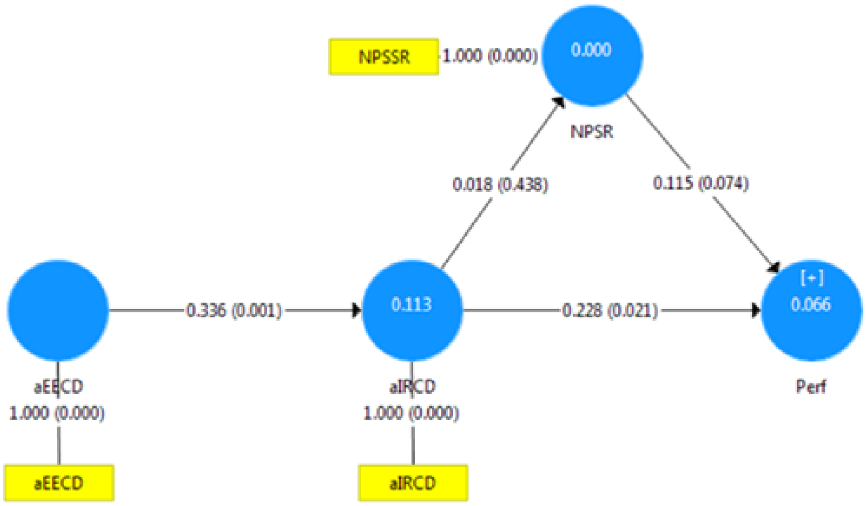


Figure 7.16 Robust test using additive combined dimensions (aEECD & aIRCD), consequence Model C.

In this consequence model, using the Exploit+Explore combined dimension to measure competence ambidexterity, and the Incremental+Radical combined dimension to measure innovation ambidexterity, gives stronger path coefficients in three instances. All levels of significance are higher. However, this model fails to measure NPSR arising from innovation ambidexterity. Findings may be limited because of the lack of consideration of the balance dimension that has been shown in the literature to be so relevant to ambidexterity.

7.12.4 Balance, a single dimension approach (BD)

Bal EE = (Exploit-Explore) = absolute difference namely the Balance Dimension

Bal IR = (Incremental-Radical) = absolute difference namely the Balance Dimension

Everything in the models associated with the 'restricted' operationalisation of ambidexterity that only use the balance metric, is altered. Formerly positive paths turn negative. Formerly significant paths become non-significant and non-significant paths become significant. This suggests a highly limited and restricted way of measuring ambidexterity (Figure 7.17, Figure 7.18).

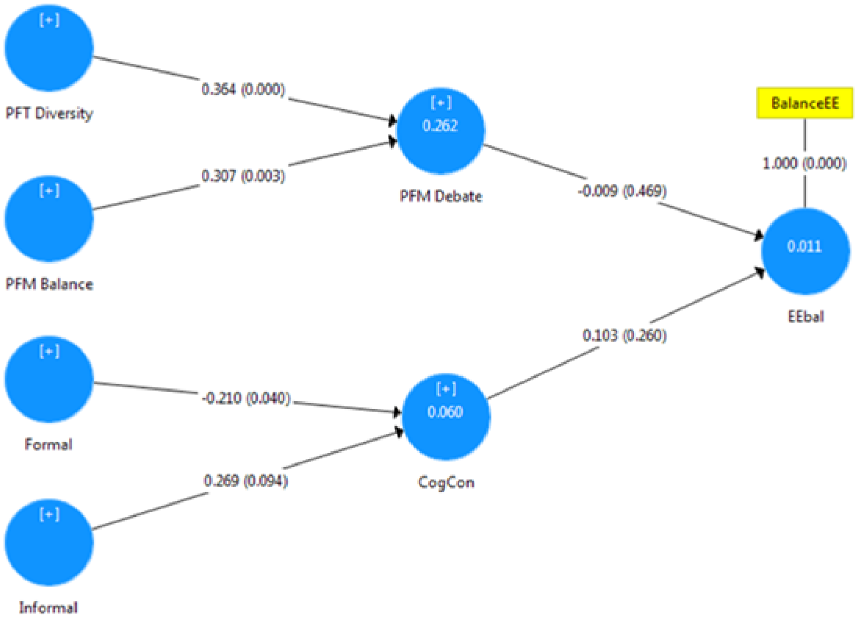


Figure 7.17 Robust test using the balance dimension in the alternative antecedent Model A2.

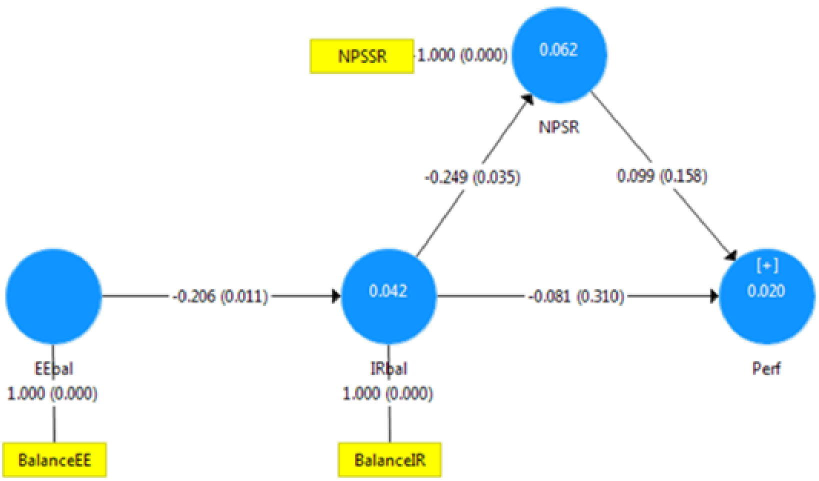


Figure 7.18 Robust test using the balance dimension in the consequence Model C.

7.13 Chapter summary

This chapter presented findings from an analysis of the useful responses of 77 respondents who partake in new product project portfolio selection (NPPS) in the high technology industry in Ireland. Findings led to the development of two models that help explain the roles of performance measures, debate, conflict, functional diversity and meeting forum, in the management of competence ambidexterity.

These models were identified as antecedent and consequence models for competence ambidexterity, namely antecedent Model A2 (the final, improved antecedent model), and consequence Model C, for competence ambidexterity.

These models were used to examine the hypothesised relationships in the generation of competence ambidexterity and its consequences, thus addressing research objectives two and three. In summary and adding to the literature on ambidexterity, portfolio management, conflict and management accounting, analyses reveal a number of interesting findings; the generation of debate based on a certain PMS design (PM-balance) by a group of individuals of diverse functional backgrounds (PFT-diverse), supports competence ambidexterity; informal meetings drive cognitive conflict, but are only based on one-to-one discussions; formal meetings are associated with reduced levels of cognitive conflict; cognitive conflict has negative effects on competence ambidexterity and informal meetings are implicated in these effects, finding that merit further research. Overall, the findings indicate that performance measurement systems (PMSs) and a diverse group of individuals play key roles in driving ambidextrous intentions (competence ambidexterity) that can lead to ambidextrous outcomes (innovation ambidexterity); and empirical evidence is provided for a positive association between innovation ambidexterity and performance outcomes. The next chapter discusses the findings presented here and links them with the interview findings presented in Chapter:4. A summary list of hypothesised relationships associated with antecedent and consequence models of ambidexterity is presented below.

- H1+ is supported. PM-balance is positively and significantly associated with PM-debate.
- H2+ is supported. PT-diversity is positively and significantly associated with PM-debate.
- H3+ is amended to an alternative AltH3+or redirected hypothesis which is supported; i.e. PM-debate is positively and significantly associated with competence ambidexterity.
- H4+ is rejected. Cognitive Conflict is negatively and significantly associated with Competence Ambidexterity.
- H5+ is rejected. Formal meetings are negatively and significantly associated with cognitive conflict.

- H6- is rejected. Informal Meetings are positively and significantly associated with cognitive conflict.
- H7+ is accepted. There is a positive and significant association between increasing competence ambidexterity and innovation ambidexterity.
- H8+ is supported. Increasing innovation ambidexterity is associated with increasing outputs of performance in terms of market share, sales growth and financial metrics.
- H9- is rejected. As innovation ambidexterity rises, a negative trend is indeed found in the output rate of successfully selected new products. However, the effect is not found to be significant.
- H10+ is supported. It indicates that increasing success in selection for an ambidextrous product portfolio is associated with increasing business unit performance.

Chapter:8 **Discussion**

'It is managements responsibility to ensure that the innovation measurement systems are designed properly and in good working order; the company's future depends on it'

(Davila et al., 2015, p. 177).

8.1 Introduction

This chapter discusses the findings reported in preceding chapters. It evaluates and interprets these findings and reflects upon how they answer the research question, fulfil the research objectives, and how the findings fit relative to the existing body of knowledge. The chapter is organised as follows.

It begins with a reiteration of the overarching research question and the study's intentions. It then provides a summary of its findings by the way of a Table briefly outlining the findings from the analyses of antecedent Model A2 and consequence Model C (Table 8.1). The chapter continues with a detailed discussion by theme and underlying issues. This discussion compares the findings with the extant literature, it relates the findings to the theoretical underpinnings of the study, and it offers opinions and explanations compared with expectations. The chapter concludes with a short discussion based on alternative conceptualisations and operationalisations of ambidexterity.

8.2 Research question and research objectives

The overarching research question asks: '*What role do performance measurement systems (PMSs) and related organisational factors (tensions, debate, conflict, functional diversity) play during NPPS in the achievement and outcome of an ambidextrous portfolio?'*

As in previous chapters, the research objectives of the study are reiterated early in the chapter.

<u>Research objective 1.</u> Analyse NPPS in high technology industry (HTI) to identify key stakeholders and explore organisational constructs relevant to ambidexterity.

<u>Research objective 2</u>. Test hypothesised relationships to derive a model of specific organisational antecedents of competence ambidexterity in NPPS.

<u>Research objective 3</u>. Test hypothesised relationships to derive a model of specific consequences of competence ambidexterity in NPPS.

8.3 Summary of the research findings

This study investigates and finds roles for performance measurement systems (PMSs) and other organisational factors (tensions, debate, conflict, functional diversity, meeting forum), in supporting portfolio ambidexterity in the paradoxical setting of new product portfolio selection (NPPS). It examines the implications of competence ambidexterity for innovation ambidexterity and for performance. More specifically, the study explores the design and use of PMSs that drive NPPS decisions. It examines how the inherent tensions of a balanced PMS and of ambidexterity and are consequently managed during NPPS. Furthermore, it examines how formal and informal controls may be implicated in NPPS decisions. Findings are summarised in the form of two models which depict the antecedents (alternative antecedent Model A2) and the consequences (consequence Model C) of competence ambidexterity in the setting of NPPS (already presented in the previous chapter in Figure 7.2 & Figure 7.8) and presented in this chapter by Figure 8.1 and Figure 8.2. A summary Table 8.1 links the hypotheses and associated paths of these models. The findings are then discussed in two parts in line with each model.

Table 8.1 Findings from analyses of antecedent Model A2 & consequence Model C

Hypothesis	**Structural path**	***Path ß***	***p* value**	Significance	Hypothesis (A or R)
H1	**PM Balance --> PM Debate**	0.30	0.00	***	Accept
H2	**PT Diversity --> PM Debate**	0.36	0.00	***	Accept
Alt H3+	**PM Debate --> mCompAmb**	0.35	0.00	***	Accept
H4+	**CogCon --> mCompAmb**	-0.16	0.09	*	Reject
H5+	**Formal --> CogCon**	-0.21	0.03	**	Reject
H6-	**Informal --> CogCon**	0.30	0.07	*	Reject
H7+	**mCompAmb --> mInnAmb**	0.16	0.10	†	Accept
H8+	**mInnAmb --> Perf**	0.19	0.03	**	Accept
H9-	**mInnAmb --> NPSR**	-0.10	0.01	**	Accept
H10+	**NPSR --> Perf**	0.14	0.00	***	Accept

Key: A=accept, R=reject. †p=0.1, *p<0.10, **p<0.05, ***p<0.01. (One-tailed bootstrap for hypothesised associations). PM=performance measures; PM-debate=debate centred on performance measures; PT=portfolio team; CogCon=cognitive conflict; mCompAmb=competence ambidexterity using multiplicative approach (m); mInnAmb=innovation ambidexterity operationalised by the multiplicative approach; NPPS=new product selection success rate; Perf=performance. Alt=alternative.

8.4 Discussion based on the antecedent Model A2

This section is based on the organisational factors and associated hypotheses relating to the antecedents of competence ambidexterity. A reminder of this model is presented in Figure 8.1.

8.4.1 PM-debate and competence ambidexterity

This study provides evidence of a direct and significant positive influence on competence ambidexterity by debate focussed on performance measures (PMs). This relationship was originally unanticipated as it was expected that PM-debate would generate cognitive conflict in the pursuit of competence ambidexterity (Bedford et al., 2019). Instead, the effect of PM-debate on cognitive conflict is found to be very small, negative and non-significant. Accordingly, and following guidance from Nitzl (2016), the alternative antecedent Model A2 (below) is proposed. It reveals that PM- debate shows a highly significant, direct and positive relationship with competence ambidexterity. This finding demonstrates that PM-debate is a new antecedent for competence ambidexterity.

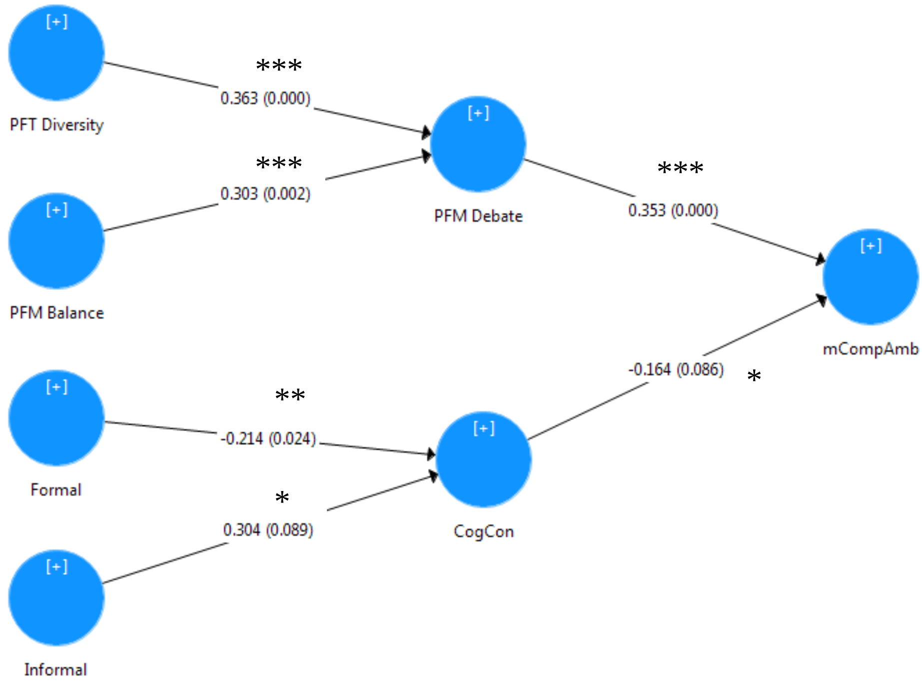


Figure 8.1 Antecedent Model A2. The antecedents of competence ambidexterity.

Path coefficients (*ß*) on the line, path significance values (*p*) in brackets. **p*<0.10, ***p*<0.05, ****p*<0.01. PFT=portfolio team; PFM=performance measures; CogCon=cognitive conflict; mCompAmb=competence ambidexterity derived by the most commonly used operationalisation, the multiplicative method (m).

This study, set in the context of NPPS, finds that high technology companies are more likely to achieve competence ambidexterity where higher levels of debate based on a balanced design of performance measures, prevail. This is in line with Bedford, Malmi & Sandelin (2016) and Dekker et al. (2013) who find that firms in pursuit of innovation strategies use accounting information that incorporates broad scope measures. Further, it aligns with findings by Bedford et al. (2019) who show that balancing the measures between those that support short term innovation and those that make longer-term innovation visible encourages debate based on the contradictory performance measures. The debate is aroused because of the tensions associated with the coexistence of measures that make simultaneously oppositional demands. Bourne et al. (2005, p. 386) find that the main drive for performance comes from 'continual interaction with the performance data.' This debate and its verbal exchanges are deemed most important for the consideration of exploration, as the actions associated with exploration tend to be more nuanced and more difficult to convey except through argumentation, robust exchanges and attention to alternative considerations (Bedford, 2015; Bedford & Malmi, 2015). Chenhall & Moers (2015) indicate the importance of demanding opposing strategies to encourage 'both/and' rather than trade-off 'either/or' decisions, as exploitation and exploration decisions are needed to achieve competence ambidexterity (Papachroni et al., 2016, 2015; Smith & Tushman, 2005). Such lively exchanges of different opinions and perspectives through PM-debate allow for the communication of implicit as well as explicit knowledge that is required to expose and appreciate the contradictory demands of ambidexterity and pave the way to drive competence ambidexterity. Indeed, Atuahene-Gima (2005) argue that if there is no interaction, there will be no innovation.

8.4.2 A balanced PMS (PM-balance) and PM-debate

This study provides evidence that a balanced PMS designed to comprise contradictory measures, fuels debate when employed during NPPS. The design pertains to the explicit choice of measures incorporated into a company's PMS to support its specific strategies (Bisbe & Malagueño, 2012; Chenhall & Langfield-Smith, 2007). PM-balance describes a design that integrates mixed and diverse contents in a way that balances effort towards exploration and exploitation simultaneously (Bedford et al., 2019). PM-balance is important for firms pursuing ambidexterity because many performance measures commonly used in innovation management 'tend to incentivise incremental innovations at the expense of radical innovations (Bedford et al., 2019, p. 32; Bedford, 2015; O' Reilly & Tushman, 2013; Neely, 2005; Eccles, 1991). A more balanced PMS helps protect against the natural tendency toward exploitation, that is needed to achieve competence ambidexterity. Indeed, Dekker et al. (2013, p. 72) explain that companies in pursuit of a mixed strategy, and especially those operating in more challenging, uncertain environments as exemplified by today's technology companies, must 'design more comprehensive and complex PMSs that are aimed at balancing effort.' Recent literature explains that the relative proportion of PM-radical to PM-incremental, namely PM-balance, is important for ambidexterity because it makes opposing strategies visible through the 'dynamic tension' it creates (Curtis & Sweeney, 2017, p. 314; Bedford, 2015). These authors explain that a consistent set of measures in support of **either** exploitation **or** exploration encourages behaviours consistent with **either** exploitation **or** exploration. It is only when a PMS is designed to pursue contradictory agendas, such as opposing types of innovation, that the dynamic tensions of exploitation **and** exploration emerge as countervailing forces that can support ambidexterity (Curtis & Sweeney, 2017). This study provides evidence that a balanced PMS (PM-balance), is instrumental in exposing contradictory tensions and arousing debate based on those opposing measures.

In line with Hall (2010, p. 308), the accounting information contained within a balanced PMS, is 'not merely exchanged verbally but [can] serve(s) a more fundamental role in prompting the discussions that take place.' Vaivio (2004) also refers to the provocative role of performance measures in deliberately maintaining controversy at the local level. The literature contends that the dynamic tensions between the long and the short-term are felt by this balanced representation of measures that support opposing strategies. The balanced PMS (PM-balance) provides the trigger for intense communication (PM-debate) to address its competing strategies and 'simultaneously achieve competing objectives' (Bedford et al., 2019, p. 32). During NPPS therefore, PM-balance provides the cue to NPPS teams members to make certain NPD selection choices that can provide for the long *and* the short term needs of a balanced NPD portfolio. In other words, the discourse based on alternative and opposing measures, forces the NPPS team to face the inherent and paradoxical tensions of the balanced-PMS and attempt to make NPD project selection decisions of opposing NPD project types, in response. These findings contribute to the innovation ambidexterity, portfolio and management accounting literatures in producing empirical evidence of PM-balance as an antecedent of PM-debate, PM-debate as an antecedent of competence ambidexterity, and PM-debate as a mediator in the relationship between the PMS guiding NPPS and the achievement of competence ambidexterity.

8.4.3 Team diversity and debate

Findings from the qualitative interviews reveal that the teams which make NPPS decisions comprise a group of members from a diverse range of functional backgrounds and experiences. Interviews also reveal that members of these teams are not averse to conducting lively debate when they meet to make NPPS decisions. Consistent with this, the survey results show that the diversity of the portfolio selection team is positively associated with PM-debate. This suggests that the greater the team diversity, the more debate that is fuelled over the contents of the PMS.

Prior studies have shown that when individuals come together, they bring their individual experiences and knowledge borne of 'different backgrounds, competencies and perspectives' to the group (Ditillo, 2004, p. 306). Indeed, Boland Jr & Tenkasi (1995, p. 351), purport that teams represent a 'community of knowing' and are especially important to 'knowledge-intensive firms' (p.350), and in dynamic environments where fast responses are needed. These are all characteristics of the high technology industries included in the current study. The aforementioned authors continue to explain that teams of specialised knowledge workers i.e. of different functional backgrounds, facilitate 'a process of distributed cognition' in which multiple specialists 'interact to create the patterns of sense-making' in an environment that is 'too varied and complex for an individual to understand in its entirety' (Parayitam & Dooley, 2011; Ditillo, 2004; Boland Jr & Tenkasi, 1995, p. 351). Such peer-to-peer collaboration and dialogue is exemplified in the PM-debate observed among diverse NPPS teams, in the current study. It suggests that a rich dialogue arises and that the perspectives and views of individuals are shared within the group as they grapple to make sense of the complex PM system directing their decisions. These findings add another antecedent of PM-debate to the literature in the form of PT-diversity, thereby contributing to the innovation ambidexterity and portfolio literatures in producing empirical evidence that PT-diversity is an antecedent of PM-debate, and, that PM-debate acts as a mediator in the relationship between a diverse NPPS team and the achievement of competence ambidexterity.

8.4.4 Cognitive conflict and competence ambidexterity

This study provides new insights to the literature on cognitive conflict. Contrary to expectations, and in the context of new product portfolio selection, cognitive conflict reveals a significant (at the $p = 0.1$ level) but negative effect on competence ambidexterity. This adds interesting observations to a field that has produced mixed and inconsistent findings to date regarding cognitive conflict. Furthermore, and also contrary to expectations, cognitive conflict does not depend on debate for its relationship with competence ambidexterity.

Early qualitative interviews and later survey responses from this study confirm that cognitive conflict (Amason, 1996; Jehn, 1995) arises during NPPS. Cognitive conflict describes issue-based, constructive handling of disagreements between individuals. Given that NPPS involves senior managers, it is anticipated that they would have the experience, maturity and skills to see value in discussing conflicting ideas and opinions in a respectful, constructive manner (De Wit et al., 2011). Indeed, cognitive conflict is lauded in the main to improve decision-making (Parayitam & Dooley, 2011; Cosier et al., 1991). De Dreu (2006) also impresses the relevance of cognitive conflict to successful innovation outcomes. Indeed, Smith et al. (2010) and Smith (2014) suggest that top management teams (TMTs) must embrace conflict to be able to manage the paradoxical tensions which are inherent to the pursuit of ambidexterity. However, the association between cognitive conflict and competence ambidexterity is found to be negative in the current study.

Furthermore, recent research conducted within TMTs by Bedford et al. (2019) demonstrates a significant and positive role for cognitive conflict in achieving competence ambidexterity and its outcomes. More specifically, these authors find that cognitive conflict is driven by debate (based on a balance PMS) that triggers cognitive conflict and then leads to competence ambidexterity. Yet, contrary to these authors' findings and this study's hypothesis, and in the context of product portfolio selection, this study shows cognitive conflict acts independently of PM-debate and furthermore, increasing levels of cognitive conflict are associated with reducing levels of competence ambidexterity.

As previously alluded to above and in the earlier literature review in chapter two, the cumulative previous research has produced some mixed findings associated with cognitive conflict and performance outcomes. Perhaps the phenomenon called groupthink Janis (1972) in Cosier et al. (1991) is responsible. Groupthink has been associated with teams that become more agreeable over time because its members become too familiar with each other. Members do not question each other's opposing opinions or beliefs as thoroughly as in the past, and instead reach a desired consensus with little task based or cognitive conflict (Lunenburg, 2012). However, this explanation seems highly unlikely within seemingly mature, highly experienced teams involved regularly in dynamic cross-functional collaborations.

Context is offered in the literature as another reason for negative outcomes associated with cognitive conflict. For example, De Dreu & Weingart (2003, p. 741) found that 'conflict had stronger negative relations with team performance in highly complex (decision making, project, mixed) [compared with] less complex (production) tasks.' The present study is set in a highly complex and dynamic context where markets are constantly changing, products become obsolete in a matter of months rather than years, customers are increasingly demanding, and competitors are constantly challenging. These contextual factors may be responsible for the negative relationship in this study between cognitive conflict and competence ambidexterity. On the other hand, De Wit et al. (2011) qualify the negative findings of the De Dreu & Weingart (2003) study. They suggest that the negative effects of cognitive conflict on group outcomes is likely due to moderators such as 'type of conflict, type of outcome, correlation between task and relationship conflict, organisational level, and how variables are operationalised and measured' (De Wit et al., 2011, p. 382). Accordingly, these authors find a positive association between cognitive conflict and group outcome within senior management teams, and when performance is measured in alternative ways.

A final consideration is the possibility that the level of cognitive conflict in the current study demonstrates the curvilinear response. Previously, research has suggested that as it rises, cognitive conflict shows a curvilinear u-shaped effect indicating a negative influence at low and at high levels of its use (Parayitam & Dooley, 2011; Lillis & Veen-Dirks, 2008; De Dreu, 2006; De Dreu & Weingart, 2003). 'At low and high levels of cognitive conflict, the teams are less productive than at moderate levels' (Parayitam & Dooley, 2011, p. 352). Inadequate levels of cognitive conflict among teams, they say, leads to poor assimilation of diverse perspectives as there is inadequate engagement and processing of task relevant information. This results in poor decision quality, poor decision commitment and ultimately, less effective teams. At the other extreme, excessive cognitive conflict leads to dysfunctional outcomes when increasing conflict spills into personality clashes, stress, interpersonal tension and decreasing levels of trust and consequently poor outcomes (De Dreu & Weingart, 2003; Simons & Peterson, 2000). However, testing for a curvilinear relationship (quadratic effect in PLS-SEM) in the current study (Figure 7.9, Figure 7.10, Appendix B, Table 10), failed to show significance. Moreover, the levels of cognitive conflict were reduced during formal meetings and therefore, could not have been excessive. Notwithstanding these findings**,** this study finds a negative antecedent effect by cognitive conflict on competence ambidexterity and the next section provides a plausible explanation related to informal meetings which may also be relevant in explaining the inconsistencies in the current body of conflict literature.

8.4.5 Meeting forum and cognitive conflict

'Our understanding of the structures and processes of informal control is rudimentary at best' (Tucker, 2019, p. 222). A combination of interview and survey findings in the current study reveals that NPPS decision-making is affected by two types of meeting forum; the formal, scheduled, group or team meetings such as NPPS meetings, identified in the current study as F in the model; and informal, impromptu, one-to-one meetings that are conducted independently of formal sessions, and are termed IF in this study. Both types of meeting forum contribute to overall NPPS decision outcomes. This study finds that each meeting forum has opposing effects on cognitive conflict. This is in line with findings recently reported by Tarba, Jansen, Mom, Raisch & Lawton (2020) that formal and informal meetings can work at cross purposes with each other. However, contrary to hypothesised expectations, formal meetings are associated with reduced levels of cognitive conflict whereas increased levels of cognitive conflict are associated with the informal forum which involved one-to-one interactions. Since cognitive conflict is strongly associated with decision quality (De Wit et al., 2011; Parayitam & Dooley, 2009; Amason, 1996), but negatively associated with competence ambidexterity in the current study, findings suggest that the meeting forum in which the conflict arises has bearings on the decisions reached, which consequently impacts ambidexterity. Meeting forum is thus identified as an antecedent of cognitive conflict. Further, these findings may explain the subsequent negative effects of cognitive conflict on competence ambidexterity discovered in this study's context. To try and explain these findings a return to the literature is merited, despite the fact that most of accrued knowledge is based on formal controls (Sitkin et al., 2020; Tucker, 2019).

8.4.6 Informal v formal meeting forum and cognitive conflict

Cardinal et al. (2017) suggest that informal mechanisms begin when individuals decide who to approach based on an individual's reputation or on trust built through previous social encounters. Inter-personal relationships develop and grow stronger through interdependence and joint problem solving, so that future informal meetings become more likely. Other authors agree that informal communications arise when a good relationship exists between individuals (Tucker, 2019; Stouthuysen, Slabbinck & Roodhooft, 2017; Chenhall et al., 2011), and where there is 'trust, a sense of goodwill and recognition of others' capabilities' (Dekker, 2004, p. 31). Interviewees in the current study reported that informal meetings take place regularly at their workplace and more notably, they occur in advance of formal meetings. Hall (2010) states that most numerical data appear to be passed by word of mouth *first*, and that formal reports serve to remind managers of what was transmitted orally. He continues to report that 'managers use these verbal contacts to easily bypass formal organisation charts and seek information from those people who have it, rather than wait for information to arrive from formal channels' (Hall, 2010, p. 307). This is important because it suggests that these informal, one-to-one, non-scheduled meetings influence outcomes of NPPS at formal meetings. Further, informal meetings appear to stimulate discussions based on disagreements as cognitive conflict rises in association with IF meetings. This indicates that it is in the informal meeting forum rather than during formal meetings that individuals air the disagreements they harbour over NPD portfolio decisions. Indeed, the disagreements may become resolved through the informal sessions leading to fewer disagreements arising during the formal meetings. Perhaps there are issues related to trust or management that prevent or reduce cognitive conflict during formal meetings. Whatever the reason, reduced levels of cognitive conflict are associated with formal meetings.

Interestingly, while researchers acknowledge that managers have strong preferences for verbal communication (Tucker, 2019), Hall (2010) contends that managers involved in complex decision making that is shrouded in uncertainty, depend heavily upon interpersonal verbal communication. So it comes as no surprise that senior managers faced with difficult new product selection decisions, and faced with challenging and contradictory performance expectations and uncertain futures, might veer towards interpersonal communications generally, and more specifically to one-to-one informal communications with respected colleagues. Hall (2010) goes to great pains to stress that the usefulness of accounting information is not solely related to its written form but is highly dependent on whether and how managers use it in their verbal communications. More closely related to the current findings, this author suggests that problems or issues which are raised by managers during verbal communications may facilitate the tailoring of accounting information to address issues those particular managers deem important. This could explain how informal meetings might allow individual managers to alter another's anticipated objections through cognitive conflict that takes place on a one-to-one basis. Handling disagreement (conflict) in an informal way could persuade others to a certain way of thinking that is managed in advance of the formal group meeting. This may explain the reduced levels of cognitive conflict found during the formal NPPS meeting sessions. Accordingly, Hall (2010, p. 307) contends that 'managers work with accounting information to make it relevant, rather than its relevance being determined solely by its content.' This may indicate that decisions associated with informal meetings are more powerful and more subjective than decisions derived during formal meetings. Informal meetings may have other implications such as one individual's decision-making preferences dominating another's (Kester et al., 2011) and subsequently the group's collective decision-making. This type of cognitive conflict may, therefore, negatively impact competence ambidexterity if it focusses on a functional specialist's agenda rather than what is best for all functions and by extension, what is in the best interests of the organisation. Indeed, a recent article by Randall et al. (2017) cautions that ambidexterity may be lost if informal meetings allow previously agreed decisions to be subsequently altered.

8.4.7 Informal & formal processes in NPD literature

This study finds that the cumulative effects of informal and formal meetings on cognitive conflict during NPPS is that cognitive conflict impacts competence ambidexterity outcomes negatively. In their recent paper in NPD, Mc Nally et al. (2013, p. 245) report that ‘nearly half of initial new product ideas are chosen to advance through the NPD pipeline via informal processes.’ These authors report that senior managers are considerably influential in making selection decisions and that their dispositional or personality traits affect portfolio decisions. Barczak et al. (2009, p. 9) concur adding ‘though formal portfolio decision-making processes have been put in place at many firms, initial idea selection (comparable to an NPD project) still seems to be a very political and champion-based activity.’ Authors agree that non-formal settings are found to be more conducive to incremental rather than radical product selections (Mc Nally et al., 2013; Barczak et al., 2009; Chao & Kavadias, 2008). Barczak et al. (2009) add that radical product idea selections require specific prompting by a wide variety of people in formal settings, in contrast to the requirements of incremental product idea selections. Perhaps these factors explain why the cognitive conflict arising during informal one-to-one meetings, is negatively associated with competence ambidexterity. Perhaps more exploitative than explorative activities are pursued in decisions made during informal meetings, which corresponds to more incremental than radical new products being supported for development. This product type imbalance is incongruent with competence ambidexterity outcomes.

Furthermore, the decisions made at formal meetings by a team, where cognitive conflict is reduced as found in the present study, are likely to be deprived of the in-depth evaluation and exchange of opposing views associated with moderate levels of cognitive conflict within a team of diverse functional specialists (Parayitam & Dooley, 2011). This is the type of cognitive conflict needed in ambidextrous settings (Bedford et al., 2019; Smith, 2014). Together these findings may explain the negative relationship found in this study between cognitive conflict and competence ambidexterity. In previously published studies on cognitive conflict generally, and on cognitive conflict and ambidexterity specifically, the type of setting or forum in which cognitive conflict arose was not reported. The findings from the current study may explicate the inconsistent findings in the extant conflict literature. If cognitive conflict arises in an informal, one-to-one setting, the decisions made may be less appropriate for the overall organisation and may explain the negative influences on competence ambidexterity. If those informal meetings dominate in portfolio selection decisions, as suggested during qualitative interviews and shown statistically by effect size during survey data analysis, this study demonstrates that informal meetings are associated with poorer competence ambidexterity outcomes.

According to Kester et al. (2011, p. 644), ‘three types of processes interact in portfolio decision-making; evidence-based, power-based and opinion-based.’ Informal meetings may allow ‘power-based and opinion-based’ portfolio decision-making processes to dominate over ‘evidence-based processes.’ The latter centres on facts and is viewed as objective, rationally based decision-making. Politics impacts power-based decision-making and opinion-based decision making is viewed as subjective and depends on managerial intuition, which itself is influenced by an individual’s experiences, leadership style, and trust for example. If one-to-one informal meetings allow politics and personal preferences to dominate during decision-making, it may explain the negative cognitive conflict-competence ambidexterity relationship. Afterall, Kester et al. (2011, p. 651) suggest that the effectiveness of portfolio decision-making is based upon a balanced interaction between all three types of processes. Sitkin et al. (2020, p. 352) suggest that ‘control researchers have focused primarily on the perspectives of controllers while often ignoring the role that controlees play in how controls are developed, deployed, and enacted in organisations.’ Evidence in the current study points to the need for research on conflict and competence ambidexterity, to examine the role played by the forum in which controlees or individuals meet, and its effect on decision making.

8.5 Discussion based on the consequence Model C

This section discusses consequences of competence ambidexterity as represented by Model C, in Figure 8.2.

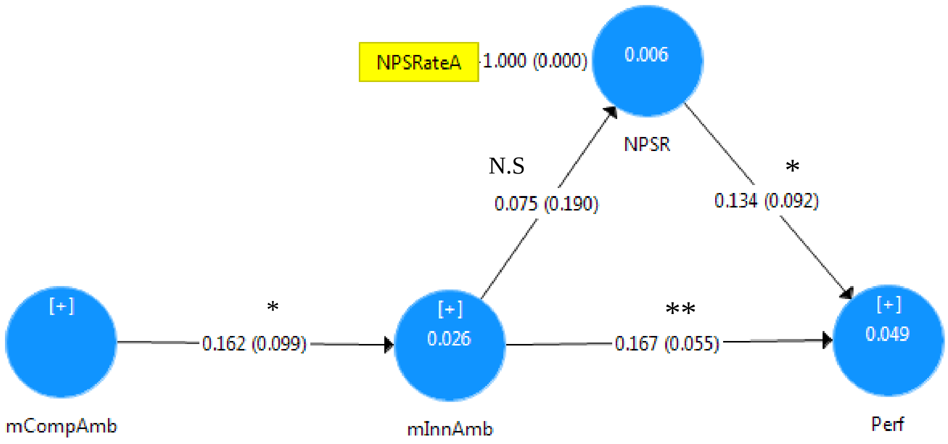


Figure 8.2 Model C. The consequences of competence ambidexterity.

Key: Path coefficients *(ß)* on the line, path significance values (*p*) in brackets. *p<0.10, **p<0.05, ***p<0.01 (One-tailed bootstrap for hypothesised associations). R square values on endogenous constructs. mCompAmb=competence ambidexterity derived by the most commonly used operationalisation multiplicative method (m); mInnAmb=innovation ambidexterity operationalised by the multiplicative method (m); NPSR=new product selection success rate; Perf=performance. NS=Not significant.

8.5.1 Competence ambidexterity and innovation ambidexterity

This study finds a positive and marginally significant association between competence and innovation ambidexterity. In other words, where competencies for ambidexterity are established, innovation ambidexterity outputs of radical and incremental innovation products are successfully realised.

The literature on organisational ambidexterity recognises that managers' 'cognitive preferences for certainty' (Bedford et al., 2019, p. 25) can lead to exploitation and the crowding out of exploration. If this occurs during NPPS it translates to a bias toward more incremental product innovations than radical ones. The current study suggests that NPPS teams are able to make NPD selection decisions that include radical and incremental innovations. This is important as the literature contends that for the opposing demands of competence ambidexterity to be realised, individuals must transcend its competing polarities (Papachroni et al., 2015; Jarzabkowski, Lê & Van De Ven, 2013; Smith & Lewis, 2011). The NPPS team members may be demonstrating a paradoxical mindset that makes them successful in achieving innovation ambidexterity (Papachroni et al., 2015; Smith, 2014; Andriopoulos & Lewis, 2010). The paradox approach moves from decisions based on 'either/or' thinking central to the trade-off approach, to one that embraces 'and/both' thinking (Andriopoulos & Lewis, 2009) otherwise known as the orthogonal approach. The literature on product portfolio management emphasises the need to 'balance' the product pipeline or product portfolio (Eling et al., 2016; Eling, Langerak & Griffin, 2015; Eling, Griffin & Langerak, 2014; Mc Nally et al., 2013; Andriopoulos & Lewis, 2009; Barczak et al., 2009; Cooper & Kleinschmidt, 1995b). The current research study suggests that NPPS and a paradoxical mindset that embraces new product ideas of opposing strategies simultaneously into the NPD project portfolio, are central to the development of project portfolio ambidexterity. The study extends the influence of paradox on competence ambidexterity into the domain of new *product portfolio selection* to encourage an ambidextrous innovation portfolio.

8.5.2 Performance implications of innovation ambidexterity

Innovation ambidexterity has a positive association with performance in this study which measured financial and non-financial measures of performance. The literatures on innovation and strategy management stress the need to 'simultaneously develop discontinuous and incremental innovations (…) for sustainable superior performance' (Lennerts, Schulze & Tomczak, 2020; Kortmann, 2015, p. 666; Junni et al., 2013). Most studies in ambidexterity focus on why and how to develop competence ambidexterity and link these to performance improvements. Fewer studies follow through on the link to financial and non-financial performance outcomes from both competence ambidexterity and innovation ambidexterity, in a single study (Solís-Molina, Hernández-Espallardo & Rodríguez-Orejuela, 2018; Raisch & Birkinshaw, 2008). The current study examines competence ambidexterity, innovation ambidexterity and performance outcomes in a single study and it provides unique empirical evidence that innovation ambidexterity positively influences performance in the context of NPPS.

Performance, based on reported self-perceptions of performance against expectations for market share growth, profit growth, sales growth, and overall performance in the previous twelve months, was assessed in this study. Positive associations were demonstrated against all performance measures. These results indicate that when companies successfully achieve innovation ambidexterity, innovation ambidexterity helps them to sustain and improve their current product markets (increasing sales growth) while simultaneously creating new product markets (increasing market-share and profit growth), rendering them more flexible and responsive to competitive and market dynamics (Simsek et al., 2009; O' Reilly & Tushman, 2008), and more resistant to future challenges (Lennerts et al., 2020).

Kester et al. (2011, p. 643) argue that 'only 3 pieces of research have empirically investigated overall [project] portfolio performance,' and that the work of Cooper et al. (2001) represents a single body of work on product development portfolios, the others being focussed on financial (Eggers, 2006) and theatre studies (Voss, Montoya-Weiss & Voss, 2006). The current study therefore contributes unique empirical evidence in the product and portfolio innovation literature that shows that if companies respond to the competing demands and select radical and incremental product developments, companies can benefit from potential outcomes of greater sales, higher profitability, and increased market share. The study concurs with findings by Mc Nally et al. (2013) and Cooper et al. (2001) that show a critical role for new product portfolio balance in predicting performance.

Further, researchers in NPD indicate the criticality of 'developing the "right" new products' (Chao & Kavadias, 2008, p. 907) for firm success. Davila et al. (2015, p. 147) profess the necessity to tailor measurement systems to a 'portfolio's mix of incremental, semi-radical and radical innovation' or suffer negative performance consequences. More recently, new product portfolio management is exalted in linking a firm's success and longevity to a portfolio or group of the right new products being concurrently developed (Mc Nally et al., 2013; Kester et al., 2011). Barczak et al. (2009) explain that unbalanced portfolios lead to less successful outcomes. Furthermore, Cooper and his colleagues have advised over many years that portfolio success depends upon the portfolio simultaneously developing a mix of incremental and radical new products (Cooper, Edgett & Kleinschmidt, 2002; Cooper et al., 2000, 1999; Cooper, Edgett & Kleinschmidt, 1997b; Cooper et al., 1997a). More latterly, the term ambidexterity is creeping from the organisational into the innovation literatures. Kortmann (2015) examines the impact of top managers' ambidextrous oriented decision-making on innovation ambidexterity. Wang & Rafiq (2014, p. 58) impress the importance of ambidexterity for new product and organisational long-term success 'particularly in high-tech firms operating in a dynamic environment.' The current study confirms the hypothesised relationship between competence and innovation ambidexterity having positive effects on the NPD portfolio and organisational performance. This is in line with former studies in organisational ambidexterity (Junni et al., 2013; Lin et al., 2013; Lubatkin et al., 2006; Gibson & Birkinshaw, 2004; He & Wong, 2004), and makes the argument stronger to foster ambidexterity in NPD and portfolio management.

8.5.3 New product success rate

Based on Eling et al. (2016), the study measured the rate of new product successes associated with a NPD portfolio and their contribution towards performance. It proposed that as the levels of innovation ambidexterity associated with the product portfolio rise, a corresponding decrease in new product success rate ensues because the increased proportion of radical to incremental product developments would take longer to develop. Further, it expected that the performance of the new products released from an increasingly ambidextrous portfolio would rise due to the increase in value associated with a greater proportion of radical-type products. Analysis of findings identifies a negative trend between innovation ambidexterity and new product success rate as expected. However, the relationship is small and non-significant. On the other hand, the relationship between NPSR and performance is significant at the 0.1 level. This suggests that a positive relationship between outputs of an ambidextrous NPD portfolio and overall performance, strengthens the cause for NPD portfolio ambidexterity.

8.6 The paradox perspective

Overall, these findings support the thesis that a paradoxical approach is critical to managing the conflicting yet interrelated agendas that form part and parcel of managing ambidexterity (Bednarek, Paroutis & Sillince, 2017; Smith et al., 2017; Papachroni et al., 2015; Smith, 2014; Jarzabkowski et al., 2013; Lin et al., 2013; Andriopoulos & Lewis, 2010; Eisenhardt et al., 2010; Lewis et al., 2002). First, there is the purposeful design of a balanced or paradoxically designed PMS that comprises measures which support exploitation, alongside measures that make exploitation's polar opposite, exploration, important. Next, the incorporation of functional diversity among teams who make product portfolio selection decisions encourages debate based on the PMS and its inherent, paradoxical demands. NPPS team members faced with these paradoxical demands employ a paradoxical approach by supporting exploitation and exploration competences shown by the achievement of portfolio ambidexterity. Further, the findings demonstrate the successful translation by study firms of competence ambidexterity into innovation ambidexterity in the form of an ambidextrous portfolio. This demonstrates a paradoxical approach again as it shows that NPD selection choices of opposing innovation type are made for the NPD portfolio since it comprises radical and incremental new products. Moreover, the findings relevant to cognitive conflict and its newly identified antecedents, namely formal and informal meeting forum, present another paradox. These antecedents are found to have opposing effects on cognitive conflict and extend the literature on cognitive conflict by showing how the forum in which conflict takes place impacts cognitive conflict and has important implications for competence ambidexterity. The paradox of formal and informal control and its relationship with conflict and ambidexterity merits further study. Overall, the discussion draws upon the combined literatures on competence and innovation ambidexterity, paradox, social conflict, portfolio management and the effects of PMSs on decision-making. These theoretical underpinnings have helped to inform a deeper understanding of competence ambidexterity in the context of NPPS, and the corresponding paradoxical interrelationships with PMSs, debate, conflict, functional diversity, and meeting forum.

8.7 Conceptualisations and operationalisation of ambidexterity

The body of research in ambidexterity reveals inconsistencies in the conceptualisation and operationalisations of ambidexterity (Wang and Rafiq, 2014; Lavie et al. 2010; Cao et al. 2009). All agree that ambidexterity is a dyad of explore/exploit or radical/incremental. Where disparity arises is how the two are viewed in combination and then on how this disparity is measured.

First there is a split between those who see ambidexterity existing as a continuum and those who believe ambidexterity exists orthogonally. As a continuum, changes in the level of one dimension (e.g. exploitation) causes changes in the opposite direction for the alternative dimension (exploration) (Luger et al. 2018; Rogan and Mors 2014; Uotila et al. 2009). Thus, as explorative activities rise, exploitative ones decrease. Followers of this approach deem that the sweet spot for ambidexterity is in the middle of the line where levels of each are identical and ‘balanced.’ However, this suggests a fifty-fifty split is optimal and leaves no room for situations in which it has been shown that greater or lesser amounts of either are preferable. This view is in line with the trade-off, ‘either/or’ approach to ambidexterity. The predominant view and that of this author, determines the second approach, that ambidexterity exists orthogonally (Jansen et al. 2006;2009; Cao et al. 2009; Lubatkin et al. 2006; Lavie and Rosenkopf, 2006; He and Wong, 2004). The orthogonal view sees both dimensions acting independently of each other, yet, coming together in complementary and reinforcing ways. This is akin to a paradox and explains the use of the paradoxical lens in this study and in the examination of ambidexterity. Ambidexterity is achieved by optimal levels of both exploration and exploitation (Simsek, 2009; Jansen et al. 2012) and is viewed more in terms of a 'juggling' rather than a 'balancing' act. Ambidexterity is about responding dynamically to changing markets so that levels of exploitation relative to exploration are never static or fixed. The optimal levels of each is contingent on context and organisational circumstances (Smith, 2014; Andriopoulos & Lewis, 2010).

Furthermore, there are fundamentally different operationalisations of ambidexterity in the literature that make comparisons with earlier literature difficult, and further make extant findings questionable in light of the discrepancies that exist. Also, there is ambiguity in the use of the construct balance, and a lack of clarity in interpreting where it is used. For example, some researchers understand competence ambidexterity as a combination of explore/exploit sub-dimensions and operationalise the combined dimension in one of two ways; by addition (Lubatkin et al. 2006; Simsek 2009) or by multiplication (Jansen et al. 2006; 2009; 2012; Lin et al. 2013; He and Wong, 2004; Gibson and Birkinshaw, 2004). Other researchers view ambidexterity as the difference between levels of exploit/explore. More specifically they operationalise this as the absolute difference between explore and exploit, named the balance dimension of ambidexterity by Cao et al. (2009). The majority of the extant literature measures ambidexterity by the multiplicative combined operationalisation. Lavie et al. (2010) acknowledge that additive, multiplicative and relative approaches lead to results that are sensitive to the modelling choice. Junni et al. (2013) examine both combination dimensions and the balance dimension separately finding that 'the performance effects are stronger when "combined" measures of organisational ambidexterity and perceptual performance are used' (p.301). In line with Lin et al. (2013, p.276) who state, 'high on both [exploitation and exploration] is better than balanced, and simultaneous is better than sequential,' the multidimensional and synergistic composition of ambidexterity is better recognised. Subsequently, Bedford et al. (2019) report that ambidexterity is achieved ‘only by balancing high levels of exploitation and exploration rather than by attaining balance at any level of emphasis’ (p.28) and they choose to operationalise competence ambidexterity by integrating combined and balance dimensions. This operationalisation is subsequently chosen in the current study as it appears to most closely match what the literature describes as ambidexterity. In all previously reported operationalisations of ambidexterity herein reported, ambidexterity was operationalised as one or other of two dimensions. None, except that of Cao et al. 2009, considered using a ‘package’ operationalisation including the combined and balance dimensions simultaneously. This study responds to calls from Junni et al. (2013) to use both combined and balanced approaches in a single study to allow for direct comparisons between different operationalisations. It shows that results are sensitive to the modelling choice especially in regard to the sole use of the ‘balance’ dimension. It also facilitates determining the degree to which an organisation is able to effectively achieve high levels of both exploitation / incremental innovation and exploration / radical innovation for competitive advantage. After all, Lin et al. (2013, p.276) say ‘it is innovation ambidexterity (…) that has the most direct and significant impact on business performance.’

8.8 Chapter summary

This chapter discussed the empirical findings of the current study in line with the current body of knowledge. It evaluated the findings to answer the overarching research question concerning the role of PMSs and other organisational factors in driving portfolio ambidexterity in the setting of NPPS within the high technology MDI and IT industries.

In addressing the research question from a paradoxical perspective, the study finds a powerful role for a purposefully balanced PMSs (PM-balance) in arousing debate based on the measures and how to respond to their inherent tensions. This debate (PM-debate) is further fuelled by an increasingly functionally diverse NPPS team. PM-debate is found to be critical in supporting competence ambidexterity. Further and interestingly, the study makes new discoveries on cognitive conflict. It finds that cognitive conflict acts independently of debate and has negative implications for competence ambidexterity. Two newly introduced antecedents of cognitive conflict (namely formal meeting forum and informal meeting forum), may have implications for these findings. Perhaps, meeting forum provides a solution for managing competing strategic agendas in this context, which, if not managed carefully, could be damaging to the achievement of ambidexterity. Further research into the microfoundations of the cognitive conflict/meeting forum/ambidexterity relationship is warranted. The chapter continued with a discussion on some consequences of competence ambidexterity, including successful innovation ambidexterity, new product success and positive performance outcomes. The chapter concluded with comments about various conceptualisations and operationalisations of competence and innovation ambidexterity that exist in the current literature and suggests the need for a more coherent conceptualisation across studies.

Chapter:9 **Conclusions, Contributions and Future Implications**

"Most new theory consists of more modest contributions with a variation, modification, or combination of existing theories"

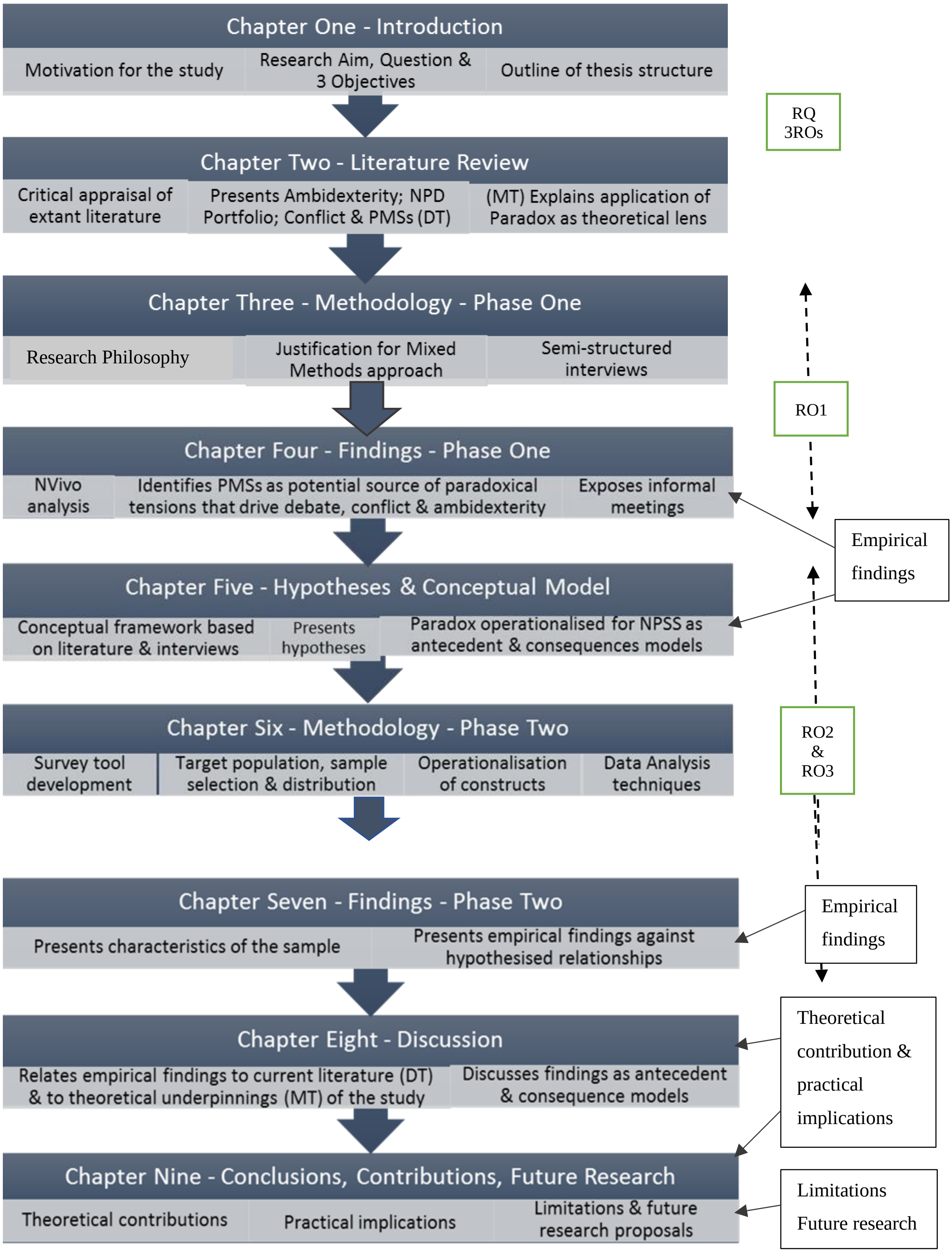
(Makadok, Burton & Barney, 2018, p. 1531).

9.1 Introduction and chapter layout

This chapter begins with a reminder of the overall intention of this research project and the significant gap in knowledge it sets out to fill. It then outlines the research outcomes and discusses how they contribute to theory and to practice. Next it considers limitations associated with the work before it provides ideas for future possible research avenues. It ends with a chapter and thesis summary. The layout of this thesis was illustrated in Chapter one, Figure 1.1. This illustration is reproduced below as Figure 9.1, with additions relevant to the current chapter.

This chapter is laid out as follows; section 9.2 reminds the reader of the overview of the research study that includes its overall aim, its research objectives, and the research approach taken. Section 9.3 provides a summary of the research conclusions (Table 9.1). Next follows a detailed discussion on the study’s theoretical contributions in section 9.4, its managerial contributions in section 9.5, and on its empirical contributions in section 9.6. Section 9.7 discusses the limitations of the study, section 9.8 outlines avenues for future research, and section 9.9 provides a short summary of the contributions. Section 9.10 brings this research study to its conclusion.

A diagrammatic representation of the thesis follows on the next page in Figure 9.1.



Key: DT = Domain Theory; MT = Method Theory; RO = Research Objective RQ =

Figure 9.1 Diagrammatic representation of the thesis

9.2 Overview of the research study

9.2.1 A reminder of the study's research aim

This research study sets out to identify if and how performance measurement systems (PMSs) and associated organisational factors, play roles in driving ambidexterity and performance in high technology organisations. The study opens with the introduction in chapter one, and acknowledges the high dependency of the vast majority of organisations on innovation to create value and to sustain viability and profitability. It highlights that markets and technologies are becoming increasingly advanced and sophisticated, and that these changes place increasing pressure on organisations to maintain competitive advantage through further innovation, in order to survive into the future. A comprehensive literature review, presented in chapter two, reveals that a certain type of innovation, namely innovation ambidexterity, achieved through what is termed competence ambidexterity (Cao et al., 2009; Smith & Tushman, 2005; He & Wong, 2004; March, 1991), is the Holy Grail of innovation as it protects companies' current and future assets. The literature further emphasises that competence ambidexterity is especially relevant to enable flexibility and responsiveness in turbulent ever-changing environments, as exist in today's high technology industry (HTI); the current day Covid-19 pandemic providing an example of the unpredictability and uncertainty that continually challenges companies, markets and individuals. However, despite lauding its achievement as critical, even crucial to organisational success and ongoing survival (Lennerts et al., 2020; Andriopoulos & Lewis, 2009; Duncan, 1976), the literature simultaneously recognises the many obstacles in achieving ambidexterity, not least due to its paradoxical nature. This study is driven by the need for a deeper understanding of the microfoundations of ambidexterity, the need to identify specific organisational factors, some of which are ubiquitous in organisations but given insufficient attention about how they interrelate, and support or hinder the achievement of ambidexterity, in highly innovative companies operating in dynamic environments.

The current study therefore responds to specific calls in the literature for research to (a) seek further knowledge on how ambidexterity is enacted (Martin, Keller & Fortwengel, 2019; Turner et al., 2015), (b) to understand how companies manage strategic dualities in practice (Birkinshaw et al., 2016; Papachroni et al., 2016; Lin et al., 2013), (c) to address questions posed about the way decisions are made to explain how some companies are more ambidextrous than others (Birkinshaw & Gupta, 2013; O' Reilly & Tushman, 2013), (d) to provide research on the mechanisms and agency associated with balancing exploration and exploitation at various levels of analysis (Lavie et al., 2010; Simsek et al., 2009) and (e) to learn how leaders manage the fundamental tension between efficiency [incremental innovations] and flexibility [radical innovations]' (Bedford et al., 2019; Eisenhardt et al., 2010, p. 1263), to support competence ambidexterity. More specifically, the study examines the design and use attributes of PMSs employed during NPPS, alongside factors that include functional diversity, debate based on the PMS, cognitive conflict and meeting forum, and studies their implications for the achievement and consequences of NPD portfolio ambidexterity. Employing the lens of paradox (for its 'both/and' approach), the study builds and tests a model of performance measurement systems and associated organisational factors that impact ambidexterity in the context of new product portfolio selection (NPPS).

9.2.2 A reminder of the study's research objectives

Three specific research objectives are set for this research study.

Research objective 1. Analyse NPPS in the high technology industry (HTI) to identify key stakeholders and explore organisational constructs relevant to ambidexterity.

Research objective 2. Test hypothesised relationships to derive a model of specific antecedents of competence ambidexterity in NPPS.

Research objective 3. Test hypothesised relationships to derive a model of specific consequences of competence ambidexterity in NPPS.

9.2.3 A reminder of the study's research approach

The study takes a positivist, functionalist philosophical approach and uses a mixed methodology design. This approach and the adoption of the paradox lens are deemed appropriate because of the socio-technical nature of NPPS, the paradoxical nature of ambidexterity, and the lack of previous research that examines NPPS through this lens, as explained and justified in chapter three. The methods used to gather and analyse research in phase one are also presented in chapter three. Chapter four provides an in-depth description of the qualitative findings. These findings identify key but unclear roles, for organisational factors (e.g. a diverse set of measures including financial and non-financial measures, a multifunctional selection team, debate, cognitive conflict and meeting forums), in guiding NPPS, and in the attainment of and the consequences for ambidexterity. Based on a combination of these interview findings and the literature, ten hypotheses are developed in chapter five. These hypotheses propose antecedent and consequence models of competence ambidexterity, and these two models are tested during the quantitative, second research phase. Chapters six and seven describe in detail the methods used and findings derived from the quantitative study. Findings produce an antecedent and a consequence model for competence ambidexterity that describe how PMSs and aforementioned organisational factors impact ambidexterity in the context of NPPS. Chapter eight provides a discussion based on the overall findings and a comparison with the extant literature. Chapter nine concludes this body of work, it highlights research contributions, research limitations and it provides suggestions for future avenues of research.

9.3 Research conclusions

Conclusions of this research are outlined briefly, summarised in Table 9.1, and presented graphically through the antecedent model and consequence model of competence ambidexterity, namely Model A2, and Model C, formerly presented as Figure 8.1, and Figure 8.2, in the previous chapter.

The study examines performance measurement systems (PMSs) and associated organisational factors to test their implications for innovation portfolio ambidexterity. As discussed in the previous chapter, the study concludes that a specifically designed PMS, one that arouses debate based on its contradictory contents, in the presence of a functionally diverse team, all play significant and positive roles in supporting competence ambidexterity during NPPS. On the other hand, the study finds that cognitive conflict acts independently of debate and reduces competence ambidexterity. The study concludes that these unexpected finding are due to the prevalence and dominance of one-to-one, informal meetings impacting negatively on the achievement of competence ambidexterity. The study also finds that competence ambidexterity translates into portfolio innovation ambidexterity, with positive performance outcomes, demonstrating that these high technology companies are able to transcend opposing polarities to achieve innovation ambidexterity (Papachroni et al., 2015; Smith, 2014; Andriopoulos & Lewis, 2010). It concludes that these positive outcomes could be better if the negative consequences associated with cognitive conflict and informal one-to-one meetings are addressed.

Table 9.1 Summary conclusions of the research study

Model	Hypothesis	Structural path	Path significance	Accept/ Reject hypothesis	Conclusions
Model A2	H1+	PM Balance --> PM Debate	***	A	A PMS that comprises measures of mixed & opposing type i.e. PMs which incentivise exploitation & support exploration, arouses debate based on the PMS
	H2+	PT Diversity --> PM Debate	***	A	Increasing functional diversity in the portfolio selection team encourages debate based on a PMS of mixed & opposing measures
	Alt H3+	PM Debate --> mCompAmb	***	A	Debate based on a PMS of mixed & opposing measures supports competence ambidexterity
	H4+	CogCon --> mCompAmb	*	R	Cognitive conflict has negative implications for competence ambidexterity
	H5+	Formal --> CogCon	**	R	Formal meetings are associated with reduced levels of cognitive conflict
Model C	H6-	Informal --> CogCon	*	R	Inormal meetings are associated with increased levels of cognitive conflict
	H7+	mCompAmb --> mInnAmb	†	A	Competence ambidexterity translates into innovation ambidexterity in the setting of NPPS in this study
	H8+	mInnAmb --> Perf	**	A	Innovation ambidexterity improves outcomes of performance
	H9-	mInnAmb --> NPSR	N.S	R	Innovation ambidexterity shows a trend towards reducing the rate of new product success
	H10+	NPSR --> Perf	***	A	As the rate of new product success increases, there is an increase in successful performance outcomes

Key: Model A2=Antecedent Model; Model C=Consequent Model; PMS=performance measurement system; PM=performance measure; CogCon=cognitive conflict; mCompAmb & mInnAmb=multiplicative approach to operationalisations of competence & innovation ambidexterity respectively; Perf=performance; NPSR=new product success rate; A=Accept hypothesis; R=Reject hypothesis; Sig.=Significance; N.S=Not significant.

9.4 Theoretical contributions

The study makes five theoretical contributions to the literature (Makadok et al., 2018) which are outlined next.

9.4.1 A conceptual framework

First, the primary theoretical contribution of this study is the development of a framework that conceptualises NPPS in the form of two models; one that represents the antecedents of portfolio ambidexterity (Model A_2), the other which represents the consequences of portfolio ambidexterity (Model C). While this framework is theoretically grounded in the combined literatures of management accounting, ambidexterity, paradox, conflict, and project portfolio management, it is refined by the interviews with 12 experts in NPPS and the quantitative study of 77 business unit portfolios. The resultant operationalised framework extends the portfolio management and ambidexterity literature by the synthesis of multiple causal mechanisms (a balanced PMS, a functionally diverse team, PM-debate, meeting forum and conflict) in a way that explains how they interact with each other through their antecedent, mediating and consequence relationships. This helps to explain the critical process of NPPS and how portfolio ambidexterity can be supported. The models (Model A_2 & Model C) therefore, serve as theory to explanation (Gregor, 2006; Goldsmith, 2002) and contribute a finer grained understanding of how PMSs and other organisational factors support ambidexterity and improve portfolio and organisational performance (Lennerts et al., 2020; Junni et al., 2013; Andriopoulos & Lewis, 2009; Raisch & Birkinshaw, 2008; He & Wong, 2004). Further, these models answer calls for microfoundational ambidexterity research to more explicitly consider the context in which individuals behave and operate (Martin et al., 2019; Felin, Foss, Heimeriks & Madsen, 2012; Eisenhardt et al., 2010).

9.4.2 Portfolio ambidexterity and Paradox

Second, little research is found in the portfolio management literature that theorises about portfolio ambidexterity or discusses how a paradoxical approach to NPPS may assist in the portfolio-ambidexterity-performance relationship. Existing prior research in the portfolio management literature is relatively diverse and disconnected (Tarba et al., 2020; Meifort, 2016), and, as reported in the literature review chapter two, it emphasises the achievement of portfolio 'balance,' not portfolio 'ambidexterity' (Cooper & Sommer, 2020; Eling et al., 2016; Markham & Lee, 2013; Mc Nally et al., 2013; Kester et al., 2011; Barczak et al., 2009; Chao & Kavadias, 2008). For rare exceptions see Petro (2017); Gurtner & Reinhardt (2016); Wang & Rafiq (2014). The current study applies the paradox approach which advocates balance through 'both/and' rather than 'either/or' decisions, to NPPS. The study achieves portfolio ambidexterity thus extending the paradox literature and the use of a paradoxical framework in achieving portfolio ambidexterity and improved performance outcomes through NPPS. Building further on paradox theory (Miron-Spektor et al., 2018; Smith, 2014), this research shows that ambidexterity requires leaders with the ability to 'cognitively juxtapose contradictions in ways that allow them to embrace rather than deny or avoid these tensions' (Tarba et al., 2020, p. 7; Lin et al., 2013; Andriopoulos & Lewis, 2010) and this fosters organisational ambidexterity.

9.4.3 PMSs, PM-debate and PT-diversity

Third, little or no research is found in the portfolio literature that establishes a relationship between PMSs and portfolio ambidexterity, nor between functional diversity and portfolio ambidexterity. The current study thus extends the portfolio management and the management accounting (MAC) literatures by guiding on the specific design of a more 'balanced' PMS and the use of this balanced design for debate by a multifunctional group of individuals during NPPS, towards the achievement of an ambidextrous portfolio. In the context of NPPS, the contents of a balanced PMS prompts individuals to select both incremental and radical project types for the development portfolio. This minimises a natural tendency or bias towards exploitation. Thus, in NPPS when a group of individuals of multifunctional backgrounds are tasked, simultaneously with the contradictory strategies demanded by a balanced PMS, debate ensues based on the contradictory measures. Multi-functional portfolio selection team members grapple with the explicit competing demands placed upon them by this balanced PMS. This debate is found to be crucial in supporting competence ambidexterity. This study provides evidence that vocal attention in the form of PM-debate is associated with the simultaneous pursuit of exploitation and exploration competences. The necessity for ambidextrous companies to simultaneously explore and exploit (Smith et al., 2010) underlies the importance of a complex and more balanced PMS in NPPS, and its use by a functionally diverse group of individuals to support portfolio ambidexterity. The current research, therefore, adds to the management accounting literature; while the construct PM-debate is a new construct introduced into the literature recently by Bedford et al. (2019), this study contributes two new antecedents of PM-debate, namely PM-balance and PT-diversity; it contributes PM-debate as a new antecedent of competence ambidexterity; and it introduces PM-debate as a mediator in two relationships; that between a balanced PMS and competence ambidexterity, and between a functionally diverse PT and competence ambidexterity. This study also extends the innovation and portfolio management literature with a greater understanding of the roles played by PMSs and a multifunctional group in supporting ambidexterity during NPPS.

9.4.4 Cognitive conflict and meeting forum (formal & informal)

The current study makes a **fourth** important contribution by providing new insights for the literature on cognitive conflict. Extending the emerging discussion on the microfoundations of organisational phenomena (Felin et al., 2012; Eisenhardt et al., 2010), relevant to ambidexterity, and in line with Martin et al. (2019), this study establishes conflict as a microfoundation of portfolio ambidexterity. Further, the current study contributes two new antecedents of cognitive conflict, namely formal meeting forum and informal meeting forum, and it provides a better understanding of portfolio ambidexterity as a social phenomenon between groups of individuals where conflict can be harnessed in more formal settings, to support ambidexterity. This depends on future research that further evaluates the microfoundations of the meeting forum-conflict-ambidexterity relationships.

Former research reported herein has emphasised an important role for conflict in companies wishing to pursue competing strategic agendas such as ambidexterity (Bedford et al., 2019; Martin et al., 2019; Smith et al., 2010; Smith & Tushman, 2005; Vaivio, 2004). Indeed, Smith et al. (2010) emphasise that conflict must be engaged between those seeking to exploit and those who wish to be more innovative (explorative), to achieve ambidexterity. This conflict, when managed well (as issue-based cognitive conflict), ultimately leads to a more comprehensive and unified decision-making that favours ambidextrous outcomes (Bedford et al., 2019; Martin et al., 2019; Smith et al., 2010). However, and surprisingly, the current study concludes that cognitive conflict arising during NPPS, acts independently of PMS-based debate and, more importantly, it negatively influences competence ambidexterity. The current study, therefore, contributes to the literature by adding cognitive conflict as an independent antecedent of competence ambidexterity, and it offers new insights into the association between cognitive conflict and ambidexterity. The study provides an explanation that may be linked to the meeting forum in which conflict arises. Meeting forum is the new construct identified and analysed in the current study. As reported and discussed at length in earlier chapters (7&8), and in the context of NPPS, the current study finds opposing effects on cognitive conflict by meeting forum's variables (formal meeting forum and informal meeting forum). Surprisingly and again unexpectedly, reduced levels of cognitive conflict are associated with formal meeting forums (comprising teams of four or more members) while increased levels of cognitive conflict are associated with informal meeting forums (one-to-one meetings). The implication is that in NPPS, informal meetings are important in managing the disagreements that arise likely due to the contradictions inherent in the pursuit of competence ambidexterity. Moreover, the study suggests that informal meetings play a more dominant role over formal meetings, as a mechanism to manage these disagreements, which consequently impacts negatively on competence ambidexterity. The explanation proffered is that since informal meetings are held on a one-to-one basis, they likely generate cognitive conflict outputs that are based on a narrower, more impoverished singular view, compared with cognitive conflict that arises during formal group meetings. The most dominant view in the extant literature is that cognitive conflict that arises between groups of individuals of varying functionalities is most beneficial to decision-making (De Wit et al., 2011; Parayitam & Dooley, 2011; Lovelace et al., 2001) and to companies facing contradictory agendas such as ambidexterity (Bedford et al., 2019; Martin et al., 2019; Smith et al., 2010). Moreover, product innovation researchers Mc Nally et al. (2013); Barczak et al. (2009), and Chao & Kavadias (2008), advocate that radical new products require prompting by a wide variety of people in a formal setting and Eling et al. (2016), recommends that firms should use more formal processes in selecting new ideas for development to generate the 'balanced' portfolio. This has important implications for future ambidexterity research.

9.4.5 Competence ambidexterity, innovation ambidexterity, new product success & performance

Fifth, this study contributes to the literature on innovation portfolio management. The consequence Model C demonstrates the realisation of portfolio competence ambidexterity into portfolio innovation ambidexterity which describes the tangible performance outputs of radical and incremental products, during NPPS. The study further demonstrates positive performance benefits associated with an ambidextrous portfolio. The ability to achieve innovation ambidexterity, signifies the capacity by the HTI studied in the current study, for successful resolution of the paradoxical challenges therein (Miron-Spektor et al., 2018; Randall et al., 2017; Kortmann, 2015; Smith, 2014; Jansen et al., 2009). Adding to the portfolio management literature, the current study predicts improved portfolio and organisational performances where portfolio ambidexterity is pursued, and portfolio innovation ambidexterity is achieved. Interestingly, the current study also identifies a moderating effect by the study's newly identified construct, meeting forum, on the relationship between competence and innovation ambidexterity (Figure 7.9 & Figure 7.10). In other words, as the prevalence of informal meetings increases, levels of innovation ambidexterity decrease indicating that radical new product choices for the NPD portfolio are replaced by more incremental product choices during NPPS. While the moderating path effect is in the small effect size range it 'does not necessarily imply an unimportant effect' (Chin et al., 2003, p.211). Further investigation in future research on the influence of meeting forum in the achievement and realisation of portfolio ambidexterity is strongly recommended. The meeting forum during which these important NPPS decisions are made, may be compromising the achievement of potentially higher levels of portfolio ambidexterity and overall performance.

9.5 Managerial contributions

To benefit from these theoretical contributions, a number of core practical contributions are made. When managers are selecting innovation projects for investment in the innovation portfolio, they are now advised of the power available to them in four top organisational factors that will assist them in achieving a balanced, ambidextrous innovation portfolio. **First**, they are advised to design a more balanced PMS that supports exploratory as well as exploitative type product innovations, to guide NPPS. It is in this balanced PMS configuration, one that simultaneously demands opposing strategic directions, that the tensions of choice between opposite project innovation types, exist. **Second**, managers are advised to ensure that NPPS decisions are conducted by a diverse, multifunctional group of individuals. This allows the important tensions arising from a balanced PMS, to be experienced by members of the NPPS team tasked with making portfolio selection decisions. Intrinsically linked to this, managers are advised to encourage active and lively debate amongst NPPS team members, during NPPS. Intense debate focussed on the tensions exposed by the balanced PMS, and between individuals with different functional backgrounds, offers benefits in broadening and deepening the scope of individuals' perceptions. Failure to do so is likely to permit cognitive biases and hence NPD selection decisions towards consistency and certainty, thus reinforcing a single type of innovation. The current study shows that this debate is critical to ambidexterity. **Third**, to benefit optimally from these factors and to create a better momentum for ambidexterity, practitioners are advised to be more cognisant of where and how the inevitable disagreements (conflicts) that arise in complex, paradoxical situations such as NPPS, are managed. Radical new product innovations require prompting by a wide variety of people in a formal setting (Bedford, 2015; Bedford & Malmi, 2015; Mc Nally et al., 2013; Barczak et al., 2009; Chao & Kavadias, 2008; Atuahene-Gima, 2005). To this end, leaders are advised to inform employees that having and airing disagreements is not just acceptable but necessary and valued (Parayitam & Dooley, 2009; Amason et al., 1995; Jehn, 1995). They also need to guide conflict management with certain rules of engagement to avoid personality based (affective) conflict, and to actively support issue-based cognitive conflict (Parayitam & Dooley, 2009; Amason, 1996). Further, they are encouraged to promote cognitive conflict during formal NPPS group meetings rather than in one-to-one informal meetings, based on this study's insights about the negative impact posed by conflict arising in one-to-one informal meetings on competence and innovation ambidexterity (Tarba et al., 2020; Tucker, 2019; Randall et al., 2017; Parayitam & Dooley, 2011). This will be challenging. However, if not pursued, this study suggests that a bias towards exploitation and incremental product innovations at the expense of exploration and radical product innovations may prevail. In other words, through informal one-to-one meetings, certain individuals may dominate portfolio selection decisions, making the efforts towards portfolio ambidexterity as directed by a balanced PMS and team diversity, vulnerable.

9.6 Empirical contributions

This study opens the black box on project portfolio selection decisions where little evidence exists in prior literature on what influences the teams making these critical decisions. Empirically, the study makes two broad contributions to the ambidexterity and portfolio management literature. **First**, it provides empirical evidence of ambidexterity in practice in high-tech firms (Wang & Rafiq, 2014). This study contributes unique empirical evidence from the quantitative study of 77 NPPS teams and qualitative research on 12 experts in NPPS, all currently operating in the high technology industry (HTI) in Ireland. This empirical evidence provides what Birkinshaw et al. (2016, p. 52), call a rare but needed 'process study that seeks to understand *how* firms manage strategic dualities in practice.' It thus provides a rich description of organisational factors relevant to the authentic, coalface of NPPS and the ambidexterity challenge. It yields evidence to show that if exploration and exploitation are managed properly, they can be simultaneously complementary to the innovation process within a project portfolio or a business unit context (Simsek et al., 2009; Gibson & Birkinshaw, 2004), rather than behaving as competing activities that must be either structurally separated (Duncan, 1976) or temporally separated (Gupta et al., 2006). It also provides empirical evidence of positive outcomes for firms (Tarba et al., 2020; Solís-Molina et al., 2018; Birkinshaw et al., 2016). The current study answers calls for research on achieving ambidexterity in 'real world contexts' (Martin et al., 2019; Jugend & Da Silva, 2014; Martinsuo, 2013; Turner et al., 2013). Further, this study provides empirical examples of specific measures identified as typically employed during NPPS (PM-incremental and PM-radical; Table 6.6), and provides evidence of the different levels of importance attributed by individuals of different functions, to these measures. As discussed in earlier chapters, critical elements associated with a PMS designed for ambidexterity include a PMS that comprises measures that incentivise incremental innovations with measures that make radical innovations more visible (Bedford et al., 2019; Davila et al., 2015; Davila et al., 2009). As previous management accounting research demonstrates, in the competing strategic setting of ambidexterity, the diversity of measures used in the PMS must be more balanced between measures that support incremental innovations, and those making radical innovations visible, to help protect against a natural bias towards exploitation (Bedford et al., 2019, p. 13; Curtis & Sweeney, 2017).

Second, the study contributes an empirical starting point from which to continue the debate on a future consistent operationalisation and measurement of ambidexterity. The findings extend extant literature that sees ambidexterity's operationalisation as an asymmetric combination of both exploitation and exploration. The current literature essentially considers exploration and exploitation as two different constructs which act independently of one another. Existing literature has most frequently taken the interaction effect (multiplicative) or the additive aggregation of exploration and exploitation, namely a combined dimension, as the proxy for measuring competence ambidexterity (Lennerts et al., 2020; Jansen et al., 2012; Lavie et al., 2010; Simsek et al., 2009; Jansen et al., 2006; Lubatkin et al., 2006; Gibson & Birkinshaw, 2004; He & Wong, 2004). Some researchers use the absolute difference between exploit and explore, namely a balance dimension, to measure ambidexterity (Cao et al., 2009). Junni et al. (2013, p. 301), examine the combination and the balance dimensions separately, finding that 'the performance effects are stronger when "combined" measures of organisational ambidexterity are used. The different conceptualisations and operationalisation of ambidexterity make comparisons with prior literature difficult and make extant findings questionable in light of the discrepancies that exist (Lavie et al., 2010). In line with Bedford et al. (2019, p. 28) who advise that ambidexterity is achieved 'only by balancing high levels of exploitation and exploration rather than by attaining balance at any level of emphasis' this study also operationalises competence ambidexterity by integrating the combined <u>and</u> balance dimensions to recognise the multidimensional (3 dimensions), complementary and synergistic composition of ambidexterity. This study responds to calls from Junni et al. (2013) to employ combined and balanced approaches in a single study to allow for direct comparisons between different operationalisations. This study concludes that results are sensitive to the operationalisation choice especially in regard to the sole use of the 'balance' dimension. It also concludes that the use of combined measures that include all multiplicative operationalisations (excluding the balance dimension), return the most favourable results i.e. path relationship are stronger by weight and in level of significance. It would benefit the field of ambidexterity research if a consistent approach was taken in future research as it would facilitate more reliable comparisons between studies.

Third, the study offers empirical support for using a mixed methods approach in research. The new construct identified in this research, namely meeting forum, emerged during phase one qualitative study. The second quantitative research phase permitted a more detailed analysis of the construct which identified its two constituent variables (formal and informal meeting forum) as antecedent variables of cognitive conflict. The unexpected, highlighted and discussed opposing effects of these antecedents on cognitive conflict and ambidexterity in NPPS, offer, arguably, the most valuable contribution in the current study.

9.7 Summary contributions

Table 9.2 Summary contributions

Contribution to literatures of	Contribution
Innovation & Portfolio Management, Management Accounting, Organisational Conflict Management, Ambidexterity & Paradox literature	An antecedent Model A_2 that provides a better understanding of NPPS & specific organisational factors relevant to the development of an ambidexterous portfolio
	A consequence Model C that contributes a better understanding of the performance outcomes associated with an ambidexterous portfolio derived during NPPS
	Evidence that a PMS specifically designed & used for intense debate can support portfolio ambidexterity with consequential positive performance outcomes
	New insights on cognitive conflict including a new antecedent construct (meeting forum) that influences ambidexterity
	Contributes support for the paradox approach in supporting project portfolio ambidexterity
	Contributes to the debate on a consistent conceptualisation & operationalisation of the ambidexterity construct
	Contributes to the credibility & value of the mixed method approach by identifying a new construct in one phase of study, namely meeting forum, that is examined further in the second phase

This research has provided valuable insights into a highly paradoxical setting. These insights should assist scholars and practitioners in managing strategic dualities in general and ambidexterity in particular and should help secure more stable future performances for innovation-dependent organisations.

This study provides unique empirical evidence and a better understanding of organisational mechanisms that guide ambidexterity. It highlights factors that are important in determining how organisations achieve a balanced product portfolio during new product portfolio selection and it makes important contributions to the extant literature and to practice as follows; First, the study contributes to the literature in innovation ambidexterity and portfolio management by enhancing our knowledge about the enablers and consequences of competence ambidexterity in NPPS. In this regard the study provides antecedent and consequence models that identify and provide a deeper appreciation of the organisational factors, namely a balanced PMS, a diverse, multifunctional team, debate, conflict and meeting forum, and their inter-relationships in facilitating and realising competence ambidexterity. Second, the study extends the paradox literature showing that a paradoxical approach is pivotal in supporting portfolio ambidexterity. Third, the study extends the management accounting literature and finds a crucial role for a balanced PMS employed for lively debate during NPPS, in achieving portfolio ambidexterity. Fourth, new insights are provided for the literature on cognitive conflict. Two new antecedents are introduced, namely, formal and informal meeting forum and these are shown to have contradictory effects on cognitive conflict. Further, and unexpectedly, cognitive conflict behaves differently in the context of NPPS and it negatively impacts competence ambidexterity. Informal meeting forum may be implicated and help in explaining the mixed and inconsistent findings associated with cognitive conflict and ambidexterity in existing literature. Fifth, the portfolio management and ambidexterity literatures are enriched with evidence from this study that NPPS can enable portfolio ambidexterity, and that portfolio ambidexterity supports positive innovation ambidexterity and performance outcomes. Based on these theoretical learnings, practitioners are first advised of the potential available to them in the balanced design of the PMS they use to guide NPPS, to support portfolio ambidexterity. Second, practitioners are encouraged in the proactive use of debate based on the balanced PMS, among a multifunctional team tasked with making NPPS decisions, to promote ambidexterity. Third, practitioners are cautioned to be prepared for the conflict likely to arise during NPPS between different functional specialists, and to carefully orchestrate this conflict during formal meeting forums. Otherwise, this study suggests that unresolved conflicts will be managed through informal one-to-one meetings which are found to negatively impact ambidexterity in NPPS. Lastly, the study in the Irish HTI, provides rare empirical evidence of ambidexterity in a real-world context, answering calls for more practitioner-based research. Moreover, empirical findings contribute support for the mixed methods research design by uncovering a new construct in one study phase that is further studied in a latter study phase. Finally, unique, empirical comparisons between five different conceptualisations and operationalisations of ambidexterity in a single study, serve to promote the debate on a more consistent approach to measuring ambidexterity that will make future studies more amenable to comparison.

9.8 Limitations of the research

The conclusions of this study need to be interpreted cautiously in light of some potential limitations. First, given the limited size of the sample employed and its restriction to technology companies based in Ireland, it is not possible to infer generalisability to the entire HTI nor to other industries. However, using a relatively homogenous, Ireland based sample (high technology firms), the sample did not suffer from economic or governmental discrepancies that might have affected results of a multi-industry and/or international sample.

Second, the impact of common method bias (CMB), on survey findings cannot be ruled out, although several steps were taken to reduce the likelihood of this. Firstly, data were collected using interviews in advance of the survey and many of the findings were consistent between the two methods. Further, since this study interviewed senior managers from multiple disciplines (e.g., marketing, R&D, CEO, operations, finance) it produced multiple perspectives minimising cumulative subjectivity (Miles & Huberman, 1994; Patton, 1990). Furthermore, steps were taken to reduce the likelihood of CMB in the quantitative study phase; anonymity was offered, common scale formats were reduced, selected items in the survey were reverse coded, close attention was paid to wording, succinct instructions were provided for survey completion, items of constructs were separated throughout the questionnaire and extensive pre-tests of the survey instrument were conducted (Podsakoff et al., 2003; Kline, Sulsky & Rever-Moriyama, 2000). In addition, a statistical analysis employing Harman's (1976) single factor test was conducted on the survey items used to form the constructs. The unrotated principal component's analysis returned twenty-four components. The variance accounted for by the first unrotated factor captured only 14% of the variance suggesting that single-source bias is not a significant concern.

Third, it is possible that other variables not included in this study may have inadvertently influenced the results. However, the study controlled for the most likely ones such as company/team size as a proxy for resources availability and environmental dynamism. Furthermore, the triangulation of empirical findings by the combined use of qualitative and quantitative methods has likely also improved the validity and reliability of this research's findings (Venkatesh et al., 2013; Modell, 2005). As an example, the discovery in the qualitative phase of the current study that informal meetings take place on a one-to-one basis and impact NPPS, proved invaluable. It directed a deeper examination of this construct during the second research phase that led to unexpected and interesting new findings regarding debate, conflict and ambidexterity.

Limitations notwithstanding, this inquiry has shed light on a more fine-grained determination of the drivers and decisions behind a more balanced, ambidextrous innovation portfolio in highly innovative companies that are competing in challenging environments.

9.9 Future research proposals

Based on conclusions from this research, some future research is proposed. First, based on existing and continuing evidence that ambidexterity is associated with longevity for innovative companies (Lennerts et al., 2020; Chen, 2017; Randall et al., 2017; Meifort, 2016; Papachroni et al., 2016), an investigation could explore if competence ambidexterity is currently part of these organisations' culture and is supported within the corporate strategy of these highly innovative companies, and if not, future research could explore the leading barriers to its implementation.

Second, PMSs are ubiquitous in decision-making, and this study provides important insights into the role of PMSs in the support of ambidexterity. Future research could examine additional attributes of accounting (e.g. different proportions of financial to non-financial measures; relative importance of various measures for portfolio balance; preferences for certain measures by certain functions; reliability of different measures for certain purposes) and additional control practices that may be important for achieving competence and innovation ambidexterity. Furthermore, intense debate based upon performance measures is advocated as critical to enabling competence ambidexterity by the current study. Future research might explore how different levels of debate intensity and levels of engagement by individuals of different functional backgrounds, impact competence ambidexterity.

Third, future research could consider longitudinal case studies to extend and complement the current findings. This could prove difficult especially in highly regulated industries which are historically slow to share industry knowledge. However, the potential insights provided by an in-depth investigation of the dynamics of the relationships identified in the current study could generate further insights for managing complex strategic uncertainties into the longer-term.

Fourth, more research is needed into the forum in which meetings take place to elucidate a more granular or microfoundational understanding of its influences on cognitive conflict. For example, a qualitative study might investigate if factors such as trust, pressures of time, or motivation may explain the reduced levels of cognitive conflict associated with formal meetings and the increased levels of cognitive conflict associated with informal meetings. The decision-making literature advocates that cross-functional collaborations and cognitive conflict drive better quality decisions, better acceptance of the decisions and better decision implementation outcomes (De Wit et al., 2011; Parayitam & Dooley, 2011; Mooney et al., 2007; Amason, 1996). Since the most recent publications in NPD and portfolio literatures recommend a return to more formal than informal decision-making processes for improved performance (Eling et al., 2016; Mc Nally et al., 2013; Barczak et al., 2009), it would seem a timely research agenda.

Finally, the current study is not focused at the level of the individual. However, individuals face tensions and paradoxical situations every day. A paradox perspective (Smith & Lewis, 2011), provides a useful orientation to managing paradoxical tensions (Birkinshaw et al., 2016). Studying the impact of organisational ambidexterity on individual decision making over time offers opportunities for researchers to examine how individuals identify and accept paradoxes with the passage of time. This could create a significant opportunity to observe and manipulate their mental models (Jones, Ross, Lynam, Perez & Leitch, 2011) along with their behavioural responses to these tensions. This could prove an exciting avenue for future research.

9.10 Chapter and thesis conclusion

This study highlights the value in studying management accounting more holistically as a 'package' that combines formal and informal controls which may 'complement each other, operate as substitutes, or act in opposition' depending on place and time (Tucker, 2019, p. 219). This study brings management accounting, ambidexterity and paradoxical thinking into the innovation portfolio literature, and it provides empirical evidence of ambidexterity in the unique and paradoxical setting of NPPS. Further, the study enhances our understanding of specific enablers and consequences of competence and innovation ambidexterity. It concludes that NPPS is the key to driving portfolio ambidexterity and it confirms leading roles for PMSs, debate, team diversity and the careful management of disagreements (conflict) that arise during the NPPS process. The study demonstrates that competence ambidexterity supports innovation ambidexterity outcomes with associated performance benefits. The capability to simultaneously explore and exploit helps organisations to reconfigure existing assets and capabilities as they face change (Wang & Rafiq, 2014; Eisenhardt et al., 2010; Teece, Pisano & Shuen, 1997). Competence ambidexterity proves vital in the face of changing markets and technology. Without it, path dependence dynamics or structural inertia drive organisations toward continued successful exploitation, and, consequently, toward failure. Once again O' Reilly & Tushman (2013, p. 330) write most eloquently with their advice that; 'the long-term survival of the firm is the sine qua non of organisational ambidexterity.' This study demonstrates how the management of PMSs, and specific organisational factors, contribute towards portfolio ambidexterity to support successful portfolio and organisation performance.

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Appendix A Supplementary to Research Methods

Appendix A, Table 1 Early coding

Name		Sources	References	Created On	Created By	Modified On	Modified By
Balance		9	29	01/11/2017 20:57	COD	13/12/2017 17:21	COD
Conflict		1	1	01/11/2017 12:46	COD	03/01/2018 16:15	COD
Culture		7	12	18/11/2017 17:22	COD	14/12/2017 14:19	COD
Customer		4	17	17/11/2017 16:22	COD	13/12/2017 17:12	COD
Decision-making		5	14	01/11/2017 12:47	COD	13/12/2017 17:40	COD
Don't know		7	10	01/11/2017 21:36	COD	13/12/2017 17:15	COD
Dynamism		5	12	01/11/2017 19:20	COD	13/12/2017 17:15	COD
Exploitative innovation		8	23	01/11/2017 12:44	COD	13/12/2017 17:40	COD
Exploratory innovation		7	33	01/11/2017 12:43	COD	13/12/2017 17:48	COD
Funtional Role		11	29	31/10/2017 19:43	COD	13/12/2017 17:48	COD
Irrelevant		10	30	17/11/2017 20:02	COD	13/12/2017 17:48	COD
Leadership		4	9	01/11/2017 21:16	COD	13/12/2017 16:23	COD
Markets		3	3	20/11/2017 18:12	COD	13/12/2017 17:40	COD
Organisation		1	2	24/11/2017 16:31	COD	13/12/2017 16:20	COD
Performance management		10	34	01/11/2017 12:47	COD	03/01/2018 15:35	COD
Portfolio		4	15	01/11/2017 22:04	COD	13/12/2017 17:40	COD
Strategy		7	26	01/11/2017 19:12	COD	14/12/2017 12:47	COD
Uncertainty		4	7	01/11/2017 20:57	COD	13/12/2017 15:42	COD

Dear **R&D/NPI or equivalent expert**,

You are invited to participate in this survey which forms part of a PhD study into performance management and new product development (NPD) portfolios. Your participation is greatly appreciated and learning from your opinions is critical to these research efforts. Your survey responses will remain **anonymous** and **confidential,** and data from this research will be reported only in the aggregate.

This survey takes just **10-12 minutes** to complete. Most questions are compulsory (marked by a red asterix), and you are free to exit the survey at any time, but we urge you not to; the more complete each survey and the more surveys completed, the richer and more valuable will be its findings so please continue to the 'complete' button. You can return to a partially completed survey to finish it.

If you have questions at any time about the survey, contact me [**Clare O'Dwyer**] at xxx@nuigalway.ie. Thank you very much for your time and support. Please start the survey now.

Appendix A, Figure 1 Survey participation invitation

Appendix A, Table 2 Unidimensional, single item constructs, measurement scales & literature source

Construct	**Indicator items**	**Measurement scale**	**Literature source**
Professional experience	1	1-3, 4-6, 7-9, 10-12, 13+ years	(Huckman, Staats & Upton, 2009; Auh & Menguc, 2005b)
Portfolio team size	1	4-6, 7-9, 10-12, 13-15, >16 persons	(Eling et al., 2016)
Duration of portfolio team meetings	1	<30 min, 30-60 min, 1-3-hour, 3-5 hour, 6-8 hour	-
Encouragement of informal team meetings	1	Likert 1-7; Strongly Discouraged to Strongly Encouraged	New
Team functional diversity	1	8 options; Yes/No to each option	(Dekker et al., 2013; Salomo et al., 2010; Auh & Menguc, 2005c; Salomo et al. 2010; Dekker et al. 2013; Bedford et al. 2019)
New Product Success Rate	1	Average percentage 1-7 scale; 1=<40; increasing in 10% intervals thereafterafter	(Eling et al., 2016)

Appendix A, Table 3 Reliability and validity tests of 2 constructs after scale reduction

Latent Variable (Abbreviation)	**Indicators**	**Convergent Validity**			**Internal Consistency Reliability**		**Discriminant Validity**
		Initial Loadings	**Indicator Reliability**	**AVE**	**Cronbach's Alpha**	**Composite Reliability**	**√AVE**
		>0.7	**>0.5**	**>0.5**	**0.6-0.9**	**0.6-0.9**	
Debate based on performance measures (PM-deb)	**PM-deb_1**	0.941	0.885	0.87	0.93	0.95	0.93
	PM-deb_2	0.944	0.891				
	PM-deb_4	0.913	0.834				
Cognitive conflict (CogCon)	**CogCon_1**	0.848	0.719	0.62	0.68	0.84	0.787
	CogCon_2	0.818	0.669				
	CogCon_4	0.687	0.472				

Appendix A, Table 4 Composite constructs statistics

	mCompAmb	**aCompAmb**	**mInnAmb**	**aInnAmb**	**PMrad**	**PMinc**	**PMAbsDiff**	**PMBal**
Max	340.48	93.84	112.00	56.00	52.00	56.00	21.00	-14.00
Min	15.84	20.24	8.89	15.56	19.00	28.00	0.00	7.00
Range	324.64	73.60	103.11	40.44	33.00	28.00	21.00	21.00
Average	185.03	65.48	58.03	36.93	40.01	43.82	5.58	1.42

Appendix A, Table 5 Harman's single factor test

Total Variance Explained

Component	Initial Eigenvalues Total	Initial Eigenvalues % of Variance	Initial Eigenvalues Cumulative %	Extraction Sums of Squared Loadings Total	Extraction Sums of Squared Loadings % of Variance	Extraction Sums of Squared Loadings Cumulative %
1	12.265	14.429	14.429	12.265	14.429	14.429
2	6.363	7.485	21.915	6.363	7.485	21.915
3	5.233	6.157	28.072	5.233	6.157	28.072
4	4.250	5.000	33.071	4.250	5.000	33.071
5	3.810	4.483	37.554	3.810	4.483	37.554
6	3.773	4.439	41.993	3.773	4.439	41.993
7	3.261	3.837	45.830	3.261	3.837	45.830
8	2.885	3.394	49.224	2.885	3.394	49.224
9	2.849	3.351	52.575	2.849	3.351	52.575
10	2.712	3.191	55.766	2.712	3.191	55.766
11	2.296	2.701	58.467	2.296	2.701	58.467
12	2.126	2.501	60.968	2.126	2.501	60.968
13	1.966	2.313	63.281	1.966	2.313	63.281
14	1.828	2.151	65.432	1.828	2.151	65.432
15	1.784	2.099	67.530	1.784	2.099	67.530
16	1.721	2.024	69.555	1.721	2.024	69.555
17	1.649	1.940	71.495	1.649	1.940	71.495
18	1.477	1.737	73.232	1.477	1.737	73.232
19	1.438	1.691	74.923	1.438	1.691	74.923
20	1.348	1.586	76.509	1.348	1.586	76.509
21	1.168	1.374	77.883	1.168	1.374	77.883
22	1.156	1.360	79.243	1.156	1.360	79.243
23	1.107	1.302	80.545	1.107	1.302	80.545
24	1.029	1.211	81.756	1.029	1.211	81.756

Extraction Method: Principal Component Analysis.

Appendix A, Table 6 Tests for normality of data

Descriptive Statistics SPSS

	N	Skewness Kolmogorov-Smirnov		Kurtosis Shapiro-Wilks	
	Statistic	Statistic	Std. Error	Statistic	Std. Error
R_Fn	77	0.684	0.274	-1.050	0.541
Fn_Yr	77	0.658	0.274	-1.024	0.541
Pro_Exp	77	-0.710	0.274	0.140	0.541
Age	76	-0.489	0.276	0.052	0.545
Sex	77	-2.433	0.274	4.021	0.541
Ind	77	0.879	0.274	-0.202	0.541
Co_Size	77	-0.550	0.274	-1.123	0.541

PT_Div	77	-0.252	0.274	-0.813	0.541
F1	77	0.354	0.274	-0.874	0.541
F2	77	0.200	0.274	-1.040	0.541
F3	77	0.228	0.274	-1.295	0.541
IF1	77	-0.171	0.274	-1.309	0.541
IF2	77	0.125	0.274	-1.377	0.541
IF3	77	1.748	0.274	1.926	0.541
IF_Enc	77	-0.035	0.274	-0.183	0.541
IFOP1	77	-0.493	0.274	-0.630	0.541
IFOP2	77	-0.492	0.274	-0.510	0.541
IFPred1	77	-0.299	0.274	-0.545	0.541
IFPred2	77	-0.228	0.274	-0.695	0.541
Res1	77	-0.189	0.274	-1.131	0.541
Res2	77	0.117	0.274	-1.058	0.541
Res3Rev	77	-0.199	0.274	-1.086	0.541
Res4	77	0.147	0.274	-1.169	0.541
R8I8	77	-1.097	0.274	1.267	0.541
PM-deb1	77	-0.558	0.274	0.130	0.541
PM-deb2	77	-0.432	0.274	0.173	0.541
PM-deb3Rev	77	-0.609	0.274	0.221	0.541
PM-deb4	77	-0.485	0.274	0.026	0.541
CogCon1	77	-0.694	0.274	0.401	0.541
CogCon2	77	-0.266	0.274	-0.198	0.541
CogCon3	77	-0.121	0.274	-0.545	0.541
CogCon4	77	0.130	0.274	-0.505	0.541
AffCon1	77	0.329	0.274	-0.727	0.541
AffCon2	77	0.266	0.274	-0.732	0.541
AffCon3	77	0.164	0.274	-0.740	0.541
AffCon4	77	0.467	0.274	-1.204	0.541
Dyn1_Comp	77	-0.159	0.274	-0.593	0.541
Dyn2_Technol	77	0.238	0.274	-1.093	0.541
Dyn3_Mkt	77	0.442	0.274	-0.090	0.541
Dyn4_CustPref	77	0.349	0.274	-0.396	0.541
Dyn5_CustNeeds	77	0.657	0.274	0.399	0.541
NPS1	77	0.141	0.274	-1.365	0.541
NPS2	77	-0.086	0.274	-1.396	0.541
NPS3	77	-0.476	0.274	-1.457	0.541
NPS4	77	-0.914	0.274	0.049	0.541
TotAvExplore	77	-0.315	0.274	-0.234	0.541
TotAvExploit	77	-0.781	0.274	1.721	0.541
mCompAmb	77	0.114	0.274	-0.172	0.541
aCompAmb	77	-0.390	0.274	0.368	0.541
Inc1	77	-0.800	0.274	-0.036	0.541

Inc2	77	-0.088	0.274	-0.615	0.541
Inc3	77	-0.063	0.274	-0.503	0.541
Rad1	77	0.167	0.274	-0.769	0.541
Rad2	77	-0.148	0.274	-0.624	0.541
Rad3	77	-0.320	0.274	-0.295	0.541
mInnovAmb	77	0.064	0.274	-0.769	0.541
aInnovAmb	77	-0.289	0.274	-0.527	0.541
Perf1_MSG	77	-0.387	0.274	-0.003	0.541
Perf2_ProfitG	77	-0.241	0.274	-0.516	0.541
Perf3_SG	77	-0.471	0.274	-0.401	0.541
Perf4_Ovr	77	-0.755	0.274	0.188	0.541

Appendix A, Table 7 Survey instrument

Survey items

Tendency to exploit

Commits to improving quality and lowering cost

Continuously improves the reliability of its products

Increases the levels of automation in its operations

Constantly surveys existing customers' satisfaction

Penetrates more deeply into its existing customer base

Fine-tunes what it offers to keep its current customers satisfied

Tendency to explore

Looks for novel technological ideas by thinking "outside the box"

Bases its success on its ability to explore new technologies

Creates products or services that are innovative to the business unit

Looks for creative ways to satisfy its customers' needs

Actively targets new customer groups

Aggressively ventures into new market segments

Resources munificence for new product innovation

We have accessible resources that can be used at short notice to support new product development (NPD) initiatives

We can obtain resources quickly to support new product development (NPD) initiatives

This business unit has few resources available in the short term to support its NPD initiatives

We have substantial resources at the discretion of management for NPD initiatives

PM-inc Performance measures that encourage more incremental than radical innovation

Potential revenue from the new product

Financial resources required for the development of the new product

Expected return (ROI, NPV, IRR) from the new product

Time-to-market associated with the new product

The new product's expected break-even time

Ability of the new product to exceed a major competitor's offering

Meeting customer expectations with the new product

Potential of the new product to satisfy multiple customer targets

PM-rad Performance measures that increase the visibility of radical innovation

The new product would balance our portfolio regarding overall product launch schedule

The new product would balance our portfolio in terms of its overall risk

The new product would diversify our portfolio in terms of product type (i.e. existing and entirely new)

The new product would balance our portfolio in terms of time to achieve profitability

Use of personal experience /intuition

Alignment of the new product with business unit strategy (assumed to be a strategy of ambidexterity)

Potential market share growth of the new product

Potential of the new product to open new markets

PM-deb Debate focussed on performance measures

Performance / evaluation measures are often discussed during NPD portfolio selection meetings

Performance / evaluation measures are frequently used to debate selection decisions during NPD portfolio selection meetings

Performance / evaluation measures rarely encourage discussion of product selection plans during NPD portfolio selection meetings (reverse scored)

Performance/evaluation measures are debated among team members during new product selection during NPD portfolio selection meetings

Cognitive conflict

To what extent are there differences of professional opinion among team members during new product portfolio selection discussions?

How much do team members disagree over new product ideas during new product portfolio selection discussions?

How often do team members disagree over resource allocation decisions during new product portfolio selection discussions?

Within your product selection team, how much conflict is there about the work you do during new product portfolio selection discussions?

Affective conflict

How much personal friction is there among team members during new product portfolio selection discussions?

To what extent are personality clashes evident among team members during new product portfolio selection discussions?

How much tension is there among team members during new product portfolio selection discussions?

To what extent are personal grudges evident within the team during new product portfolio selection discussions?

Informal meetings

In advance of NPD portfolio selection meetings, there are opportunities for one-to-one, face-to-face meetings to discuss products under review

Smaller ad hoc (informal / impromptu) meetings are held in advance of NPD portfolio selection meetings to discuss new product selection decisions

New product selection decisions are predictable in advance of new product portfolio selection meetings

It is rare to know, in advance of NPD portfolio selection meetings, the opinions of team members about products under review

How often do you communicate with team members about new product selection decisions in an impromptu (unplanned) manner, in each of the following ways?

Impromptu one-to-one, face-to-face conversations (e.g., in the hall) (never; daily; 2-4times a week; once a week; 2-3times a month; monthly; quarterly)

Impromptu one-to-one phone / teleconference conversations (never; daily;2-4times a week; once a week;2-3times a month; monthly; quarterly)

Informal one-to-one, face-to-face conversations in a non-work setting (never; daily;2-4times a week; once a week;2-3times a month; monthly; quarterly)

To what extent are impromptu (informal) meetings encouraged or discouraged in your organisation or business unit?

Formal meetings

How often do you communicate with team members about new product selection decisions in a scheduled (planned) manner, in each of the following ways?

Scheduled group meetings or conference calls (never; daily;2-4times a week; once a week;2-3times a month; monthly; quarterly)

Scheduled one-to-one, face-to-face meetings (never; daily;2-4times a week; once a week;2-3times a month; monthly; quarterly)

Scheduled one-to-one phone / teleconference conversations (never; daily;2-4times a week; once a week;2-3times a month; monthly; quarterly)

Incremental innovation

Our new product portfolio frequently introduced incremental new products

Compared to our major competitor, we introduced more incremental new products

Compared to our major competitor, the % of successful new incremental product innovations was greater

Radical innovation

Our new product portfolio frequently introduced radical new products

Compared to our major competitor, our new product portfolio introduced more radical new products

Compared to our major competitor, the % of successful new radical product innovations was greater

Performance of the business unit / organisation compared with expectations

Market share growth in the last year compared with expectations

Profit growth in the last year compared with expectations

Sales growth in the last year compared with expectations

Overall performance in the last year compared with expectations

New product success

On average what percent of new product concepts (100%) pass the screening stage in the new product development (NPD) process? (1-40%;41-50%;51-60%;61-70%;71-80%;81-90%;91-100%)

On average what percent of the products remaining after screening are selected into the new product development (NPD) portfolio? (1-40%;41-50%;51-60%;61-70%;71-80%;81-90%;91-100%)

On average what percent of the selected new products are commercialised? (1-40%;41-50%;51-60%;61-70%;71-80%;81-90%;91-100%)

New product success rate

Based on your organisation's / business unit's definition of a successful new product, what percent of all new products introduced into the market during the last 3 years, were successful? (1-40%;41-50%;51-60%;61-70%;71-80%;81-90%;91-100%)

Team diversity

What is the title of your current role?

How many years have you worked in your current role? (13;4-6;7-9;10-12;13+)

How many years professional experience do you have? (20-29;30-39;40-49;50+)

Are you male or female?

What functional specialties are represented on your new product portfolio selection team?

In your organisation / business unit, roughly how many individuals partake in new product portfolio selection meetings?

Appendix B Supplementary to PLS-SEM findings

Appendix B, Table 1 SmartPLS-SEM set up following recommendations from Hair et al. (2017)

Data file Settings	
Data file	OrigDataPlusNov19.sav [79 records]
Missing value marker	none
Data Setup Settings	
Algorithm to handle missing data	Mean Replacement
Weighting Vector	-
PLS Algorithm Settings	
Data metric	Mean 0, Var 1
Initial Weights	1
Max. number of iterations	**300**
Stop criterion	7
Use Lohmoeller settings?	No
Weighting scheme	Path
Bootstrapping Settings	
Complexity	Basic Bootstrapping
Confidence interval method	Bias-Corrected and Accelerated (BCa) Bootstrap
Parallel processing	Yes
Samples	**5000**
Significance level	**0.05**
Test type	**One Tailed**
Construct Outer Weighting Mode Settings	
CogCon	Automatic
Formal	Automatic
Informal	Automatic
PFT Diversity	Automatic
PM Balance	Automatic
PM Debate	Automatic
mCompAmb	Automatic

Appendix B, Table 2 Total indirect effects statistics for antecedent Model A1

							Confidence Interval	
Model Paths	**Original Sample**	**Sample Mean**	**Standard Deviation**	**T Statistics**	***P* Values**	**Bias**	**5.00%**	**95.00%**
CogCon -> mCompAmb								
Formal -> CogCon								
Formal -> mCompAmb	0.04	0.03	0.03	1.17	0.12	-0.01	0	0.12
Informal -> CogCon								
Informal -> mCompAm	-0.06	-0.05	0.06	1.04	0.15	0.01	-0.15	0.04
PT Diversity -> CogCo	-0.07	-0.07	0.06	1.14	0.13	0	-0.16	0.04
PT Diversity -> PM Del								
PT Diversity -> mComp	-0.01	0	0.03	0.22	0.41	0.01	-0.06	0.03
PM Balance -> CogCon	-0.06	-0.06	0.06	1	0.16	0	-0.16	0.02
PM Balance -> PM Deb								
PM Balance -> mComp	0.02	0.02	0.03	0.67	0.25	0	-0.02	0.09
PM Debate -> CogCon								
PM Debate -> mCompA	0.04	0.05	0.05	0.81	0.21	0.01	-0.01	0.14

None are significant. There are no mediation effects.

Appendix B, Table 3 Total effects statistics for antecedent Model A1

Model Paths	Original Sample	Sample Mean	Standard Deviation	T Statistics	*P* Values	Bias	Confidence Interval 5.00%	95.00%
CogCon -> mCompAmb	-0.21	-0.19	0.14	1.53	0.06	0.01	-0.39	0.05
Formal -> CogCon	-0.19	-0.16	0.12	1.58	0.06	0.03	-0.39	-0.02
Formal -> mCompAmb	0.04	0.03	0.03	1.17	0.12	-0.01	0	0.12
Informal -> CogCon	0.3	0.28	0.2	1.49	0.07	-0.02	-0.32	0.46
Informal -> mCompAm	-0.06	-0.05	0.06	1.04	0.15	0.01	-0.15	0.04
PT Diversity -> CogCo	0.03	0.02	0.14	0.24	0.4	-0.01	-0.18	0.27
PT Diversity -> PM Del	0.36	0.36	0.1	3.68	0	-0.01	0.18	0.51
PT Diversity -> mComp	-0.01	0	0.03	0.22	0.41	0.01	-0.06	0.03
PM Balance -> CogCon	-0.11	-0.1	0.16	0.71	0.24	0.01	-0.31	0.22
PM Balance -> PM Deb	0.31	0.3	0.11	2.82	0	-0.01	0.12	0.48
PM Balance -> mComp	0.02	0.02	0.03	0.67	0.25	0	-0.02	0.09
PM Debate -> CogCon	-0.19	-0.2	0.16	1.21	0.11	-0.01	-0.38	0.2
PM Debate -> mCompA	0.04	0.05	0.05	0.81	0.21	0.01	-0.01	0.14

This includes all paths, direct and indirect paths.

Appendix B, Table 4 Model fit statistics for antecedent Model A1

	Saturated M	Estimated M
SRMR	0.08	0.11
d_ULS	0.59	1.04
d_G	0.29	0.34
Chi-Square	138.53	156.02
NFI	0.66	0.62
	rms Theta	0.22

Appendix B, Table 5 Model fit significance statistics for antecedent Model A1

			Significance Interval	
SRMR	Original Sar	Sample Mea	95%	99%
Saturated Mod	0.08	0.08	0.13	0.16
Estimated Mod	0.11	0.09	0.14	0.16
d_ULS	Original Sar	Sample Mea	95%	99%
Saturated Mod	0.59	0.58	1.59	2.35
Estimated Mod	1.04	0.74	1.66	2.45
d_G	Original Sar	Sample Mea	95%	99%
Saturated Mod	0.29	0.26	0.44	0.57
Estimated Mod	0.34	0.28	0.45	0.59

Key for Table 4; SRMR=Standardised Root Mean Square Residual, values <0.08 considered good fit (Hu and Bentler, 1999; Henseler et al. 2014); d_ULS=the squared Euclidean distance; d_G=the Geodesic distance; NFI=Normed Fit Index, values from 0.9 preferred (Lohmöller, 1989); Rms_theta=Root mean squared residual covariance matrix of the outer model residuals (Lohmöller, 1989), values<0.12 preferred (Henseler et al. 2014). See * below

Appendix B, Table 6 Model fit statistics, antecedent Model A2

	Saturated M	Estimated M
SRMR	**0.04**	**0.07**
d_ULS	0.04	0.13
d_G	0.05	0.05
Chi-Square	21.4	24.29
NFI	0.93	0.92
	rms Theta	0.2

Appendix B, Table 7 Model fit significance statistics, antecedent Model A2 (emphasis on SRMR, preferable <8)

	Original Sample	Sample Mean (M)	95%	99%
SRMR				
Saturated Model	0.04	0.04	0.05	0.07
Estimated Model	**0.07**	**0.05**	**0.08**	**0.11**
d_ULS				
Saturated Model	0.04	0.04	0.07	0.13
Estimated Model	0.13	0.09	0.2	0.32
d_G				
Saturated Model	0.05	0.06	0.11	0.21
Estimated Model	0.05	0.07	0.12	0.23

Key: SRMR=Standardised Root Mean Square Residual, values <0.08 considered good fit (Hu and Bentler, 1999; Henseler et al. 2014); d_ULS=the squared Euclidean distance; d_G=the Geodesic distance; NFI=Normed Fit Index, values 0.9 and over preferred (Lohmöller, 1989); Rms_theta= Root mean squared residual covariance matrix of the outer model residuals, values<0.12 preferred (Henseler et al. 2014). See * below

Appendix B, Table 8 Model fit statistics, moderator antecedent Model A2

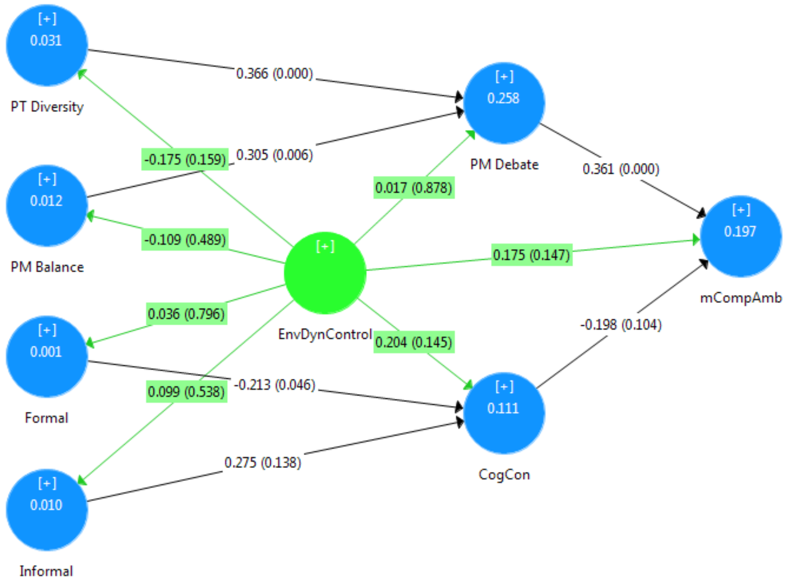
	Saturated M	Estimated M
SRMR	**0.07**	**0.08**
d_ULS	0.3	0.39
d_G	0.14	0.15
Chi-Square	64.06	66.85
NFI	0.83	0.82
	rms Theta	0.18

Appendix B, Table 9 Model fit significance statistics, moderator antecedent Model A2 (emphasis on SRMR, preferable <8)

SRMR	Original Sample	Sample Mean (M)	95%	99%
Saturated Model	0.07	0.06	0.08	0.16
Estimated Model	**0.08**	**0.08**	**0.12**	**0.15**
d_ULS				
Saturated Model	0.3	0.2	0.33	1.33
Estimated Model	0.39	0.37	0.75	1.29
d_G				
Saturated Model	0.14	0.14	0.23	0.41
Estimated Model	0.15	0.16	0.25	0.4

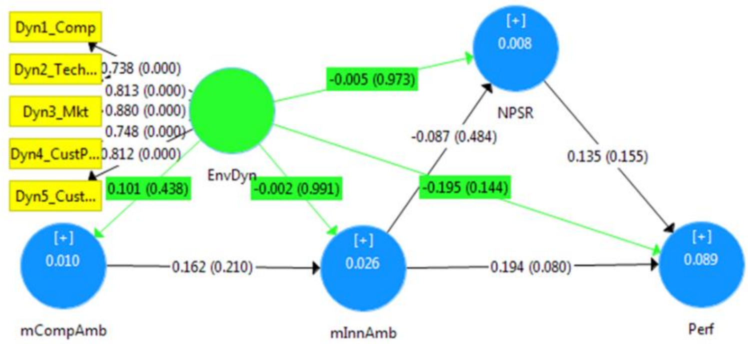
Key for Table 6; SRMR=Standardised Root Mean Square Residual, values <0.08 considered good fit (Hu and Bentler, 1999; Henseler et al. 2014); d_ULS=the squared Euclidean distance; d_G=the Geodesic distance; NFI=Normed Fit Index, values from 0.9 preferred (Lohmöller, 1989); ms_theta=Root mean squared residual covariance matrix of the outer model residuals (Lohmöller, 1989), values<0.12 preferred (Henseler et al. 2014). See * below

*Researchers should be **very cautious** to report and use model fit in PLS-SEM (Hair et al. 2017). The proposed criteria are in their early stage of research, **are not fully understood** (e.g., the critical threshold values), and are often not useful for PLS-SEM. Even though, some researchers started requesting to report these new model fit indices for PLS-SEM. SmartPLS provides them but believes that there is much more research necessary to apply them appropriately. So far, these criteria usually should not be reported and used for the PLS-SEM results assessment (Hair et al. 2017).



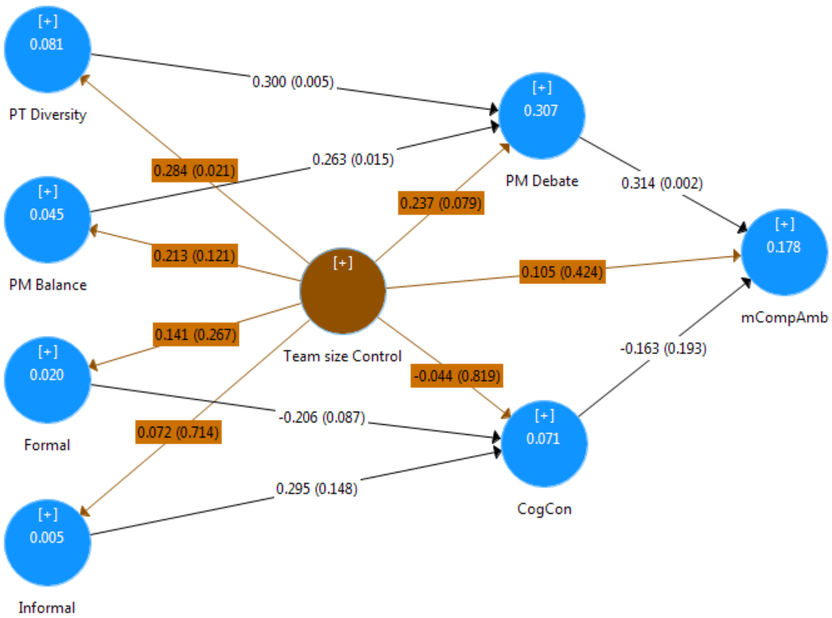
Appendix B, Figure 1 Control test for environmental dynamism represented in green, Alternative antecedent Model A2

Key: Path coefficients (*ß*) on the line, path significance values (*p*) in brackets, *p<0.10, **p<0.05, ***p<0.01. All tests are 2-tailed to examine control effects. EnvDyn=environmental dynamism in green shows no significant paths (all p>0.1). R square values on constructs. PT=portfolio team; PM=performance measures; CogCon=cognitive conflict; mCompAmb=competence ambidexterity derived by the most commonly used operationalisation multiplicative method (m); When *p* values on structural model paths are divided by 2 to revert to 1-tailed test values, all model paths previously significant remain significant indicating no influence by the control variables.



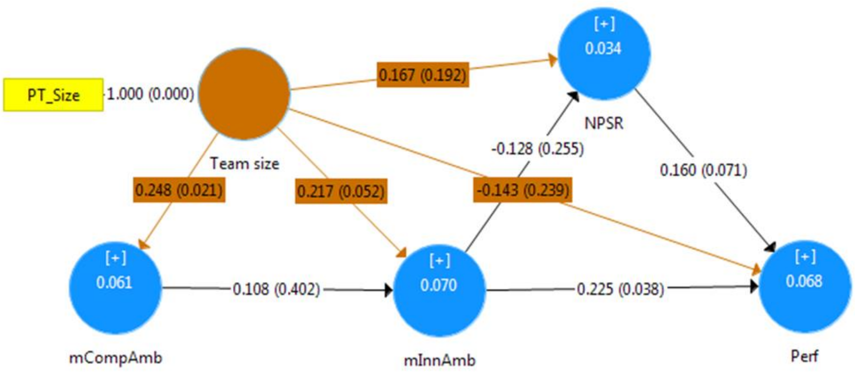
Appendix B, Figure 2 Control test for environmental dynamism represented in green, consequences Model C

Key: Path coefficients (*ß*) on the line, path significance values (*p*) in brackets, *p<0.10, **p<0.05, ***p<0.01. All tests are 2-tailed to examine control effects. EnvDyn=environmental dynamism in green shows no significant paths (all p>0.1). R square values on constructs. mCompAmb=competence ambidexterity derived by the most commonly used operationalisation multiplicative method (m); InnAmb=innovation ambidexterity derived by the most commonly used operationalisation multiplicative method (m); When *p* values on structural model paths are divided by 2 to revert to 1-tailed test values, all model paths previously significant remain significant indicating no influence by the control variables.



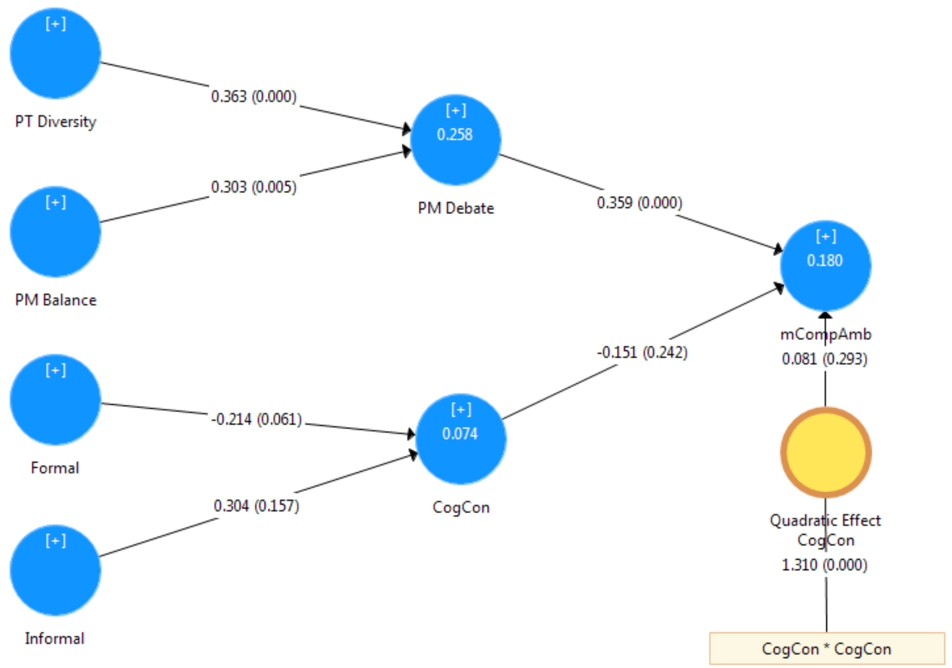
Appendix B, Figure 3 Control test for team size represented in brown, Alternative antecedent Model A2

Key: Path coefficients (ß) on the line, path significance values (*p*) in brackets, *p<0.10, **p<0.05, ***p<0.01. All tests are 2-tailed to examine control effects. Team size paths in brown. As expected, PT size shows 2 significant paths; to PT-diversity and to PM-debate; but all structural paths remain significant at 1-tailed level. R square values are given on constructs. PT=portfolio team; PM=performance measures; CogCon=cognitive conflict; CompAmb=competence ambidexterity derived by the most commonly used operationalisation multiplicative method (m); When *p* values on structural model paths are divided by 2 to revert to 1-tailed test, all model paths remain significant.



Appendix B, Figure 4 Control test for team size represented in brown, consequences Model C

Key: Path coefficients (ß) on the line, path significance values (*p*) in brackets, *p<0.10, **p<0.05, ***p<0.01. All tests are 2-tailed to examine control effects. Team size paths in brown. Portfolio team size shows 2 significant paths; to competence ambidexterity (mCompAmb), and to innovation ambidexterity (mInnAmb). All model paths remain the same except for mCompAmb to mInnAmb which becomes non-significant.



Appendix B, Figure 5 Moderation test by cognitive conflict on competence ambidexterity; antecedent Model A2.

Appendix B, Table 10 Moderation test by cognitive conflict on competence ambidexterity results; antecedent Model A2

Model Path	Original Sa	Sample Me	Standard De	T Statistics (	*P* Values	Bias	2.5%	97.5%
CogCon -> mCompAmb	**-0.15**	-0.14	0.13	1.17	**0.24**	0.01	-0.35	0.16
Formal -> CogCon	**-0.21**	-0.19	0.11	1.87	**0.06**	0.02	-0.43	0
Informal -> CogCon	**0.3**	0.28	0.22	1.41	**0.16**	-0.02	-0.47	0.45
PM Balance -> PM Debate	**0.3**	0.3	0.11	2.8	**0.01**	0	0.07	0.5
PM Debate -> mCompAmb	**0.36**	0.36	0.1	3.73	**0.00**	0	0.16	0.53
PT Diversity -> PM Debate	**0.36**	0.36	0.1	3.65	**0.00**	-0.01	0.15	0.54
Quadratic Effect CogCon -> mCompAmb	**0.08**	0.08	0.08	1.05	**0.29**	0	-0.07	0.23

Appendix C Survey Questionnaire

1 survey hardcopy & on-line version

NUI Galway
OÉ Gaillimh

IRISH RESEARCH COUNCIL
An Chomhairle um Thaighde in Éirinn

PERFORMANCE MANAGEMENT

&

NEW PRODUCT

PORTFOLIO SELECTION

The study is a collaboration between the J.E. Cairnes School of Business & Economics and the College of Engineering & Informatics, National University of Ireland, Galway, and is supported by the Irish Research Council.

Dear **R&D/NPI or equivalent expert,**

You are invited to participate in this survey which forms part of a PhD study into performance management and new product development (NPD) portfolios. Your participation is greatly appreciated and learning from your opinions is critical to these research efforts. Your survey responses will remain **anonymous** and **confidential,** and data from this research will be reported only in the aggregate.

This survey takes just **10-12 minutes** to complete. Most questions are compulsory (marked by a red asterix), and you are free to exit the survey at any time, but we urge you not to; the more complete each survey and the more surveys completed, the richer and more valuable will be its findings so please continue to the 'complete' button. You can return to a partially completed survey to finish it.

If you have questions at any time about the survey, contact me [**Clare O'Dwyer**] at c.odwyer12@nuigalway.ie. Thank you very much for your time and support. Please start the survey now.

Section A. In this section we seek to capture information about you and your current employment.

***Q1.** What is the **title** of your current **role**?

Q2. How many **years** have you worked in your current **role?**

1 - 3	4 – 6	7 – 9	10 -12	13+
❑	❑	❑	❑	❑

***Q3.** How many years **professional experience** do you have**?**

1 - 10	11 – 20	21 – 30	31+
❑	❑	❑	❑

Q4. What is your **age range?**

20-29	30-39	40-49	50+
❑	❑	❑	❑

Q5. Are you

Male?	Female?
❑	❑

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***Q6.** In what **industry** do you work?

Medical Devices	Information Technology	Other? Please specify
☐	☐	

***Q7.** Please indicate the number of **full-time equivalent employees** in your organisation (your site only if there is >1 site):

Small (< 50 employees)	Medium (50-250 employees)	Large (> 250 employees)
☐	☐	☐

Section B. Here we wish to learn more about your new product portfolio selection team.

In this survey, the new product portfolio selection team is the team in which you participate in making product **selection** decisions for the new product development (NPD) portfolio. This NPD portfolio may be a single organisational portfolio, or one associated with an individual business unit (BU) within your organisation.

***Q8.** Typically**, what functional specialties** are represented on your new product portfolio selection team?

	Yes
Research and Development	☐
Operations / Process Development	☐
Sales / Marketing	☐
Finance	☐
Quality / Regulation	☐
Business Unit General Manager / CEO	☐
Clinical	☐
Program Management	☐
Other (please specify):	☐

Q9. In your organisation / business unit, roughly **how many** individuals partake in new product portfolio selection meetings?

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***Q10. How often** do you communicate with team members **about new product selection** decisions in a **scheduled** (planned) or **impromptu** (unplanned) manner, in each of the following ways?

	Never	Daily	2-4 times a week	Once a week	2-3 times a month	Monthly	Quarterly
Scheduled group meetings or conference calls	☐	☐	☐	☐	☐	☐	☐
Scheduled one-to-one, face-to-face meetings	☐	☐	☐	☐	☐	☐	☐
Scheduled one-to-one phone / teleconference conversations	☐	☐	☐	☐	☐	☐	☐
Impromptu one-to-one, face-to-face conversations (e.g., in the hall)	☐	☐	☐	☐	☐	☐	☐
Impromptu one-to-one phone / teleconference conversations	☐	☐	☐	☐	☐	☐	☐
Informal one-to-one, face-to-face conversations in a non-work setting	☐	☐	☐	☐	☐	☐	☐
Other (please specify)	☐	☐	☐	☐	☐	☐	☐

***Q11**. In your organisation or business unit, to what extent are **impromptu (informal**) meetings **encouraged** or **discouraged**?

	Strongly Discouraged						**Strongly Encouraged**
	1	**2**	**3**	**4**	**5**	**6**	**7**
Impromptu (informal) meetings are	☐	☐	☐	☐	☐	☐	☐

Q12. In your organisation or business unit, in general **how much time** is devoted to each new product portfolio selection meeting**?**

< 30 min	30 – 60 min	1-3 hr	3-5 hr	6-8 hr
☐	☐	☐	☐	☐

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Section C: New Product Innovation.

In section C, we seek to gather information about the **type of product innovations** pursued by your organisation / business unit and the availability of **resources** for product innovation.

***Q13.** Please indicate the extent to which you **agree** or **disagree** with each of the following statements for your business unit's **new product portfolio**:

	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
We have accessible resources that can be used at short notice to support new product development (NPD) initiatives	❑	❑	❑	❑	❑	❑	❑
We can obtain resources quickly to support new product development (NPD) initiatives	❑	❑	❑	❑	❑	❑	❑
This business unit has few resources available in the short term to support its NPD initiatives	❑	❑	❑	❑	❑	❑	❑
We have substantial resources at the discretion of management for NPD initiatives	❑	❑	❑	❑	❑	❑	❑

***Q14.** Please indicate the extent to which you **agree** or **disagree** with the following statements. Would you describe your business unit as one that:

	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
Looks for novel technological ideas by thinking "outside the box"	❑	❑	❑	❑	❑	❑	❑
Bases its success on its ability to explore new technologies	❑	❑	❑	❑	❑	❑	❑
Commits to improving quality and lowering cost	❑	❑	❑	❑	❑	❑	❑
Continuously improves the reliability of its products	❑	❑	❑	❑	❑	❑	❑
Creates products or services that are innovative to the business unit	❑	❑	❑	❑	❑	❑	❑

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*Q.14 continued: Would you describe your business unit as one that:	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
Looks for creative ways to satisfy its customers' needs	❑	❑	❑	❑	❑	❑	❑
Increases the levels of automation in its operations	❑	❑	❑	❑	❑	❑	❑
Constantly surveys existing customers' satisfaction	❑	❑	❑	❑	❑	❑	❑
Actively targets new customer groups	❑	❑	❑	❑	❑	❑	❑
Fine-tunes what it offers to keep its current customers satisfied	❑	❑	❑	❑	❑	❑	❑
Aggressively ventures into new market segments	❑	❑	❑	❑	❑	❑	❑

Section D: Performance Measurement / Evaluation Criteria.

In this part of the questionnaire we wish to learn more about the criteria that are important in the management of your organisation's / business unit's new product portfolio.

*Q15. Please **rate** the level of **importance** actually given to **each** of the following **when selecting a new product** for your business unit's **new product development (NPD) portfolio:**

	Not Important 1	2	3	4	5	6	Critically Important 7
The new product would balance our portfolio regarding overall product **launch schedule**	❑	❑	❑	❑	❑	❑	❑
The new product would balance our portfolio in terms of its **overall risk**	❑	❑	❑	❑	❑	❑	❑
The new product would diversify our portfolio in terms of **product type** (i.e. existing and entirely new)	❑	❑	❑	❑	❑	❑	❑
The new product would balance our portfolio in terms of **time to achieve profitability**	❑	❑	❑	❑	❑	❑	❑

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***Q16.** How would you **rate** the **importance** given to **each** of the following when **selecting a new product** for your organisation's / business unit's new product **portfolio**:

	Not Important 1	2	3	4	5	6	Critically Important 7
Your personal experience /intuition	❑	❑	❑	❑	❑	❑	❑
Alignment of the new product with business unit strategy	❑	❑	❑	❑	❑	❑	❑
Potential revenue from the new product	❑	❑	❑	❑	❑	❑	❑
Potential market share growth of the new product	❑	❑	❑	❑	❑	❑	❑
Potential of the new product to open new markets	❑	❑	❑	❑	❑	❑	❑
Potential of the new product to satisfy multiple customer targets	❑	❑	❑	❑	❑	❑	❑
Financial resources required for the development of the new product	❑	❑	❑	❑	❑	❑	❑
Expected return (ROI, NPV, IRR) from the new product	❑	❑	❑	❑	❑	❑	❑
Time-to-market associated with the new product	❑	❑	❑	❑	❑	❑	❑
The new product's expected break-even time	❑	❑	❑	❑	❑	❑	❑
Ability of the new product to exceed a major competitor's offering	❑	❑	❑	❑	❑	❑	❑
Meeting customer expectations	❑	❑	❑	❑	❑	❑	❑
Other (please specify)	❑	❑	❑	❑	❑	❑	❑

***Q17.** Please indicate the extent to which you **agree** or **disagree** with the following statements about the **use** of performance/evaluation **measures** during NPD portfolio selection meetings**:**

	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
Performance / evaluation measures are often discussed	❑	❑	❑	❑	❑	❑	❑
Performance / evaluation measures are frequently used to debate selection decisions	❑	❑	❑	❑	❑	❑	❑
Performance / evaluation measures rarely encourage discussion of product selection plans	❑	❑	❑	❑	❑	❑	❑
Performance/evaluation measures are debated among team members during new product selection	❑	❑	❑	❑	❑	❑	❑

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***Q18**. In relation to **discussions** about new product portfolio selection:

	Never				A Very Great Deal
	1	2	3	4	5
To what extent are there differences of professional opinion among team members?	❏	❏	❏	❏	❏
How much do team members disagree over new product ideas?	❏	❏	❏	❏	❏
How often do team members disagree over resource allocation decisions?	❏	❏	❏	❏	❏
Within your product selection team, how much conflict is there about the work you do?	❏	❏	❏	❏	❏

***Q19.** Please indicate the extent to which you **agree** or **disagree** with **each** of the following statements:

	Strongly Disagree				Strongly Agree
	1	2	3	4	5
In advance of NPD portfolio selection meetings, there are opportunities for one-to-one, face-to-face meetings to discuss products under review	❏	❏	❏	❏	❏
Smaller ad hoc (informal / impromptu) meetings are held in advance of NPD portfolio selection meetings to discuss new product selection decisions	❏	❏	❏	❏	❏
New product selection decisions are predictable in advance of new product portfolio selection meetings	❏	❏	❏	❏	❏
It is rare to know, in advance of NPD portfolio selection meetings, the opinions of team members about products under review	❏	❏	❏	❏	❏

Q20. During new product portfolio selection discussions:

	None				A Very Great Deal
	1	2	3	4	5
How much personal friction is there among team members?	❏	❏	❏	❏	❏
To what extent are personality clashes evident among team members?	❏	❏	❏	❏	❏
How much tension is there among team members?	❏	❏	❏	❏	❏
To what extent are personal grudges evident within the team?	❏	❏	❏	❏	❏

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Section E: Portfolio Innovation Performance.

In this **penultimate section**, we wish to learn about the **types** of product innovations produced by your organisation's / business unit's new product portfolio.

Radical product innovations describe fundamental changes to existing products, breakthrough products, or new-to-the-world products.
Incremental product innovations refer to small improvements to existing products, re-positioning of existing products or cost reductions to existing products.

***Q21.** In relation to **the new product portfolio** associated with **your** organization / business unit, please indicate the extent to which you **agree** or **disagree** with **each** of the following statements relating to **the last 3 years:**

	Strongly Disagree				Strongly Agree
	1	2	3	4	5
Our new product portfolio frequently introduced **incremental** new products	❑	❑	❑	❑	❑
Compared to our major competitor, we introduced more **incremental** new products	❑	❑	❑	❑	❑
Compared to our major competitor, the % of successful new **incremental** product innovations was greater	❑	❑	❑	❑	❑
Our new product portfolio frequently introduced **radical** new products	❑	❑	❑	❑	❑
Compared to our major competitor, our new product portfolio introduced more **radical** new products	❑	❑	❑	❑	❑
Compared to our major competitor, the % of successful new **radical** product innovations was greater	❑	❑	❑	❑	❑

***Q22.** In the **last year**, how would you **rate** the **performance** of the business unit / organisation you represent on **each** the following **compared with expectations?**

	Significantly Lower				Significantly Higher
	1	2	3	4	5
Market share growth	❑	❑	❑	❑	❑
Profit growth	❑	❑	❑	❑	❑
Sales growth	❑	❑	❑	❑	❑
Overall performance	❑	❑	❑	❑	❑

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***Q23.** In your organisation / business unit, **on average** what **percent** of new product **concepts (100%)** pass the **screening stage** in the new product development (NPD) process?

1-40%	41-50%	51-60%	61-70%	71-80%	81-90%	91-100%
❑	❑	❑	❑	❑	❑	❑

***Q24.** In your organisation / business unit, on **average** what **percent** of the products remaining after **screening** (q.23), **are selected** into the new product development (NPD) portfolio?

1-40%	41-50%	51-60%	61-70%	71-80%	81-90%	91-100%
❑	❑	❑	❑	❑	❑	❑

***Q25.** In your organisation / business unit, on **average** what **percent** of the **selected** new products (q.24) are **commercialised**?

1-40%	41-50%	51-60%	61-70%	71-80%	81-90%	91-100%
❑	❑	❑	❑	❑	❑	❑

***Q26.** Based on **your** organisation's / business unit's **definition** of a successful new product, **what percent** of **all new products** introduced into the market during the last **3 years,** were **successful?**

1-40%	41-50%	51-60%	61-70%	71-80%	81-90%	91-100%
❑	❑	❑	❑	❑	❑	❑

Section F: Organisational Environment (Final Question).

In this **final question** we wish to learn about the degree of **competitiveness** and / or **dynamism** associated with your working **environment**.

Q27. Please indicate whether you **agree** or **disagree** with how well the following statements describe the **market and competitive environment** in which you have worked **during the past 3 years**:

	Strongly Disagree 1	2	3	4	Strongly Agree 5
The actions of local and foreign competitors in our major markets were changing quite rapidly	❑	❑	❑	❑	❑
Technological changes in our industry were rapid and unpredictable	❑	❑	❑	❑	❑
The market competitive conditions were highly unpredictable	❑	❑	❑	❑	❑
Customers' product preferences changed quite rapidly	❑	❑	❑	❑	❑
Changes in customers' needs were quite unpredictable	❑	❑	❑	❑	❑

If you have any other comments or suggestions in relation to the management of new product selection and the use of performance / evaluation measures, please add below:

Would you like to receive a copy of assimilated results of this study? Yes ☐ No ☐

If you include your contact details, please be assured that they will remain **anonymous and confidential.**

Name:
Mobile or office phone:
E-mail address:

Thank you VERY much for completing this survey.
Your time and patience is greatly appreciated.

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