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Faculty of the Arts, Design and Media (ADM)

Idea Management: Enhancing External Innovation Capabilities within Front-End Activities

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Idea Management: Enhancing External Innovation Capabilities in Front-End Activities

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ABSTRACT

This study examines and verifies the factors influencing idea management in enhancing external innovation capabilities within front-end activities in large organisations. Previous studies have identified idea management as being in serious need of better management. This research aims to address this need by adding new knowledge and understanding to how organisations generate, search and select ideas internally and externally.

Innovation is rapidly becoming a strategic priority, but there is a large gap between the perceived importance of innovation and the effectiveness of approaches used to support innovation. Idea management works under the premise that the innovation process is too important to be left to chance. Ideas are the starting point to every innovation. This research examines the concept of idea management, which acknowledges the importance of external ideas within the innovation process. External sources offer a huge amount of knowledge and ideas, much of which is unexpected and can therefore promote disruptive innovation. Idea management is characterised by a high degree of complexity and must be organised efficiently in order to work in the long-term.

It is well established that there is a general lack of clarity, definition and understanding within the front-end of innovation in terms of language, processes and activities. This is why it is also referred to as the fuzzy front-end, occurring prior to when an idea receives formal funding. Several key activities include opportunity identification, problem definition, environmental scanning, and idea generation and evaluation. These activities involve leveraging internal and external innovation capabilities and is one of the reasons why this research focuses on better understanding and visualising this interaction by improving idea management practices.

This iCase award was funded by the EPSRC and the multinational consumer goods company, Procter & Gamble (P&G). The research outcomes are of interest to large organisations looking to enhance how they manage their internal and external ideas. On a smaller scale, effective practices for internal idea generation are identified which could be of use to SMEs. The thesis will add to the field of front-end innovation literature regarding idea management effective practices, supported by quantitative data on a global scale.

A blended methods approach was used where insights were verified through iteration between a systematic literature review, front-end model comparison, global industrial interviews, and a main survey conducted within P&G. This organisation is well known for their success with external search practices for innovation. The industrial interviews were conducted with P&G's 'Connect + Develop' practitioners and were vital to gain an understanding of language and challenges related to the research questions. This guided the development of an industrial survey which assessed the effectiveness of an idea sourcing tool adopted by P&G. The findings from the survey provide further insight into how innovation landscaping tools are used in practice and ways in which to increase levels of tool adoption.

This research finds that organisations do want to find and leverage high quality ideas but are unsure of how to best search for and select them. The proposed 'Idea Infinity Framework' helps to visualise, orientate and kick-start search and select processes in organisations. It argues that visualising the sources, interactions and issues to be aware of for idea quality will improve the effectiveness of front-end activities, as well as make better use of practitioner time, effort and funds. This study argues that idea management should take a proactive approach rather than a passive approach to the management of ideas (i.e. search and select) and become more integrated.

Keywords:

Idea management, front-end innovation, open innovation, idea generation, business success.

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I would like to give my thanks to my thesis committee and my Director of Studies, Professor Simon Bolton for his leadership and motivation. He has been such an inspirational supervisor and a great role model, who has facilitated my personal and professional development throughout this process.

I would also like to thank my sponsors, Procter and Gamble and the EPSRC. Michael Duncan acting as my industrial supervisor made this iCase study possible. Many other members of P&G were also a big help in agreeing to take part in the research and providing valuable feedback and advice.

Finally, I would like to offer a huge thanks to my family as they are my main support for everything I do.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ABS	Association of Business Schools
BU	Business Unit
C+D	Connect and Develop
EPSRC	Engineering and Physical Sciences Research Council
FE	Front-End
FEI	Front-End of Innovation
FFE	Fuzzy Front-End
FMCG	Fast Moving Consumer Goods
GNPD	Global New Products Database
IIF	Idea Infinity Framework
IIM	Integrated Idea Management
IM	Idea Management
IMS	Idea Management Systems
IP	Intellectual Property
ISP	Innovation Service Provider
JPIM	Journal of Product Innovation Management
NPD	New Product Development
NPPD	New Product Process Development
OI	Open Innovation
P&G	Procter and Gamble
PDMA	Product Development and Management Association
PMI	Plus, Minus, Interesting
R&D Mgmt	Research and Development Management
ROI	Return on Investment
SCM	Supply Chain Management
SME	Small & Medium Enterprise

1 INTRODUCTION

This research aims to contribute to the current field of knowledge of idea management in front-end innovation literature. The focus is on large scale organisations where cognitive and structural aspects act as barriers against attempts to make use of ideas within different functions of an organisation (Seshadri and Shapira, 2003).

This chapter will introduce the research focus and its surrounding context within the following headings:

- Context
- Key Authors
- Identified Gap
- Contribution
- Focus
- Theory Review Commentary
- Data Collection and Analysis
- Findings
- Discussion
- Conclusion
- Thesis Structure

1.1 Context

The project was first conceived by Professor Simon Bolton at Cranfield University and Dr Michael Duncan at P&G, in response to the EPSRC's 2010 call for applications for iCase awards. P&G was eager to continue its partnership with Professor Bolton, and to develop a research project of direct relevance to its core work of innovation and new product development. Initial conversations resulted in the elaboration of a study that was designed to evaluate the effectiveness of a digital tool to assist in innovation-related knowledge-transfer, as a means of enhancing innovation, and idea management processes.

The context of this research is the front-end of innovation, also known as the FFE, which is the phase where initial product concepts are conceived (Khurana and Rosenthal, 1998; Koen *et al*., 2001; Montoya-Weiss and O'Driscoll, 2000; Reid and de Brentani, 2004). There is no widely accepted definition of the front-end (Achiche *et al*., 2013). Smith and Reinertsen (1998) have been credited to having popularised the term "fuzzy front-end" (Reid and de Brentani, 2004; Verworn, 2009). On one hand, Reid and de Brentani (2004) used the term FFE to denote the earliest phase of the NPD process, roughly equated to all the time and activity spent on an idea prior to the first official group meeting for an NPD project, on the other hand Khurana and Rosenthal (1998) stated that the front-end entails all activities prior to the time a business unit commits to the funding and launch of a NPD project or decides not to do so (i.e. go / no-go decision).

In essence, the FFE involves the "*activities taking place prior to the formal, well-structured new product process development*" (Koen *et al*., 2001: 3). The FFE and its relative position to the Stage-Gate process is shown below in Figure 1.

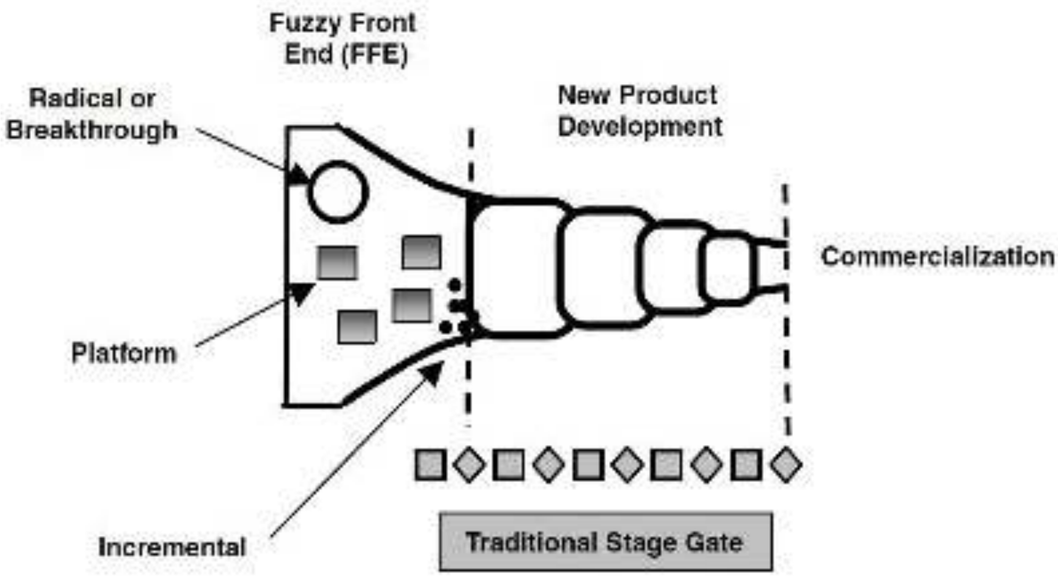


Figure 1 Location of Fuzzy Front-End in Relation to NPD Process

Source: Koen (2004): 82

The main characteristics within the FFE include high degrees of market and technical uncertainty (Soukhoroukova *et al*., 2012; Poskela and Martinsuo, 2009; Mullins and Sutherland, 1998) and extraordinary requirements for creativity (Amabile, 1988). The front-end is fuzzy as it is where complex information processing, a range of tacit knowledge, conflicting organisational pressures, uncertainty and high stakes meet (Khurana and Rosenthal, 1998). In order to maintain clarity the term front-end of innovation will be used as the terminology of the FFE implies a mysterious phase without accounting for responsibility (Koen *et al*., 2001).

Acklin (2010) stated that the FFE is crucial to the later direction and result of an innovation project. Reid and de Brentani (2004) made a major contribution to the FFE literature by distinguishing between early and late innovation phases. The ability to nurture innovation depends on whether the company has the organisational capabilities to do so (Davila *et al*., 2006). Innovation in organisations is often left as an informal ad-hoc process as Desouza *et al*., stated: "*innovation occurs by serendipity rather than by deliberate management*" (2009: 8). This research therefore will investigate the use of formal tools and how they are used in practice in informal, front-end innovation practices.

Idea management is a sub-domain of innovation management (Westerski *et al*., 2011). The Product Development and Management Association (PDMA) held a major study of New Product Development (NPD) trends in 2003, where idea generation and idea management were identified as being poorly managed within the fuzzy front-end (Barczak *et al.,* 2009). They also found that only 60-65% of generated ideas were formally recorded and that new ideas fade away if they are not immediately championed by an individual (Barczak *et al.,* 2009).

Effectively accessing knowledge from external sources is becoming increasingly recognised as a key factor for a firm's competitiveness (Huggins *et al.*, 2010). Partnerships can open the door to multiple knowledge sources and accessing and integrating information from these sources can greatly enhance the knowledge base of organisations, help to fuel sustainable innovation and achieve competitive differentiation (Baloh *et al.*, 2008).

Innovation can be seen as ideas that have been developed and implemented (Van de Ven, 1986). Such a perspective means that all innovations originate from ideas and that, to successfully innovate, firms need to have a sustainable flow of ideas from which to choose (Boeddrich, 2004). Firms that successfully innovate have an ability to implement more and better ideas than their competitors and thereby to gain an advantage (Francis and Bessant, 2005). Innovation is also described as the successful exploitation of new ideas. It is the process that carries them through to new products, new services, new ways of running the business or even new ways of doing business:

"*Innovation is doing something new that is both useful and valued, and it requires an entrepreneurial management for its exploitation*"

(Roos and O'Connor, 2015: 9).

Martins *et al*., (2003) highlight this problem of misuse of terminology in relation to creativity and innovation, by indicating that the concepts of creativity and innovation are often used interchangeably in literature. They suggest that some definitions of creativity focus on the nature of thought processes and intellectual activity used to generate new insights or solutions to problems.

This lack of agreed definitions for the front-end (or fuzzy) stages of NPD also applies to established activities within each stage. Creativity has been defined as "… *the recognition of an opportunity or the inspiration that develops an idea. Innovation is the implementation of all ideas - big and small*." (Wood, 2003: 22), whereas innovation consists of successfully implementing creative ideas within an organisation (Amabile *et al*., 1996).

The definition of idea management employed in this research is the "…*process of recognizing the need for ideas, and generating and evaluating them*" (Vandenbosch *et al*., 2006: 260). An important point has been raised about existing IM definitions not including how ideas are sourced: "*the dominant focus of idea management [is] on creation and selection [and] may ignore an important aspect of sourcing from different groups*" (Soukhoroukova *et al*., 2012: 110). This research addresses this existing limitation and conducts an in-depth empirical study on the effectiveness of an idea sourcing tool.

Many innovation process models can be summarised into several steps (see Figure 2). A Stage-Gate innovation system is used by virtually every best performing company (Cooper and Edgett, 2007) as such a disciplined process has been stated to be key to success (Cooper, 2011). The companies used in this research use an adaptation of this process, allowing for greater complementarity of identified IM best practice. The Stage-Gate system also provides a grounded understanding of the research context within academia and industry, however it is recognised that other innovation systems exist.

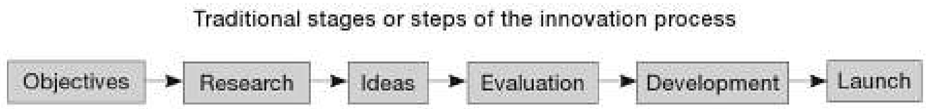


Figure 2 Traditional Innovation Process

Source: De Bes and Kotler (2011): 15

Ideas are complex, wholes of interrelated elements that form part of larger wholes. Idea evolution is strongly shaped and judged by the organisational context, in the end not all ideas are equal (Bakker, 2006). Not all ideas will be good ones and not all good ones will ultimately produce the desired result. Companies are under constant pressure to stimulate the search for and generation of new ideas internally and externally (Kessler *et al*., 2000). Ideas have also been defined as general concepts of what might be technically or economically feasible (Knudsen, 2007).

It appears that few companies have a clear definition of what an idea is. A lack of a clear definition makes it more difficult to extract ideas from other types of information (Karlsson and Törlind, 2013). Bakker *et al*., (2006) define a creative idea as a new and adequate contribution. An idea has also been defined as "*the initial, most embryonic form of a new product or service idea*" (Montoya-Weiss and O'Driscoll, 2000: 145), typically characterised by a one-line description accompanied by a high-level technical diagram. A concept is defined as a form, technology, and a clear statement of customer benefit.

Other definitions focus on the personal characteristics and intellectual abilities of individuals, and still others focus on the product with regard to the different qualities and outcomes of creative attempts (Arad *et al*., 1997). Evaluating creativity has been argued to be considered at the level of a person, organisation, industry, profession and wider (Ford, 1995).

There is a lack of clarity, definition and understanding within the field regarding the nature of ideas within the FFE and not much is known about effective performance management processes (Van Aken and Nagel, 2004). Koen *et al., (*2001) believed that this is primarily due to a lack of common language and definition of key components at the FFE. In addition, Reid and de Brentani (2004) identify individuals linking corporate-level and individual-level knowledge with new information from their environment, as an area not well understood in the FFE.

This research argues that idea management practices in organisations should take a proactive approach rather than a passive approach when searching and selecting ideas. One way to do this is to leverage existing internal and external capabilities. By examining how an organisation is set up to deliver its innovation offerings, a myriad of challenges can be overcome. To this end, enhancing existing tools, processes, and strategies or conceiving new ones that can prompt behavioural and cultural changes. Globalisation is changing and new economies and centres for innovation are emerging and capital, ideas, goods and people are moving more freely between them (Dodgson *et al*., 2006). The problem is not that there is a shortage of ideas, but it is in fact how you manage and implement these ideas that are important (Koen *et al*., 2001). This further supports the benefit of enhancing search and select practices for idea management. This research therefore aims to contribute knowledge regarding how ideas are managed within effective idea management practices supported by a benchmark company case study.

Key Authors

This research draws upon the work of recognised authors within the field of front-end innovation literature. Key authors which have had a direct impact on developing the thinking behind this research are Koen *et al*., (2001) who wrote about how to achieve a common language within the front-end, Björk and Magnusson (2009) covered where good ideas come from relating to network connectivity on idea quality, and Nilsson *et al*., (2002) made a contribution by classifying certain idea management systems depending on their purpose.

Majaro (1992) wrote a highly relevant book, which provided much context on issues regarding managing ideas for profit within large organisations. It identified different creativity tools and techniques, proposed how they should be implemented in practice as well as methods to increase their effectiveness. Additional key authors were identified from an exploratory review of 166 papers along with an in-depth review of 80 relevant papers from the *Journal of Product Innovation Management*, *R and D Management*, and *Technovation*.

Table 1 shows the authors and their publications, which have been most frequently cited (i.e. duplicated at least 6 times). The key publications have been highlighted. The citation figures were produced from Web of Science at the time that the study was conducted. The process ensures that the research which is making an impact in the academic community is reviewed.

The citation figures were produced by performing a ‘cited reference search’ using the Web of Science electronic database. The work of these authors has been reviewed in order to gain an understanding of the current state of the art in front-end innovation, idea management, idea quality, and organisational creativity literature.

Table 1 Key Authors and Publications

Subject Area	Key Authors*	Key Publications	Times Cited**
Organisational Knowledge	Nonaka, I. and Takeuchi, H. (1995)	The Knowledge Creating Company. Book	25,054
Absorptive Capacity	Cohen, W. M. and Levinthal, D. A. (1990)	Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly*	16,041
Organisational Knowledge	Nonaka, I. (1994)	A Dynamic Theory of Organizational Knowledge Creation. *Organization Science*	10,274
Organisational Learning	March, J. G. (1991)	Exploration and exploitation in organizational learning. *Organization Science*	9,733
Product Development	Clark, K. B., and Fujimoto, T. (1991)	Product Development Peformance. Book	3,922
Knowledge Flow/Communication	Allen, T. J. (1977)	Managing the Flow of Technology. Book	3,722
Innovation, Lead Users	von Hippel, E. (1986)	Lead Users: A Source of Novel Product Concepts. *Management Science*	2,156
Innovation Management	Van de Ven, (1986)	Central Problems in the Management of Innovation. *Management Science*	1,934
Organisational Creativity	Amabile, T. M. (1988, 98)	How to Kill Creativity. *Harvard Business Review*	1,222
Voice of the Customer	Griffin, A., and Hauser, J. R. (1993)	The voice of the customer. *Marketing Science*	1,187
NPD	Smith, P. G. and Reinertsen, D. G. (1991)	Developing Products in Half the Time. Book	1,016
NPD	Cooper, R. G. and Kleinschmidt, E. J. (1996)	Benchmarking the Firm's Critical Success Factors in New Product Development. *Journal of Product Innovation Management*	532
P&G 'Connect & Develop' / Open Innovation	Huston, L., and Sakkab, N. (2006)	Connect and Develop: Inside Proctor and Gamble's New Model for Innovation. *Harvard Business Review*	485
Involving Suppliers in NPD	Handfield, *et al.*, (1999)	Involving Suppliers in New Product Development. California Management Review	405
NPD	Song, M.X. and Parry, M.E. (1997)	The determinants of Japanese new product successes. *Journal of Marketing Research*	390
FFE in NPD	Khurana, A. and Rosenthal, S. R. (1997, 98)	Towards Holistic "Front Ends" in New Product Development. *Journal of Product Innovation Management* Integrating the fuzzy front-end of new product development. *Sloan Management Review*	389 340
FFE	Koen *et al.*, (2001)	Providing clarity and a common language to the "fuzzy front end." *Research Technology*	272
Open Innovation	Chesbrough, H. W. (2004)	Managing Open Innovation. *Research Technology Management*	248
FFE	Reid, S.E. and de Brentani, U. (2004)	The Fuzzy Front End of New Product Development for Discontinuous Innovations: A Theoretical Model. *Journal of Product Innovation Management*	244
NPD	Cooper, R. G. (1988)	Predevelopment activities determine new product success. *Industrial Marketing Management*	240
FFE in NPD	Kim, J., and Wilemon, D. (2002)	Focusing on the Fuzzy Front End in New Product Development. *R&D Management*	190
Communication During FFE	Moenaert, *et al.*, (1995)	R&D/marketing communication during the fuzzy front-end. *IEEE Transactions on Engineering Management*	174
FFE	Montoya-Weiss, M. M., and T. M. O'Driscoll, (2000)	From experience: Applying performance support technology in the fuzzy front end. *Journal of Product*	95
FFE	Reinertsen, D.G. (1999)	Taking the fuzziness out of the fuzzy front-end. *Research Technology Management*	84

* - name duplicated at least 8 times in additional references list of read papers to-date and not including joint authorship papers that were not duplicated at least 8 times

** - total number of times cited in google scholar (12 May 2012)

1.2 Research Gaps

The literature review revealed research gaps emerging from the key research areas. The identified research gaps are summarised below:

The first gap in knowledge is a lack of research on how ideas are sourced for idea management (Soukhoroukova *et al*., 2012) i.e. not just identifying internal and external innovation sources. The IIF provides a visual explanation of how organisations search for and select ideas, internally and externally, and thus goes beyond simply identifying innovation sources. This research focused on how to better integrate the external sourcing and evaluation processes to feed better quality ideas into the pipeline.

The second gap in knowledge is a lack of academic literature on helping to understanding how ideas get going within organisations (McGuinness, 1990). This research will explore several aspects of how idea are generated and transferred throughout the front-end phases. This includes activities such as idea selling, organisational criteria, fit to the need or problem and highlighting the nature of processes involved.

Finally, a conceptual gap exists between the generation and the selection of ideas and their transformation into innovations. This is due to different processes and skills occurring with generation compared to selection as well as differing outcomes. While this study does not focus on idea implementation after the initial ideation phases, it does contribute to the literature on idea generation and idea selection. This is difficult with other studies also establishing the importance of these front-end activities, such as a need to explore further methods, concepts and tools to support the processing of ideas into innovations (Blohm *et al*., 2011).

As well as addressing the stated research gaps, there is a general need for further research regarding the development of ideas in organisations (McGuiness, 1990). Gaining insights from a quantitative study on idea management will help identify any emerging gaps that may be of interest to other researchers.

Contribution

The study will address the identified gaps and make a contribution to new knowledge by focusing on understanding how to improve front-end innovation practices in relation to idea management within large organisations. It aims to understand the factors impacting on the integration of internal and external ideas, including the effectiveness of search and select tools. A key outcome will be to provide a flexible search and select framework that will allow organisations to orientate their external search and select processes, evaluate their existing idea sourcing tools and aid key effective idea management practices.

Very little attention has been given to ensuring that potentially good ideas do not escape within an organisation (Vandermerwe, 1987). Therefore, the main knowledge contribution of this project will be to add to the FFE literature through conducting an in-depth case study to gain insight into idea management and idea generation effective practice to enhance innovation in organisations. This research also answers 'what is a good quality idea' by analysing the literature for idea quality criteria. Recommendations on open innovation tool effectiveness, increasing adoption of tools and identifying the challenges and barriers associated with them.

Principles that will also be considered are barriers to search and select tool adoption and touch on factors impacting on innovation performance. This is a key issue for the case study with P&G since this was of importance to how they conduct their external searches and the tools they use to do so. The research focus is on external innovation capabilities and how they interact with internal innovation capabilities to generate better quality ideas.

1.3 Focus

This research focuses on identifying how idea management and external idea sourcing tools can be used to enhance innovation activities within front-end (FE) activities. The importance of the fuzzy front-end and effective idea management practices has been acknowledged in the literature. A systematic review of front-end literature allowed the identification of key trends, emerging themes, gaps and success factors, which were subsequently published.

Only 19% of businesses have been judged to have a proficient ideation front-end to feed their development funnel (Cooper *et al*., 2004). This research will contribute to the current field of idea management within front-end innovation literature. Other authors have emphasised the importance of idea management (see Barczak *et al.,* 2009). This research is helping to address a need to explore further external methods, concepts and tools to support the processing of ideas into innovations (Ebner *et al*., 2009).

Investigating how impacting external issues relate to idea management practices will help achieve a holistic study where internal and external practices are considered. This is important as raw ideas are the starting point of the creation of new, commercially successful products (Stevens and Burley, 1997). The impact and importance of FFE activities is represented within the literature, however it is lightly researched in comparison with research on the NPD process (Glassman, 2009). Figure 3 illustrates the interaction of internal and external capabilities impact on concept generation in the front-end to deliver differentiated concepts.

The FFE is where uncertainty is at its highest, which is especially true with discontinuous innovation (de Brentani and Reid, 2004) and is where embryonic (or very early stage) ideas (Souder and Ziegler, 1977), or potential ideas are located. It has become apparent that the FFE is fuzzy in terms of idea management at the embryonic idea stage due to the lack of literature found dedicated to this topic.

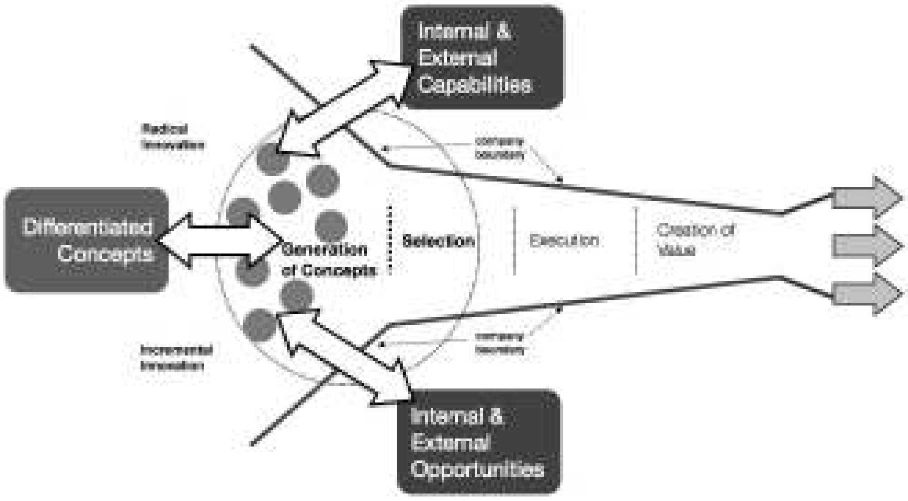


Figure 3 Differentiated Innovation Model

Source: Brun *et al*., (2013): 53

This research focuses on embryonic ideas rather than more fully formed ideas as this is where there is greater potential to improve existing innovation processes. According to Smith and Reinertsen (1998), actions taken at the fuzzy front-end to improve the NPD process, achieve the greatest time savings for the least expense. Acklin (2010) supported this view stating that the early phase of innovation management, the fuzzy front-end, is crucial to the later direction and result of an innovation project.

Investigating how embryonic ideas are managed in the front-end of innovation (FEI) is critical to answering the research question: how do you increase the quality and quantity of ideas that can be brought to market? Managing ideas has been recognised as a complex issue in the literature. Vandenbosch and Saatcioglu (2006) stated that they do not presume there is an ideal process for the management of ideas and that they do not know how idea management systems emerge.

This research argues that idea management should be more integrated and processes facilitate the implementation of not only good quality internal ideas, but also external ideas within the innovation process.

The subject area for this research brings together a range of management science disciplines including product innovation, design thinking, open innovation, relationship management, idea generation, fuzzy front-end (FFE), creativity, and the front-end of innovation. The focus of the research is on how to improve idea management processes within the context of front-end activities as effective IM has the greatest impact on successful product innovation (Cooper, 2011).

Theory Review Commentary

Innovating organisations rarely lack ideas for new products. However, nearly all indicate that they require improved mechanisms for two clear phases: evaluating and selecting ideas, and managing high-quality ideas. The situation has become more complex as organisations have looked beyond their own boundaries to source and co-develop ideas with external partners (a phenomenon known as ‘open innovation’ (Chesbrough, 2006). Though the advantages of open working are widely known, the shift has introduced (a) novel challenges to the idea generation milieu, and (b) new phases and factors into the idea development system (Enkel *et al*., 2009).

Considerable literature exists on best practices for the start and stages within the NPD, but little research has been done identifying best practices for the front-end (Koen *et al*., 2001). Most companies struggle with several front-end problems mostly due to a lack of disciplined execution rather than confusion over what should be done (Khurana and Rosenthal, 1998). These problems in the innovation cycle are in problem definition, strategy setting, technology procurement or development, and the setting of expectations (Mirvis *et al*., 1991).

Innovating companies indicate that they experience difficulties along three vectors: 1) integration or blending of external and internal sources of knowledge and ideas, 2) effective use (and organisation-wide adoption) of tools and routines deployed in idea generation and management, and 3) incorporation of modern effective practice re: high quality idea creation and processing. In summary, companies report a need for an intelligent and flexible framework that will aid them in the identification and selection process with respect to excellent ideas and quality partners. The application of effective search and select practices is key to innovation success, and it is the creation and enhancement of such practices that this study is designed to address.

Figure 4 illustrates the overall framework for this PhD. It frames the research questions in relation to literature review issues and in context alongside five front-end stages, four of which have been established by the Design Council (2005). The pre-discovery (referred to as establishing) phase was identified through a literature review need and has been called various other terms such as the pre-development stage. Reviewing the literature has helped to identify patterns in findings from multiple sources and from the understanding and synthesis of these findings, the research aim, objectives and research questions for the study was then able to be established. Research questions three and four (labelled C and D in the PhD framework) are related not only to literature, but to the main industrial case study survey (linked to research question four) and are all interconnected by the need to understand how to source and generate better quality ideas.

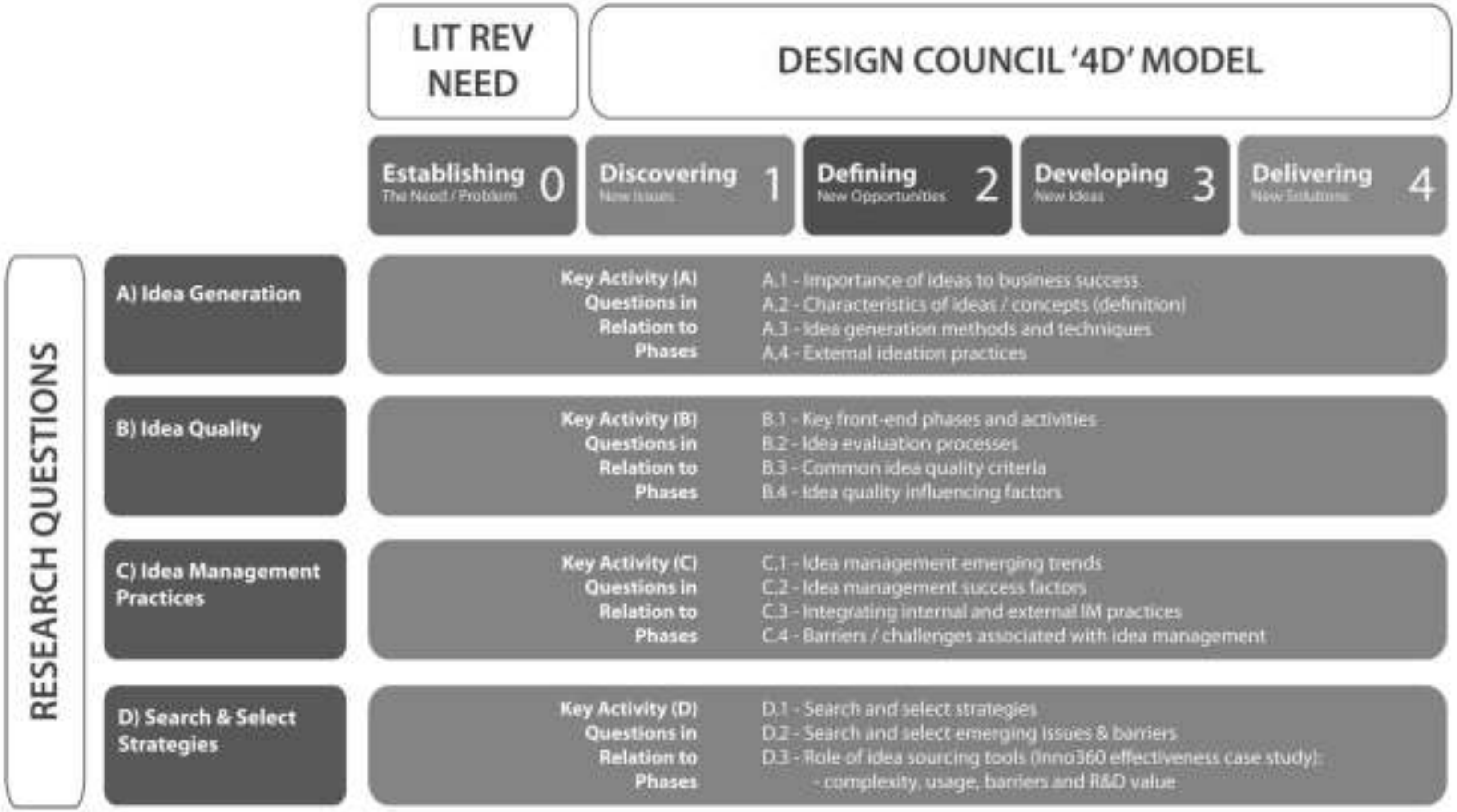


Figure 4 PhD Framework

Source: Author (2016)

1.4 Research Aim, Objectives and Questions

Research Aim and Objectives

The purpose of this thesis is to address research gaps related to the factors affecting the role of idea management in maximising internal and external innovation capabilities within front-end activities. It will also provide practitioners guidance to diagnose and enhance their idea management practices in relation to search and select tools and practices in their organisations. The main aim of this PhD is therefore:

> To increase the understanding of influencing factors for idea management within internal and external practices, with a focus on the integration of search and select tools within front-end innovation to achieve better quality ideas.

In order to achieve this aim, four research objectives are formulated as follows:

1) Systematically identify and investigate contemporary practices relating to (innovation-related) idea management, including idea generation methods.
2) Examine such practices with particular regard to factors including: stakeholders and power relations in idea generation settings, idea evaluation criteria, types of innovation, characteristics of ideas, and integration of internal and external sources of ideas.
3) Investigate the nature and implications of external relationships (with customers, suppliers, users) and the ways in which inputs from the latter are incorporated (searched and selected) in early phases of the idea generation process.
4) Examine issues of complexity and uncertainty in current search and select processes, and the methods deployed to reduce or exploit their implications.

Essentially, the study is designed to examine the factors affecting idea management practice, suggest how idea generation and evaluation processes might be enhanced to improve idea quality, identify means of better integrating internal and external sources of ideas (partners), and consider methods for the reduction of uncertainty in idea management and processing. It is also designed to provide a flexible search and select framework that will allow organisations to visualise their searching processes to achieve outcomes and aid effective idea management practices.

Research Questions

The research questions were identified and refined from a critical analysis of the emerging research themes from a systematic literature review. The literature review encompassed four main topics of idea management, idea generation, idea quality, and search and select strategies. This process was iterative and reflects the importance and relevance of the sub-issues in the literature and within industry for each central research question.

This process helped focus the attention on these four questions and their related sub-issues. The research questions answered in the literature review are as follows:

(RQ1) **Idea generation:** How are ideas generated internally and externally and what are the effective practices for idea generation within front-end activities in organisations?

(RQ2) **Idea quality:** What is a good quality idea and what criteria are used to evaluate idea quality internally and externally within front-end activities in organisations?

(RQ3) **Effective IM practices:** What internal and external idea management practices and sources enhance innovation capabilities in organisations within front-end activities?

(RQ4) **Search and select strategies**: How can the effectiveness of internal and external search and select strategies and tools be improved within industry and what barriers are associated within front-end practices?

Each research question will have the following outcomes:

- Emerging themes and issues
- Success factors
- Recommendations

The evaluation of Inno360 is a key part of addressing research question four, as the tool serves as a case study example to examine the effectiveness of a current industrial search and select tool for ideas and knowledge. This study evaluated the current level of effectiveness of the tool in industry. It also identified barriers to use of the tool for practitioners via an internal company survey.

A summary of the research questions and their related measures are detailed below in Table 2. These measures helped to focus the research activity for each question.

Table 2 Core Research Questions and Measures

Research Questions & Measures
RQ1: Idea generation: How are ideas generated internally and externally and what are the effective practices for idea generation within front-end activities in organisations? *Measures: Importance, frequency, nature of processes*
RQ2: Idea quality: What is a good quality idea and what criteria are used to evaluate idea quality within front-end activities in organisations? *Measures: Quality, evaluation*
RQ3: Effective IM practices: What internal and external idea management practices and sources enhance innovation capabilities in organisations within front-end activities? *Measures: Nature of processes, sources, effectiveness*
RQ4: Search and select strategies: How can the effectiveness of internal and external search and select strategies and tools be improved within industry and what barriers are associated within front-end practices? *Measures: Nature of processes, frequency, effectiveness of Inno360, barriers*

1.5 Corporate Deliverables

This research is an industrial CASE award which is two-thirds funded by the Engineering and Physical Sciences Research Council (EPSRC) and one-third funded by Procter and Gamble. It aims to work in partnership with industry in order to deliver requirements for both industry and academia. This industrial input will help to inform the research and provide access to appropriate practitioners for data collection purposes.

There is an important distinction to be made between the academic research questions for this project and the industry-based deliverables. The application of a tool will improve practice, whereas knowledge and understanding is developed inductively through application and refinement (Moultrie *et al*., 2007). A valid contribution is made to academia as new knowledge is generated from investigating internal practices already recognised as best practice within the literature.

P&G face several challenges around managing collaborative relationships, as the organisation has 90,000 suppliers providing raw materials to 150 manufacturing plants as well as finished products (Ragu, 2009). Building trust with retailers and reaching millions of customers facilitates the buildup of complexities, with the majority of their innovation coming from external sources, such as Connect + Develop, as well as its supply base. Managers always must listen to customers, but they must be aware of the direction in which different customers will lead them (Christensen, 2006).

The corporate deliverables and objectives for this research to P&G include:

- a review of contemporary literature with recommendations on effective practice with respect to idea management. This will assist in improving the organisation's knowledge of and alignment with current practice,
- an innovation framework that (a) details effective practices for seeking and selecting external ideas, one that is tailored to P&G culture, and (b) facilitates evaluation of existing open innovation tools and barriers, and

- a set of insights / recommendation (on the basis of the survey and validation interviews) relating to usage, effectiveness and future deployment of Inno360.

The developed search and select framework will facilitate the understanding of affecting factors and aid the generation of new knowledge to the field, supported by an industrial perspective. This research can also potentially impact on P&G's ability to generate a step change in their capability and aid their understanding and knowledge of how to orientate their search and select practices to access internal and external innovation opportunities. It will impact on their competitiveness by helping the company to conduct external searches more efficiently due to a greater embedded nature of Inno360.

This study has the potential for knowledge to be transferred to other organisations that need to extract more innovation value from their internal and external capabilities in order to deliver business objectives.

Data Collection and Analysis

A single case study model is the methodology used for this research. The type of projects are FEI-based, where users will look to searching tools to help them meet the business need. Time was spent working with tool owners in P&G to explore how they use landscaping tools to search and select external opportunities. An agreement was reached to be involved in a P&G project in China to link a landscaping tool to the research. This allowed for the opportunity to witness current industry practices relevant to this research in a different culture.

Reviewing the effectiveness of the landscaping tool, called Inno360, is of importance as it is a working example of an open innovation tool which integrates internal and external sources to enhance innovation ecosystems. This provided an opportunity to improve how the use of the tool aligns to P&G practices, particularly on a project basis. For this research, getting access to quantitative data on a global scale is valuable and not often achieved with studies on the front-end of innovation. Most studies on the front-end are qualitative in nature (Koen *et al*., 2001), therefore the blended methods approach used in this research is likely to provide new insights and findings related to idea management (IM).

The blended methods approach incorporates exploratory interviews to gain qualitative insights as well as a quantitative survey to enhance validity and reliability of data, also called the mixed methods approach (Johnson and Onwuegbuzie, 2004). The exploratory interviews were undertaken to understand the language used within industry and identify key everyday issues and challenges within their idea management practices. The scoping and validation interviews involved C+D practitioners whereas the Inno360 effectiveness survey incorporated all P&G practitioners registered to Inno360, including those in the R&D function. Follow-up validation interviews were conducted to verify the main findings from the survey.

This empirical study was built using the "purposive sampling strategy". A 16% response rate was achieved from a targeted 953 tool users (and non-users) within P&G. This response rate was obtained due to the internal promotion of the importance of the survey via recommendation from senior management. This offsets the disadvantages of interview surveys where participant numbers are often very low with high qualitative data.

In order to draw meaningful insights regarding current FE activities and tools within the literature, 15 FE models were chosen for comparison in order to identify common front-end activities and practices. These models were broken down and re-arranged into the five-stage FE process. This allowed the tools, activities, and phases to be more easily compared in a visual format. In addition to finding the common tools and activities this allowed for the development of a framework summarising the stated benefits, goals, definitions and internal or external tool focus for each model. From this framework, it was clear that there is a lack of common tools, particularly external, related to each of the five stages. This research targets the establishing phase and its link to external idea sourcing tools.

A series of frameworks were developed using an 'input, action and output' format, cross-referencing the 4D model (see Methodology chapter). Consequently, this research makes a contribution to new knowledge by identifying a need to include a pre-discovery stage called ‘establish’. The purpose of this new stage is to address the problem identified within industry that project teams struggle with clearly defining their focus right at the start of the process. It was also identified in the literature that there is a need for an establishing phase (termed as *Problem Definition*) prior to current search processes within large organisations.

A descriptive approach was selected to analyse the data. The adoption of this approach supported the aim of this research to identify and describe what industry is doing regarding effective practice idea management. Thematic coding analysis was used, as described by Robson (2011) and Liamputtong and Ezzy (2005), to summarise key emerging themes from a large amount of qualitative data. This is also known as a process called clustering where concepts are grouped with similar concepts (Davila *et al*., 2006).

Findings

The findings chapter will introduce and detail the results from the main survey. It is structured into four key sections: 1) scoping interviews, 2) main survey, 3) validation interviews, and 4) summary of findings. Each section identifies emergent themes from the responses, presents quantitative and qualitative data, and summarises the key findings of each data set. The final summary of findings discusses the interrelationships between each of the data sets.

Discussion

The purpose of this chapter is to discuss the emergent themes in further detail and the extent to how they are consistent with previously published knowledge on each topic. It is structured via each of the four research questions. The discussion will suggest that the surveyed practitioners acknowledge the importance of need definition to the success of their search and select practices in front-end activities, which supports the work of Jeppesen (2005) and

McGuinness (1990). However, the results indicate that practitioners typically focus on finding the right data to fit the need under tight time constraints. This search urgency is reflected in how they describe their use of alternative tools, such as Google, which they use for its speed, relevancy and high level of familiarity.

Multiple issues regarding the usability and effectiveness of idea sourcing tools are discussed with reference to the conducted empirical research in this study. Practitioners experience issues and barriers related to their search mind-set, pre-search preparation, level of expertise and user background, complexity of the question, and priority level of the search. Uncertainty over the use of tools within the organisation appears to be due to a general lack of clarity over the real tool value and benefits offered to users.

In addition, there can also be a lack of problem focus in terms of defining search terms to input into a tool. Users are highly outcome-driven and require tools that can deliver search requirements efficiently. Their activities are typically undertaken through informal methods, primarily personal interaction within their networks and networks of their colleagues, supported by Tushman and Scanlan (1981) as boundary-spanning individuals require strong internal and external connections as well as technical and social skills.

Conclusion

The conclusion will return the research questions and highlight the ways in which the findings have contributed to current knowledge. This chapter has a focus on application to industrial practice as well as academia. It will clarify the key messages through the proposal of a new innovation framework which was developed in order to help organisations orientate and visualise their search and select practices for idea management. The section closes with a discussion of the limitations of the study and an outline of further research opportunities.

1.6 Thesis Structure

This study is comprised of six chapters in total. The structure and content of each of the forthcoming chapters is summarised below:

Chapter 1: **Introduction** - provides an overview of the thesis. It identifies the research background, gaps, research focus, research aim and objectives, research questions and a PhD framework. It also details the corporate deliverables for this industrial study, concluding with a summary of the research design.

Chapter 2: **Literature Review** - identifies the literature to position this study across a number of related research fields. It is structured into three main sections: 1) factors affecting idea management, 2) factors affecting idea generation and quality, and 3) factors affecting search and select strategies. Each section concludes with a section summarising effective practices and gaps. It also lays out the theoretical grounds for the research aim and questions.

Chapter 3: **Research Methodology** - details how the study was conducted including study orientation and implementation. Primary and secondary data collection is described along with employed data analysis techniques and a discussion. The relevant supporting research methodologies are detailed along with the rationale for the research methodology. In addition, the background information supporting the case study company and digital tool is given along with limitations of the chosen methodology.

Chapter 4: **Findings** - analyses and presents the findings from the empirical study. It is structured into three main sections following the research design: i) scoping interviews, ii) main survey, and iii) validation interviews. It concludes with a synthesis of the emerging insights and main findings.

Chapter 5: **Discussion** - synthesises the key findings from the previous chapter and answers the four research questions. The relationship between the identified factors is also discussed. It does this by comparing and discussing the found results with relevant existing literature.

Chapter 6: **Conclusion -** sets out the contributions to new knowledge from the study and identifies how three research gaps have been addressed. An innovation framework is proposed for idea management, in various levels of detail. The implications for practitioners and researchers are suggested along with the strengths and limitations of the employed research. The opportunities for further research and a final reflection conclude the thesis.

The following chapter details the literature review for this research.

2 LITERATURE REVIEW

Introduction

The aim of this literature review chapter is to generate an in-depth understanding of the factors affecting the generation, sourcing and management of internal and external ideas in front-end innovation activities. In order to achieve that goal, the literature review adopts a multi-trajectory approach exploring three key areas:

2.1) **Factors Affecting Idea Management**
2.2) **Factors Affecting Idea Generation and Quality**
2.3) **Factors Affecting Search and Select Strategies**

The rationale for adopting this approach relates to the strong interrelationship between the success of the front-end innovation process and how well ideas and / or needs are initially defined, the established importance of search and select strategies for finding external innovation, and the effective implementation of idea sourcing tools within large organisations.

This chapter provides a critique of the literature surrounding idea management in front-end innovation. The systematic review helped shape the research questions that will be answered by this empirical study (see Introduction chapter). Each section explores a series of emerging themes and issues derived from multiple sources within high-quality journal literature and other publications. An analytical summary closes each section with an overall summary at the end of each chapter.

The focus of section one is to provide an in-depth review of the factors affecting idea management (IM). The first section sub-divides findings into three themes that focus on a) front-end phases and activities, b) idea management practices, and c) idea management trends and success factors. It concludes with a summary of effective practices and gaps to explore how idea management can be improved for organisations.

Section two provides a review of factors affecting idea generation and quality which are two important aspects of idea management. The second section also sub-divides findings into three themes focusing on a) the importance of ideas to success, b) idea generation methods and techniques, and c) idea evaluation and quality criteria. It concludes with a summary of effective idea generation and idea quality and knowledge gaps.

Section three reviews the factors affecting search and select strategies. This discusses three areas of a) search and select practices, b) search and select barriers, and c) the role of idea sourcing tools. This last area in particular relates to tools used within internal and external idea management practices. It concludes with a summary of effective search and select strategies as well as gaps in front-end innovation present in the literature.

The concept of idea management has been investigated in more depth, looking specifically at idea generation, idea quality and idea evaluation. This will form the theoretical background for the project through the accumulation and analysis of existing literature within the subject area, which subsequently led to the identification of gaps in knowledge. Identifying effective practices in idea management from the literature and covering the key areas within the research questions, informed the case study analysis and provided the foundation for development of the innovation framework and tools discussed in the Research Methodology chapter.

2.1 Factors Affecting Idea Management

Introduction

The literature review is designed to examine emergent themes from the works of key authors and state-of-the-art knowledge on the subject area within top-ranked journals. This first section focuses on identifying the emergent themes in relation to factors affecting idea management. This has provided the study with a thorough grounding within the front-end of innovation literature, further developed by synthesising findings with the following two literature review sections.

This section has been sub-divided into three identified trajectories:

2.1) Factors Affecting Idea Management:

2.1.1) Front-End Phases and Activities (articulating the need for an establishing phase)

2.1.2) Parameters that Influence Idea Management Practices (integrating external innovation)

2.1.3) Idea Management Trends and Success Factors

This section concludes by summarising the emergent effective practices within the above explored themes regarding factors affecting idea management.

2.1.1 Front-End Phases and Activities

Front-End Innovation

Innovation has many definitions but has been defined as the successful implementation of creative ideas within an organisation (Amabile *et al*., 1996). The fuzzy front-end sits within the wider remit of front-end of innovation, which is the phase where initial product concepts are conceived (Khurana and Rosenthal, 1998; Koen *et al*., 2001; Montoya-Weiss and O'Driscoll, 2000; Reid and de Brentani, 2004). The literature suggests that although hundreds of concepts may be found in the concept generation step, only five to 20 will be seriously considered (Ulrich and Eppinger, 1995). The implication here is that most ideas will not be considered (under prevailing operating modes) within the innovation pipeline.

Similarly to the definitions of innovation, there are several definitions found in the literature for the fuzzy front-end, also known as the FFE. Smith and Reinertsen (1998) have been credited to having popularised the term "fuzzy front-end" (Reid and de Brentani, 2004; Verworn, 2009; Koen *et al*., 2001). Kim and Wilemon defined the fuzzy front-end as "…*the period between when an opportunity is first considered and when an idea is judged ready for development*" (2002: 270).

Acklin (2010) stated that the fuzzy front-end is crucial to the later direction and result of an innovation project. The front-end challenges and threats seem to be very similar across different industries, companies and PDD processes (Brem and Voigt, 2009). The so-called 'idea tunnel', which resulted from an older concept called 'development funnel' (Hayes *et al*., 1988), is the elementary basic model for front-end considerations.

The term front-end fuzziness has been used interchangeably to refer to other terms such as uncertainty, ambiguity, variability, equivocality, and complexity (e.g., Doll and Zhang, 2001; Kim and Wilemon, 2002). Other authors go on to state that uncertainty and equivocality reduction are critical to success in the fuzzy front-end (Frishammar *et al*., 2011).

Process models have been developed to try and decrease fuzziness and to increase a systematic approach in the front-end of innovation (Cooper, 1998; Koen *et al*., 2001). However, formal process models have been criticised as they promote an optimal model for the front-end without considering contextual factors (Poskela and Martinsuo, 2009). The disadvantages connected to process formalisation include: decreased innovativeness, corner-cutting, negative employee attitudes, and excess bureaucracy with decreased flexibility (Amabile, 1998; Bonner *et al*., 2002; Ramaswami, 1996). These act as barriers to the flow of ideas within large organisations. However having formalisation and a structured process with in-built flexibility for ideation has been found to improve effectiveness by authors such as Brem and Voigt (2009).

The early stages of New Service Development are often called the fuzzy front-end of the innovation process as they typically involve imprecise processes and ad-hoc decisions (Montoya-Weiss and O'Driscoll, 2000). A firm can benefit substantially by optimising and improving the fuzzy front-end of an innovation process (Dahl and Moreau, 2002; Reinertsen, 1999). According to Smith and Reinertsen (1998) actions taken at the fuzzy front-end to improve the NPD process, achieve the greatest time savings for the least expense.

Early activities are broad and include opportunity identification and exploration, whilst later activities consist of information collection and concept development preparing to transfer into the NPD process (Crawford and Di Benedetto, 2008). Some researchers have presented models for structuring these pre-project phases (e.g., Khurana and Rosenthal, 1998; Koen *et al*., 2001). A common trait of these models is their aim to reduce uncertainty. Some authors have argued that there is not one front-end process suitable for all situations (Nobelius and Trygg, 2002). Instead, companies need to be able to rapidly introduce changes late in the process, a planned flexibility (Verganti, 1997).

Mootee (2011) provided a strategic innovation process consisting of seven clarifying phases for the fuzzy front-end (see Table 3). These best practices were identified from applying principles of FEI activities in over 100 companies. These seven phases clarify the different nature of the processes that take place, and provide support for the use of environmental scanning and involvement of customers within the ideation process.

Table 3 Clarifying Fuzzy Front-End Phases

Fuzzy Front-End Phases	Description
Phase 1: Uncover Customer Insights	• includes four core activities: design field research, conduct ethnographic research, frame the insights and organise data, and present deliverables
Phase 2: Develop Strategic Foresights	• includes primary tools: environmental scanning, context mapping, scenarios development, and scenarios workshop
Phase 3: Strategic Sense-making and Opportunity Mapping	• includes five activities: validating themes, forming combinations, crafting thick descriptions, testing, meta mapping, and design
Phase 4: Ideation and Concept Development	• includes: group sharing of initial ideas, ideation and concept re-articulation, written descriptions, idea / concept review and selection, and initial 2D concept sketching
Phase 5: Rapid Concept Prototyping	• includes three levels of output and fidelity: low-fidelity rapid prototype, mid-fidelity rapid prototype, and 3D CAD based rendering and modelling
Phase 6: Customer Co-Creation	• includes core activities: goal setting, lab design, co-creative facilitation, post-lab reviews, key insights and recommendations, and knowledge transfer
Phase 7: Brand and Marketing Assessment	• clarifies overarching fuzzy front-end process framework

Source: Adapted from Mootee, (2011)

Another study by Verworn (2009) found that bringing people together from different functions early on in the process enhanced planning of the front-end. It was also found that intensive initial planning helped to reduce market and technological uncertainty.

The most popular front-end model was developed by Koen *et al.*, (2001) based on research with 23 companies proficient in New Product Process Development (NPPD). It illustrates the new concept development model in a circular shape, with ideas flowing within five core elements with external influencing factors (see Figure 5), driven by a central engine comprising of leadership and culture.

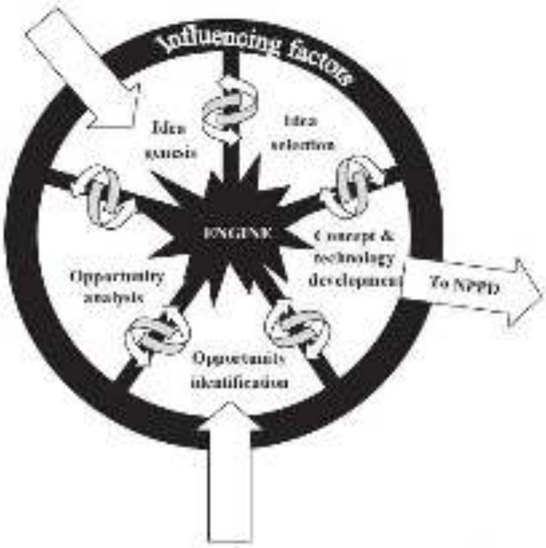


Figure 5 New Concept Development Model

Source: Koen *et al*., (2001): 47

What models such as this have in common is that they are all based on qualitative case studies (Brem and Voigt, 2009). However, it has been argued that taking a quantitative approach is not merely helpful to structuring the front-end process, but is of "*paramount importance*" as no critical design decisions can be made without quantitative methods (Reinertsen, 1999: 30). This highlights the need for more quantitative studies on exploring and identifying front-end activities and practices that practitioners use in industry.

The Need for an Establishing Phase

Improved IM will ensure valuable ideas are captured and explored to minimise loss and maximise the management of idea opportunities (Vandermerwe, 1987). As several studies note, the organisations that excel in managing the fuzzy front-end (FFE) phase are more likely to win the innovation race (e.g. Dwyer and Mellor, 1991).

It is well established that execution has a strong positive relationship with NPD success (Cooper, 1998). For example, experience has shown that pre-development work pays for itself in reduced development time and improved success rates (Cooper, 1993). Both the NPD and design communities place most importance on pre-development activities, including the need for strong market and customer intelligence (Moultrie *et al*., 2007).

Poor definition of product requirements was the reason most cited for product development delays. A study focusing on product development acceleration noted that process delays occur when there is poor understanding of customer requirements and insufficient knowledge of a product's technology and market forces. These include competition, suppliers and distributors, all of which should be addressed in the FFE (Gupta and Wilemon, 1990).

Previous research on idea management recognises that a lack of ideas is not the problem (Markides, 1998), it lies in how to successfully manage the process from a turning an idea into a used product (El Bassiti and Ajhoun, 2013). This element of implementation is often the difference between creativity and innovation in terms of definition. This is a key insight from the literature, and one that informed the research study. It highlights the need for a framework which helps to visualise and manage internal and external interactions in idea management.

Problems seem to be more complex in larger organisations, where there is a need to narrow the focus of the search process (McGuinness, 1990). There were no deliberate efforts to better define the initial problem in the search processes examined in the study by McGuinness (1990). It has been argued that idea management systems need to become more complex to handle different forms of innovation (Sandström and Björk, 2010), in terms of incremental and disruptive innovation. Certainly, recognising differences in the classes of innovation or ideas that are required affects the way in which an organisation will approach development and implementation.

McGuinness (1990) conducted a study previously in small firms and later aimed to discover whether a similar pattern of idea search was present in organisations. He found an additional phase present in organisations that was not present for small firms, which was problem definition. It is therefore stated that there is a requirement for an initial stage of *Problem Definition*, prior to *Detection*, *Credibility*

Seeking and *Intensive Search,* shown in Figure 6 (McGuinness, 1990; Nilsson *et al*., 2002).

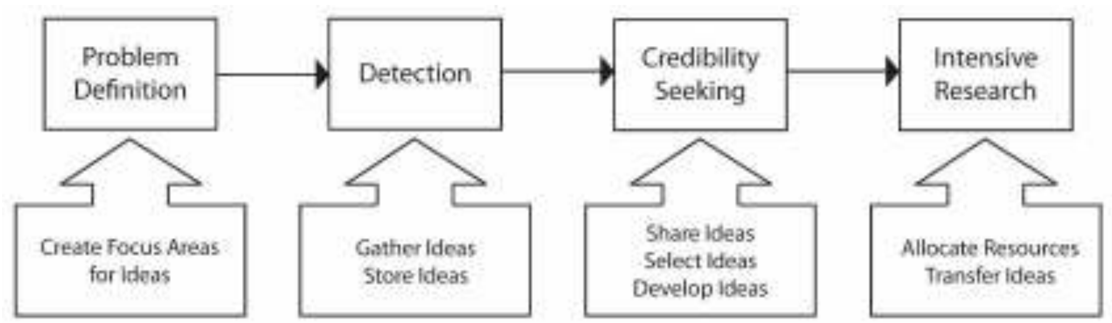


Figure 6 How Idea Management Supports Idea Generation

Source: Adapted from Conway and McGuinness (1986); McGuinness (1990) by Nilsson *et al*., (2002)

This diagram illustrates complementary activities between idea management and idea generation. Most companies struggle with front-end problems mostly due to a lack of disciplined execution rather than confusion over what should be done (Khurana and Rosenthal, 1998). The pre-development stages including the idea, preliminary assessment and concept require more focus (Cooper, 1988). These findings support the addition of an 'establishing' stage prior to discovery in the five-stage model used in the research framework.

It has been found that most front-end projects in process development are reactive, making it difficult to plan ahead. Consequently, the evaluation of front-end activities is sometimes based on personal judgments and gut feeling (Kurkkio *et al*., 2011). There is therefore a call for research that make idea quality criteria more explicit. This finding along with others suggests that the front-end needs to be made more proactive and include flexible tools along with trained people to use them. These findings on front-end models reveal that organisations need a phase for problem definition which informs any 'search and select' processes for ideas and innovation.

2.1.2 Parameters that Influence Idea Management Practices

Concept and Idea Definition

Within the literature, there is inconsistency in the use of the definition of a concept and an idea. For example, an ethnographic study of a concept car development project and 16 manager interviews found that the word 'concept' was used slightly differently from the pure meaning of 'idea' (Backman *et al*., 2007). The word 'concept' has the meaning of a 'development concept' i.e. a set of proposed solutions complying with a set of fixed constraints. Additional definitions of ideas include: "*Ideas are very early, only fuzzy, solutions to problems. They are rough drafts that need to be developed into feasible versions*." (Boeddrich, 2004: 278).

A concept is defined as "…*a set of ideas (each from a different level of abstraction), and their relationships, which are as a whole expected to perform one or more required functions as subject of an identified problem... An idea is the representation of a concept at a certain level of abstraction*" (Verhaegen *et al*., 2013: 244). Srinivasan and Chakrabarti (2010) proposed a similar definition, however the terms tend to be used interchangeably in the literature. This poses a problem in that a lack of clarity in whether organisations are dealing with a concept or idea will impact which route is the most appropriate for development. A less defined concept, including a set of ideas, will need to be treated differently to a single idea which may work in multiple different contexts.

It is clear from the literature that ideas and concepts lack a consistent order, which comes first? This study argues that an idea precedes a concept as concepts tend to involve more elements and emerge from a set of ideas applied within a new context.

Idea Management Systems

Traditionally, systems for handling ideas have been paper-based, making them difficult to administrate (Nilsson *et al*., 2002). Idea management tools can be categorised as mainly internal, external or both. There are numerous idea generation and digital idea management tools included in the literature, therefore this research focuses on external tools and how they can link to internal industrial projects. Additional external factors that shape innovation strategy include: capabilities in the external network, industry structure, competition and rate of technological change (Davila *et al*., 2006). These all influence search and select strategies for new ideas and solutions.

Pavia (1991) performed a study of 118 small, young, high-tech firms and found a tendency to use informal processes for sourcing external ideas, and formal identification methods for internal sources of ideas. Nijssen and Lieshout (1995) found that the use of formal tools is correlated with higher profitability, and their use for customer involvement is mainly found in large companies. Processes need to be put in place to manage the innovation process. This involves defining formal stages of the innovation cycle, identifying participants and their roles, and the support tools (Standing and Kiniti, 2011).

The effective implementation of tools is influenced by numerous factors. Woodman *et al*., (1993) suggested that external and intra-organisational influences have an impact on organisational innovation, such as knowledge acquisition and resource acquisition (Cohen and Levinthal, 1990). Transformational leadership is effective in playing external roles such as boundary spanning and entrepreneurship (Howell and Higgins, 1990). Studies have shown a positive association between external communication and innovation (Damanpour, 1991). This is applicable when evaluating the effectiveness of innovation tools, where the behaviour and perceptions of practitioners have implications for how they are adopted within the company.

Hornitzky (2009) analysed 56 electronic software idea management packages, the majority of which were commercial, and identified several common features: a web platform allowing for communication with portable devices, a workspace for collaboration and found that the majority of tools focus on application within a particular organisation. Companies often have people dedicated to keeping, either computerised or other, active databases to collect ideas and create access to them. If a project does not go ahead at first, companies assure and secure documentation of all ideas for better timed opportunities later (Zien and Buckler, 1997). This notion is supported by other authors as it has been identified that less than 30% of ideas are formally recorded in a convenient place for others to find (Sandström and Björk, 2010). This is a unique challenge for larger organisations, as compared to smaller companies: size is a factor in why many ideas get lost or simply forgotten within organisations.

It is suggested in the literature that the level of innovativeness matters in regards to the types of tools and frameworks used. It has been argued there may have to be a more formal framework for low innovation and a more flexible framework for innovative projects (Peters, 2006). In general, successful new product companies are more likely to have a formal new products process, unless they are very small, as they are guided by clearly understood strategies (Crawford, 1994).

Understanding User Needs

Deeper techniques, such as ethnographic studies, are both difficult and time-consuming. Further, the task of understanding user needs is growing ever more difficult as firms increasingly strive to learn about and serve the unique needs of "markets of one," and as the pace of change in markets and user needs grows ever faster. He advocates that manufacturers are starting to abandon their increasingly frustrating efforts to understand users' needs accurately and in detail. Instead, they learn to outsource key need-related innovation tasks to their users, after equipping them with appropriate 'user toolkits for innovation'. He suggests that the benefits of shifting design activities to users relates to: (1) access to "sticky" user information and (2) with achieving faster, better and cheaper "learning by doing" (Enkel *et al*., 2009).

Customer interaction has been identified to be very useful in the front-end stages of the innovation process (Alam, 2006; Gruner and Homburg, 2000) as they are the most information intensive (Zahay *et al*., 2004). User toolkits for innovation allow greater scope for users to apply their understanding of a need more directly and thus will generally result in products that fit the need better (Hippel, 2001).

External communication with key customers has been highlighted as a key success factor for product development projects (Katz and Tushman, 1981).

Toolkits for innovation enable users to carry out cycles of trial-and-error learning and offer a solution space that includes all their designs. Users are able to use them with their own design language and skills. This means that user-friendly well-designed toolkits do not need to engage in much additional training to use them competently. Properly-designed toolkits ensure custom products and services designed by users will be producible on manufacturer production equipment without requiring revisions by manufacturers. User needs and the user environment are very complex and full of sticky, costly-to-transfer information. Katz and Tushman (1981) argued that toolkits deliver the greatest value when users need information is sticky.

Customer needs can be defined as divergences between the existing and the desired situation (Kärkkäinen, 2002), and may exist or materialise in the future (Holt *et al*., 1984). Existing needs can be further divided into articulated and latent needs. Latent needs are not apparent to customers, but they still exist and are unmet within the market (Jaworski *et al*., 2000). Thus, they do not emerge onto the conscious level until the new product or service is presented (Holt, 1976). As long as these needs are not met, customers are not dissatisfied because they are still ignorant of them (de Heer *et al*., 2002). Customer behaviour can be influenced directly, i.e. without regard to the cognitive structures, or indirectly, i.e. causing cognitive change, which then changes the behaviour.

Users' needs typically change over time (Rosenberg, 1982). The degree of stickiness is defined as the incremental expenditure required to transfer a certain unit of information to a specified locus in a form that is useable to the information seeker. Von Hippel (1994) indicated that when cost is low, information stickiness also tends to be low, when it is high, stickiness is also high. It is suggested that high information stickiness may be due to the attributes of information itself, specifically the way in which information is encoded (Nelson and Winter, 1982), alternatively, it may be a function of the absorptive capacity of information seekers (Cohen and Levinthal, 1990).

Here the literature supports the involvement of customers as a valuable source of external innovation. However, processes need to be in place that can understand and translate what is produced into something that feeds into the innovation pipeline. For example, the learning from studies on user toolkits showed that i) making the learning barrier as minimal as possible, ii) ensuring users are able to input their own language, and iii) are encouraged to use the toolkit are essential factors in enhancing usability and adoption (Thomke and von Hippel, 2002). As will be discussed later in this thesis, the understanding of a need has emerged as the key factor driving ideation and development efforts.

Problem Definition

Sebastian (2005) acknowledged the difficulty in managing innovation as most design problems are ill-defined, interconnected with many factors, and are always in dynamic tension with the solutions. The design process is iterative, while the analysis often is done through synthesis (Sebastian, 2005). Problems and solutions are interactively refined and co-evolve through continuous iteration, rather than first defining a problem and searching for a solution (Dorst and Cross, 2001). There is a long stated belief that creativity can only occur from serendipity and lacks a formal process, however, others argue against that there is "*… no evidence, except for subjective reports, that unconscious incubation or leaps of insight occur. Creativity results from having a problem to solve and solving it well*." (Vandenbosch and Saatcioglu, 2006: 11).

Majaro (1992) stated that a well-defined problem should be: a) stated in short and precise words, b) be clear and unambiguous, and c) be defined in terms that will facilitate the measurement of results. As described above, poor problem statements are vague, cover too many sub-causes, are badly-focussed which leaves a team unable to establish whether they have been successful or not in their efforts. Delivering clear and measurable results to share within a project team is one of the most powerful drivers of tool use within industry.

The more one knows about the criteria a solution must meet and the greater the role these criteria play in solution generation, the better the solution will tend to be. It has been argued that one key to success is ‘selective encoding’ (Sieg *et al*., 2010). While the criteria for a solution should be as precise as possible, the problem statement should refrain from furthering any particular solution path over another, e.g., focusing on solutions pursued in past internal work (Sieg *et al*., 2010). This supports the need to have a need defined as much as possible from the start.

Lawson’s explanation of attempts to define design would narrow the view from a design discipline or become too general where the definition is not very useful (Lawson, 2006). The importance of allowing time for problem definition has been emphasised by one of the world’s greatest scientific thinkers, Albert Einstein;

“*If I had an hour to solve a problem and my life depended on the solution, I would spend the first 55 minutes determining the proper question to ask, for once I know the proper question, I could solve the problem in less than five minutes*”

(Einstein cited by Vogt *et al*., 2003)

The need for problem definition is characterised by finding innovative solutions to a problem that is non-obvious “…*by reframing the problem and formulating a first hypothesis, new approaches and solutions beyond incremental changes become more feasible*” (Acklin, 2010: 55). This reframing of the problem offers a new approach to generating more radical innovation. Frequently, companies begin the stages of FE without a clear definition or analysis of the process to go from opportunity identification to concepts, hence they often either abort the process or start over (Koen *et al*., 2002).

Jeppesen (2005) argued that in order to solve a problem, necessary information and problem-solving capabilities must be brought together-virtually or physically at a single locus. To the product developer, the identification of user needs is an essential undertaking, which, is constrained by the costs of acquiring the relevant information. In addition they face the problem that users locally hold essential ‘sticky information’ defined as information that is costly to acquire, transfer, and use in a new location (Von Hippel, 1994).

Organisational Creativity

Creativity is associated with the part of the innovation process which is labelled as idea generation (Majaro, 1992). This approach is consistent with the definition of Heap (1989) who defined creativity as: "*the synthesis of new ideas and concepts… where innovation is the implementation of creativity*". In addition, Titus (2000) more simply defined creativity as the birth of imaginative new ideas. Furthermore, Smith *et al*., (1999) argued that idea generation based on an expansive view of knowledge creation is essentially the grouping and integration of ideas from many sources of accepted knowledge, prior to the screening of those ideas.

Creativity has been stated to be that which "…*results in the generation of new and useful ideas or the combination of existing ideas into new and useful concepts to satisfy a need*" (Farid-Foad *et al*., 1993). Creativity has been emphasised as an individual and solitary process, whilst innovation is a more inclusive process involving many people (Rosenfeld and Servo, 1991). This is why innovation is the most applicable word for this research since it focuses on exploring the internal and external networks and connections between many people to foster innovation.

In addition to this, size can affect a unit's innovation and performance (Tsai, 2001). The results of Tsai's study indicated that a unit's innovative capability is significantly increased by its centrality in the intraorganisational network. In order to generate ideas that will be successful in the market all of which are suggested by Brem and Voigt (2009):

- take into consideration company corporate strategy,
- include obvious benefits of ideas' target audience, and
- use a systematically structured and carried out concept identification phase.

An idea becomes more valuable every time it is taken into consideration (i.e. put back into a person's brain). The full potential of creative ideas in the workplace will be tapped only in companies with a creative idea loop. This is a place where highly creative employees are allowed to play with fuzzy and weird ideas (Boeddrich, 2004). Organisations should therefore allow employees time in order to conduct these innovation activities.

In general, most ideas do not occur in the workplace. They emerge when people's brains experience alpha-wave situations. Typical alpha-wave situations are daydreaming, jogging, taking a shower, conducting small talk with friends etc. Empirical research shows that, in such situations, the idea for solving a problem emerges from the subconscious, i.e. during reflection. It occurs if an isolated problem is confronted with an item not related to the problem or the company.

Martins *et al*., (2003) had a study which established that organisations today are knowledge-based and their success and survival depend on creativity, innovation, discovery and inventiveness and that rate of change is accelerating rapidly as new knowledge, idea generation and global diffusion increase (Kim and Mauborgne, 1999). Creativity and innovation have a role to play in this change process for survival. Many organisations and leaders try to create an institutional framework in which creativity and innovation will be accepted as basic cultural norms in the midst of technological and other changes. Organisational culture appears to have an influence on the degree to which creativity and innovation are stimulated in an organisation (Martins *et al*., 2003). However creating an innovation culture is easier said than done in practice.

Spanjol *et al*., (2011) conducted a survey of 182 managers to investigate how strategic orientation impacts the front-end of innovation, specifically on two ideation outcomes: ideation volume and ideation novelty. They found that an emphasis on market search behaviour leads to significantly greater quantities of new product ideas generated by a firm. Product ideation novelty was found to be significantly enhanced by a technology orientation. Subsequently, they suggested that market orientation may be less of an influencing factor on ideation when compared to the implementation and commercialisation phases of NPD.

The above factors involve the collaboration of everyone within an organisation in order to drive an innovation culture. Ideas and tacit knowledge are pre-existing and companies need to allow for experimentation and reflection on ideas.

2.1.3 Idea Management Trends and Success Factors

Defining Idea Management

Before investigating best practices of idea management, the term itself needs to be defined. A universally agreed definition of idea management is not present within the literature, which could be due to lack of common language and differing contexts. This is because idea management is an elaborative and complex process, involving varied and complex internal and external networks. There are, however, several proposed definitions of idea management present in relevant studies on the topic (Vandenbosch *et al*., 2006; Bakker *et al*., 2006; Boeddrich, 2004). The most notable being the Product Development and Management Association (PDMA) who identified idea management as an area of NPD that is in 'serious' need of improved management (Barczak *et al.,* 2009).

The working definition of the concept of idea management emphasises the importance of internal and external interactions and ideas. So much so that others have added the word 'integrated' prior to IM which makes the point that not only internal idea sources, but also external ones are included within the innovation process (Brem and Voigt, 2007). Idea management needs to constantly utilise internal and external sources for new ideas (see Figure 7).

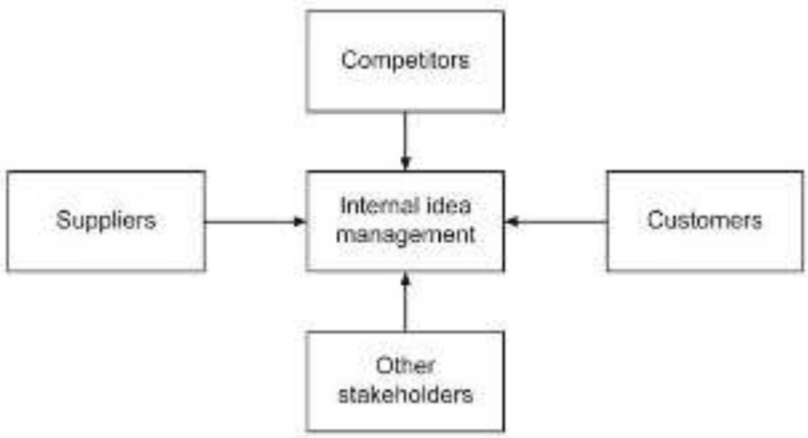


Figure 7 Five Factors of Integrated Idea Management

Source: Brem and Voigt, 2007: 311

In this research, idea management is treated as a process that incorporates the FE activities of opportunity identification, idea generation or ideation, and idea evaluation. Similarly to the FFE, idea management lacks a well-accepted definition however several have been proposed. For example, idea management has been labelled as the phase before the project decision "…*idea management = phase before the project decision*…" (Boeddrich, 2004: 275). The definition that this research will use is given below:

"*Idea management is not just concerned with generating ideas; it is also concerned with recognizing the need for them and evaluating them…*" (Vandenbosch *et al.*, 2006: 263). However, although this definition includes ideation, the generation of ideas is separate from idea management. Rather generation is one aspect within IM and the other areas are about idea sourcing, and idea evaluation and selection. Both of these constructs come under the domain of creativity.

In addition, other definitions support the sourcing of ideas within the definition of idea management, such as: "*Integrated idea management itself serves as a coordinating and tracing platform that gathers all relevant ideas from inside and outside the company and makes sure that these ideas – depending on the various kinds of ideas – are appropriately used in the corporate innovation process*" (Brem and Voigt, 2007: 312).

Idea management goes beyond the bringing together of ideas in a company and the tools used in order to achieve this. Rather, from the literature discussed above, idea management incorporates idea sourcing, generation, evaluation, and selection.

The idea management process has also been described as the generation of new concepts, through combining organisational knowledge and collective intelligence, aligned by contextual factors such as strategy, goals and needs (El Bassiti and Ajhoun, 2013). It is characterised by a high degree of complexity and must be organised efficiently in order to work in the long-term. The complexity of technological innovation is due to the development dependency on collaboration between different areas of expertise (Bertola and Teixeira, 2003).

Traditionally, idea management has helped companies use their human resources more effectively, ensuring that people from across an organisation are actively feeding the innovation pipeline (Lamont, 2004). Idea management systems (IMS) are numerous in quantity and are typically software based tools enabling internal or external parties to submit ideas to an organisation. Some examples used in industry such as Galileo, etc. Ideas are often developed in idea management systems and within an organisational context. More research is needed on how the design of such systems can foster idea generation (Selart and Johansen, 2011).

Ideas can originate internally (from employees) or externally (from customers, business partners, competitors government or academia) (Standing and Kiniti, 2011). Idea management is a sophisticated and holistic approach which integrates different innovation sources. Successful innovating companies have people dedicated to keeping active databases to collect ideas and create access to them (Zien and Buckler, 1997).

A large challenge regarding terminology was experienced where words are used interchangeably within front-end literature, such as opportunity, idea, concept and solution as found in other studies (Kornish and Ulrich, 2011). Figure 8 simply illustrates the main terms used which are often used within the studies reviewed for this research. This confusion over definition is likely due to the varying levels of definition for each term, with some more concrete in the literature than others.

Figure 8 Idea, Concept and Solution

Source: Author (2016)

Cumming (1999) claimed that the level of idea generation is related to the level of creativity within human resources within an organisation. The author argues that a concept turns into an idea, which raises the question as to the order of an idea turning into a concept or a concept turning into an idea. It may even come down to the level of definition. An idea has been described as appropriate, useful and actionable (Amabile, 1998). As indicated earlier, this study argues that ideas precede concepts as a result of the increased complexity and elements that a concept might incorporate.

Typically, if a project does not go ahead at first, documentation of all ideas are secured so that they can be investigated for better-timed opportunities later. However, having an overwhelming amount of ideas, mostly from outside an organisation, leads to a costly evaluation and delay costs (Reinertsen, 1999). Therefore there is a need for effective idea management processes that can cut managerial time spent evaluating ideas, most of which tend to be off-strategy (Cooper and Edgett, 2008). More research is needed to evaluate practical implementation of IM and its integration of external partners.

In summary, idea management definitions are moving towards recognising the complex interactions that occur internally and externally and are therefore acknowledging the importance of integration. There is agreement that idea management is about generating, sourcing and evaluating ideas to facilitate innovation efforts. However, there is still confusion over various interchangeable terminologies within idea management. This lack of consistency is making it harder for organisations to adopt one particular process, and quite often companies create a model that embodies their own processes and adapt it when required. Frameworks are potential highly useful tools if they can be adapted to suit the needs of a particular business, where certain innovation sources are more effective than others.

Idea Management Trends

A paper summarising idea management trends was published alongside this study. The paper identifies IM trends and success factors (see Chinneck and Bolton, 2013). Three main trends are noted: 1) idea quantity vs quality, 2) internal vs external practices and 3) systematic vs ad-hoc processes. Complexity is added particularly with organisations encouraging external idea submission as these ideas need to be treated differently to internally generated ones.

Other idea management literature focuses on software and web programs, which store, manage, and screen ideas (Glassman, 2009). This software based approach seems indicative of the move towards making idea management as automatic as possible. The number of raw ideas required at the beginning of the innovation process to achieve one commercially successful innovation has been given a vast range of results in the literature from 3,000 (Stevens and Burley, 1997), 100 (Cooper and Edgett, 2007), 60 (Majaro, 1992), 25 (Griffin, 1997) to 6.6 (Barczak *et al*., 2009). Despite this debate the principal of 'quantity breeds quality' prevails within the literature but is inconclusive.

There is a trend moving away from a closed innovation paradigm to an open innovation paradigm in which external ideas are exploited for competitive advantage (Chesbrough, 2006). Seeking ideas from outside the firm applies best to a handful of industries, such as consumer goods (Huston and Sakkab, 2006). Two principals are required for searching for external help: (1) know where to look for the information you need and (2) have the information made available when someone asks for it (Mueller, 1986). This trend is particularly important to IM as ideas from external sources will need to be managed differently from internal ideas due to challenges such as the 'not invented here' (NIH) syndrome (Majaro, 1992). Absorptive capacity is a critical part of an organisation's innovation capability (Tang, 1998) in order to internally implement external ideas.

Majaro (1992) reinforced the influence of the NIH syndrome by identifying additional reasons for poor quality and quantity of submitted ideas in suggestion systems. These were poor promotion of the scheme, lack of motivation, lack of feedback, a poor screening system, lack of tangible benefits and a general negativity towards ideas of others. The NIH syndrome means that those responsible for screening ideas, typically regard those originating from external sources as always bad and internal ideas as always better. This attitude has a devastating impact on the flow of suggestions. This view was disputed by King (1990) as he noted a bias towards imported external ideas, which Flynn *et al*., (2003) suggested could be because it is easier to adapt the creativity of someone else rather than develop an innovative company culture.

Tidd *et al*., (1997) stressed that innovation in large firms especially relies on their own research and development (R&D) departments, judgments based on formal criteria and procedures, and deliberate organisational designs. As a firm grows the number of functions and departments increase, which often diminishes the chance that ideas will find an "*appropriate ear*" (Majaro, 1992, p. 30) as informal communication suffers. Effective idea management offers a repository for ideas from anywhere in an organisation to be documented and shared.

The last trend is the move away from the view that creativity and innovation can only be achieved through serendipity (Flynn *et al*., 2003) or ad-hoc processes. For instance, it has been suggested that the process of generating novel ideas is not completely random (Simonton, 1988). Academics are encouraging a more structured process with built-in flexibility that can be a more effective method of generating creative ideas. The management challenge is achieving the right balance between allowing space for individuals to be creative whilst still generating ideas that address the problem statement. The final success of IM strongly depends on the right process structure for the different kinds of ideas and the corresponding organisational implementation (Brem and Voigt, 2009).

These trends support the development of a framework which provides guidance as to which idea sources are the most effective for innovation, whilst providing flexibility for adaptation to meet changing organisational needs over time.

Idea Management Types

Innovative organisations rely on multiple sources for ideas and also rely on multiple channels and mechanisms to bring ideas to further development (Tang, 1998). In a study where 49 executives were interviewed, five management types were identified. Each management type has different implications for the kinds of ideas that are generated and their implementation: incrementalists (experience-based decision makers and use a fixed set of relationships inside and outside their organisation), consensus builders (quicker to react to changes and do not rely on their own expertise as much), searchers (search for differing points of view and make decisions based on idea synthesis), debaters (create thought experiments to understand and use external inputs as stimuli for debating issues), assessors (manifest patterns associated with other idea management types) (Vandenbosch and Saatcioglu, 2006). These different idea management types should be considered particularly during ideation as they identify who is more likely to use external sources to enhance their own decision-making (i.e. incrementalists and debaters).

Research on innovation has shown that continual commitment to an idea, collective ownership and participation are critical for success (Vandenbosch and Saatcioglu, 2006). People engender patterns of idea management and organisations must learn how to maximise the value of each approach as employing people with creative archetypes may be more fruitful than creating environments which are conducive to idea generation (Vandenbosch and Saatcioglu, 2006). Monge *et al.,* (1992) stated that being well informed and participating in group communication are causes of innovation in organisations. Knowledge sharing also yields ideas for new technologies and new products that help build innovative capability (Langrish *et al*., 1972).

Martinsuo and Poskela (2011) argued that debate exists in the literature regarding the degree to which concept evaluation should be formal or informal. Formal evaluation has the advantage of being able to compare projects with one another which provide a fair evaluation process for the idea generators as well as supplying consistent knowledge to the decision makers (Koen *et al*., 2002; Montoya-Weiss and O'Driscoll, 2000). Conversely, informal open-ended question lists and a conversational evaluation mode is suggested when preparing a project to enable creativity, negotiation, and prioritisation of various viewpoints (Henriksen and Traynor, 1999). Idea evaluation and selection should be less rigorous in the front-end of the project than in the development project itself (Koen *et al*., 2001). This is so that potentially good quality ideas are not dismissed too early when they are yet to be developed.

Effective Practices for Integration

Best practice has been defined as the technique, method, process, or activity that is more effective at delivering a particular outcome than any other technique, method, process, or activity within that domain (Camp, 1989). They represent methods, tools, or techniques associated with improved performance (Belliveau *et al.,* 2004).

Benchmarking is a process of collecting process performance data from a number of organisations to allow them to assess their performance individually and as a whole (Belliveau *et al.,* 2004). This research uses the term effective practice as there is rarely a single best method or practice that is always better than any other, but rather practices vary in their level of effectiveness. Consistently high-performing companies, such as P&G or Emerson Electric, have developed proficient idea-to-launch systems and model the way (Ledford, 2007) and are currently seen by many as a benchmark for open innovation practices.

Fairbank and Williams (2001) viewed idea management as a way to increase continuous improvement capabilities. In studying 22 idea management systems in small and large manufacturers, Carrier (1998) pointed out that those systems rarely lead to sweeping innovations, but are rather aimed at improving organisational efficiency, competitiveness or improving certain practices. In terms of software, idea management systems have been getting more sophisticated since the 1990s. This along with a move towards open innovation has established a growing trend towards making these systems evaluate ideas automatically.

Different ideas need to be evaluated and developed in different ways. This is supported as a distinction has been made between incremental and radical ideas (Sandström and Björk, 2010). Findings from the PDMA best practice in NPD study (Barczak *et al*., 2009) revealed that after an idea is classified after submission, it then takes a different path depending on its nature. Only 60-65% of ideas that are generated are formally recorded in any way, with less than half of these recorded in a convenient place for others to find. This is partly why many ideas simply get lost or forgotten within organisations (Sandström and Björk, 2010). This means a great potential pool of valuable ideas is lost in organisations.

One of the benefits of being an international organisation is the opportunity to cross-fertilise ideas from different environments within subsidiaries. Figure 9 demonstrates how the flow of ideas can be improved through the use of a central focal point, which receives, collates, and transmits ideas to all parts of an organisation. Without a system like this in place, winning innovations developed in one country are not disseminated to other countries in the same organisation. The total expenditure of implementing such a system is justified in the benefits gained in tangible and intangible ways (Majaro, 1992). For this global scale of innovation, the importance of sharing and communicating innovation activities becomes clear.

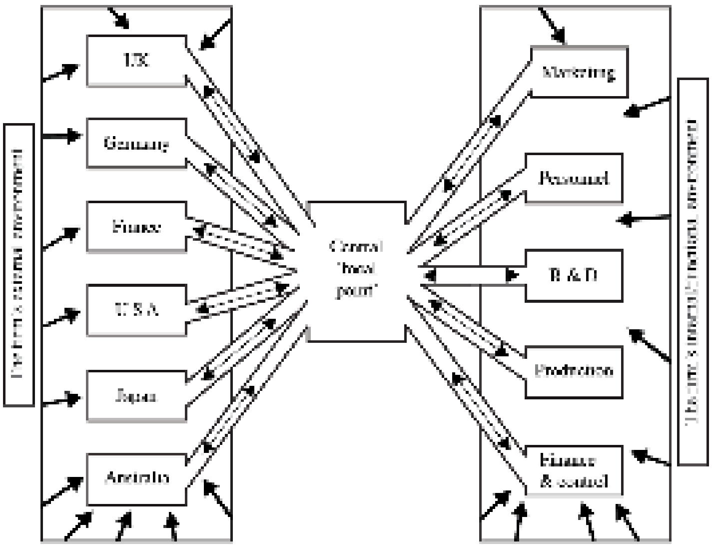


Figure 9 Idea Flow in a Multinational Firm Organised to Communicate Ideas

Source: Majaro (1992): 36

Additional effective practices for idea management include: scanning high and low, providing focus for idea generation, being clear about the innovation ambition, and offering a clear structure (von Stamm, 2008). This range of activities is important as they include a mixture of cultural and practical methods during idea generation in organisations. Starting with lots of ideas and encouraging experimentation but quick narrowing down, summarising and combining, making submission of ideas easy and providing good support, ensuring rejections are not taken personally, and managing and storing all ideas (von Stamm, 2008) are factors which are supported by various other authors such as De Bono (2010), Prather and Turrell (2002), and Cooper and Edgett (2009). This suggests that allowing for experimentation without stringent criteria during initial ideation is beneficial for innovation outcomes.

Verworn *et al*., (2008) compared the FFE between radical and incremental innovation projects in 497 Japanese manufacturing firms and found that it was more difficult to estimate the market size and price sensitivity of the customers of radical NPD projects compared with incremental projects. This might be because assessments have to be made years in advance of the probable date of the product's launch and at a time where the customer lacks clear definition (Deszca *et al*., 1999: 616). There was less knowledge about competitors and their products and respondents learned significantly more during the more innovative projects. It is clear that these factors focus on strategically managing ideas and supporting idea submitters.

Idea Management Models

Several idea management models have been proposed, however, few have been empirically validated. A more recent model named the 'idea management life cycle' describes four interlinking stages of generation, interlinking, improvement, and validation all encompassed by a central learning engine (see Figure 10). Each stage has a decision gate and the model has a surrounding context aiming to emphasise innovation network aspects (El Bassiti and Ajhoun, 2013).

Figure 10 Idea Management Life Cycle

Source: El Bassiti and Ajhoun (2013): 554

Another model describes the stages of idea evolution as: idea generation, idea improvement, idea selection, idea implementation and idea deployment (see Figure 11). It also touches on detailing input and output deliverables for each stage. It emphasises the role of multi-functional teams in generating, improving, selecting, implementing and deploying ideas in organisations.

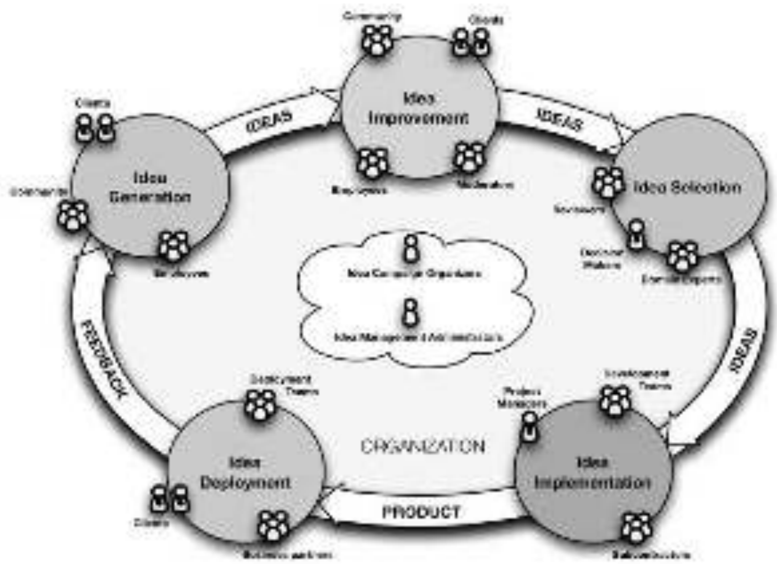


Figure 11 Idea Life Cycle and Communities

Source: Westerski *et al.*, (2011): 496

The Structured Idea Management (SIM) ideation process is proposed by Arthur D. Little (Figure 12) and has been successfully implemented in companies for over 20 years (2005). These seven steps prevent two common mistakes made in the innovation process: understanding the difference between incremental versus radical ideas, and recognising the value of idea fragments (Davila *et al*., 2006).

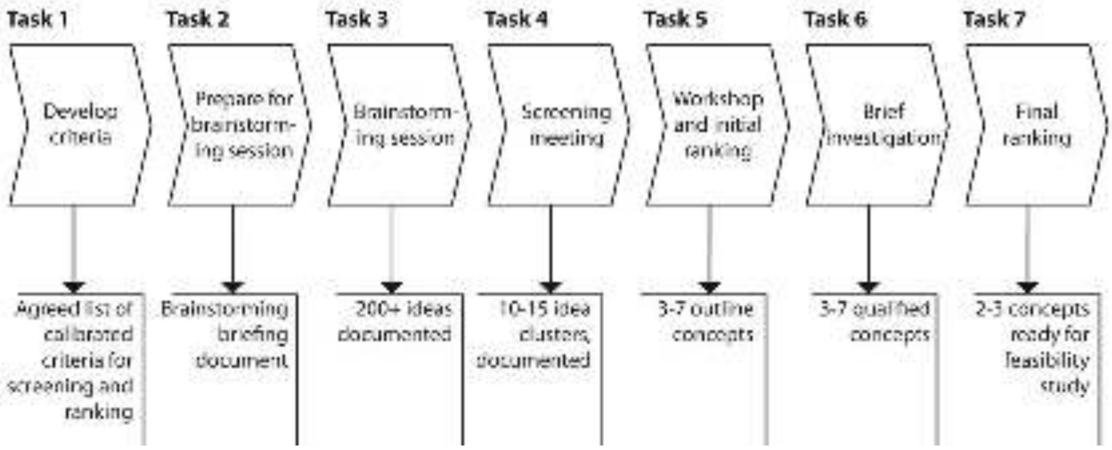


Figure 12 Structured Ideation Process

Source: Adapted from Davila *et al*., (2006): 129 citing Navigant Consulting and Arthur D. Little (2005)

The Structured Ideation Process focuses on specific physical outputs of each task. This focus on the deliverables is something that is lacking in other processes. The interaction between internal and external integration is significantly related to both market share and financial performance (Droge *et al*., 2004). It is recommended that when companies are deciding whether to go internal or external, i may be better to proceed simultaneously rather than sequentially (Droge *et al*., 2004).

There is a need to ensure that an adequate system is in place for receiving and acknowledging ideas, categorising them and ensuring their systemic implementation (Bessant and Francis, 1999). Typically such idea management systems will make a three or four way split between ideas which:

1) are acknowledged but not directly implementable,
2) can be implemented directly by the suggesting individual or group,

3) may require additional support from specialists,
4) represent major projects which might be taken forward by a larger and more specialised group.

Enabling such a system requires different levels of collection and evaluation of ideas, typically a first pass will involve a team leader or supervisor and will sift out most of the first two categories (the majority of ideas). Thereafter a representative group involving supervisors, team leaders, specialists etc., might look at more complex suggestions and the few major projects that might emerge can be reviewed at senior management level (Bessant and Francis, 1999).

Two creativity management models have been proposed which focus on how ideas are developed in organisations. Several authors have developed a so-called three-step model, distinguishing between ‘idea extraction’, ‘idea landing’ and ‘idea follow-up’ (Van Dijk and Van den Ende, 2002). The process of organisational ideation is sub-divided into four factors: idea inducement, the pathways, the rules of the road and ‘gate control’ (Hellström and Hellström, 2002). The model shifts the attention to structures that include ambiguity and informal management.

Bakker *et al*., (2006) argued that the creative process in organisations is a matter of political strategies where an idea generator has to sell his / her idea, and that this should be considered in idea management literature. What is missing from these two models is how a manager can deal with the tension between creativity as expression and creativity as purposeful action (Bakker *et al*., 2006). Many ideas that arise in an organisational context are hardly free from interpretations, expectations and other experiences that ideators have developed in their working life – these are the people, operating within different organisational cultural contexts, who give meaning to the ideas (Drazin *et al*., 1999; Weick, 1995). A key factor in this research is that people are the driving force behind any innovation, whether it is idea generation or achieving political buy-in, people are at the heart of making organisational innovation happen (Green and Oliver, 2010).

In the same vein, Dombrowski *et al*., (2007) stated from their experiences, that each successful innovation story has people who champion the idea, rally for support at each stage of the innovation process and make it their mission to make the innovation successful. A research model is proposed that explains how a creative individual uses political strategies to get their idea funded in an organisation (see Figure 13). This is significant to idea management practices as political processes occur in selling ideas to gain buy-in to get ideas into NPD (Bakker *et al*., 2006; Howell and Sheab, 2001; Nijhof *et al*., 2002). Often the idea selling process is seen as a type of litmus test that ideas need to pass in order to get further along the pipeline.

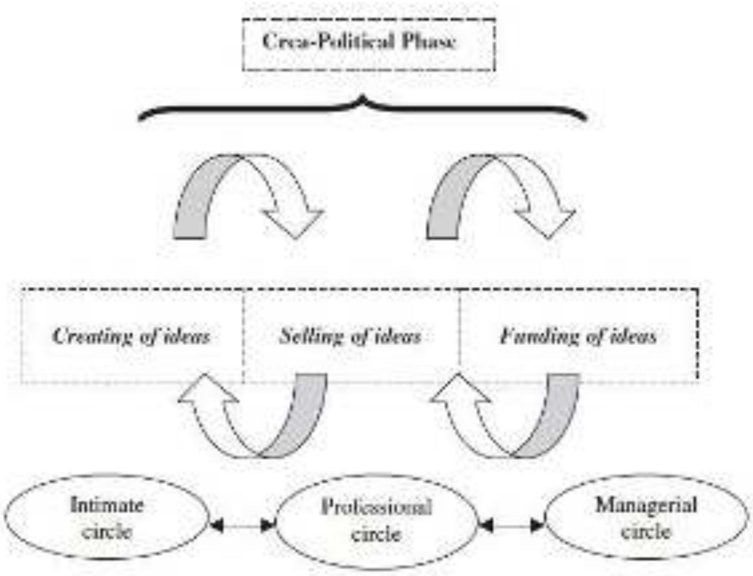


Figure 13 Crea-Political Process Model

Source: Bakker *et al.*, (2006): 301

Additional key elements of idea management have been identified by Gamlin *et al.*, (2007) as follows: (i) have a clear business purpose for the ideation event, (ii) understand the window of opportunity, (iii) tap into a diverse pool of idea contributors, and (iv) look at challenges in a different way, and (v) develop an idea through collaboration. These effective practices bring to light the importance of clarity of purpose, diversity within teams for ideation and reframing a challenge or problem in order to solve it in an innovative way.

The importance of external factors to ideation and innovation practices has been visualised in other models. For example, as seen in Figure 14 innovation culture overarches the internal creative process and phases. This model makes a distinction between the roles of employees, incentives for innovation and employed tools. It also shows the interrelationship between processes like generation, development and selection which is not always present in existing idea management models. This research argues that this iteration between phases and selection processes are critical to creativity and innovation in practice.

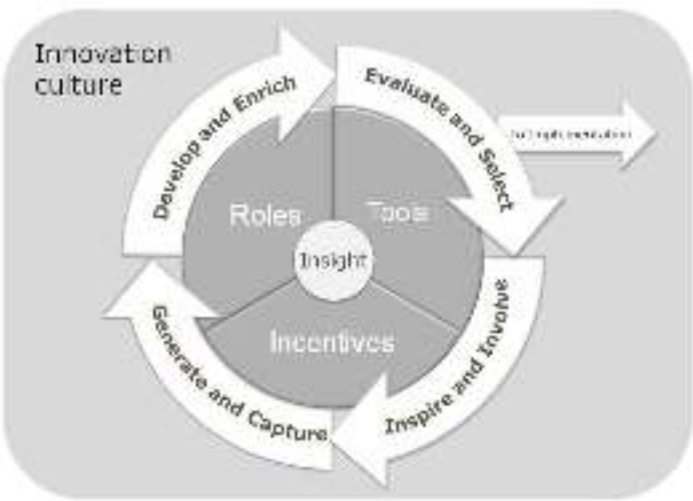


Figure 14 Idea Management Concept

Source: Iversen *et al.*, (2009): 3

In summary, effective idea management practices encompass many bodies of literature: including individual and organisational creativity, knowledge management, networking, and supplier relationships. It is proposed in this research that it is vital that management support and share a clear view of how they want an idea management system to work with their external stakeholders. The importance of external environment and inputs has been acknowledged in some models but there is a lack of consistency in how they are portrayed.

Idea Management Success Factors

It has been suggested that there is no lack of ideas in organisations, however there is a problem that these ideas do not seem to be absorbed by the product development process (Wilson, 1966). A paper by Nilsson *et al*., (2002) is highly relevant in subject matter and their study used a very similar methodology to the one proposed in this research. The authors developed a theoretical framework identifying nine important dimensions of idea management systems in small companies: the system purpose, the types of ideas in focus, role of information technology, people having access to the system, congruence with business strategy, role of the innovator in idea development, idea evaluation, idea transformation, and finally innovation incentive structure used for participation. Although based on a study on smaller companies, many of these factors are arguably applicable to large organisations.

Nilsson *et al*., (2002) compared the approach of idea management systems used in three case studies and found that each company had a different emphasis and used their systems in very different ways. For example, the purpose can be to generate good ideas consistent with overall business strategy or primarily be used to stimulate new ideas (Nilsson *et al*., 2002). Due to these differences, they proposed the division of an IM system into ‘transportation of ideas’ and ‘knowledge creation’ as detailed in Table 4.

Table 4 Classification of Idea Management Systems

Source: Nilsson *et al*., (2002)

Dimensions of an Idea Management System	Transportation of Ideas	Knowledge Creation
Purpose	Transportation of ideas	Creation of knowledge
Degree of solution content	High	Low
Evaluation and transport to product development	A formal evaluation by a team and transfer to an appropriate product development project	Informal evaluation and transfer through interaction between individuals in the organisation

A ‘Transportation of Ideas’ based idea management system supports ideas with a high degree of solution content and is used to transfer ideas into the NPD process. In contrast, a knowledge creation system has the purpose to let individual ideas become visible to the whole organisation and value of ideas is decided by interaction of employees interested in the idea. These findings suggest that determining the emphasis of IM is important in order to determine appropriate evaluation processes and measures of success for ideas.

There are some key points to consider to ensure the success of an idea program (Gorski and Heinekamp, 2002):

- gain management support,
- design a program for your company,
- make it easy to submit ideas,
- measure success,
- provide results,
- offer feedback and immediate acknowledgment, and
- recognise and communicate success stories.

In practice the integration of internal and external innovation entails three challenges: maximisation, incorporation, and motivation (West and Gallagher, 2006). Collaboration is particularly important during the idea management phase involving critically evaluating, refining and prioritising ideas using multiple perspectives and modes of thinking (Hornitzky, 2009). Idea management helps companies to use their human resources more effectively ensuring people from across the organisation are actively feeding the innovation pipeline (Lamont, 2004).

After an idea is classified after submission, it then takes a different path depending on its nature. This can be done by an evaluation board and assess the market and technology novelty of the idea in relation to the company’s resources and capabilities. Idea generation and effective transfer of know-how is predominantly face-to-face (Boutellier *et al*., 2008). Informal and face-to-face communication is unique in that it facilitates the transfer of complex and novel information that can provide unexpected answers to problems (Salomo *et al*., 2003).

A weakness in some existing idea management systems is the lack of ideator involvement for developing an idea. Frese *et al*., (1999) studied a steel company's idea suggestion scheme, which was effective in stimulating a large number of new ideas over a ninety-year period. They did not provide employees with the freedom to elaborate on new ideas before suggesting them as a management committee evaluated the ideas and decided on the outcome. This runs counter to other studies that promote the freedom of employees to elaborate and develop ideas.

Additional idea management success factors have been detailed in a previous paper produced from this research (see Chinneck and Bolton, 2013). In terms of process, these included using a systematic process, allowing sufficient time, employ an idea selection and evaluation method, establishing a clear business purpose, understand the window of opportunity, reframing challenges, understand difference between incremental and radical ideas, and recognising the value of idea fragments. In terms of people, these were stated as having creative employees, tapping into a diverse pool of idea contributors, collaboration, continual idea commitment, ownership, and high idea submission (Chinneck and Bolton, 2013).

2.1.4 Summary of Effective Practices in Idea Management

Multiple issues and themes have emerged from the literature within this section covering the three trajectories of the review. These identified themes have been summarised as follows:

- the growing need for a pre-discovery front-end phase, called 'establish'
- a shifting emphasis of idea management systems towards idea sourcing
- a greater importance of integrating external sources of innovation.

On analysis of the literature on factors affecting idea management, it appears that the purpose of the IMS affects how ideas are managed, due to the added complexities surrounding multiple sources of innovation and the nature of activities. A key outcome of this research is to understand what search and select processes methods are used and why, and additionally whether the factors identified in the literature are present in the empirical study. The review on idea management found that the purpose of IM is important and should be classified in order to expose what types of ideas a company is looking for and where they are most likely to find them.

Idea management works on a global scale for organisations and work by Majaro (1992) identified that having a central focal point is important to cross-fertilise and leverage ideas internationally. Idea management types regarding people was discussed as well as key characteristics involved in external search behaviours. This is relevant to ideation as certain tools and techniques could be overlooked which can increase the effectiveness of idea generation efforts. Research suggests that a mixture of both is present, each with their own benefits and drawbacks. A review of existing idea management models revealed a mixture of frameworks, processes and systems. This variation in terminology is common within front-end models and literature, however this adds to confusion over their relative meanings. Therefore, to help clarify these differences this research has set out definitions found in the literature in Table 5.

In summary, this section looked at the factors affecting idea management and why. Firstly front-end phases and activities were defined as early and late stage, with opportunity identification and exploration early on in the process, while later activities consist of information collection and concept development. Defining the initial problem is a key activity which can cause delays if the problem or need is poorly defined. The need for an establishing phase in order to define the need early was also introduced.

Table 5 Definitions of Framework, Process and Systems

Sources: Included in table

Dimensions	Definition
Framework	"*a framework should specify relationships among phenomena of interest such as a model showing dependent and independent variables or a classification scheme that sheds light on a broader phenomenon*" Schwarz *et al*., (2007).
Process	"*a structured and measured set of activities designed to produce a specific output for a particular customer or market*" Davenport (1993): 5.
System	"*a group of components (devices, objects or agents) serving a common purpose, i.e. working towards a common objective or overall function*" Bergek *et al*., (2008): 3.

Secondly, factors influencing IM included the importance of distinguishing between an idea and concept with various definitions in the literature. Organisational creativity is complex taking into account people and processes, such as market search behaviour, size of organisation, and strategic orientation. These all contribute to how organisations look externally for ideas. Thirdly, idea management trends related to idea quality over quantity, greater emphasis on external innovation, and the use of systematic processes rather than ad-hoc informal processes, detailed in Chinneck and Bolton (2013). The review also identified controversy over whether formal IM practices are beneficial for innovation over serendipity and concluded that adding structure with in-built flexibility is beneficial for innovation.

2.2 Factors Affecting Idea Generation and Quality

Introduction

This second section of the literature review engages with the variety of methods organisations use to generate and evaluate their ideas. In particular, the methods of evaluating idea quality are addressed. In order to unpack and explore the complex nature of idea generation and quality criteria, this section is sub-divided into three trajectories:

2.2) Factors Affecting Idea Generation and Quality:

2.2.1) Importance of Ideas to Success

2.2.2) Idea Generation Methods and Techniques

2.2.3) Idea Evaluation and Quality Criteria

This section concludes by summarising the emergent issues within the above explored themes regarding factors affecting idea generation and quality.

2.2.1 Importance of Ideas to Success

Ideas are the "*engine*" of innovation (Davila *et al*., 2006: 127) and are at the core of idea management practices. There is a recent call for process studies on how to successfully implement ideas generated from idea management systems (van den Ende *et al*., 2015). Studies provide evidence of the real economic value firms can accumulate from various forms of idea management systems. Ideas can originate internally (from employees) or externally (from customers, business partners, competitors government or academia).

According to Wu and Fang (2010) although idea generation is the starting point of innovation, organisations are often unsure about how or who generates these ideas. Clearly defined, well-researched ideas have been stated to form the basis of successful new product ventures (Flynn *et al*., 2003).

For creativity to become innovation, divergent idea generation must be followed by convergent idea selection (Rietzschel *et al*., 2006). There is need to evaluate ideas and select those that are worthy of implementation. Ideas must fit with the mission and values of an organisation and must also have commercial value (Desouza *et al*., 2009). Advocating for ideas is crucial otherwise the idea may end up in a ‘‘black hole’’, a place where good ideas that will never be realised end up because there is no sponsorship (Schepers *et al*., 1999).

According to the results of a global survey conducted by management consultancy, Arthur D. Little (2005), the most important factors in idea management are creative employees, a method to effectively select and evaluate the best ideas, a systematic process to generate ideas and available time to generate new ideas.

Ideas for innovation are important for the long-term survival and competitiveness of firms, being the main source for new products, services, processes, and drivers of change (Fontana and Giustiniano, 2015). Two key requisites for innovation are: customer insight to identify an unmet need, and technology awareness to identify a particular enabling technology (Fetterhoff and Voelkel, 2006). It is acknowledged that an important factor in gaining creative insights is immersion in one’s subject matter (Flynn *et al*., 2003).

Existing literature on idea generation has a focus on a source-based approach to idea generation with emphasis on external knowledge sources such as customers, markets and competitors. A seminal work by Osborn (1963) more than 50 years ago recommended that idea generation should be regarded as a separate activity from idea evaluation. He also developed the idea of brainstorming, where the classic rules of ‘no criticism’ and quantity will eventually result in quality apply, rules which still stand strong in ideation methods today.

Rochford (1991) identified that idea generation is under intense scrutiny in the literature because this stage dictates the later stages of the innovation process. Despite this importance of the idea generation stage, many companies do not pay much attention to it (Feldman and Page, 1984; Sowrey, 1990) because idea generation is a chancy process where ideas may be detected on hunches, observations, discussion or by accident (Stasch *et al*., 1992). The current study argues that innovation is too important to leave to chance and that many techniques and methods can facilitate the generation and management of good quality ideas.

2.2.2 Idea Generation Methods and Techniques

A large gap has been identified in previous research between the perceived importance of innovation and the effectiveness of approaches and methods used to support innovation (Shani and Divyapriya, 2011). Idea generation belongs to the fuzzy front-end of the development process, recognised as a key leverage point for a firm (Hauser *et al*., 2006). There is a belief that idea generation is not only fundamental to product design but also enables the creation of viable business platforms (Best, 2009). There are numerous methods and techniques for generating ideas. Within the creativity literature, a total of 172 idea generation methods have been identified and categorised into three types: strategies, tactics, and enablers (Smith, 1998).

Formal idea generation methods have also been broadly classified into two categories: intuitive and logical within an engineering context (Shah *et al*., 2003). Intuitive methods have been sub-classified into five categories: germinal, transformational, progressive, organisational, and hybrid. Germinal methods aim to produce ideas from scratch, which include morphological analysis (Zwicky, 1969), brainstorming (Osborn, 1963) and the K–J method (Hogarth, 1980). Transformational methods generate ideas by modifying existing ones, and include methods such as checklists, random stimuli, and the PMI (plus-minus-interesting) method (de Bono, 1970). Progressive methods generate ideas by repeating the same steps many times, generating ideas in discrete progressive steps such as Method 6-3-5 (Rohrbach, 1969), C-Sketch (collaborative) (Shah *et al*., 2001), and the gallery method (Pahl and Beitz, 1996).

Organisational methods help designers group generate ideas in some meaningful way, for example, with the affinity method, storyboarding (VanGundy, 1988), and fishbone diagrams. Hybrid methods like synectics combine different techniques to address varying needs at different phases of ideation (Shah *et al*., 2003). The second category of logical methods may be classified into two categories: history-based and analytical. These methods use past solutions catalogued in a form of database. These methods have two common features, they formalise the idea generation procedure through rules and they externalise thinking (Shah *et al*., 2000).

There has been debate on whether idea generation is brought about from informal serendipity rather than structured management (Desouza *et al*., 2009), however research suggested that some level of structure is beneficial to the process. Rickards (1988) for example, suggested that basic training in idea generation techniques across the workforce should take place.

Sowrey (1990) and Parnes (1961) suggested that there is a strong relationship between the number of idea generation techniques and the number of successful products. Theme-based idea generation has been found to be the highest idea yield mechanism (Wagner and Hayashi, 1994). Bessant and Francis (1999) suggested a classification of continuous idea generation, differentiating between operational and strategic goals.

Methods of developing ideas include wording changes to problems, turning negatives into positives and changing the focus of problems (Evans and Lindsay, 1999). Nijssen and Lieshout (1995) categorised the most popular tools for new product development according to their purpose into four groups as follows:

1) Idea generation, includes creative (such as brainstorming, synectics and morphological analysis) and non-creative tools (such as focus groups, surveys, observation, Delphi method, scenarios, expert opinion and product life cycle),

2) Product optimisation, including conjoint analysis, quality function deployment, concept testing, prototype testing and pilot plant / in-home use test,

3) Marketing mix optimisation, including simulated test marketing, mini-market, limited prediction, including computer prediction models, diffusion models, and economic models such as ROI-analysis and pay-back time,

4) Prediction, including computer prediction models, diffusion models, and economic models, such as ROI-analysis and pay-back time.

Past metrics have focused on the quantity of ideas and not the quality of those ideas (Callaghan, 2009). Literature stated that individual brainstorming out-performs group ideation, however group brainstorming persists as a preference to idea generation possibly due to the high level of enjoyment gained (Callaghan, 2009). A drawback to group or teams is that they minimise internal conflict and focus on issues that maximise consensus (Van de Ven, 1986). It can be argued that a mixture of both group and individual ideation works best, combining the strengths of each method in quality and quantity. Similar methods are the nominal group technique which aims to do just that.

In the early stages of idea generation when communicating ideas, an individual shares his or her knowledge with others. In addition, the individual receives input from other people on how to improve it. This input might include relevant task knowledge or a change in perspectives (Madjar, 2008). Furthermore, individuals might build on the ideas suggested by others to develop their own ideas. This incubation is the foundation for the popularity of brainstorming groups (see Paulus, 2000).

Typically users are contacted after the company has developed a new concept for a product or service in order to evaluate them, e.g. focus groups (McQuarrie and McIntyre, 1986). Some argued that users do not have sufficient technical knowledge to produce innovations (Christensen and Bower, 1996), or that they cannot articulate their needs (Leonard and Rayport, 1997). Others stated that there are pitfalls associated with relying too heavily on users (Poetz and Schreier, 2012). However users are a valuable source of ideas and hold the potential to change how a problem is framed in order to communicate and discuss it with others.

Existing literature on idea generation focuses on the sources of ideas with emphasis on external knowledge sources such as customers, markets and competitors (McAdam, 2004). Wikström (1995) was of the opinion that intensive interaction with potential customers is a likely source of generating new ideas and new ways of doing business. Bitner *et al*., (2000) recommended the close involvement of customers in the design process of technology-based services. Certain types of users, so-called lead users, have invented the majority of products in certain industries (Urban and von Hippel, 1988). One major challenge in applying the lead-user method has been the reliable and efficient identification of leading-edge users in the first place (Lilien *et al*., 2002; Lüthje and Herstatt, 2004). This problem seems most severe in consumer goods fields where overall user populations appear to be 'unmanageably' large (i.e. several hundred thousand consumers or more).

Ideation Method Effectiveness

It was argued that idea generation research should focus on understanding the devices that make techniques effective rather than the methods themselves. Everyone has ideas all the time, however not all of them are creative nor do they all lead to innovations (Vandenbosch and Saatcioglu, 2006). Numerous idea generation techniques are present within the literature but less is present on how effective these techniques are for generating the highest number of good quality ideas. Much of the existing research on new product ideation focuses on understanding different techniques for generating ideas (Cooper and Edgett, 2008; Goldenberg *et al*., 1999).

Interestingly, simply identifying idea generation methods and techniques is now not enough. Practitioners and researchers are now focusing on identifying which idea generation techniques are the most effective. Several metrics have been proposed to evaluate the performance of idea generation techniques, including the total number of design ideas generated, the total number of categories of ideas generated, the uniqueness or novelty, and the practicality of ideas (Nelson *et al*., 2009). Many authors use different scales to assess specific traits of the ideas and then average those (Silvia *et al*., 2009). One of the most agreed upon scales is the assessment of originality and feasibility (Rietzschel *et al*., 2007).

Idea generation techniques that generate the highest numbers of actionable ideas allow for the natural roleplaying of personality types (Callaghan, 2009). This is important as companies want to generate ideas that are actionable (Majaro, 1992) and the main role of IM is in ensuring these ideas are captured and managed effectively (Du Preez and Louw, 2008). This current study suggests that there is no 'best' method for idea evaluation. However, there is agreement on the above factors that should be considered when assessing ideas for NPD.

From a historic perspective, Anderson (1975) considered three kinds of experiential variation that can help generate more innovative ideas through reframing a narrow problem perspective: adding, removing, and rearranging stimuli. These techniques can be directly applied to the front-end activity of idea generation to generate more innovative ideas. One benefit of group idea sharing is that other group members can serve as cues for potential classifications and related ideas in the stated domains (Kohn *et al*., 2011).

Craig and Zimring (2000) critiqued brainstorming as a contrived activity where participants, sharing and discussing their ideas, are assumed to stimulate thinking within a group, which serves as a general model of unstructured interaction. They argued that when applied to design, brainstorming has the capacity to ensure that certain interpretations of a problem and design alternatives are available to those who would not have otherwise thought of them. More importantly, it encourages the formation of altogether new avenues for developing new concepts.

Group research methods and focus groups are still advocated for early-stage innovation to uncover needs, generate and evaluate ideas despite the proven inefficiencies (Furnham, 2000). Diehl and Stroebe (1987) believed that group interactions caused the destruction of ideas primarily due to three occurrences: (1) free-riding by individuals, (2) evaluation apprehension, and (3) production blocking. P&G have de-emphasised focus groups in favour of individual methods such as individual interviews and ethnography (Lafley and Charan, 2008).

Mullins and Sutherland (1998) investigated best practices for new product and service development. One of the best practices included user involvement for idea generation, and the use of mock-ups and prototypes to understand customer usage and benefits. This was for both idea generation and evaluation.

In a study assessing UK service companies, brainstorming came top with suggestion boxes the lowest rated in idea generation methods (Kelly and Storey, 2000). They found that only half had a formal strategy and that idea generation was undertaken on an ad-hoc basis. Idea screening was identified to typically not support strategy. These findings raise the question as to why companies are still relying on informal idea generation. A possible reason as to why this is the case may reside in a greater reliance on personal 'gut feeling' than is typically accounted for during idea evaluation. This conflict between intangible gut feel (which may or may not be based on direct experience) and more logical measures such as potential ROI, can make idea evaluation more difficult than simply a check box exercise.

Figure 15 shows the rated effectiveness and popularity of 18 ideation methods from a study by Cooper and Edgett (2008) involving over 160 companies. It shows various internal and external idea generation methods, with the majority being externally based. Studies such as this are hard to find compared to those that describe numerous idea generation techniques. In addition, the distinction between internal and external methods is appropriate for the nature of this study.

The most popular ideation method was setting up an internal idea capture system, which formally solicits new product ideas from employees and then screening and handling these ideas through a structured process (Cooper and Edgett, 2008). The three other methods rated as the most useful idea sources included: (1) peripheral vision, which is assessing the external world to identify trends and threats and define potential new products, (2) disruptive technologies, which involves monitoring technological trends formally to identify disruptive technologies, and (3) patent mapping which involves mapping others' patents to see where the technical and competitive activity is and identify areas for new products.

The challenge is that most of these systems are poorly constructed and ineffectively managed, as they do not define areas of focus with an innovation strategy. This alignment to strategy can determine whether an idea continues through the innovation pipeline or is rejected. There is no single idea generation method which gives the highest number of good ideas, as industry context plays a role in determining which idea source will provide the best ideas (Glassman, 2009).

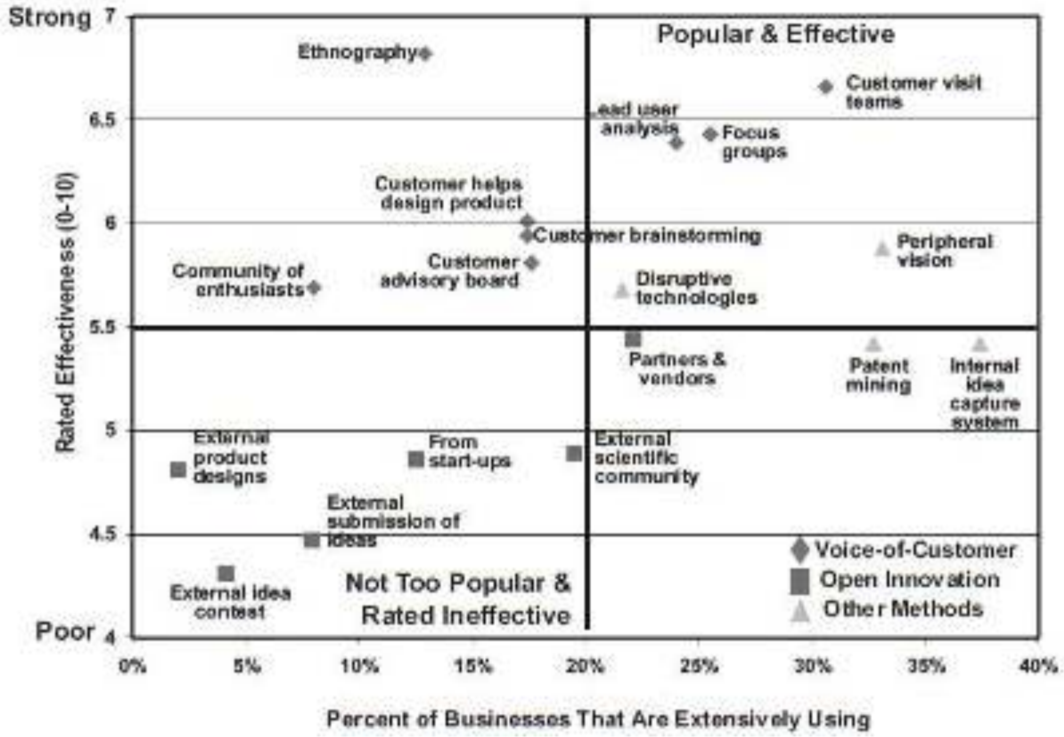


Figure 15 Effectiveness and Popularity of 18 Ideation Methods

Source: Cooper and Edgett (2008): 15

Callaghan (2009) conducted a study involving three teams and 12 students which found that brainstorming techniques generating the highest levels of actionable ideas, are not techniques that give participants a high level of satisfaction. The author states that this could be due to the conversational aspect of the session where teams spent more time talking about ideas rather than generating them. The techniques enabling the greater number of actionable ideas allowed for the natural roleplaying of personality types through a loosely structured technique (Callaghan, 2009).

Some earlier studies on innovation management have highlighted the importance of proactive approaches when developing innovations. Kaplan (1999) and Rice *et al*., (1998) accentuated the role of proactiveness in stimulating radical innovations within the firm. Hyysalo’s (2004) study emphasised the importance of anticipating prospective use during a radical innovation development process, and the study by O’Connor and Veryzer (2001) concentrated on market visioning in radical innovation development. Similarly, Narver *et al*., (2004) studied reactive and proactive market orientation in terms of creating and sustaining new-product success, and came to the conclusion that both were needed, but proactive orientation seems to be especially important.

These findings underpin the critical notion that innovation does not happen purely by serendipity, but by organisations taking innovation seriously, investing in it and communicating its importance to their employees.

Intrinsic and Extrinsic Incentives

Critical to understanding organisational capabilities is recognising the complementarities among processes, between processes and incentives (Teece *et al*., 1997). Much research exists on incentives for innovation and a key distinction has been made between intrinsic and extrinsic motivations. Intrinsic motivations are about internal rewards, such as enjoyment or peer recognition, compared to extrinsic motivations which are external benefits, such as monetary (Griffiths-Hemans and Grover, 2006; Soukhoroukova *et al*., 2012). Intrinsic motivations have been proven to be more important than extrinsic incentives regarding innovation efforts (Poskela and Martinsuo, 2009; Griffiths-Hemans and Grover, 2006).

There is a large dormant reservoir of useful ideas in many companies, but communicating these ideas is not simply a matter of offering large bonuses. Rewards need to be used in such a manner that the intrinsic motivation is not undermined by too strong an emphasis on these extrinsic motivators (Van Dijk and Van den Ende, 2002). As Angle (1988) argued recognition of achievement (i.e. intrinsic reward) is also a strong and important motivator.

Many companies have established internal idea collection and handling systems. The best innovating companies attach rewards or recognition to the submission of ideas. Recognition is typically not monetary, but peer praise, which is viewed as more effective than financial rewards. Saint Gobain (a major French glass and materials company) installed a worldwide ideation system. Idea submitters get points as their ideas move through each gate in the company's stage-gate process, with more points awarded at successive gates. Points can be accumulated and later redeemed for significant prizes.

The 'skunk-works' model popularised by Peters and Waterman (1982) is an example of a fuzzy archetype that allows individuals to work on projects in their own time. Skunk-works seem to work largely through intrinsic motivation. The improvised style of the typical skunk-works seems to be an important ingredient for creativity (Kohn, 1995). Skunk-works are suggested as a possible method to performing dalliances with new innovation partners. The external environment not only involves the market but institutions and suppliers, acting as a "*rich source of ideas, stimuli and knowledge*" (Phillips *et al*., 2006: 455).

A fully automated system had been functioning in Xerox, named the Ideamanager, which creates the possibility for employees to both give their suggestion and to monitor its progress with regard to the evaluation and possible implementation online. It included stages of extract, landing, and follow-up and uses credits for gift vouchers and small monetary incentives as well as quarterly meetings for idea committees and 'idea and suggestor of the year' events. The new suggestion system led to a great increase in the number of suggestions, from 250 to over 1,000 annually (Van Dijk and Van den Ende, 2002).

2.2.3 Idea Evaluation and Quality Criteria

Idea Quality Criteria

Idea quality and idea generation have been emphasised as important determinants in innovation success as ideas are the main resources and starting point of innovation (Koc and Ceylan, 2007). However there is little agreement amongst researchers as to what constitutes quality of ideas. Some definitions that have been used are 1) originality, 2) feasibility, 3) effectiveness, 4) importance, and 5) uniqueness (Fern, 1982). Others define a quality idea as one that contains the following three characteristics. First, the idea should apply to the problem at hand (Aiken *et al*., 1996). Second, it should be an effective solution (Valacich *et al*., 1995). Third, it should be implementable (Diehl and Stroebe, 1987). A quality idea is an implementable solution that will solve the problem, and is argued regardless of whether or not the idea itself is novel or unusual.

In contrast to this, Dean *et al*., (2006) defined a creative idea as a quality idea that is also novel. A novel idea has been defined as one that is rare, unusual, or uncommon (Connolly *et al*., 1993). The most novel idea is an idea that is totally unique, conversely, the least novel idea is the most common one (MacCrimmon and Wagner, 1994). The novelty of any idea must be judged in relation to how uncommon it is in the mind of the idea rater or how uncommon it is in the overall population of ideas. The best ideas are attractive but also meet the firm’s objectives (Majaro, 1992). Although novelty may not be a factor in whether an idea solves a problem or not, the author would argue that novelty is something that is strongly associated with an idea of high quality.

The quality, and not the source of the idea, is the most important factor in assessing the development and market potential of the idea in R&D intense firms. Individual interviews have been found to generate ideas of significantly higher quality than focus groups. Focus groups of eight members generated significantly more ideas then focus groups of four members (Fern, 1982). High-quality ideas are those likely to yield successful outcomes for decision makers. Low quality ideas are those unlikely to result in successful outcomes (Reinig and Briggs, 2008). However, most often the primary dependent variable in ideation research is the number of ideas produced, rather than their quality (see Diehl and Stroebe 1987; Fjermestad and Hiltz, 1999 for reviews). Within this research, finding or generating ideas of high quality is the main factor in judging the effectiveness of methods and tools employed.

To avoid confusion between novelty only studies and creativity studies where creativity is based on novelty plus other quality constructs, it has been recommended that the terms be used according to their definition. In other words, the term creative should be reserved for ideas that are novel and also have other quality attributes (Dean *et al*., 2006). MacCrimmon and Wagner (1994) identified four dimensions for idea quality:

- **Novelty**: an idea is most novel if nobody has expressed it before,
- **Workability**: an idea is workable if it does not violate known constraints or if it can be easily implemented,
- **Relevance**: an idea is relevant if it satisfies the goals set by the problem solver, and
- **Thoroughness**: an idea is thorough if it is worked out in detail.

Van der Lugt (2003) found a strong connection between the perceived quality of an idea and the number of links it generates i.e. ideas it builds on, and ideas that build on it. In addition, some evidence was found that good ideas may be composite, involving three different topics. The more meaningful and helpful the idea, the denser the network of links it is involved in (Van der Lugt, 2001). Table 6 shows a summary of idea quality constructs and their definition in the literature. This helps describe how to measure these indices.

The literature review revealed that some studies did not use financial measures for screening ideas, but rather preferred to evaluate new products by a much more intangible factor, ‘gut feel’. The majority of companies rely on one approach of either relying on gut feel to evaluate new products or a consistent set of criteria (Pavia, 1991). For the latter, it has been argued that what does matter is how well these criteria are used to make critical NPD project continuation decisions (Schmidt *et al*., 2009).

Table 6 Idea Evaluation Constructs

Source: Dean *et al*., (2006), adapted by Chou (2014): 445

Construct		Dimension	
C_1	Novelty: *Novelty refers to the degree to which an idea is original and modifies a paradigm. A novel idea is not only rare but also has the characteristic of being ingenious, imaginative, or surprising*	C_{11}	Originality: *The degree to which an idea is not only rare but is also ingenious, imaginative, or surprising*
		C_{12}	Paradigm relatedness: *The degree to which an idea is paradigm preserving or paradigm modifying. Paradigm modifying ideas are sometimes radical or transformational*
C_2	Workability (feasibility): *Workability refers to the degree to which an idea can be successfully adopted by an organization, where adoption incorporates the generation, development, and implementation of new ideas or behaviors. An idea is workable if it can be easily implemented and does not violate known constraints*	C_{21}	Acceptability: *The degree to which the idea is socially, legally, or politically acceptable*
		C_{22}	Implementability: *The degree to which the idea can be easily implemented*
C_3	Relevance: *Relevance refers to how well an idea can be applied to the stated problem and will be effective at solving the problem. To be relevant, an idea must apply specifically to the problem at hand and it must be reasonable to expect that the idea will solve the problem*	C_{31}	Applicability: *The degree to which the idea clearly applies to the stated problem*
		C_{32}	Effectiveness: *The degree to which the idea will solve the problem*
C_4	Specificity: *Specificity refers to how well an idea is "thought out" and whether it has a complete, detailed and elaborate description. An idea is specific if it is clear, concise, and exact*	C_{41}	Implicational explicitness: *The degree to which there is a clear relationship between the recommended action and the expected outcome*
		C_{42}	Completeness: *The number of independent subcomponents into which the idea can be decomposed, and the breadth of coverage with regard to who, what, where, when, why and how*
		C_{43}	Clarity: *The degree to which the idea is clearly communicated with regard to grammar and word usage*

Creativity is typically viewed as a characteristic of an environment, a process, a person, or a product (Rhodes, 1961). In terms of idea generation, environments, processes, persons, and groups that generate more novel ideas, or ideas that are not only novel but that also have other desirable attributes, are sometimes considered more creative than sources that produce fewer ideas with these qualities. Creativity can also be measured in terms of the characteristics of a product, such as an idea. Meaning it applies to the problem, is an effective and implementable solution, and is also novel (MacCrimmon and Wagner, 1994).

Kijkuit and Van den Ende (2007) proposed that the networks of employees surrounding an idea affect the quality of that idea and its chances of adoption. They distinguished between three phases in the front-end, the generation, development and evaluation phase. They also proposed that the structure and content of the network of the idea should change over these phases for the network to contribute to the quality of the idea. It suggests that evaluation should be embedded within each phase, particularly when searching externally.

Some studies proposed using more specific metrics to measure the quality of a set of ideas. For example, a study used 14 metrics corresponding to different branches of a taxonomy tree (Westerski *et al*., 2013):

1) Trigger: experience completeness, situational dependence, relatedness
2) Idea: dependability, adaptiveness, originality, originality scope
3) Community: cooperativeness
4) Implementation: freshness, integrity, applicability scope, constructiveness, scope, dependability.

There is also a distinction to be made due to where ideas originate from i.e. their source. Innovative ideas can come from ordinary or lead-users (Magnusson, 2009; Kristensson *et al*., 2004) and have their own relating factors and idea type outcomes depending on their exposure to information. Similarly, ideas from suppliers tend to have a more technical nature (technology push) rather than a user needs nature (market pull).

A key insight is that the literature parameters illustrate that idea quality is multi-dimensional. This adds more complexity to how ideas are judged and selected within the innovation pipeline. As discussed, although idea novelty is not considered an essential criteria for idea quality by some authors, the majority of literature reviewed in this research included idea quality as a key selection criteria affecting the success of ideas. Idea evaluation was also identified as an activity which should occur within each innovation phase, particularly when utilising external innovation networks. This emphasises the importance of idea evaluation when sourcing ideas from external sources.

Idea Selection

Another important aspect of idea management systems is that they place systems and processes to implement a ‘stage-gate’ or idea funnel process where ideas are systematically filtered and assessed against criteria. Selart and Johansen (2011) stated that there is a great potential for value focused thinking as their results demonstrate a positive effect on idea quality. Thus, these ideas have a greater potential to meet the criteria used for evaluation in idea management systems. There is a risk that criteria for a product’s go / no-go decision are not always quantifiable or comparable, and criteria may directly conflict or interact with one another (Ahn and Dyckhoff, 1997).

Aspects relating to the idea description as well as the type of idea may have an influence on the selection process. One traditional approach to idea screening is to ask one or a few experts to go over transcripts of ideas and evaluate them (Urban and Hauser, 1993). However, their judgements might not always reflect consumer's needs and preferences. Toubia and Florès (2007) proposed an approach for involving consumers in idea screening. In their study, they asked consumers to indicate which ideas they believe to be "good" however they do not restrict the definition of a "good" idea. Their definition of quality ignores other important criteria such as cost, feasibility, or fit with company core competencies (Ozer, 2005).

The type of ideas has been identified as an influencing factor for front-end innovation. There is a need to distinguish between different types of concepts and their obstacles for being included in the NPD process (Backman *et al*., 2007), in addition to differentiating between radical and incremental ideas (Garcia and Calantone, 2002). A broad scope and a strong alignment is important for incremental ideas, whereas radical innovations are mainly generated by using a focused scope aimed at technology experts and by paying much attention to the processing of ideas (Van Dijk and Van den Ende, 2002).

Titus (2000) stated that 'old ideas never die' and instead, they are kept in corporate or individual memory until more appropriate circumstances for their application. Good ideas are the result of having non-redundant, heterogeneous contacts that enable a person to generate ideas by combining diverse information (Burt, 2004). In terms of evaluation, Cooper *et al*., (2002) found that sophisticated organisations have defined go / kill gates and specific gate criteria, with an emphasis on strategic criteria, for example, fit with core capabilities, market need, and financial objectives.

Schmidt *et al*., (2009) conducted a study of 425 PDMA members to compare evaluation criteria used at the review points in NPD and found different review practices for incremental versus radical projects. They found that more review points are used for radical projects than incremental ones and that more criteria are used to evaluate incremental projects than radical projects. This is likely due to the increased uncertainty associated with radical innovation projects where more evaluation points are needed to clarify progress. The number of criteria decreasing with radical projects may be due to acknowledgment that too many criteria would restrict the innovative aspects of the idea. The initial screen is related to the performance of a product in the market, supporting past research which has shown the importance of the initial screening activity and its relationship to new product performance (Cooper and Kleinschmidt, 1987).

It is argued that all new concepts need to be conceptualised before being introduced to the NPD process (Backman *et al*., 2007). The use of multiple functional groups, each with a different perspective, may be involved in the evaluation decision and can add to complexity, uncertainty, and imprecision (Ahn and Dyckhoff, 1997). It is also suggested that review practices might differ across national boundaries (Schmidt *et al*., 2009).

Taking Ideas to Market

Björk and Magnusson (2009) argued that in order to increase the number of high-quality innovation ideas created by individuals, the possibility of interacting with other people should be supported and facilitated. They suggested that key examples of this include creating and supporting communities, using idea generation techniques in projects and other groups, increasing formal collaboration between individuals from different departments, and improving sharing. Jones *et al.,* (2002) identified ten steps for successfully taking ideas to market:

- define a balanced innovation strategy,
- create an open and supportive culture,
- leverage all stakeholders to generate ideas,
- conduct efficient idea assessment and selection,
- use a clearly defined but flexible generic process,

- provide clear accountability and empower the team,
- focus on value generation,
- always pilot and test,
- ensure effective launch management, and
- do not forget post-launch learning reviews.

Rickards and Freedman (1978) suggested a dimension to the separation of idea generation and evaluation. They deduced that an additional ‘time’ separation or ‘deferment-of-judgement’ should occur in the idea generation phase. This time factor will allow the creativity process to develop before idea evaluation takes place. Similarly, Henry and Walker (1991) considered the need for a period of ‘incubation’ in idea generation. This foregrounds the need for a period of incubation and reflection, previously identified in this review as an important part of the creative process.

2.2.4 Summary of Effective Practices in Ideation and Quality

On analysis of the literature on factors affecting idea generation, evaluation and idea quality, the findings crossed multiple boundaries of cognitive psychology and creativity techniques. Within this section, the trajectories of the review identified several themes as follows:

- idea generation should include individual and collaborative activities,
- idea generation is mainly ad-hoc rather than structured,
- the trend for multi-dimensional idea evaluation aligned to strategy,
- the importance of boundary spanning.

It is clear that the way in which ideas are generated impacts on quality, covering several issues including individual versus group brainstorming, the type of idea source, user knowledge of technology, and the role of stimulus. The most common idea quality criteria are originality, feasibility, customer benefit and factors such as organisational / strategic fit. The emergence of intangible criteria is also acknowledged as influencing idea evaluation and selection (i.e. gut feel /

experience). In addition, external factors were found to affect idea generation outputs. For example, the amount of technical knowledge available to the ideator impacts the level of novelty in their ideas i.e. those with low technical subject knowledge were found to generate ideas which were more novel compared to those with high technical knowledge (Magnusson, 2009). Users can be taught about limitations of a technological platform and adapt to these restrictions in their ideation; however, this was found to come at the cost of reduced originality.

In addition to identifying the emerging topics, this section addressed the research question what is a good quality idea. Idea evaluation, is multi-dimensional taking into account various factors such as novelty, feasibility, fit with capabilities and strategy and customer benefit. It appears that criteria can be generalisable but also specific criteria for projects can be used. Creativity appears to be the measurable characteristic of novelty, a factor which needs to be included in idea evaluation. Idea evaluation is often seen as a phase in and of itself but should be embedded as a process in every innovation phase. Interesting, intangible evaluation factors are also at play including gut feel and political factors such as senior management edicts.

In summary, there is a need to link idea quality to key constructs, characteristics and measures. There is also a distinction with differing practices and measures involved with incremental versus radical ideas.

2.3 Factors Affecting Search and Select Strategies

Introduction

This final section of the literature review focuses on identifying the factors affecting search and select strategies, with an emphasis on the role of digital tools to source ideas. This adds context to the main survey assessing the effectiveness of a digital tool and its impact on idea management practices. This section is sub-divided into three identified trajectories:

2.3) Factors Affecting Search and Select Strategies:

2.3.1) Search and Select Practices

2.3.2) Search and Select Barriers

2.3.3) Role of Idea Sourcing Tools

This section concludes by summarising the emergent issues within the above explored themes regarding factors affecting search and select strategies (see Section 2.3.4).

2.3.1 Search and Select Practices

In order to find and incorporate external knowledge and ideas into an internal innovation process, practitioners must search for this knowledge and select or prioritise which data and information is most relevant to answering a need or problem. These capabilities are described as dynamic capabilities since they are continually changing and adapting to the environment. Two processes have been argued to be critical to the operation of dynamic capabilities: search and selection processes and asset orchestration processes (Sharma and Shanks, 2011). Search processes involve the identification of a need or an opportunity, while selection processes involve processes for formulating actions and allocating resources (Helfat *et al*., 2007).

Search Strategies

The significance of idea search and idea generation in triggering the innovation process is well acknowledged in the literature, as it is the original idea that ultimately leads to an innovative market offering (Cooper 1986; Rothberg, 1981). Firms that rely too heavily on their internal expertise might be blocked from finding alternative and potentially more successful solutions (March, 1991; Martin and Mitchell, 1998). Katila and Ahuja (2002) also found that the extent to which a firm explores external knowledge is positively related to successful new product innovation. So what are the sources of external innovation available to organisations? Figure 16 illustrates formal and informal methods and sources of finding innovative ideas internally and externally.

Figure 16 Sources of Innovation

Source: Tidd *et al*., (2013): 234

Customers represent the most preferred external source for NPD (Knudsen, 2007). The results indicated that competitors are used more often at the ideation stage and only rarely at the stage of completion alone, due to the competitive nature of the relationship. External relationships with universities or private research institutes only exist to a very limited degree. External relationships need to be coordinated internally to be successful (Hillebrand and Biemans, 2004). This supports the argument of idea management needing to become more integrated to improve effectiveness, something which can be termed as merging, both internal and external capabilities.

Another external source discussed in the literature on innovation search processes are suppliers as their involvement has been found to have a positive effect on innovative performance. Design involvement by suppliers can help in identifying potential problems and solutions earlier, reducing both time and cost of the design effort (Handfield, 2000). Frishammar and Hörte's (2005) study of 206 medium-sized firms found that innovation performance was positively associated with scanning the technological environment, while scanning customers, suppliers, and competitors proved to be negatively correlated with innovation performance. These findings illustrate that certain innovation sources are used at particular stages of the idea development process and their effects on innovation performance.

Some argued that the searching process is more important than the actual finding (Lawson, 2006). For example, IDEO described three spaces of: inspiration, ideation and implementation. Inspiration is the problem / opportunity that motivates the search for solutions, ideation is the process of generating, developing, and testing ideas, and implementation is the path that leads from project stage into people's lives (IDEO, 2015).

Long *et al*., (2010) proposed internal and external sources of product innovation as shown in Table 7.

Table 7 Internal and External Sources of Product Innovation

Source: Long *et al*., (2010): 3

Internal sources of product innovation	External sources of product innovation
an inner personnel for developing	the suggestion, the advice, the desire from a customer
an inner personnel for sale	the information on an competitor
a superior administrator	a wholesaler, a shopkeeper, an agent
an operator from production department	the patent
	a researcher, an inventor, a consultant company
	the related information on the government
	an on-the-spot investigation, an elicitation from a real object
	the information from a news media
	the information from the internet
	an elicitation from the nature

Bonner and Walker (2004) argued that lead users will resist new technology and products and will insist on incremental improvements to existing products. Suppliers and universities are important external sources of knowledge for innovative performance (Escribano *et al*., 2009). Supplementary knowledge is positively associated with innovative performance and calls for managers to include knowledge compatibility as a decision criteria.

A study on how expert entrepreneurs conceptualise the creation of new markets identified two types of search processes in their contextualisation. They discussed rational search and selection (formal decision theory) and heuristic search and selection (behavioural theories) (Dew *et al*., 2011). Rational search has a key idea that search is optimising, based on the goals of the search agent. This type of search is described as unconstrained and includes a vast number of possibilities (Dew *et al*., 2011).

Heuristic search, on the other hand, suggests that agents search locally for innovation (among possibilities close to their starting point) within a firm's behaviour (e.g. Nelson and Winter, 1982). In other words, they search based on their local knowledge (Shane, 2001). These different types of searches directly impact innovation sources used, suggesting these strategies exhibit different priorities and search breadth to the same problem, potentially yielding different results.

Exploration and exploitation strategies are not just internal to the firm. Alliance networks are often used to support these strategies. Exploration strategies have a focus on learning new ideas from new partners (Dittrich and Duysters, 2007). Companies that follow an exploration strategy will look for partners with distinctly different capabilities. On the other hand companies pursuing an exploitation strategy will search for companies with similar technological capabilities.

Phillips *et al*., (2006) argued for the need for a new type of supply chain relationship, termed strategic dalliances. In contrast to the traditional strategic alliances, these relationships are short-lived, non-committal and foster discontinuous innovation capability. Their study confirmed that discontinuous innovation firms embark on short-term relationships, or dalliances with new, unfamiliar suppliers. The value of these relationships is the exploration of a new sector and knowledge with little or no resource commitment. This indicates that the level of familiarity with partners affects the success of certain types of innovation.

A number of search strategies have been proposed for finding external innovation (see Table 8). These activities are typically explorative in nature. The challenge in managing innovation is how to seek out and find relevant triggers early and well enough to do something about them (Tidd *et al*., 2013). This implies that innovation practitioners must be actively searching for potential innovation leads not only within their field of interest, but in other sectors that may bring about breakthrough innovation solutions.

Dittrich and Duysters (2007) investigated innovation networks and collaboration strategies of large firms and argued that in exploration networks, partner turnover will be higher than in exploitation networks. Interfirm networks offer flexibility, speed, innovation and the ability to adjust to changing market conditions and strategic opportunities (Dittrich and Duysters, 2007).

Table 8 Extending Search Strategies for Innovation

Source: Tidd *et al*., (2013): 278

Search Strategy	Mode of Operation
Sending out scouts	Dispatch idea hunters to track down new innovation triggers.
Exploring multiple futures	Use futures techniques to explore alternative possible futures; and develop innovation options from that.
Using the web	Harness the power of the web, through online communities, and virtual worlds, for example, to detect new trends.
Working with active users	Team up with product and service users to see the ways in which they change and develop existing offerings.
Deep diving	Study what people actually do, rather than what they say they do.
Probe and learn	Use prototyping as mechanism to explore emergent phenomena and act as boundary object to bring key stakeholders into the innovation process.
Mobilise the mainstream	Bring mainstream actors into the product and service development process.
Corporate venturing	Create and deploy venture units.
Corporate entrepreneurship and intrapreneuring	Stimulate and nurture the entrepreneurial talent inside the organisation.
Use brokers and bridges	Cast the ideas net far and wide and connect with other industries.
Deliberate diversity	Create diverse teams and a diverse workforce.
Idea generators	Use creativity tools.

Un *et al*., (2010) argued that firms benefit from external collaboration, however, not all collaborations have the same impact on product innovation. Their study of 781 manufacturing firms between 1998 and 2002 found that R&D collaborations with suppliers have the largest positive influence on product innovation, followed by collaboration with universities. R&D collaborations with universities or suppliers have long-lasting influences. Customer collaborations appeared to have no influence and collaboration with competitors had a short-lived negative impact on product innovation. This is because competitors tend to actively block the transfer of useful knowledge as well as lack the breadth of knowledge useful for product innovation for the focal firm.

Aguiler (1967) defined the way an organisation may scan the environment as: surveillance mode, conditioned viewing, informal search and formal search. Environmental scanning methods, when treated as innovative scanning processes, are tools not only for idea generation and opportunity identification, but also for uncertainty reduction (Börjesson *et al*., 2006).

Activation triggers such as change in a dominant design may also influence the determined locus of search for external sources of knowledge (Tidd *et al*., 2013). Approaches to increase the likelihood of finding suitable innovation partners include: placing multiple technology scouts in global regions of high start-up activity, using third-party technology scouts through venture partnerships, co-funding technology incubators, allowing first rights on new developments, and creating Internet portals to your company that will direct technology firms seeking partnership for commercialisation (Fetterhoff and Voelkel, 2006).

These findings have proven that the nature of external collaborations is important in shaping certain innovation outputs. Organisations should therefore employ a mixture of relationships dependent on the innovation sought. The findings show no lack of innovation sources available, however, how to best utilise and nuture external relationships is a factor that adds to complexity.

Opportunity Identification

Opportunity identification is the initial stage in the new product development process where ideas for new products are generated and screened. It is one of the key activities of front-end innovation. The focus of the front-end is mainly on opportunity identification and analysis (Belliveau *et al*., 2004; Khurana and Rosenthal, 2002). Khurana and Rosenthal (1998) built on the definition set by previous authors and define the front-end as including product strategy formulation and communication, opportunity identification and assessment, idea generation, product definition, project planning, and executive reviews.

The front-end mainly focuses on opportunity identification and analysis prior to actual IM (Belliveau *et al*., 2004, Khurana and Rosenthal, 2002). Opportunity identification is practiced in higher-innovation-level companies and includes identifying business and technological goals consistent with the environment (Koen *et al*., 2001). Opportunity identification and analysis are core front-end activities (Achiche *et al*., 2013).

Idea generation was included in ten FE models used in this research (see Research Methodology), making it the most commonly integrated front-end activity. Opportunity identification was the next most common activity, present in seven models. Interestingly, technology development and product definition are only included in one model each. This may be because their importance is more established in the later stages of innovation rather than at the early stages. It may also be the case that these areas are included within other stages and not explicitly stated as separate stages.

Opportunity identification is a stage where organisational resources interact with stimuli to further develop the resources. During this stage, synthesis and incubation within the creative process occurs (Kao, 1989). The use of certain facilitation tools such as mind-mapping, data-mining and cross functional teams can act as an enabler to this activity.

Collaboration with External Organisations

Collaboration has been considered to be a 'meta-capability,' that is, something so important that it transcends a simple skill set (Liedtka, 1996). Ohly *et al*., (2010) argued that creativity requires collaboration. Although an idea may originate with an individual, through sharing the idea, the individual receives input from others and may build on the ideas suggested by others to develop the ideas. The sharing of ideas, for example in brainstorming sessions, should stimulate additional associations or ideas.

Sharing and teaching among and across business units and alliances can be an effective way of promoting collaborative innovation, if a business culture already emphasises learning (DeLong and Fahey, 2000). Learning requires common codes of communication and coordinated search procedures (Teece *et al*., 1997).

A study of SMEs in Australia conducted by Sawang and Matthews (2010) found that firms with external collaboration were three times more likely to introduce new products than firms that did not collaborate externally. They found that firms that sought ideas or solutions from an external network such as suppliers, or business partners reported higher levels of new product introduction than firms that did not have any external collaboration.

Gathering external information allows a project team to gain a clearer understanding of current customer need as well as potential ones (Chandy and Tellis, 1998), market size and growth rates, marketing strategy ideas, regulation trends, and the market responsiveness indicators. External groups are sources of valuable information and innovative ideas.

Individuals can act as gatekeepers by deciding on the value of externally derived information to their organisation, as well as whether that information will be shared (Reid and De Brentani, 2004). Gatekeepers direct information along one path in the organisation rather than another and decide whether or not to share information gained from the environment with others (Reid and De Brentani, 2004).

Strong ties to suppliers can be valuable as the relationships may reduce development costs, promote higher quality with fewer defects, reduce time to market, and help incorporate supplier-originated innovation (Bonaccorsi and Lipparini, 1994). Decisions to co-operate with external groups should be made based on what sources of fuzziness are most critical in managing the FFE i.e. markets, technologies, or regulatory issues (Kim and Wilemon, 2002).

A past study found that companies use potential external partners in different ways. Of the 144 companies used in this study, 83% mainly link with non-competing market and technology leaders, 79% partner with world-class universities and 61% with local universities (Enkel *et al*., 2009). This is because innovation can be stimulated through learning processes and companies that cooperate within a network are more successful than those that do not (Mohannak, 2007).

Dynamic Capabilities

The key role of innovation in managing the uncertainty facing organisations and creating added value is becoming recognised as increasingly important as are the dynamic knowledge capabilities underpinning it (Tidd *et al*., 2013). Innovation capabilities are key dynamic capabilities accumulated over time (López-Mielgo *et al*., 2009). Dynamic capabilities are also described as a firm's "…*ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments*" (Teece *et al*., 1997: 516). An alternate definition states that it is the capacity of an organisation to purposely create, extend or modify its resource base (Helfat *et al*., 2007).

Innovative firms manage their innovation through managing knowledge and information flows as sources of innovation and market knowledge, which together may be components of broader dynamic capabilities of firms (Jensen *et al*., 2007). Innovative capabilities rely on interactions among individuals, groups, organisations, and subsystems (Teece, 1996) because such interactions magnify knowledge and learning (Nonaka, 1994). Enhanced innovative capabilities depend on the frequency, density, and quality of interactions both within and outside the MNC group (Persaud, 2005).

Empirical data from a survey involving over 2,300 Spanish companies from 1991 to 1999, found that more companies innovate in their processes than in their products (López-Mielgo *et al*., 2009). Their results strongly confirm a positive link between innovation capabilities and quality management.

Absorptive Capacity

Since there is such a rich environment which is full of potential innovation, it's easy to assume that every organisation will find and make use of them. The reality is that they differ widely in their ability to make use of such trigger signals (Tidd *et al*., 2013). The measure of the ability of an organisation to find and use new knowledge has been termed as 'absorptive capacity' by Cohen and Levinthal

(1990). Absorptive capacity is a critical part of an organisation's innovation capability (Tang, 1998) in order to internally implement external ideas.

Successful organisations have the capacity to absorb innovation into the organisational culture and management processes (Syrett and Lammiman, 1997; Tushman and O'Reilly, 1997). To develop an effective absorptive capacity, intensity of effort is critical over and above merely exposing an individual to relevant prior knowledge (Cohen and Levinthal, 1990). Four elements of absorptive capacity have been identified: acquisition, assimilation, transformation and exploitation (Zahra and George, 2002). Mechanisms that affect absorptive capacity include:

(1) related prior knowledge,
(2) communication network,
(3) communication climate,
(4) and scanning mechanisms (Tu *et al*., 2006)

A firm must have a nominal level of absorptive capacity if they are to understand, interpret and realise the benefits of a new idea by an outside source (Cohen and Levinthal, 1990). Absorptive capacity of organisational units has been identified as a factor which can increase innovation as well as performance capabilities (Tsai, 2001; Cohen and Levinthal, 1990). Organisational units that possess relevant prior knowledge are likely to have a better understanding of new technology that can generate new ideas and develop new products. Having a high level of absorptive capacity enables organisations to harness new knowledge from other units to help their innovative activities.

A unit's external knowledge access is characterised by its network position. The interaction between network position and absorptive capacity has been identified to be critical to intraorganisational knowledge sharing and affects innovation and performance (Tsai, 2001). Azadegan *et al*., (2008) argued that a manufacturer's absorptive capacity positively moderates the impact of supplier innovativeness on the manufacturer's performance.

Suppliers have been shown to provide a source of innovative ideas and critical technologies (Bonaccorsi and Lipparini, 1994; Nishiguchi and Ikeda, 1996). Petersen *et al*., (2003) proposed three critical factors form the foundation for a successful supplier integration effort: (1) understanding the focal suppliers' capabilities and design expertise, as well as the technical risks, (2) ensuring that technology and cost information flows between the design team and the supplier, and (3) ensuring that the supplier has an on-going active role on the design team.

A study which analysed 289 papers on absorptive capacity concluded that the concept has been reified (i.e. the process by which we forget the authorship of ideas and theories, objectify them and then forget that we have done so) (Lane *et al*., 2006). This suggests that the topic has received great interest in the academic community but that this can bring greater ambiguity over the original meaning of the terminology involved.

Scholars studying inter-organisational networks argued that innovating companies may form a network of relationships with external parties to draw new ideas in developing new products (Rosenkopf and Nerkar, 2001). March (1991) identified two different forms of organisational learning: exploratory and exploitative learning. Exploratory learning refers to the pursuit of new knowledge that leads to more variations and may create new customer value, whereas exploitative learning refers to refining and deepening existing knowledge to enrich current customer value.

Organisational Learning

Key features of an innovative climate are cross-functional collaboration, proactive scanning through extensive boundary spanning, acquiring and using new technologies, and, more generally, openness to new ideas and willingness to take risks and adapt to emerging (or create new) technological and market trends (Acur *et al*., 2012). Learning is cumulative and performance is greatest when the object of learning is related to what is already known (Cohen and Levinthal, 1990). An organisation committed to learning can enhance its innovation capability in three ways:

1) it is more likely to be committed to innovation, have state-of-the-art technology, and use that technology in innovations. It is more likely to have the capacity to build and market a technological breakthrough.

2) the organisation is not likely to miss opportunities created by emerging market demand because it has the knowledge and ability to understand and anticipate customer needs (Cahill, 1996).

3) an organisation committed to learning is likely to have greater innovation capability than competitors (Damanpour, 1991). A characteristic is that the organisation closely monitors competitors' actions in the market (Gatignon and Xuereb, 1997). It understands the strengths and weaknesses of rivals and learns not only from their successes but also from their failures (Slater and Narver, 1994).

External learning starts with the identification of new ideas by an outside source. After a new idea is identified by a boundary-spanning individual, they must transfer the knowledge throughout the organisation. They need to have a strong network of internal and external connections as well as strong technical and social skills (Tushman and Scanlan, 1981). Due to differing knowledge access and learning capacity, organisational units have differing learning capabilities which have a significant impact on their innovation and performance (Tsai, 2001).

Internal learning allows the firm to develop its own core competencies and appropriate more profits and external learning is required for a firm to develop a broader knowledge base, be aware of cutting-edge technologies, and remain flexible (Grant, 1996). Their findings confirm the belief that when employees work together with internally generated ideas from an early stage, they associate more strongly with the project and have greater commitment to its successful completion. In addition, internal project champions for internal ideas give a favourable image and are seen to be more effective (Kessler *et al*., 2000). Verganti (1997) argued from his study of 19 Italian and Swedish companies, that systemic learning from past experiences is the real keystone toward an effective management of the early phases of product development processes. Systemic knowledge, the capability of team members to detect the impacts of specific early decisions on the downstream phases of the product life cycle, was identified as crucial. An organisation has the resource and capability to learn from projects but this must be managed in order to make an impact to the innovation cycle.

In their study of 184 Taiwanese electronic companies, Chiang and Hung (2010) found that in order to pursue good performance in radical product innovations, managers should draw new ideas from a large number of external knowledge sources (open search breadth). Hence, maintaining broad contacts with a number of external parties to source new ideas can help managers improve radical innovation performance. Alternatively, if managers pursue incremental innovation performance, they tell managers to access new ideas intensively from external knowledge channels (greater search depth). Deep external search can facilitate absorption of in-depth and detailed technological and customer knowledge. This, in turn, can enhance incremental innovation performance.

Research suggests that early involvement of partners (suppliers and customers) and developing relationships with partners in FEI is especially important. Since suppliers share information and problems from the beginning, participants can save time in preparing their own or joint technologies and requirements. The project team can also learn about these external groups' capabilities early and develop long-term relationships based on trust and information sharing (Kim and Wilemon, 2002).

Open Innovation Archetypes

Two archetypes have been identified with open innovation: outside-in and inside-out processes. The former enrich a firm’s own knowledge base through integration with external knowledge sources, such as suppliers, and customers. Inside-out processes involve firms commercialising internally developed ideas and technologies and do not turn them into products to offer to their own customers. Coupled processes build on strong ties with innovation network partners (strategic alliances) and have formally established collaboration activities and co-development partnerships. This shows that these different approaches to sourcing innovation externally impact the sources used.

Deciding what to search for is partly shaped by four variables: the expected reach (or variety), the costs, the risk involved, and the speed with which an idea can be brought to market (Nambisan and Sawhney, 2007). For internal searches, several success factors have been identified: 1) suspend judgment, 2) generate a lot of ideas, 3) welcome ideas that may seem infeasible, and 4) use graphical and physical media (Ulrich and Eppinger, 1995).

A broadcast search involves searches and problem solving leveraged via online communities. An example is a company called InnoCentive, successful for scientific problems, which provides a large variety of new ideas (Pisano and Verganti, 2008; Lakhani, 2006). The Italian brand Alessi, rely on small expert networks for new solutions to design problems (Pisano and Verganti, 2008). It is argued that the seeker and the solver(s) must be sufficiently close, in cognition and language, to enable meaningful communication (Nooteboom, 1999). Technological distance has also been found to influence a firm's ability to absorb external knowledge (Brunswicker and Hutschek, 2010).

The culture of a firm drives the adoption of externally generated and sourced ideas. Political resistance to new externally generated ideas may be high, known as the not-invented-here (NIH) syndrome (Katz and Allen, 1982). *"The phrase "not invented here" is common in manufacturing industries and thus, openness to outside influences is a facilitator of absorption and exploitation of new ideas*" (Brunswicker and Hutschek, 2010: 697). A way to combat the NIH syndrome is by organisations placing higher value on external ideas, as has been done by organisations such as Proctor & Gamble.

A study of 50 teams by Katz and Allen (1982), found that during R&D teams' first two years, the number of ideas is high, but after about three or four years, the creative output peaks and declines. They believed that over time, team members focus more strongly on the virtues of their own ideas and a not-invented-here attitude toward outsiders' ideas develops (Katz and Allen, 1982). Brunswicker and Hutschek (2010) stated that an open innovation strategy needs to be developed on a case-by-case basis with consideration for boundary conditions and a firm's technological competency, problem complexity and fit with a firm's business model.

This suggests that an organisation has to continually drive employees to value and encourage the use of external ideas within their innovation culture in order to be successful in the long-term. However as previously identified, often the problem with external ideas is the lack of fit with an organisational strategy. This calls for a framework that guides idea management and idea generation in a way that fits an organisation's strategic direction in order to enhance chances of progression to NPD.

Existing P&G Process Models

P&G is an often cited organisation with effective practices in open innovation, with many well-known case studies having used P&G as an example (Huston and Sakkab, 2006). These studies have identified several process models adopted by P&G to be released into the academic domain. Consumer goods companies such as Procter & Gamble face the threat of generic, unbranded products entering their markets. The challenge facing companies such as these is whether to offer their own generic products along with more well-known brands.

One study found that P&G uses a group of 70 professionals called technology entrepreneurs who lead the company's efforts in identifying and organising their innovation needs (Witzeman *et al*., 2006). P&G's technology entrepreneurs identify and capture product innovativeness and a NeedsTracker helps connect innovative suppliers with internal needs of a company's internal units. These demonstrate how absorptive capacity can link external innovativeness with internal capabilities (Azadegan *et al*., 2008). Dodgson *et al.,* (2006) documented the important facilitating role of information and communication technologies at

Procter and Gamble's adopted open innovation strategy. One of these models is provided in Figure 17. Here the internal and external innovation sources are clearly identified. However, this serves as an overview since more realistic diagrams would show a myriad of other connections and relationships within each innovation source.

Figure 17 P&G Internal and External Leverage Capabilities
Source: Sakkab, (2002): 40

The organisation has numerous communities of practice, such as bleach, polymers, analytical chemistry, flexible automation and robotics, technology entrepreneurs, fast cycle development, and organic chemistry. One of the most important external sources of capability to be developed by P&G is the Technology Entrepreneurs network. This is an extended network of 70 individuals who are expert data mining specialists. They use the most advanced data mining visualisation tools to search billions of web pages, scientific literature and databases and global patent databases (Dodgson *et al*., 2006).

One of the ways in which they focus on external searches for innovation is with Connect + Develop (C+D). C+D is about finding good ideas and bringing them in to enhance and capitalise on internal capabilities (Huston and Sakkab, 2006). It was crucial for them to know exactly what they were looking for, or where to play. They would seek ideas that had some degree of success already, and thus see working products, prototypes, or technologies, and evidence of consumer interest for products. There was a focus on ideas and products that would benefit from application of P&G technology, marketing, or other capabilities. This adds to the importance of merging together ideas with capabilities. Figure 18 shows three more process models used within P&G. All of them have a commonality in that they include clearly defined phases contributing to the flow of innovation development and simple criteria within each phase.

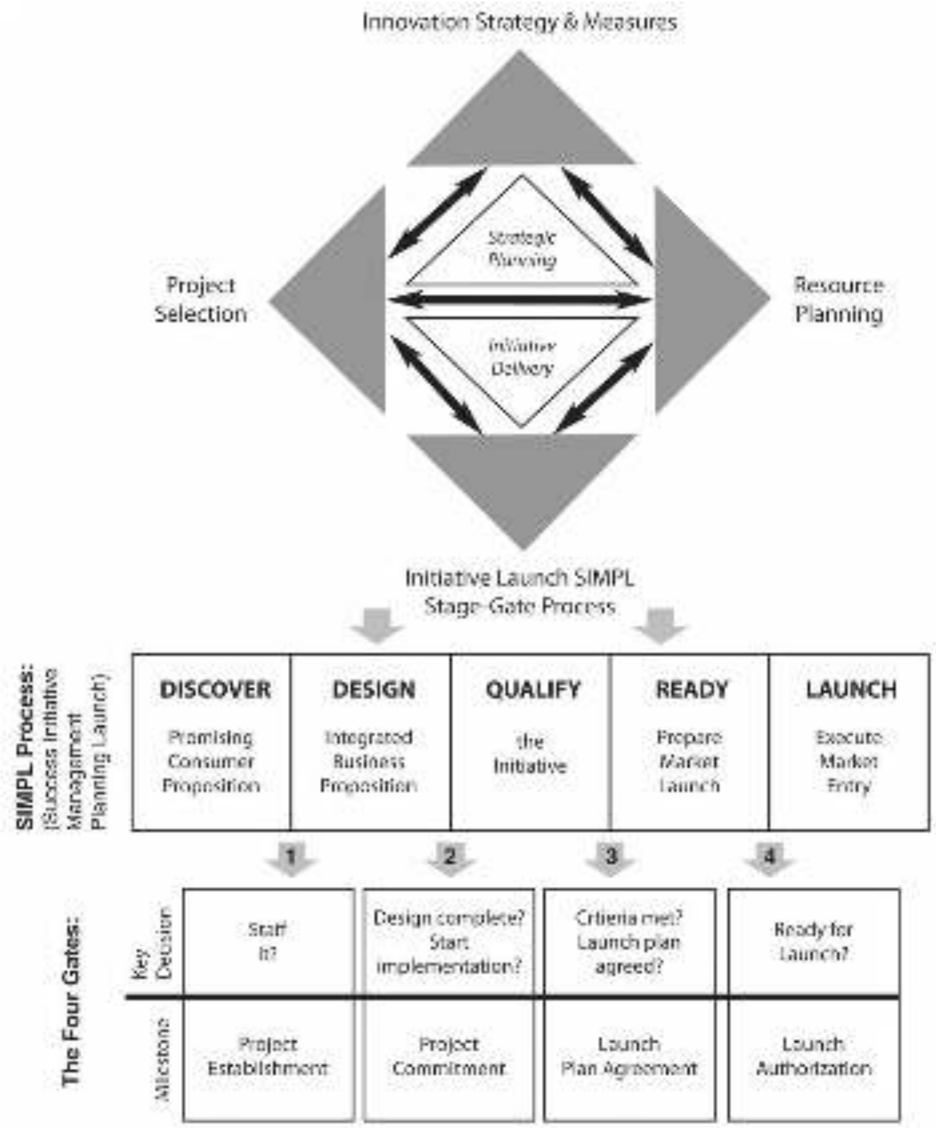


Figure 18 P&G SIMPL Process

Source: Adapted from Cooper and Mills, (2005): 10 & 12

P&G collaborate with partners across the supply network to win consumers at the point of purchase (Ragu, 2009). In order to achieve this, they implemented an online system called 'Web Order Management', this enabled retailers to not only connect with P&G anytime and anywhere, but also to access P&G's promotions, inventory, scheduling information and easily replenish stocks (Ragu, 2009). This illustrates the significant role of IT in corporate processes is widely established and is in fact, being readily applied to idea management. This informed the need for this research to explore how to improve the effectiveness of a digital tool which aims to help with search and select practices. This called for a framework that identifies the internal and external processes at play and resources available to practitioners during the search for solutions.

Benefits of Knowledge Outsourcing

Extensive external integration with customers, suppliers and sources of knowledge is crucial for successful innovation (Freeman, 1991; Szulanski, 1996). It is argued that cognitive distance plays an important role which highlights the external innovation search process and the ability of a firm to absorb external knowledge (Brunswicker and Hutschek, 2010). Greater degrees of cognitive distance tend to yield opportunities for highly novel solutions. It is argued to relate to three areas: product-market, technology and science in the external innovation search (March, 1991; Li *et al*., 2008).

The knowledge needed to discover, invent, and innovate often involves not only existing knowledge but also the generation and acquisition of new knowledge, shared knowledge, and learning (Howells, 2002). This links to cognitive distance as discussed above as interactions internally and externally can impact the disruptiveness of new ideas. To support and facilitate the ideation process, the knowledge about what influences the quality of the ideas created is important.

Irrespective of where an idea emerges, it is clear that what is crucial for creating innovation is knowledge (Howells, 2002). Hence, the sources of innovation can be found anywhere good opportunities exist for accessing information and for creating new knowledge. From a managerial standpoint, the fact that innovation ideas like other types of knowledge (Tsoukas, 1996) are distributed not only in the formal organisation but also throughout informal networks gives rise to a set of challenges. The early innovation phase within the search field process is inspired by a company's innovation strategy (Lichtenthaler, 2003). Whenever a customer is integrated into the company's search field or innovation process, they acquire company know-how while contributing their own knowledge or ideas (Lukas and Ferrell, 2000).

Partnerships can open the door to multiple knowledge sources and accessing and integrating information from these sources can greatly enhance the knowledge base of organisations, help to fuel sustainable innovation and achieve competitive differentiation (Baloh *et al*., 2008). They reduce the costs of internal knowledge creation, can choose to purchase the best-of-breed and not incur the cost or risk of in-house innovation and the organisation can act in an agile manner and acquire knowledge that arises out of emergent needs "…*as the competitive environment is highly dynamic, being able to satisfy emergent needs is critical*" (Baloh *et al*., 2008: 104).

A firm that works very closely with its customers to develop enriched supply relationships is likely to be highly capable of pursuing incremental innovation, such is the case at sustaining innovation companies 3M, Boeing, Black and Decker, Hewlett Packard and Hitachi who are developing long-term, high-trust supply relationships (Spekman *et al*., 1998; Cavusgil *et al*., 2003). Christensen (1997) stated that exploiting knowledge flows within existing and established value networks is often the worst thing a firm can do to avoid disruption to its markets as a consequence of innovation.

Organisations have realised that they must partner with external entities to source ideas, know-how and capabilities (Baloh *et al*., 2008). Competitive pressure has driven the mind-set shift towards the outsourcing of innovation (Baloh *et al*., 2008). Baloh *et al*., (2008) proposed three different forms of business partner collaboration for outsourcing: innovation through acquisition, strategic alliances and the OS innovation model. Their study found that interviewees repeatedly stated that the complementary knowledge base of the business partner is the key selection factor. They also found that companies successful at integrating external knowledge begin by considering the strategy for integration. They distinguished two types of integration strategies: 1) know-how projects: firm's intention to utilise specialised knowledge of a business partner and 2) capacity projects. These require different approaches due to the nature of their outcomes.

Trust and reliability is important when selecting innovation partners as well as complementary competences of both parties involved (Baloh *et al*., 2008). Cultural fit is another critical consideration as it increases when decision speed, tolerated risks, and work-related values are similar. The results of Calantone *et al*.,'s (2002) study suggest that innovation is a broad process of learning which enables the implementation of new ideas, products, or processes which also reflects an appreciation for and the desire to assimilate new ideas (Hurley and Hult, 1998). Organisational learning and communication of results can help prevent work starting from scratch within different departments.

In summary these benefits to knowledge outsourcing are recognised in the literature, however implementing and managing these relationships is difficult and requires effort from both parties to keep it alive. A strategy for integration must be in place in order to fully utilise potential partners and analyse whether they have a complementary knowledge base. On the other hand, spontaneous relationships and partnerships that occur in an *ad-hoc* fashion are also important to nurture within employee networks.

Sourcing Internally Versus Externally

An important source of innovation is companies from other industries, as most innovation is based upon a recombination of existing knowledge, concepts, and technology (Enkel *et al*., 2009). New ideas may come from a variety of sources: feedback from customers (Pascale, 1984; Urban and von Hippel, 1988), lead users, competitors (reverse engineering, benchmarking best practice), others outside industry universities, government research centres (Imai *et al*., 1988), and partnerships.

According to the project type organisations can decide whether to source ideas internally or externally. Internal sourcing may be effective with projects that involve tacit, systemic and complex knowledge (Kessler *et al*., 2000). Kessler *et al*., (2000) argued that knowledge of the idea generation phase should be internally sourced in order to maintain competitive advantage. This is due to idea generation knowledge being more abstract and tacit in nature (Kogut and Zander, 1992).

Kessler *et al*., (2000) conducted a study of 75 NPD projects in 10 U.S firms and found that more external sourcing during the early (idea generation) stage was related with lower competitive success. They argued that firms are more likely to build ‘isolating mechanisms’ (Rumelt, 1984) and develop significant ‘first mover advantages’ (Lieberman and Montgomery, 1988) when ideas and technologies are internally sourced. Interestingly, externally sourced ideas often move more quickly from concept to market (Huston and Sakkab, 2006).

Screening Ideas

Idea screening is a distinct subset of idea generation. The success rate of ideas is a debated issue with a vast range of numbers given for producing a commercially successful idea from 3,000 (Stevens and Burley, 1997) to 6.6 ideas (Barczak *et al*., 2009). Studies have shown that innovative organisations average 65 acceptable ideas per year compared with 35 ideas per year for non-innovative organisations (Sowrey, 1990). This range of numbers suggests that the idea screening process is influenced by many factors within a company and may be treated more subjectively compared to latter NPD processes.

Kelly and Storey (2000) stated the need to screen ideas because of the amount of resources required to bring a single idea to market readiness. A possible danger in idea screening organisations is that they will reject ideas based on social construction more than the quality of the ideas, therefore resource-based criteria for screening ideas is ultimately a trade-off with creativity.

Smith *et al*., (1999) described the front-end innovation process as composing of six stages: 1) identification of transitions in key markets and technologies, 2) knowledge of relevant external scientific breakthroughs, 3) competitor's patent activities and long-term business strategies, 4) new business intelligence for evolving market gaps, 5) technology / business core strengths and weaknesses, and 6) understanding of how cross-business opportunities, linked with customer needs which might offer different ways of approaching the market.

The selection of ideas suggested by others in organisations is influenced by several mechanisms. The following factors should be considered when employees submit ideas in a digital format: country bias, business unit bias - managers tend to favour ideas from employees working within their own business unit, site bias - ideas are chosen far more often when employees are working at their actual site, length of the proposal (the optimal word length was 250 words), tone of the proposal - proposals highlighting an idea's upside for the company had better chances of receiving further consideration, size of the organisation - the larger the unit, the more likely managers will pass along ideas, and degree of hierarchy - the more hierarchy in a unit, the less chance they will declare an idea (Reitzig, 2011: 50).

Reitzig (2011) stated that in order to maximise the number of potential "blockbusters" at the end of the innovation process, companies need to begin with as many employees as possible and encourage them to contribute their ideas individually before putting them in a group. He also found that a large multinational company spent between 5,500 and 11,000 hours (or 715 to 1,430 workdays) of total manager assessment time, without including time needed for implementation, to evaluate 20,000 ideas (Reitzig, 2011). This therefore represents an opportunity to reduce the time spent on idea evaluation to reduce costs.

It is difficult to justify investing significant sums of money on idea evaluation unless there is a reason to believe that there will be a payoff. This is because there are financial costs as well as time and other resource costs, along with a risk of breeding internal scepticism about whether innovation can be managed (Reitzig, 2011). There is a need for integrated research to investigate how organisations develop philosophies of knowledge, create knowledge and generate ideas thus enhancing creativity and innovation.

A major failing of organisations is not following through and ensuring that ideas are implemented. The bigger the idea the more likely it seems that this is to happen. It is important that those responsible for implementation have their roles monitored and measured and that software assesses this. This suggests auditing a small percentage of ideas to see that they realise the value expected of them is useful (Wood, 2003).

Another way of looking at how to screen ideas is by front-end economics i.e. calculating the process costs considering the expense of screening, cost of errors and costs of delays (see Figure 19). This figure shows that the process cost is dominated by the cost of delay. Additional filters should only be added when its benefits exceed its costs (i.e. number of days of delay, high idea rejection). The delay costs have been argued to cost a large amount more than decreasing investment in bad quality ideas (Reinertsen, 1999). They argued that the sequence of filters is important as the cheapest filter which rejects the most opportunities should be in place first, so that concurrent filters can lower total costs than sequential filtering (Reinertsen, 1999).

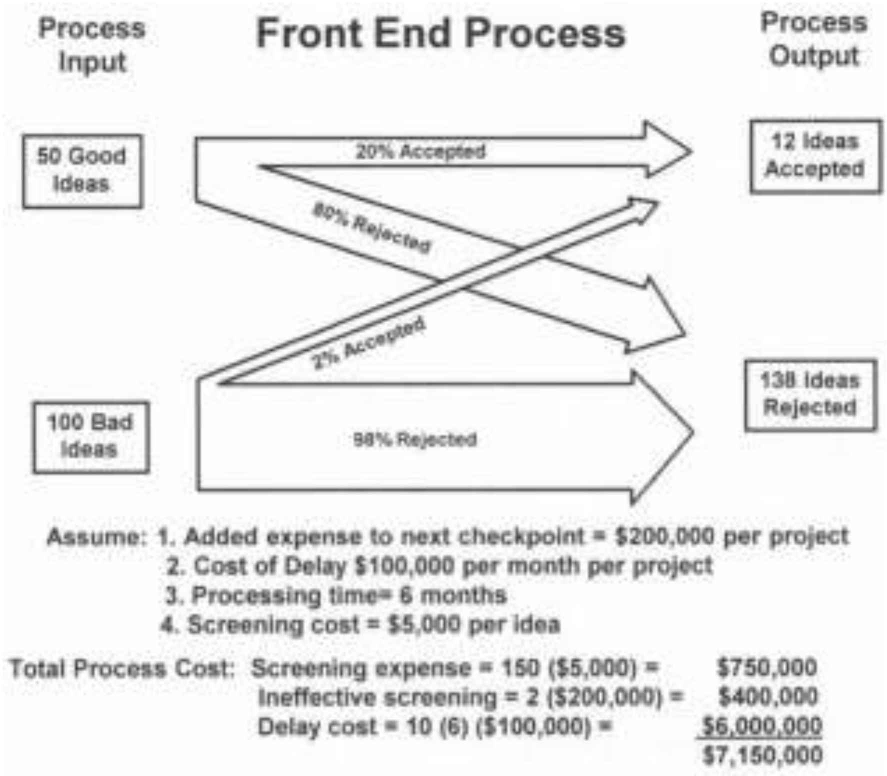


Figure 19 The Process Costs of Idea Screening

Source: Reinertsen, (1999): 27

An efficient management process has ideas which fall into four categories with each type of idea handled differently:

- Ideas of a purely local nature that the supervisor can implement within his / her authority,
- Ideas of a local nature but may be applicable to and should be disseminated to other work teams,
- Ideas of a local nature that need higher level/corporate approval before implementation,
- Ideas that have corporate-wide implications or represent breakthrough ideas that need higher level / corporate approval before implementation (Wood, 2003).

Song and Montoya-Weiss (1998) found that project planning can be counterproductive for highly innovative projects, whereas Tatikonda and

Montoya-Weiss (2001) stated that process formality has a positive impact on project operational outcomes.

Two issues are important for senior managers to understand about their idea filtration process (1) what happens when they delegate the selection process to their subordinates, and (2) how the organisational structure top management puts in place affects the decision-making behaviour of their staff (Reitzig, 2011). Reitzig stated that "*the real challenge in selecting good ideas is optimizing the trade-off between the direct selection costs on the one hand and the costs of both missing out on good ideas and implementing the wrong ideas on the other*" (Reitzig, 2011: 49).

To be a successful and innovative organisation Wood (2003) asserts that we must have the following processes in place: an effective idea-generation system, a way to handle ideas quickly, an effective idea-evaluation process, a way to ensure that ideas are implemented, and a method for recognising / rewarding those involved.

Boundary Spanning

De Brentani and Reid (2004) stated that informal networking and information sharing through boundary-spanning activities have been shown to be of importance during the FFE for discontinuous innovations. On average, more relationships are explored and used at the early stages of the NPD processes compared to the completion of the innovation (Knudsen, 2007). Dombrowski *et al*., (2007) stated that the greatest challenge to successful boundary spanning is the artefact of language, which can consist of words, actions and behaviours. Within organisations that are in the same industry, different specialists develop a language all their own.

Results from previous organisational studies positively relate high boundary spanning activity to a high project performance (Sonnenwald, 1996). Tushman (1977) argued that effective management of communication across boundaries is critical for successful innovation. He identified that the people responsible for such a role are called boundary spanners. At Leo Burnett, an American advertising company, there are lead teams for each project and collaboration across the vertical silos is encouraged within the team.

Boundary spanners operate at the boundary of an organisation performing organisational tasks and relating the organisation to outside elements. They are responsible for information exchange between the organisation and its task environment (Reid and De Brentani, 2004). As globalisation gains more and more momentum, boundary spanning will also become more prevalent in coming years (Dombrowski *et al*., 2007). However, these boundary-spanning individuals can be ineffective in their role due to inadequate networks or are not effective collectors and disseminators of information.

There is also a grassroots effort that occurs within each unit to help in knowledge sharing. Newcomers in IDEO are encouraged to seek help, share knowledge and give help and the culture of collaborative innovation is enhanced by IDEO's reward systems (Hargadon and Sutton, 1997). InnoCentive is another innovation example of an effective and sustainable boundary-spanning structure and P&G among other companies have paid membership fees and seek solutions with InnoCentive (Kramer, 2006).

A study involving 40 managers found that people were overwhelmingly the most important source of important information / knowledge for a project (Cross *et al*., 2001). They received information from other people far more frequently than with impersonal sources, such as personal computer archives, the internet, or the organisation's knowledge management database. Four features emerged from their study: 1) knowing what another person knows and when to turn to them, 2) the ability to gain timely access to that person, 3) the willingness of the person sought to engage in problem solving, and 4) a degree of safety in the relationship that promoted learning and creativity (Cross *et al*., 2001). In addition, they found that the typical domains which yield benefit are: senior management networks, communities of practice and collaborative initiatives such as new product development, R&D units or joint ventures and alliances (Cross *et al*., 2001).

Search Depth

Laursen and Salter (2006) focused on the depth and breadth of external search and found that external search depth was greatest early on within the product life cycle. In the latter stages, innovative firms scan across a wider number of search channels. Quantitative empirical research confirms that the breadth of external search or the diversity of external sources for innovation input has a positive impact on innovation performance (Laursen and Salter, 2006). Open search depth is defined as the extent to which managers draw ideas intensively from external sources. If the company wishes to intensively source ideas from a given knowledge channel, it must naturally maintain strong and frequent contacts with that knowledge source (Leana and Van Buren, 1999).

Firms that search external knowledge sources widely and deeply, tend to be more innovative (Whelan *et al*., 2010). However, a tipping point exists where if a firm's search becomes too wide or deep, this decreases their innovation performance curvilinear relationship between external search for knowledge and innovation performance. Holmes and Smart (2009) distinguished two approaches to open innovation: a more exploratory approach resulting in an emergent innovation process, and a focused and pre-determined search activity to exploit the non-profit partner's resources. Driven by the need to address societal and social issues they demonstrated the value of an open innovation approach.

Size is the most obvious and most often studied company characteristic in open innovation. Strategic orientations (e.g. market orientation or resource orientation) influence the strength and direction of an outward looking focus (Huizingh, 2011). Other aspects of innovation strategies may be relevant as well, such as incremental versus radical innovations, the stage in the innovation process, and the stage in the product life cycle. The more radical the innovation, the more effectively external search depth will influence innovative performance (Laursen and Salter, 2006). This is important as an issue as exploratory organisational learning may facilitate radical innovation performance (Kang *et al*., 2007).

For a fuzzy "search field", such as a customer need and its underlying market functions, knowledge may not be easily partitioned upfront (Lee and Veloso, 2008; von Hippel, 1990). The organisational orientation is critical for creating a climate that encourages innovation (Gatignon *et al*., 1997). Similarly, the interactions between functional departments (e.g. R&D and marketing) have been shown to impact innovation and new product success (Ayers *et al*., 1997). Amabile (1988) argued that innovation in an organisation is significantly influenced by the extent of creativity-relevant skills possessed by its employees. This human element is growing in importance as the popularity of digital idea management tools increases. This is also true for innovation efforts as tools and software serve as aids – it is people that carry out the innovation processes that are required.

2.3.2 Search and Select Barriers

Surveys by the leading business organisations and wide discussions with businesses of all types revealed that the main construct obstacles for searching externally for knowledge and ideas are: lack of awareness and experience, lack of belief in the value of, or confidence in, the outcome, not knowing where to turn for specialised help, limited ambition or appetite for risk, and too many other pressures on the business (Cox, 2005). This section will explore other barriers to idea management search and selection processes whilst identifying the importance of integration within innovation processes.

Idea Integration Barriers

There is an almost unlimited number of tactics and practices that an organisation can use to achieve integration (Ghoshal and Bartlett, 1996). It has been suggested that organisations lack the will to put ideas or tactics into action: "*The problem usually is not lack of tactics or ideas; it is lack of will to put the tactics into practice*" (Markides, 1998: 41).

A key problem is that firms integrating internal and external innovations can face higher coordination costs and risks than if all activities were internalised. Open source has yet to resolve the IP issues of accepting donations from a wide community of unknown contributors (West and Gallagher, 2006). Companies today invest simultaneously in open and closed innovation as too much openness can negatively impact a companies' long-term innovation success due to loss of control and core competencies (Enkel *et al*., 2009).

The majority of companies that strategically innovate tend to be entrepreneurial start-ups or new market entrants, and it is rare to find a strategic innovator that is also an established industry big player (Markides, 1998). This hints at the difficulties of risking a 'sure thing' for uncertainty. In too many companies, the generation of great ideas takes place, but somehow they disappear into a black corporate hole or, as some people phrase it, somewhere between ideation and commercialisation, these great ideas die in the 'valley of death' (Markham *et al*., 2010; Cooper, 2011).

The larger the company, the more likely it is that there are creative ideas to be found, but the less likely it is that such ideas will ever reach the right person (Belliveau, 2002). Established companies find it hard to innovate because of structural and cultural inertia, internal politics, complacency, fear of cannibalisation, fear of destroying existing competencies, status quo satisfaction, and a lack of incentive to abandon a certain present for an uncertain future (Markides, 1998). In support of this, smaller firms are better able to respond to changes and be innovative due to less bureaucracy, hierarchical thinking and the expense associated with information systems that large firms employ (Welsch *et al*., 2001).

Adams *et al*., (1998) investigated 40 NPD efforts in 15 large organisations and identified barriers to organisational learning of market data: avoiding ambiguity, compartmentalised thinking, and inertia. They argued that in acquiring market information, people typically focus on less ambiguous, more easily understood technologies and business facts. In addition, the 'imported talent' syndrome is a barrier to building a creative culture and is the notion that progress and innovation can only be achieved by importing external talent (Majaro, 1992). This notion can be humiliating for creative individuals within a firm as well as demolish confidence and motivation.

Given all these barriers to innovation, it is understandable why there are not more strategic innovations emerging from established organisations. However, Intel, Kresge, and Boddington were established and conceptualised their businesses differently to start 'playing the game' in a totally different way (Markides, 1998).

Barriers to Knowledge Flow

The term knowledge flow refers to the exchange of technological and market knowledge within and across organisational boundaries (Argote and Ingram, 2000). For global corporations, a major approach for competitive advantage lies in training highly specialised professionals, developing knowledge of new technologies and making risky research investments (Bertola and Teixeira, 2003). A key success factor is their capacity to protect and improve corporate knowledge as a foundation for future continuous innovations (Bertola and Teixeira, 2003).

A variety of internal and external barriers must be overcome to make such integration work well. Firstly, there may be resistance at a number of levels within the organisation to sharing sensitive information with suppliers. Second, in many organisations, a 'not invented here' culture poses a challenge to the acceptance of ideas coming from suppliers (Ragatz *et al*., 1997).

The structure of organisations can impede this knowledge flow. Formal organisational structures continue to impede, rather than to aid, knowledge transfer (Brown and Duguid, 2001). Systems of superiority management and a focus upon local rather than broad sources of knowledge, experience and skills affect knowledge flow. This demonstrates how the flow of knowledge within the corporation can be restricted through bureaucracy and the use of rigid frameworks for reporting and sharing knowledge assets.

Ad-hoc organisational overlays (Bryan and Joyce, 2005) are used to describe mechanisms that companies use to integrate subjects otherwise isolated from each other by vertical systems. Vertical ‘silos’ of employees are separated by functional boundaries, or in the case of multiunit firms, by business group, increasing duplication of resources, reducing efficiency and critically impeding the exchange of knowledge assets (Allen *et al*., 2007). Formal organisational structures have been argued to impede knowledge flow and therefore innovation. Brown and Duguid (2001) labelled a ‘complex ecology’ of the organisation, whereby firms outwardly retain their M-form structure, while developing processes within for knowledge sharing and innovation (Allen *et al*., 2007).

The geographical and organisational boundaries separating staff are often cited as factors affecting communication and collaboration within firms. Cross and Parker (2004) observed that national boundaries indeed formed an obstacle to the transfer of knowledge between them. There is a common agreement that implementing new product development processes, or changing work procedures in an organisation, is more difficult and takes time because of resistance to change, structural and cultural barriers (West, 2002). Eliminating resistance to change requires top management support, alignment of processes to achieve design business objectives, and the introduction of effective idea management procedures and resources to maintain and deliver commitment.

Search Area Familiarity

Prior studies have shown that entrepreneurs entering unfamiliar fields are on average, less successful (Cooper and Gimeno-Gascon, 1992). This raises questions about whether experience or inexperienced entrepreneurs might benefit from a greater emphasis upon gathering and utilising external information as they enter new fields (Cooper *et al*., 1995). Cooper *et al*.,’s (1995) study on 1,176 new ventures, found that confidence had an effect on information search, as founders who were more confident sought out less information. In addition, they found that those who had no entrepreneurial experience sought more information. However, those that ventured into very different fields sought out less information on average. Interestingly, experience entrepreneurs searched with about the same intensity regardless of whether they knew the field or not. This appears to support rigour and consistency as a success factor particularly in unfamiliar search areas.

Figure 20 Levels of Uncertainty

Source: Gillund *et al*., (2008): 187; adapted from Walker *et al*., (2003): 12

Unfamiliarity is said to be concurrent with uncertainty. According to Walker *et al*., (2003) the nature of uncertainty can either be epistemological (knowledge) or ontological (science) (see Figure 20). A gradual change has been described from 'knowing for certain' (determinism), to 'not even knowing what you do not know' (total ignorance). Theory states that epistemological uncertainty refers to a lack of knowledge or appropriate methodologies to appropriately investigate a scientific problem. With more research and improved models, epistemological uncertainty can in theory be reduced. Ontological uncertainty, on the other hand, describes uncertainty that is due to inherent variability and complexity of a given problem under investigation (Gillund *et al.,* 2008). This research argues that it is not possible to remove all uncertainty. However, becoming more aware of areas that are not currently being investigated due to a lack of knowledge or expertise, may hold-out the promise of solutions to problems.

Scanning and Scouting

Empirical results have supported the idea that selectivity in scanning contributes to firm performance (Boyd and Fulk, 1996; Daft *et al*., 1988). Searching is broad, open, and based on a willingness to revise or update existing knowledge (Choo, 2001). Further to this, it has been indicated that sectors of the external environment differ in their importance and uncertainty (Daft *et al*., 1988) where firms can benefit from focusing on the right sectors.

Environmental scanning is an important as scanning is the first link in the chain of perceptions and actions that permit organisations to adapt to their environment (Hambrick, 1981). Most environmental scanning studies have focused on either a) how the scanning activity is performed or, b) the relationship between environmental scanning and certain variables such as specialty level or personality dimensions. Scouting provides general information about markets, technology and competition (Ancona and Caldwell, 1989). Scouting activities appear to be more important during early front-end phases when specifications are still being defined (Ancona and Caldwell, 1989). The task environment (including customer, competitor, and technological sectors) changes more rapidly and is therefore perceived as more important than the general environment (social, economic, and regulatory sectors) (Bourgeois, 1980).

Schuh *et al*., (2014) compared these three activities in terms of characterisation, goal, search space and time horizon (see Figure 21). It is clear that each search type has different advantages over the other in terms of breadth of search and level of detail.

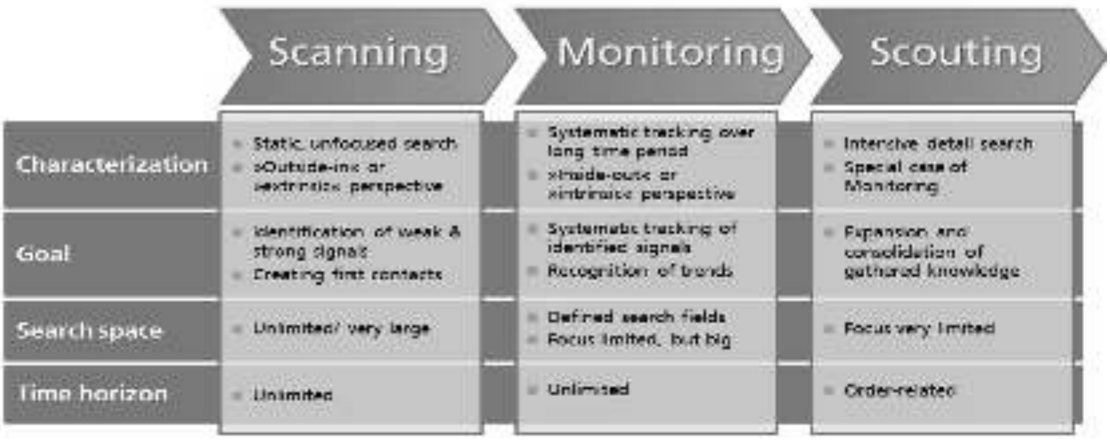


Figure 21 Scanning, Monitoring and Scouting Activity Comparison

Source: Schuh *et al*., (2014): 3194; adapted from Wellensiek *et al*., (2011); and Krystek and Müller-Stewens, (1993)

Unsolicited Idea Management

One of the biggest challenges of idea management is how to handle unsolicited ideas. Unsolicited ideas are submitted by the external world to an organisation where they believe the idea will be of interest. This is essentiality the opposite to a solicited or purposefully selected search driven by organisations. Solicited searches are proactive in nature whilst unsolicited searches are reactive. This is due to solicited searches being driven by a business need internally due to external market conditions and unsolicited searches are letting the market spontaneously offer solutions to problems or needs that may or may not have been released by an organisation. How to manage external unsolicited ideas is an important issue concerning idea management as organisations can be overwhelmed by the sheer amount of external ideas submitted.

Ideas from external sources will need to be managed differently from internal ideas due to challenges such as the ‘not invented here’ (NIH) syndrome (Majaro, 1992). Overcoming these barriers can depend on relationship structuring, i.e. trust development, shared training, risk / reward sharing agreements, agreement on performance measures, top management commitment and confidence in supplier’s capabilities (Ragatz *et al*., 1997).

Two challenges have been identified with managing the unsolicited idea process: (1) quality and quantity and (2) IP protection and ownership (Alexy *et al*., 2012). There is a tension between an organisations’ desire to welcome unsolicited ideas and its fears of dealing with too many and becoming overwhelmed with submissions. Many organisations raise the problems of having too many ideas, of poor quality and fit with the organisation and disputes over ownership of ideas (Alexy *et al*., 2012). There are clearly challenges concerning low quality, high quantity, and IP for unsolicited idea management. Figure 22 illustrates the flow of unsolicited ideas moving inwards towards a firm’s R&D function.

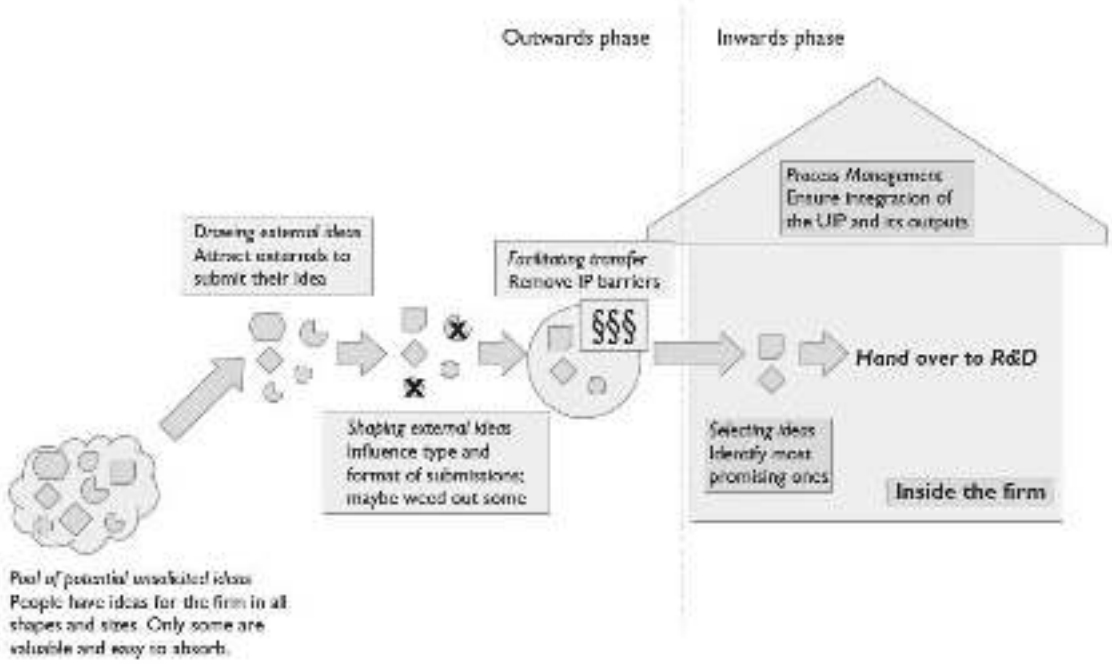


Figure 22 Unsolicited Idea Management Model

Source: Alexy *et al*., (2012): 125

Marzano argued that we should not be thinking about companies in terms of business units, but rather as a "*portfolio of competences*" (2005: 24) and then consider how they can be combined in ways which are not limited by traditional business unit boundaries. He also recommends that companies should question whether they need new competences in order to give the market what it wants. This supports the view that business units constrain innovative practices due to poor communication resulting from hierarchy which changes the information vital to the process (Hakatie and Ryynänen, 2007).

One way to address these challenges is by lowering visibility, allowing firms to target specific audiences (such as venture capitalists, academics, or technology networks) to attract fewer but better ideas. In addition, strict criteria are typically used to quickly filter out ideas unlikely to be of interest. These criteria are purposely put into place as a way to manage the flow of ideas and aid in dealing with complexity. However, more intangible factors also play a part in filtering out potentially good ideas. Another challenge is in shaping the flow of ideas and freeing up managerial attention to focus on the most valuable ideas.

Reasons for Idea Rejection

A relevant question for idea management is what happens to ideas that are rejected? Research has shown that the more radical an idea is, the more risky it is likely to be and the more likely it is managers will reject it (Ahuja and Lampert, 2001; Dewett, 2006; March, 1991). Vandermerwe (1987) remarked that at least six of the seven characteristics contain an organisational dimension, suggesting that ideas are killed for reasons other than the quality of the idea. The personal risk that managers take by sponsoring a new idea that may later fail plays a major role in their tendency to reject radical ideas (Ahuja and Lampert, 2001; March, 1991).

The creative process is uncertain because no one can predict whether the pursuit of a new idea will result in a positive outcome. Organisations reject ideas for a number of reasons, some being due to technical standards not matching, the potential market being too small, and / or the technology not being available (Alam, 2003). Alam’s (2003) research provided several insights into the reasons behind idea rejection. He found that ideas are rejected because technical standards do not match, the potential market is too small, or the technology is not available. Rejected ideas should not be discarded but kept in an “idea bank” as suggested by Cooper (1993), and kept aside for future consideration as market or technology changes can affect the feasibility and market potential.

In the daily reality and practice of the organisation, people of different backgrounds will identify the quality of an idea. Even if an idea can be potentially useful, it can still be rejected and perhaps put into an archive. This functions as a backup of rejected ideas with which new ideas can be compared and re-evaluated at a later time. This is because ideas can become useful due to changing technologies in production, a bigger research budget and / or other contextual factors such as developments in the market.

Mainemelis (2001) stated that voluntary pursuits engender high degrees of emotional attachment to a new idea and that this attachment increases as a function of time and effort invested in working on an idea. When managers reject ideas, employees experience frustration, sadness or anger (Amabile *et al*., 2005). Research on the effects of feedback on creativity has shown that a creative product is more likely to be generated when employees receive constructive feedback from a broad range of people during idea elaboration (Csikszentmihalyi, 1997).

The rejection of ideas can be influenced by cultural processes over and above selection criteria. Creative deviance presupposes that an employee has already generated a new idea and evaluated it as being worth pursuing but a manager has instructed them to not continue working on the idea (Mainemelis, 2010).

It has been found that there are two main routes for managing rejected ideas: codification and personalisation (Karlsson and Törlind, 2013). The codification approach is systematic where ideas are codified and stored for easy retrieval and reuse. It makes ideas visible and searchable within an organisation. The personalisation approach relies on individuals to take ownership of the ideas and carry them forward, either implicitly or explicitly.

The level of maturity of an idea appears to affect how it is documented. It has been suggested that if an idea is well tested and elaborated, it would usually have been reported, however if an idea is more immature and dismissed at an early stage then a lot less will have been documented (Karlsson and Törlind, 2013). Responsibility for rejected ideas and maturity of ideas both seem to affect the processing of rejected ideas.

2.3.3 Role of Idea Sourcing Tools

Digital Tools for Idea Sourcing

Firms are now being driven to implement changes that will help speed products through development and improve process efficiency and NPD effectiveness (Griffin, 1997). Ducati, Procter & Gamble, 3M, and many others have created online platforms that aim to integrate their customer's innovative new product ideas into NPD processes more actively, more directly, and more systematically

(Ogawa and Piller, 2006). This suggests a growing emphasis on the use of digital tools to improve integration in innovation processes.

Wood (2003) stated that idea management software should be able to a) handle duplicate ideas, b) link ideas to assessors / evaluators, c) allow everyone to search for existing ideas and d) build on those ideas from other people. This links directly to the argument for searching tools (such as Inno360) and how they can enhance idea management activities. Franke and Piller (2004) advocated that the advent of the Internet has facilitated new forms of producer-customer interaction in product development (Sharma and Sheth, 2004). They argued that online toolkits offer an interesting interaction platform for user innovation and design (Thomke and von Hippel, 2002).

Web 2.0 tools are defined as a new generation of web based collaborative tools that are changing the way people work and the way information is created and shared (Dearstyne, 2007). Web 2.0 tools have experience phenomenal growth in the last couple of years. In organisations, wikis can be used for collaboration between individuals or teams, located at the same location or at different locations. Prasarnphanich and Wagner (2009) argued that wikis offer more opportunities for collaboration than other web 2.0 tools. Semantic web technologies have also been implemented to improve IM in numerous papers (Westerski *et al*., 2010).

Standing and Kiniti (2011) explored how wikis can be used in different innovation stages. The unique characteristics of wiki technology include: collaborative authorship, instant publication, versioning, and simplicity of authorship. In organisations, tacit knowledge is difficult to capture and exploit because it resides inside people (Stenmark, 2000) and is deeply rooted in each individuals action experiences as well as the ideals, values and emotions they hold (Desouza, 2003). Web 2.0 technologies, including blogs, wikis and discussion forums, have been proposed as a way to overcome the problem of managing tacit knowledge in organisations. These processes are carried out through a discussion forum with questions and answers or through a blog typified by a process of storytelling.

A debate emerged in regards to systems versus process idea management. The term ‘idea management’ when used in relation to IT, is in reference to systems that emerged in the late 90s (Rozwell *et al*., 2002). These platforms aid idea management and allow organisations to track community generated ideas as they progress through an enterprise. The goals and scope of those tools has been continuously evolving ever since their origins (Westerski *et al*., 2011).

In a comparative study, more ideas were generated with software than without due to forced associations (Wagner and Hayashi, 1994). The knowledge system, as a tool for idea management, can only facilitate the capturing, selection and enhancing of ideas among members of the organisation. The important success factor for the overall success of an idea in the Eureka! system was adequate feedback from the managers to the ideator (Bakker *et al*., 2006). For a community of practice to function it needs to generate and appropriate a shared repertoire of ideas and creativity.

Idea management systems have taken advantage of the Web 2.0 techniques to extend the original submission boxes as idea capture methods. As a consequence, richer and better organised user input data brought new opportunities to develop towards better data presentation and selection (Westerski *et al*., 2011). However, one of the main barriers is that the human side of a system is ignored, and the added work of administration becomes burdensome (Prather and Turrell, 2002).

Digital tools can support constrained serendipitous interactions that lead to valuable combined innovations (Austin *et al*., 2012). Active search and idea capture programs and systems, such as Galileo at Nortel, encourage employees and other constituencies to make suggestions based on observations and experience (Montoya-Weiss and O’Driscoll, 2000). Benefits include capitalising on the efficiencies given by computer systems for idea management and knowledge sharing, which enables all employees in R&D and those connected to be challenged and involved in the innovation process (Prather and Turrell, 2002).

A common characteristic of new methods, such as idea markets, is their use of widely distributed knowledge through the interconnection of ideas from a vast number of participants (Toubia, 2006). Soukhoroukova *et al*., (2012) conducted an empirical study to explore the performance of idea markets over 36 days within a large technological company including over 500 participants. The results indicated that idea markets are a feasible method to support the fuzzy front-end of NPD. Idea markets enable the sourcing of multiple ideas from various idea contributors, enable interactive group decisions as filtering mechanisms, and combine the sourcing of ideas with their evaluation (Soukhoroukova *et al*., 2012). They offer a formal process to capture, select and distribute ideas in an organisation. This describes the purpose behind idea management systems.

Application of Idea Sourcing Tools

Historically, the precursors of idea management system-based approaches were simple suggestion boxes maintained as part of internal corporate systems or with the advent of internet i.e. company homepage. However, this approach did not introduce any software facilities that would actually aid the management of captured community ideas. These suggestion boxes were just an additional input mechanism. The abilities to store, display and organise the submitted ideas gave birth to idea management systems.

The capabilities approach suggests that if a firm looks inside itself, and at its market environment, sooner or later it will find a business opportunity (Teece *et al*., 1994). However, a firm needs to have tools to exploit and appropriate knowledge embedded in new organisational innovations (Welsch *et al*., 2001). Firms which are engaged globally generate more innovations that feed into higher productivity, largely because they learn more from more sources (Criscuolo *et al*., 2010). It is the use of a tool that determines whether value is created or not (Thomke, 2006).

Scanning boundaries as well as depth of analysis within these boundaries are important considerations for scanning teams. The generation of new ideas is normally not the challenge, but rather how the ideas are managed and implemented in an organisation (Koen *et al*., 2001). The organisation's responsiveness, i.e. willingness to act upon the information (Kohli and Jaworski, 1990) is a critical issue for success in environmental scanning initiatives.

There are drawbacks and benefits to using electronic or digital idea management systems. Due to their easy accessibility, the possible thresholds for new innovative ideas are lowered. The system enables ideators to develop ideas that otherwise would not come up but can also lead to indolence if the ideator thinks that the system will do the hard work. An electronic IM system produces an effect within a context in which creative ideas must be transformed into practicable ideas. It acts as an enabling tool during interactions with others in the company. The more people practitioners are familiar with and can discuss an idea within the company, the more likely it is that an idea will ultimately be funded (Bakker *et al*., 2006).

Although many formal tools for product development have been designed, the awareness and usage of them is generally surprisingly infrequent (Hanna *et al*., 1995; Nijssen and Lieshout, 1995). However, Nijssen and Lieshout (1995) have found that use of formal tools is correlated with higher profitability. The use of formal tools for customer involvement is mainly found in the large companies. The only formal tool that is used by the small companies is prototype testing (Ulrich and Eppinger, 1995).

The main reason referred to for not using additional tools for customer involvement is the cost factor. The number of customers is also cited as a problem (Lagrosen, 2005). Interestingly, some companies claim that they have too few customers for formal tools to be appropriate whereas other companies allege that they have too many customers for formal tools to be feasible. Earlier research showed that customer involvement increases the likelihood of new product success. However, another study showed that the use of formal methods for customer involvement is rather infrequent (Nijssen and Lieshout, 1995). It rather indicates that the managers' knowledge of the available methods is rather limited.

Especially relevant to this research is the finding that allowing users to use visualisation features enables ideators to generate further ideas. Theme and product visualisation modules in software hold hundreds of images to create a much “*richer stimulus base*” (Wagner and Hayashi, 1994: 151). A key finding of a study was that theme-based idea generation produced the best results overall for idea quantity and quality. They also argued that the benefits of using digital idea generation:

- allow use by individuals not explicitly trained,
- formalises the approach and leverages multi-media and artificial intelligence extensions,
- increases functionality compared to paper-and-pencil or verbal idea generation,
- allows individuals to generate more ideas without direct interviewer intervention.

2.3.4 Summary of Effective Practices in Search and Select Strategies

On analysis of the literature on factors affecting search and select strategies, there was an emphasis on the strategic decisions made in regards to how a search will actually be conducted. A strategic decision impacts which sources of innovation are the most effective at meeting a stated need. Within this section, the three trajectories of the review identified the following themes:

- strategic decisions on depth and breadth of search
- level of definition of the customer need
- importance of learning to build and retain internal knowledge
- growing popularity of digital idea management systems
- clarity of decision to search internally or externally
- promoting greater integration to improve effectiveness.

It emerged that search and select practices are a key part of dynamic capability within organisations, which requires decision-makers to implement change (Helfat *et al*., 2007). Boundary spanning and utilising informal networks also emerged as important influencing factors for enhancing innovation capability. The ability for an organisation to implement found external opportunities, termed absorptive capacity, is critical to success. Search and select processes were identified as critical to the operation of dynamic capabilities of organisations. Search and selection processes may also include designing new business models, selecting co-specialised assets, selecting investments and organisational, governance and incentive structures (Sharma and Shanks, 2011; Helfat *et al*., 2007).

One knowledge gap identified is a sense of how firms actually search for and detect new product ideas is missing (Conway and McGuiness, 1986). The opportunity for more efficient idea screening methods has the potential to save companies large costs associated with delays. This is especially related to unsolicited idea management. It was also clear that organisational structure and culture has important effects on how a company searches externally for innovation, as well the barriers involved with bureaucracy and hierarchy (Majaro, 1992).

Research shows that there are advantages to internal ideas and barriers to external ideas, such as the NIH syndrome. This raises the question as to whether organisations view all external ideas at a disadvantage from the start. If so, potentially good external ideas have an immediate disadvantage and are less likely to be implemented. In other words, internal and external ideas could have differing levels of credibility, impacted by organisational culture. This links to incentives and who finds the idea and the role of intrinsic motivations.

Other search and select barriers included external source preference (for customers) over others which may not always be the best source of ideas for a particular problem. The level of technical knowledge was identified as an influencing factor for customers generating new ideas and affected levels of novelty and feasibility. Another barrier for organisations is typically going for incremental innovation over radical due to fears over high risk. This is understandable however for businesses to grow, this fear needs to be overcome through using systematic processes to try and mitigate risks as much as possible.

Types of search strategy were identified as exploration and exploitation, which depends on the phase of innovation an organisation is in. External groups are sources of valuable information and innovation ideas, and so dynamic capabilities are essential to the success of an externally searching firm. Since search processes involve the identification of a need, and selection involves processes for actions and resources, more firms innovate in their processes rather than products. Neglecting the importance of defining a need is something which organisations need to mitigate and has emerged through various sections of this research. Another critical factor for external searches is absorptive capacity, since organisations need to make use and learn from external innovation. This learning combined with boundary spanning are all important to the success of search and select strategies.

2.4 Literature Review Conclusions

The main aim of the systematic literature review was to generate an in-depth understanding of the factors affecting the generation and management of ideas within front-end innovation literature. The purpose was to gain an in-depth understanding of the field of knowledge, identify key authors and papers, and discover current gaps in knowledge in idea management practices. Several key emerging themes and success factors were also identified and further discussed. In summation, this chapter detailed key issues that have emerged from the identified themes that have influenced the focus of this study. The importance of external sources of knowledge for companies' innovation efforts is well established in diverse strands of literature, particularly within Chesbrough (2006). The literature findings highlight the need for a framework which links internal and external influencing factors. This would be particularly relevant within complex and / or uncertain situations in front-end innovation.

It was found that there is a level of agreement on which key phases are involved within the FEI. Typically existing models include four to five phases, illustrated in the 15 model comparison. However, there is much less agreement on which particular activities and tools are used within those phases. There are numerous tools that can be applied to FE activities. Further still, there is even less of an accurate understanding of which particular tools are the most effective within each phase.

The research focuses on exploring the factors affecting idea management in maximising product innovation capabilities in front-end activities. Research areas include: idea management methods and tools, idea generation techniques, sources of ideas, idea evaluation and external knowledge integration. One of the biggest challenges identified was how to handle unsolicited ideas, due to high volume and low quality. This means that the initial criteria used to filter external ideas are critical in determining whether an idea receives attention or not internally.

In relation to idea generation and quality, a significant observation has been a shift towards collaborative idea generation particularly with the popularity of tools capable of analysing vast quantities of data. This suggests that the role of the user in how these tools are used can only increase in its importance and impact on innovative capability in organisations. The trend of the quality of ideas being more important over large quantities of ideas is supported by the literature. It was found that idea quality is multi-dimensional and takes into consideration multiple areas including idea novelty. This builds on the advantages associated with evaluating fewer, more high potential ideas as this saves a great deal of managerial time and effort. It is argued that evaluation should be incorporated within each innovation phase. Therefore, it is fundamental that idea quality criteria are clear and understood by those not only in decision-making positions, but by those conducting search and select practices.

What emerged from the review was the need for an establishing phase with includes preparation activities ahead of the Discovery phase. This was supported by the literature as a key success factor in early innovation stages, and in relation to search and select practices. This need for an establishing phase was apparent despite being identified under various terminologies. This highlights the issue of clarity of language in front-end activities. Findings suggest that time for preparation, planning, and sense-making activities drive how a search is conducted. This suggests a need for a framework which helps practitioners orientate and visualise internal and external factors which influence search processes. In addition, it was clear that external ideas have the problem of being off-strategy to organisations, and therefore unlikely to be used in idea pipelines.

The knowledge gained from the literature review sparked the question, 'with so many ideas available internally and externally for organisations, how do digital tools help with search and select processes in practice?' For example, issues such as acknowledging the human side of tools in practice were identified. This question facilitated the formation of the main survey in analysing the effectiveness of an innovation tool used in P&G.

The following chapter details the overall methodology employed for this research.

3 RESEARCH METHODOLOGY

3.1 Introduction

The aim of this chapter is to explain the underlying thinking behind the operalisation of this study. It will provide a structured overview of why and how the study has been implemented. It then explains the rationale behind how the research tools, fundamental to the study, were selected and developed. The processes used to analyse the quantitative and qualitative data is also detailed along with a discussion, which reflects on the results through synthesis. The chapter will conclude by highlighting the potential limitations with the selected methods employed.

The rest of the chapter is structured as follows:

- Study contextualisation
- Development of research tools
- Study implementation
- Data analysis
- Discussion and conclusions
- Limitations

3.2 Study Contextualisation

The following information outlines the philosophical precepts and rationale that have helped orientate the study.

The philosophical position taken for this research combines both that of interpretivism (Walsham, 1995) and social constructionism (Shotter, 1993) approaches due to the complex nature of the research area. This means that the researcher has influence to take part, gather rich data to induce ideas and incorporate stakeholder perspectives using a small number of case studies (Yin, 2003). Interpretive papers provide evidence of a nondeterministic perspective, with the intent of increasing understanding of a phenomena and the setting from the perspective of participants (Walsham, 1995). This appropriately describes the approach and rationale of this research as the focus was to increase the general understanding of the situation (Easterby-Smith *et al*., 2002). To add further context, following Nonaka's (1994) definition this research accepts that knowledge is justified true belief.

Industry and academia understand that a high degree of complexity exists in idea management practices in organisations (Brem and Voigt, 2007). Therefore, industry has to develop methods of dealing with the complexity whilst running everyday activities. Part of the challenge is the difference in speed between industry and academia. Activities within academia tend to take a longer amount of time but go deeply into issues, whereas industry has short time frames to deliver requirements. They also tend to have very different requirements. It is therefore often problematic to get the two domains to work together efficiently.

This study takes the academic approach to understand the context and effective practices in the literature whilst communicating with industry so that both parties achieve a shared understanding, essentially linking theory to practice and practice into theory. There are sub-issues surrounding idea management such as the type of market stimulus data used within idea generation. Strategic orientation has been found to have an impact on new product ideation volume and novelty (Spanjol *et al*., 2011).

The study was specifically orientated to undertake a multi-perspective (importance / relevance, frequency, complexity) examination of two clearly defined problems: (1) understanding what organisations actually do in practice compared to the literature and (2) determining the challenges organisations experience during their idea management practices. Exploring the differences between these two problems will also bring about new insights. It was also designed to combine qualitative and quantitative data. This approach utilises strong quantitative data from a main survey and insightful contextual data gathered from qualitative interviews. The study was planned and structured around a systematic and logical process, in order to bridge the gap between idea management and generation and the role of search and select. This was achieved by investigating a P&G landscaping tool detailed in the Methodology section.

Conducting a quantitative survey investigating the effectiveness of a search tool was therefore highly relevant to the core research topic. The insights from the main study informed the innovation framework for this research and revealed a number of recommendations of the implementation of similar tools. The key question is how to make an existing tool more effective by understanding its links to current practices and whether it can be adapted to better suit the needs of the company.

The study was guided by the need to understand how idea management is currently conducted within industry and how aligned or misaligned that is with effective practices described within the literature. This is because idea management is not carried out well or with discipline in many companies. Preliminary reading reinforced the challenges with idea management, particularly how external ideas are integrated internally.

3.3 Development of Research Tools

The main steps of this research will now be outlined including how the key issues and findings link throughout the study. This visualisation process helped to clarify the overall flow of the study and ensured that key findings from the survey are linked back to literature and inform the final discussion and conclusion.

The PhD framework adopts the 4D model (see Figure 23) which includes four phases: Discover, Define, Develop and Deliver (Design Council, 2005). This helped to structure the found front-end innovation activities within the literature into a consistent format for comparison. This research found a need for an establishing phase and has been added prior to the 4D model as shown. This helped position where the important issues emerged from this research.

The 4D model has been increasingly adopted in other recent studies (Yuan and Dong, 2014; Lin, 2014, Bolton, 2014), including within service design (see Ma *et al*., 2014; Lin *et al*., 2012). The 4D model phases were used to structure the 'input, action, output' frameworks developed within this research (15 FE model comparison analysis) which detail the activities found within the front-end innovation literature.

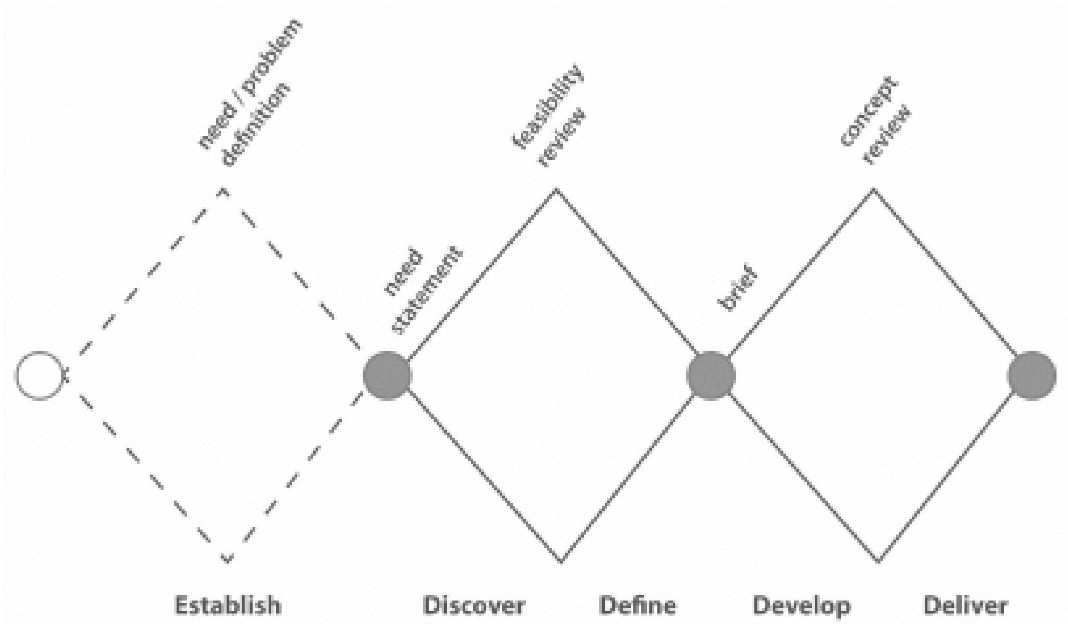


Figure 23 Establishing Phase and Design Council 4D Model

Source: Adapted from Design Council (2005)

Journals and Literature Type

The type of literature reviewed was distinguished following a characterisation set out by Wallace and Wray (2006). They argued that identifying the type of literature helps the reader to decide how convincing and generalisable an author's claims are. The *Journal of Product Innovation Management (JPIM)*, *R and D Management (R&D Mgmt)*, and *Technovation* are the world elite three and four star journals under innovation, as graded by the Association of Business Schools (ABS) journal quality guide (Harvey *et al*., 2010).

The remaining journals were selected according to a PDMA study on influential product design journals spanning three eras (Biemans *et al*., 2007) along with Luch and Swan's (2011) study. *Harvard Business Review* is not a peer-reviewed journal and was removed in accordance with the exclusion criteria (see Table 9). *Organization Studies* was selected as a replacement due its relevant subject area, high grade and recommendations academics in the field.

Table 9 Article Inclusion and Exclusion Criteria

Source: Author (2016)

Relevance Criterion	Inclusion	Exclusion
Study Type	Empirical, conceptual, theoretical, and case studies in academic journals. Organisation-based	Company reports, conference papers, newspapers, magazines, trade journals. SME-based
Document	Full text access from specified databases	Title and/or abstract available only from specified databases
Language	English	Non-English publications
Sector	No restrictions, but preference for FMCG relevant articles	
Time Period	1980 - 2015	Studies published before 1980
Relevance	Does the article suggest maximising innovation / idea management capability principles? Does the publication refer to an organisational activity producing enhanced innovation / idea management capability? Does the publication refer to best practice innovation / idea management strategies?	Is the article non-peer reviewed? Does the article highlight strategy and innovation without reference to managerial implications? Does the article refer to strategies not embedded within FEI literature?

Of the 134 papers analysed from the three top ranked journals: 39% were theoretical, 33% research, 27% practice and 1% policy (see Table 10). The literature type is fairly evenly split between theoretical, research and practice, however there is a low percentage of policy literature in comparison.

This result is not surprising as the literature reviewed was written for an academic audience as opposed to policy-makers. A total of 80% papers provided empirical evidence to support their arguments. This illustrates the high level of importance placed on empirical evidence within these top academic journals and reinforces the statement that high quality research is being used to inform this research.

Table 10 Journal Literature Type Breakdown

Source: Author (2016)

JPIM, R&D MGMT & Technovation Papers Combined Literature Type		
Category	**No. Relevant Papers**	**%**
Theoretical	52	38.8% / 39%
Research	44	32.8% / 33%
Practice	37	27.6% / 27%
Policy	1	0.7% / 1%
Total:	134	
Empirical	107	80%
Non-Empirical	27	20%
Total:	134	

Dominant Paper Topics

Figure 24 illustrates the broad topics of the papers reviewed within the top three journals. It reveals three dominant topics, with NPD being the most popular topic with 22 papers, followed jointly by the FFE with 18 and OI as the second most popular topics with 18 papers out of 134.

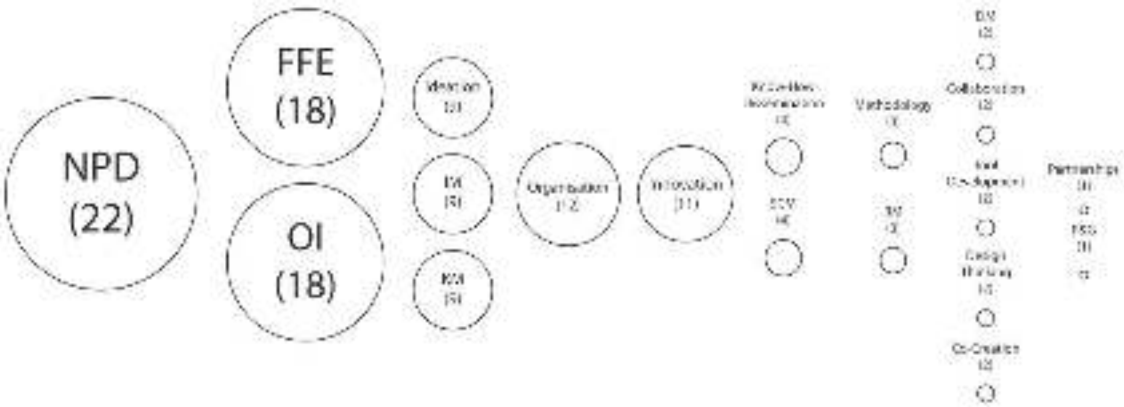


Figure 24 Proportional Illustration of Topics Addressed in Literature

Source: Author (2012)

It should be noted that the number of papers addressing these topics is not necessarily an indicator of their importance. It does indicate that they are more established within the literature reviewed. Research topics receiving less attention but which may be highly relevant were also reviewed. In order to achieve this, the themes and sub-themes were identified to (1) understand how established the themes are and (2) identify their relevance to this research.

Key Research Themes

The literature review areas were initially informed by the research aim, questions and objectives and have been iteratively refined to reflect emerging topics. This refinement was beneficial as it clearly determined the research scope and is expected to continue throughout the research. In project management, scope creep refers to uncontrolled changes in a project's initial boundaries (Kazemipoor and Shirazi, 2012). In order to minimise the risk of substantial scope creep, several steps have been taken including: defining a clear research aim and objectives, breaking the research down into major and minor milestones, incorporating an appropriate amount of flexibility into the research questions, setting measureable completion criteria, and expecting that some scope creep will occur.

An analysis was conducted of the areas addressed in the collected papers to extract key research themes. This illustrates how representative the themes are within this research. The results of the thematic analysis are illustrated in a timeline format in Figure 25. This displays the five research themes with the numbers above the dotted lines representing the number of papers published in each year addressing that theme. The shaded circles represent the most published years for each theme.

The timeline reveals the level of establishment of key themes and the year with the most published papers for each theme. This illustration was created so that the range of years and the most frequently published years for each theme could be easily identified and communicated. A breakdown of the sub-themes grouped making up the overarching themes is provided in Table 11. The sub-themes with an asterisk (*) were mentioned at least once across all three journals. This suggests that these sub-themes are acknowledged as important across a broader range of disciplines. These marked sub-themes may be more well-established due to their clear definitions within the literature.

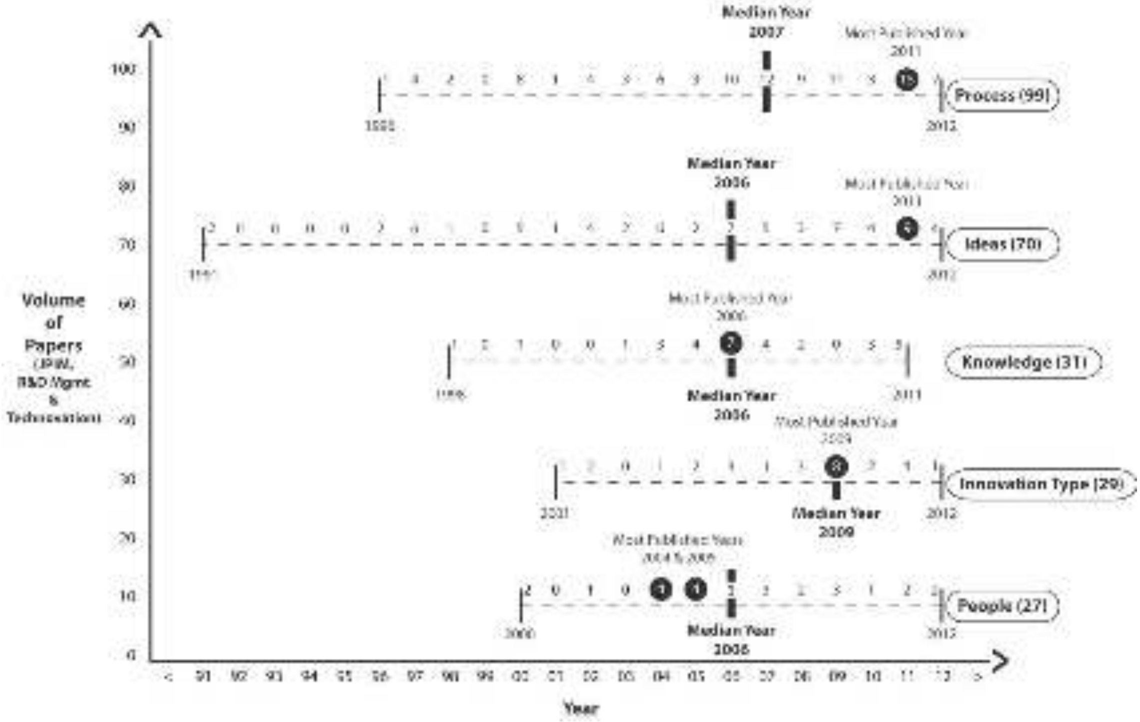


Figure 25 Key Theme Publication Timeline

Source: Author (2012)

Within the scope of the papers reviewed, the theme of *ideas* is the most well-established theme covering the widest range of years. In comparison, *innovation type* was the least established theme. The median years for each theme are similar with 2006 being the median year for three out of the five themes. These results support the statement that this research addresses areas receiving greater attention in recent years.

Table 11 Papers Addressing Overarching Themes and Sub-Themes

Source: Author (2012)

Overarching Themes	Sub-Themes				
Process (99)	NPD (31)	Formal vs Informal Process* (20)	FFE (22)	Network Effects (13)	Creativity (11)
Ideas (70)	External Sources of Ideas* (24)	Internal Sources of Ideas* (17)	Idea Generation (15)	Evaluating Ideas (14)	
Knowledge (31)	Tacit Knowledge (18)	Knowledge Dissemination* (13)			
Innovation Type (29)	Radical Innovation* (15)	Incremental Innovation* (14)			
People (27)	Communication* (14)	Intrinsic vs Extrinsic Motivations* (13)	(x) number of papers addressing topic in 3 journals * topic addressed across all 3 journals		

Process was formed from five sub-themes and had the highest number of papers addressing it with 99, *ideas* was composed of four sub-themes with 70 papers and the remaining three themes had two sub-themes of 30 papers each.

Innovation type impacts IM due to the different idea sourcing methods. For example, supplier involvement in the search for market information gathering activities is positively related to incremental innovation success (Song and Thieme, 2009). The theme of *people* is vital as all themes involve personal interaction and formal and informal social processes, which have a substantial impact on how ideas are managed and communicated within an organisation. All of the identified themes relate to the role of idea management and can be grouped under organisational culture.

Innovation Framework Development

In order to develop frameworks summarising common literature review innovation activities, 15 front-end models were selected and repositioned into the five-stage ‘input, action, and output’ format (see Appendix A.3). A full breakdown of the front-end models and their activities included (marked with a tick) and non-included (marked with a cross) is given in Figure 26 .

These 15 models in particular were selected because: (1) of their establishment in front-end literature (see Figure 27), (2) they included front-end phases relevant to this research, and (3) the author(s) made a visual depiction of the process (see Appendix A.1). Please note that the citation figures were correct at the time of analysis and are likely to change over time. These requirements were important to enable a fair comparison of the models to discover commonalities.

Front-End Model	Author(s)	Source	Management Support	Strategic Direction	Idea Generation	Idea Analysis	Market & Technology Analysis	Environmental Scanning	Idea Selection / Screening	Opportunity Identification	Opportunity Analysis	Concept Development	Product Definition	Feasibility & Project Planning	Technology Development	Influencing Factors
			Front-End Activities													
New Concept Development Model (NCD)	Koen et al., (2001)	Research Technology Management	✓	✗	✓	✗	✗	✗	✓	✓	✓	✓	✗	✗	✓	✓
Front End of NPD Process Model	Khurana and Rosenthal (1998)	Journal of Product Innovation Management	✗	✗	✓	✗	✓	✗	✗	✓	✗	✓	✗	✓	✗	✗
Front End Model	Boeddrich (2004) cited by Brem and Voigt (2009)	Creativity and Innovation Management	✓	✗	✓	✓	✓	✗	✓	✗	✗	✓	✗	✗	✗	✗
The Galileo Process	Montoya-Weiss and O'Driscoll (2000)	Journal of Product Innovation Management	✗	✗	✗	✓	✗	✗	✓	✗	✗	✓	✗	✗	✗	✗
Front End Stage of Process Development	Kurkkio et al., (2011)	Technovation	✗	✗	✓	✓	✗	✗	✓	✗	✗	✗	✗	✓	✗	✗
Idea Generation Methodology	Flynn et al., (2003)	International Journal of Innovation Management	✓	✓	✓	✗	✗	✓	✗	✓	✓	✗	✗	✗	✗	✓
Fuzzy Front-End Information Flow and Decision-Making Process: Discontinuous Innovations	Reid and de Brentani (2004)	Journal of Product Innovation Management	✗	✗	✗	✗	✗	✓	✗	✓	✗	✗	✗	✗	✗	✓
A Model of Predevelopment Activities	Murphy and Kumar (1997)	R&D Management	✓	✓	✓	✗	✗	✓	✗	✓	✗	✗	✓	✓	✗	✗
FFE Framework	Hüsig and Kohn (2003)	10th International Product Development Management Conference	✓	✓	✗	✗	✗	✓	✗	✓	✗	✓	✗	✗	✗	✓
Integrated Front End Process Model	Sandmeier et al., (2004) cited by Brem and Voigt (2009)	R&D Management Conference	✗	✗	✗	✗	✓	✗	✓	✓	✗	✓	✗	✓	✗	✗

FE Models: Political Process / Transfer of Ideas Focus			Idea Generation	Idea Selling	Idea Acceptance	Idea Funding	Idea Implementation
The Crea-Political Process Model	Bakker et al., (2006)	Creativity and Innovation Management	✓	✓	✗	✓	✗
Standardised Stages of the Corporate Innovation Process	Thom (1980) cited by Brem and Voigt (2009)	Technovation (Brem and Voigt)	✓	✓	✓	✗	✓
Overview of Corporate Innovation Management Process	Brem and Voigt (2009)	Technovation	✓	✗	✓	✗	✓
The Innovation Process	Hornitzky (2006)	Thesis (not peer-reviewed)	✓	✗	✗	✗	✓

Figure 26 FE Model Activity Comparison

Source: Author (2016)

It has been argued that comparing FE processes of one company to another is nearly impossible due to no common language or definitions (Koen *et al*., 2001). This research argues that although there is inconsistency in language, there are common activities and methods used in front-end phases which can be identified.

A series of frameworks have been developed from identifying common effective practices from the literature. Firstly, a main framework was developed using a simple input, actions, and outputs format. The 15 process models were then split into their phases, as described by the authors, and subsequently reordered into one (or none) of the five front-end stages. The frameworks were reproduced using the PhD framework as a guide, allowing for an easier comparison across models. All of the activities specified by each model were placed into the framework. The developed frameworks facilitated the understanding of impacting factors and aided in the generation of new knowledge to the field.

Figure 27 Most Established FE Models by Citation

Source: Author (2016)

It was found from the comparison that only four out of the 15 models included an establishing phase, but interestingly, the most highly cited model did include one (see Khurana and Rosenthal, 1998). This raises the question as to why this is the case, whether this effective practice stage is known but hard to implement or there is a prevailing belief that this very early stage cannot be regulated with tools. All of the models, except one, included a discovery phase as opportunity identification is well established in most literature. There is little agreement on specific tools to use throughout the process and they are less specified particularly in the early phases. All of the models finish the idea generation activity after stage four and the use of a multidisciplinary team for idea evaluation was a frequent action.

Extracting Theories from the Literature Review

From preliminary reading it was apparent that many empirical studies (including qualitative case studies) as defined by Shelanski and Klein (1995), were generic in nature regarding front-end activities. The aim of the multi-theme literature review employed in this research was to not only focus on gaps in knowledge, but to identify factors affecting idea generation and quality, idea management, and search and select strategies.

Search and select strategies emerged from a sub-set theme to a critical theme underpinning this study as well as industrial emphasis. This uncovered relevant issues, trends and common practices within each area. By adopting a systematic literature review it was possible to identify a series of principle issues that helped focus this study.

The literature review therefore targeted the following principle areas:

1) **Idea Generation Issues:**
    - Front-end phases and activities
    - Importance of ideas
    - Definition of ideas and concepts
    - Idea generation methods

2) **Idea Quality Issues:**
   - Factors affecting idea quality
   - Idea evaluation
   - Idea quality criteria
3) **Idea Management Issues:**
   - Idea management practices
   - Idea management trends
   - Idea management success factors
4) **Search and Select Issues:**
   - Search and select strategies
   - Tool integration barriers
   - Addressing tool integration barriers

By critically analysing emergent themes from the review, it was possible to identify this series of principle issues (Literature Review). It was clear that issues spanned both internal and external domains, although this research focuses more on external factors due to the nature of idea management. One of the emerging trends was the need for an establishing phase in front-end activities. In particular, the search and select concept proved to be fundamental in synthesising collected insights and driving the development of the innovation framework. This enabled search and select practices to be incorporated into the design of the questions for the validation interviews. It was also invaluable in focusing attention onto the stated research questions (see page 17).

The establishing phase is critical in defining the need or problem in front-end innovation. This links to the success of search and select strategies since searching often starts with the need or problem statement.

The benefits of undertaking this multi-theme approach enabled the survey tool to be structured around three key factors (1) phases within front-end innovation activities (Design Council, 2014) (2) main research question areas and, (3) specific questions derived from the literature review process relating to the research questions. Figure 28 visualises the relationship between the research questions and front-end phases. From the literature review process, the importance of search and select strategies emerged both to idea management practices and P&G activities.

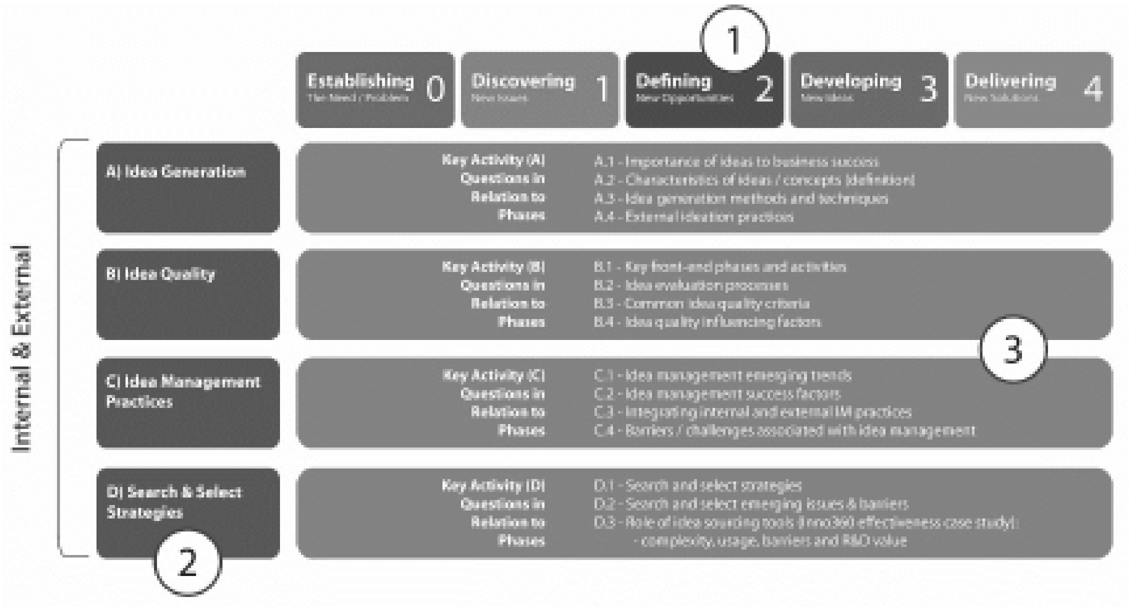
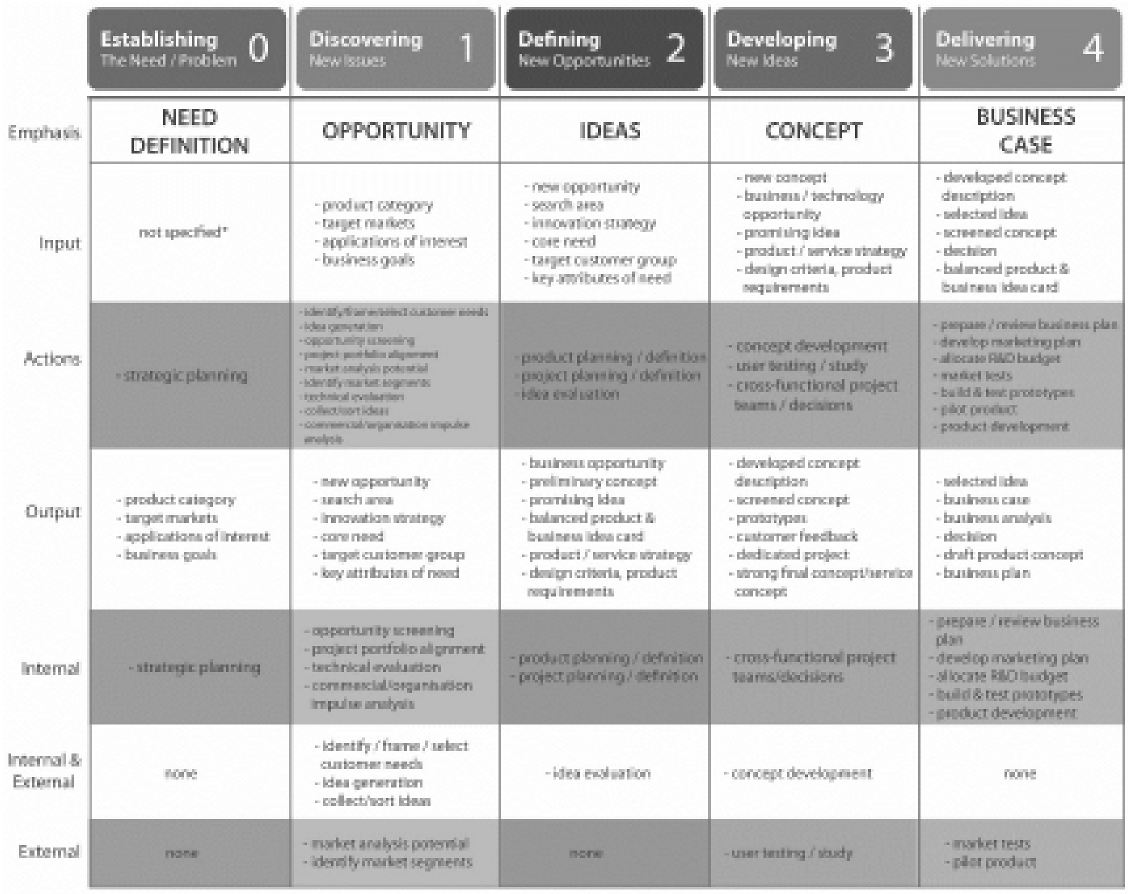


Figure 28 PhD Framework Key Factors

Source: Author (2016)

Front-End Emphasis and Common Activities

Each section of the framework corresponds to a particular front-end stage of 0) establishing, 1) discovering, 2) defining, 3) developing or 4) delivering (see Appendix A.3). Iterative processes are common in front-end models, but little is written regarding effective practice in the transition between stages. An additional framework was made as Figure 29 which details the inputs, outputs and common activities. It also identifies whether the activities are internal, external or both.



	Establishing 0 The Need / Problem	Discovering 1 New Issues	Defining 2 New Opportunities	Developing 3 New Ideas	Delivering 4 New Solutions
Emphasis	NEED DEFINITION	OPPORTUNITY	IDEAS	CONCEPT	BUSINESS CASE
Input	not specified*	- product category - target markets - applications of interest - business goals	- new opportunity - search area - innovation strategy - core need - target customer group - key attributes of need	- new concept - business / technology opportunity - promising idea - product / service strategy - design criteria, product requirements	- developed concept description - selected idea - screened concept - decision - balanced product & business idea card
Actions	- strategic planning	- identify/frame/select customer needs - idea generation - opportunity screening - project portfolio alignment - market analysis potential - identify market segments - technical evaluation - collect/sort ideas - commercial/organisation impulse analysis	- product planning / definition - project planning / definition - idea evaluation	- concept development - user testing / study - cross-functional project teams / decisions	- prepare / review business plan - develop marketing plan - allocate R&D budget - market tests - build & test prototypes - pilot product - product development
Output	- product category - target markets - applications of interest - business goals	- new opportunity - search area - innovation strategy - core need - target customer group - key attributes of need	- business opportunity - preliminary concept - promising idea - balanced product & business idea card - product / service strategy - design criteria, product requirements	- developed concept description - screened concept - prototypes - customer feedback - dedicated project - strong final concept/service concept	- selected idea - business case - business analysis - decision - draft product concept - business plan
Internal	- strategic planning	- opportunity screening - project portfolio alignment - technical evaluation - commercial/organisation impulse analysis	- product planning / definition - project planning / definition	- cross-functional project teams/decisions	- prepare / review business plan - develop marketing plan - allocate R&D budget - build & test prototypes - product development
Internal & External	none	- identify / frame / select customer needs - idea generation - collect/sort ideas	- idea evaluation	- concept development	none
External	none	- market analysis potential - identify market segments	none	- user testing / study	- market tests - pilot product

Figure 29 Common Inputs, Outputs and Activities for FE Stages

Source: Author (2016)

From this framework, it was clear that there is a lack of common tools, particularly externally related tools for each of the five stages. Only the activities and tools that were mentioned at least twice in the 15 FE models were included. The common activities (mentioned three or more times in separate sources) of each phase are detailed in Table 12.

Table 12 Common Activities in 15 FE Models

Stage	Actions: Activity	Frequency in 15 FE Models
0 Establishing	None duplicated three or more times	N/A
1 Discovering	Identify/frame/select customer needs	5
	Idea generation	4
	Opportunity screening	4

	Project portfolio alignment	4
2 Defining	Product planning/definition	5
	Project planning/definition	5
3 Developing	Concept development	4
4 Delivering	None replicated three or more times	N/A

Table 12 illustrates that there are no dominant activities are used specifically within a particular phase. It should be noted that there were numerous other tools and activities, however, the majority were included only once or twice in the scope of the 15 models analysed. It is likely that many tools perform the same function but are given different names, either due to differing model context or varying degrees of specificity. Actions were grouped according to similar terminology, however, a distinct effort was made to not overly generalise and group activities together that may otherwise not embody the same characteristics.

Market analysis appears to be a very important throughout the front-end stages and raises the issue of how and what types of market stimulus data are used in industry. There was also a clear mixture of formal and informal activities throughout, with more informal activities during the early stages. Timescales were rarely provided for each stage or the front-end in general. It is not unusual for organisations to take months or years before they start work on a compelling product opportunity (Smith and Reinertsen, 1998).

The comparative analysis between front-end models revealed that each of the five front-end stages could be labeled with their relative emphasis according to actions and outputs. The establishing phase has an emphasis on strategy and positioning, discovering finds new opportunities, defining emphasises the idea, developing advances an idea into a concept, and the delivering stage builds a business case. This reduction in uncertainty as the front-end progresses is supported in the literature as critical to success (Frishammar *et al.*, 2011; Verworn, 2009).

Whilst the Design Council stated that the project brief is a key outcome of the discovery stage and a clear problem definition is the outcome from the define stage (Design Council, 2014), there is a distinct lack of specified inputs and outputs for each stage in current literature. Accordingly, only two input and output deliverables were included in more than one of the 15 models. These were ‘new opportunity’ (stated three times as an output from the discovering stage) and ‘new concept’ (stated two times as a defining stage output). All of the remaining inputs and outputs were mentioned only once. Similarly, these deliverables were not generalised in order to maintain integrity of used terminology and intended meaning.

3.4 Study Implementation

In order to investigate the exploratory nature of the research questions, well-established methods were considered which include case studies, histories and experiments (Yin, 2003). Because this study attempts to understand what Yin (2003) described as complex social phenomena within a real-life context, the case study method was found to be the most appropriate which also allows for the understanding of the complete idea management process within an organisation.

This research was delivered in four key phases based around the following key activities:

Phase 1 (12 months) Literature Review and Evaluation of Existing Practices:

- Identification of existing FE models and processes
- Examination of existing idea management tools, methods and techniques
- Exploration of existing company FE innovation practices

Phase 2 (12 months) Main Survey and Analysis:

- Plan and implement pilot study
- Planning and revision of main survey with industry
- Implementation of online survey within P&G
- Conduct interviews to validate survey findings

Phase 3 (12 months) Development of Idea-Driven Innovation Framework:

- Identification of issues within emerging themes
- Development of innovation framework – search and select practices

Phase 4 (6 months+) Writing Up:

- Synthesis of key issues and research contribution
- Writing up thesis

The empirical body of this study was completed using three methods of data collection: i) scoping interviews, ii) main survey, and iii) validation interviews. A diagram summarising the data sets and their characteristics is given below in Figure 30.

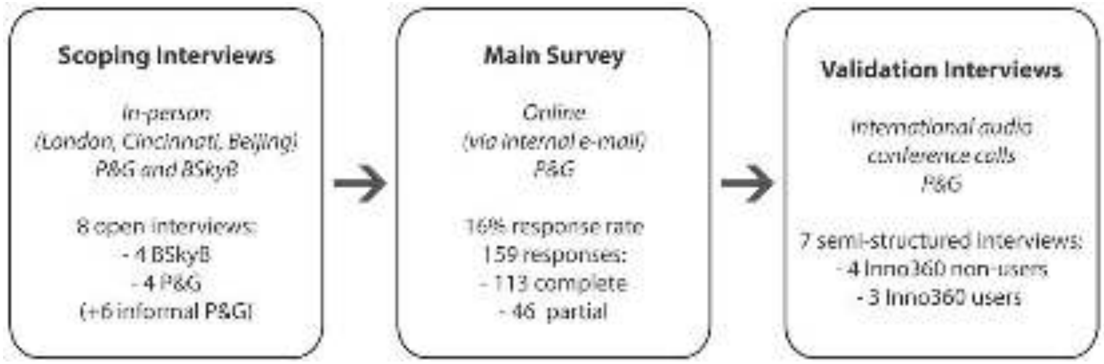


Figure 30 Three Data Set Summaries

Source: Author (2016)

The survey was kept as concise as possible in an attempt to increase the response rate, while also ensuring that the survey purpose was not missed (Dillman, 1978). Consequently, the constructs and linked scales were the result of an in-depth analysis, assessment and triangulation of insights from the literature review and practitioner interviews (Malhotra and Grover, 1998).

The main aim of this research is to examine idea management within front-end activities and contextualise by exploring the effectiveness of an internal and external searching tool used in industry. The findings from a survey analysing the effectiveness of a current OI tool will help identify potential improvement areas and therefore recommendations for industry. It also plays a vital role in answering research questions such as: ‘what tools can be used to maximise external innovation capabilities’ and ‘how can this innovation know-how be disseminated?’

A systematic process was used to gather, collate and organise the data collected. Figure 31 illustrates the systematic process followed in order to identify and collect relevant journal papers for review. The literature search was kept broad in order to let gaps in the literature help refine the research questions. Once the data collection strategy was established, the focus was on collating relevant journal papers for subsequent filtering and reading. The main electronic databases for sourcing the literature were the following: Scopus, Web of Knowledge, ABI Inform Complete and EBSCO.

In addition, the research strategy was informed by the ‘5WH’ method which asks six simple but key questions of: “who”, “what”, “when”, “where”, “why”, and “how”. Table 13 outlines the classification dimensions of the 5WH method. As described, all questions look at practices internally and externally to an organisation.

Table 13 “5WH” Question Classification

“5WH” Question	**Classification Dimensions for Integrated Idea Management**
What?	The nature and characteristics of internal and external idea management
Why?	The cause and / or purpose of idea management, internally and externally
When?	When are ideas generated, sourced and managed internally and externally
Where?	Front-end innovation activities, internal and external
Who?	Who will collect the data or ideas / decision-making actors both internally and externally
How?	How are ideas generated, sourced and managed internally and externally

This is a question-asking method widely used in journalism to quickly explore cause-and-effect relationships for a stated problem. The research questions were inspired by this simple method and helped ensure the overall context relating to idea management was considered. It also provides clarity around the problems posed by each research question and enable a better understanding of stakeholders and the values of the problem (Mitleton-Kelly, 2011).

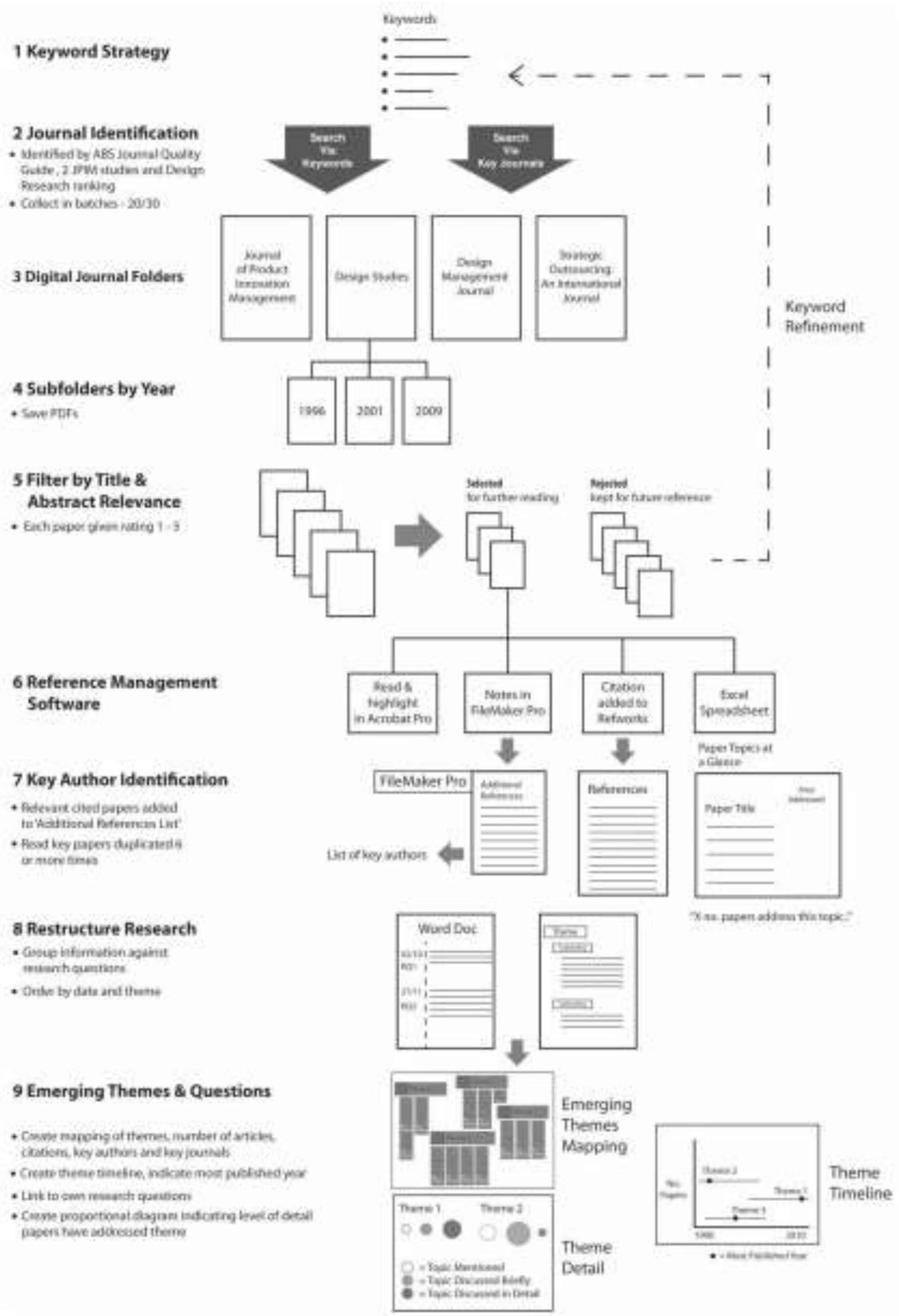


Figure 31 Literature Review Data Collection Strategy

Source: Author (2016)

Scoping Interviews

Interviewing in qualitative research is increasingly being seen as moral inquiry (Kvale and Brinkmann, 2009). A series of eight scoping interviews were conducted in two organisations, along with six additional informal discussions. These were done with external innovation managers in order to identify internal and external idea management practices. They were also used to gain an understanding of internal language, issues and challenges experienced within both organisations.

In total, four scoping interviews (all lasting approximately 90 minutes) were completed involving five external innovation managers in P&G's C+D programme. In addition, internal documents were provided which supported the discussions. Interviews were held globally in Cincinnati (America) within P&G HQ and Beijing (China).

In order to understand industrial search and select practices better, an Inno360 tool training session was attended in Beijing. This helped explain how the tool worked, its key features and gather insights from the training. It involved an introductory presentation and a live audio conference connection with three US-based tool owners. This allowed P&G attendees to work on their own computers and ask questions throughout the session.

Four scoping interviews were also held with Sky which explored their internal and external idea management practices and project portfolios. The interviewees were all involved in New Product Development with one specialising in external relationship management. In addition, a one-day workshop was held in which literature findings for idea generation and evaluation was reviewed. This feedback was useful regarding the methods used as well as improving clarity on their project pipeline.

Industrial Input

A key component of this research is to disseminate insights and findings to help improve practices for the external world. A presentation was given in April 2013 in London to give an overview of research progress to four regional C+D directors and one global director. The main outcome was positive for the importance of the establishing phase and that the link should be strengthened with the use of external tools. This meeting facilitated discussion with industry and the refining the link of the research to industrial needs.

In order to gain an understanding about the organisational product research process, an agreement was reached to be involved in a P&G project based in China. There was an opportunity to conduct interviews and analyse the potential for linking an open innovation tool with this research. This in turn formed the basis for the main survey employed which investigated the effectiveness of Inno360, an open innovation tool currently used in P&G. This input has also helped refine the thinking behind what is relevant within this research to industry as well as to literature.

Company Descriptions

Sky and P&G were the organisations utilised in this study, with the majority of primary data collected from P&G overall. The companies work in two different sectors, Fast Moving Consumer Goods (FMCG) and Mass Media. They vary in size from 31,000 employees to over 118,000 employees. Their net profits are £7.6 billion (Sky annual report, 2014) and over $83 billion (P&G annual report, 2014) respectively.

This research was two-thirds funded by the EPRSC and one-third funded by Procter & Gamble (P&G). This partnership provided a unique opportunity to gain in-depth access and conduct research that would have otherwise been very difficult to achieve. P&G is a multinational company and is often cited as a world leader in their front-end innovation practices with their ‘Connect and Develop’ strategy (Huston and Sakkab, 2006; Cooper, 2011; Dodgson *et al*., 2006). The organisation has been identified as among the most admired innovators within the industry (Arthur D. Little, 2005), with other innovation studies using them as a case study example (Dodgson *et al*., 2006).

The Connect + Develop (C+D) strategy involves over 1,000 active agreements with innovation partners worldwide and over 50% of product initiatives involve collaboration with outside innovators (P&G website, 2016). This reputation for external innovation practices made P&G a highly suitable case study company for this research. The effective practices were reviewed in P&G to discover how ideas are managed internally and externally in a large organisation.

The other organisation used in this study was Sky, formerly British Sky Broadcasting or BSkyB. The company was formed in 1990 and was known as Europe's leading entertainment company. Sky was selected as an appropriate comparison case company to validate the findings from P&G. The fact that they operate within a different industry, enables a comparison to be made between practices to identify commonalities in regards to idea management. In addition, they were accessible via existing projects during the start of the research.

This gave valuable opportunities to spend time discussing their issues with idea management and offering advice from the literature on how to improve practices. P&G shares similar characteristics with Sky and has been chosen as a suitable case study as both companies:

- are large-scale, global organisations facing similar challenges,
- place high importance on innovation within their culture, and
- have an existing connection enabling effective and open communication.

Investigating the differences between their idea management processes would provide valuable insights to inform future research areas. Although the empirical component of this research is a P&G case study, investigating the IM processes within Sky helps contextualise the research. Another main difference between the two companies is their focus. P&G are a consumer-driven company due to the nature of the FMCG industry, whereas Sky is technology-driven offering complex, high-technology products.

Inno360 Description

Founded in 2008, Inno360 is a cloud-based innovation management platform and Idea Management System. The company has worked with global R&D leaders to understand effective practices in large and small enterprises (Inno360, 2015). The tool is not exclusive to P&G and has two other founding companies: General Mills and the U.S Air Force. They improve the system via on-going feedback from over 15 additional customers including Givaudan, BASF, and GSK.

The tool has a broad global application and therefore has global tool owners who are responsible for the use of Inno360 internally within P&G. An Inno360 training session was attended in P&G Beijing Innovation Centre, May 2013. It was in the format of a live conference call with the US to several tool trainers. This formed the main background knowledge of the tool used in the survey and following interviews. P&G uses two types of search process, solicited (proactive) and unsolicited (reactive) each with their own particular phases and stage-gates. Results stress the importance of a clear project definition during the establishing phase, a key insight of this research supported by literature.

Inno360 works as a virtual landscaping tool targeting average R&D employees and C+D practitioners. The concept is that it acts as a starting point and performs a broad, quick virtual landscape. The concept of an innovation landscape is to characterise and describe different aspects that influence and shape innovation, and find out what you do not know. The innovation landscape provides a powerful tool to understand interrelations between those aspects (Ehlert, 2014). Inno360 described four types of landscaping, 1) conceptual / knowledge, 2) technology, 3) thought leader / expertise, and 4) competitive (Inno360, 2015).

The tool does this by combining dozens of external web resources and P&G intranet resources. Users can type in their needs and the tool will search all of the desired internal and external resources for matches. Inno360 has four key areas to facilitate searching processes: find, analyse, share and connect. Each phase has a specific purpose and feeds into the first three stages of P&G’s solicited search process (see Figure 32).

Figure 32 P&G Solicited Search Process

Source: Author adaptation of P&G process (2015)

The capabilities include a one search Google-type search, white space identification: defined as new markets, gaps in existing markets, or market opportunities that that a company wishes to pursue that can only be addressed by a different business model than is currently used (Johnson, 2010), personal development, combines sites together using internal and external sources, offers online tool training and provides data visualisation features. It offers a more secure search as it searches P&G internal websites and external resources, including patent databases, literature, and suppliers. It also links to specialist sources that the company is subscribed to, such as Mintel reports.

One of the main selling points of Inno360 is the visualisation features which provide graphical representations of collected data (see Figure 33). These graphic tools include foam trees and cluster circles, which work best in Google Chrome. The cluster circles group data by certain characteristics such as topic, organisation name, year, or inventor etc. Users can find new terms as it takes results and puts them into a circle format with sub-topics. Inno360 acts not only as a search tool, but as a tool of analysis and building connection.

Inner topics are the main sections and are shown in red. It displays the number of results found for each topic and clicking on a sub-topic gives a smaller result set. There is also an option to save the cluster circles generated. Foam trees as shown in the following diagram, provide a different visual image compared to cluster circles. They display similar topics but over larger areas which are determined to be the most relevant. It can filter results and show area sub-topics to the user. Other Inno360 features available include tag clouds.

Tool benefits include finding patent data and helping users to filter results. It was acknowledged that it performs a slower search than tools such as Google, however, giving more relevant and visual results. This saves practitioners effort and time because it searches multiple resources simultaneously. It integrates internal and external innovation knowledge sources, facilitates connections between data and people, and is a single tool which can visualise the data and results and searches can be shared. The weaknesses is that it is a tool which requires training to use even at a basic level so it appears complicated and difficult to use.

Figure 33 Inno360 Screenshots

Source: Inno360 Training Presentation (2014)

One of the issues with Inno360 is that effectiveness can be based on the relevance of the search terms used. Analysis features can trigger and provide alternative keywords for users, however, it is up to the user to iterate their terms in order to find the most promising leads. With these visualisation features, users can see terminology they did not originally enter which can be helpful for redefining search terms. The main study discusses these factors among others in the use of this tool for innovation.

Adoption of the tool is established to varying degrees within P&G on an international scale. At the time of the survey, Inno360 had four years of development within P&G in the U.S. The aim for P&G was to gain more understanding about the current effectiveness of the tool within the company, link with search and select practices and provide recommendations to improve levels of adoption if appropriate. This in turn would aid a decision on the future rollout of the tool globally.

Research Design

The concept of 'idea management' is the abstraction and the case study topic is the FEI-based project in an organisation. This has been identified to be a more concrete topic than relationships or projects (Yin, 2003). In order to increase the validity of results, data triangulation was used which involves gathering data such as interviews, observation and documents (Robson, 2011; Denzin, 2006). An important challenge to address for result validation is how to minimise bias during the validation stage.

The basic unit of analysis is the FE process of New Product Development, as used by Khurana and Rosenthal (1998). Using qualitative case studies is a validated method for achieving the aim of this research as existing front-end models have been based on this method (Brem and Voigt, 2009). The P&G case study is exploratory as the purpose is to build new theories when the subject is not well defined (Yin, 2003). This method also allows for the hypothesis to be generated through observing the phenomenon in a real-life context.

The overall flow of the research strategy was as follows: initial research questions, literature review, scoping interviews, pilot survey, main survey, and validation interviews. A cascade model (see Figure 34) was developed to visualise this process design and gives further details on what is involved within each section of the research.

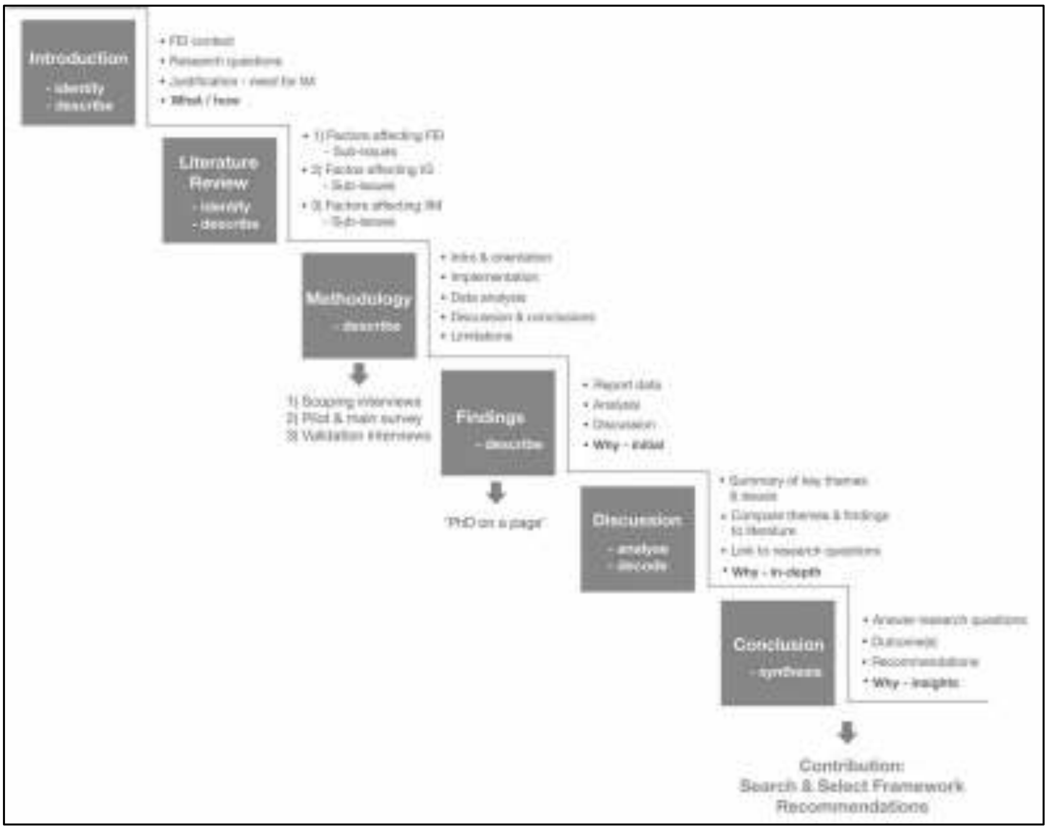


Figure 34 Research Design - Cascade Model

Source: Author (2016)

The literature review identified emerging themes and gaps used to create a conceptual innovation framework. The issues found from the literature are linked to the industrial survey due to a growing importance of evaluating effectiveness of innovation practices in industry, an increasing popularity of the use of digital tools in integrated innovation and a need to provide empirical evidence for the formalisation of idea management.

This research provides qualitative and quantitative evidence to validate identified factors affecting IM in corporate front-end innovation activities. The literature review was continually converged in order to identify the existing effective practice tools and methods: such as idea management processes, external engagement strategies and relationship mapping techniques as well as knowledge gaps.

Results were statistically analysed in order to determine their significance using techniques validated in similar studies. Ethical approval was gained according to the relevant rules and regulations of the organisation.

Research Validity

The concept of ‘idea management’ is the abstraction and the case study topic is the organisation within this research. This has been identified to be a more concrete topic than relationships or projects (Yin, 2003). In order to increase the credibility and validity of the results, data triangulation will be used which involves using more than one method of gathering data such as interviews, observation and documents (Robson, 2011; Denzin, 2006).

An important challenge to address for result validation is how to minimise bias during the tool evaluation stage with P&G. This was addressed by the survey being distributed to all users registered with the tool. In addition, validation interviews were done with both Inno360 users and non-users to get both perspectives.

There are two tactics for increasing the reliability of the case study method results: a) using a case study protocol and b) developing a case study database. This is so that another investigator could conduct the same case over again using the same procedures to arrive at the same conclusion (Yin, 2003). As this study involves the use of a survey, it should be conducted in an ethical manner that accords with best research practice (Kelley *et al*., 2003).

The larger the sample size, the more certain a model’s internal validity as the sample size affects measures of statistical significance (Christensen, 2006). Building upon seminal work on non-response bias in mail surveys (Armstrong and Overton, 1977), more recent studies have looked into non-response bias in web-based surveys. Web-based (internet-based / electronic / online) surveys are commonly used for data collection for a geographically diverse population (Atif *et al*., 2012).

In order to minimise non-response bias, the response rate can be maximised by paying special attention to the survey distribution, communication plan and questionnaire design. Dillman (2000) described these approaches in his Tailored Design Method, a method to maximise both quantity and quality of responses. This study therefore made efforts to reduce this bias by using internal promotion via senior management, sending a follow-up reminder one week after launch, and by simplifying the format and reducing survey length.

In order to verify the relevance of the found literature, two research validity techniques were used:

(1) Key Authors by Citation - to ensure that the key authors and their work on a certain topic have been reviewed, a list was made to illustrate the frequency of citations each author received. A key author is defined as one which has produced a peer-reviewed publication which has been cited frequently by other scholars. Using citation-based measures to assess impact, importance or quality of a scientist's work shows how often and where s/he has been cited (Meho and Yang, 2006).

(2) Research Emerging Themes Mapping - to demonstrate the emerging research themes, a visual mapping was generated. The methodology used to create this map was based on the affinity diagram, or KJ Method, and organises large amounts of ideas into natural relationships (Tague, 2005). This works as a visual communication tool providing a summary at a glance of the research. It also enables the identification of areas where more research needs to be found and therefore supports the described journal database search strategy. Each theme included the following information:

- Number of articles found relating to theme
- Key authors and number of citations
- Key journals

This enabled the research themes to be tracked over recent years and gave a higher-level understanding of the bigger picture being shown by the research.

Survey Design

The Inno360 survey was born from the need of industry to understand the effectiveness of this tool with plans for further roll-out across the company in the pipeline. This need was discovered by presenting research findings and discussing challenges during interviews. Discussions were underlined with the desire for mutually beneficial outcomes.

The survey aimed to assess the effectiveness of Inno360 as a searching tool and its value within FE activities. This survey aimed to confirm search and select success factors and their alignment to effective practices. It was iteratively reviewed by P&G tool owners to ensure relevance to requirements and suitability of language. The final survey design is provided in Appendix B.

The Inno360 effectiveness survey was launched internally within P&G in February 2014 for a period of three weeks until March 2014. The survey was designed and gave careful consideration to include P&G language, practices and relevant issues. It was also accompanied by a cover message from senior management in the organisation emphasising the importance of the survey.

It was initially administered to all 953 practitioners who were registered to Inno360 and had accessed the platform in the last 6 months. The link was sent out for a second time one week after launch to serve as a reminder, a common practice in similar surveys (Shih and Fan, 2008). This increased the survey response rate from 9% to 16%, which is above average for similar surveys. The survey received a total of 159 P&G practitioner responses, with 113 completed responses and 46 partial responses.

The main survey questions explored learnings from the literature review and were refined in collaboration from industry. A focus on a few key areas was necessary to keep the survey as concise as possible as Dillman (1991) identified a short survey length as a key factor to increase response rates. Therefore the content focused on the following areas of Inno360: frequency of use, other landscaping tools, what embodies success, effectiveness of tool capabilities, barriers to effectiveness, usefulness of site attributes and areas liked and disliked. The validation interviews also covered broader areas around searching strategies.

The above parameters link directly to research questions 3 and 4 regarding effective idea management and innovation sources, and effectiveness of search and select strategies and tools within industry respectively. It also included a question on associated barriers and other searching tools used. Analysing how Inno360 as a search tool works in practice, how and why it is or isn't successful and gaining insights on barriers experienced by practitioners provided valuable insight into idea management practices.

This empirical study employed a "purposive sampling strategy" to enhance understanding of selected individuals or group experiences for developing theories and concepts (Devers and Frankel, 2000). This method allows for revision throughout the research process as more knowledge of the setting and subjects are obtained. More specifically, the survey and interviews represented typical cases (i.e. those who are "average" for those being studied) (Miles and Huberman, 1994).

The use of Likert scales in questionnaires is abundant in similar studies (see Martinsuo and Poskela, 2011) and was used in the main survey. The survey was built using the online platform SurveyGizmo, providing unlimited response rates and a user-friendly interface that automatically collects and helps to analyse results. This was particularly important as the survey targets all currently registered Inno360 users within P&G. The survey itself was composed of five pages and an introductory page, and had 11 questions.

The outputs from the survey were supported by separate analysis performed in SPSS software (e.g. standard deviation) and Excel. Initial findings were then validated through follow-up interviews with P&G practitioners. A total of seven validation interviews were conducted via international audio calls. The participants were split into two groups, three Inno360 users and four non-Inno360 users. This was done so that responses were received from both perspectives in order to gain an objective view on the strengths and weaknesses of Inno360 within P&G.

Selection of Participants

The P&G participants involved in the scoping interviews were selected due to their expertise as they are high-level innovation managers active within C+D. They were based in America with subsequent interviews held in China. Similarly, the Sky participants were involved in NPD processes and were of a similar standing in the organisation. It was also important that they were actively involved in idea management processes in order to gather the most relevant insights.

The Inno360 effectiveness survey was sent to all 953 users (i.e. the number of registered users who had accessed the platform within the last 9 months). This was done through P&G internal distribution channels by tool owners and had support from senior management. This allowed for the maximum number of employees to have the opportunity to complete the survey.

The participants for the validation interviews were all P&G employees working (or had previously worked) within C+D and had experience in the company's search and select practices. They were chosen as appropriate candidates by P&G tool owners. This researcher asked them to provide the names of Inno360 users and non-users in order to gather insights from two differing perspectives. As described previously, these were done to represent views of typical users and non-users of the platform anonymously.

Survey Testing

A pilot run of the survey was conducted after the survey was converted into a digital format in SurveyGizmo for testing purposes. The initial drafts were first reviewed multiple times by two internal Inno360 tool owners over a few months via several international conference calls and e-mail exchanges. Once the survey was nearing completion, it was forwarded to other C+D practitioners for a test run. The pilot study involved nine participants over a period of one month from December 2013 to January 2014 to test the functionality and reporting capabilities of the tool.

Several revisions were made to the survey were based on feedback from the tool owners. Similar types of surveys for reviewing Inno360 had been conducted within the company previously, therefore new questions were incorporated that had been asked in previous preliminary surveys in order to compare results more easily. The revisions made the survey more concise and user-friendly for participants to complete.

The tool owners had previous experience in conducting internal surveys and so produced several recommendations to increase response rates, such as reducing the number of questions, ensuring simple language, running the survey within particular time-frames, and ensuring senior management support and endorsement was clear. This process was facilitated by frequent conference calls to the U.S throughout the development of the survey.

From the pilot study and scoping interviews the following key issues were identified:

- organisations have many tools available, therefore identifying the most effective are important to search and select activities,
- complexity and uncertainty is present on multiple levels, primarily through the vast networks of networks for employees. Often, the connections are ad-hoc and spontaneous and therefore difficult to track or kick-start the process when required,
- it is common in organisations to reject the vast majority of externally submitted ideas due to incorrect IP or lack of fit with strategy, which makes idea evaluation using the right criteria critical to internal and external idea management,
- there is no lack of ideas, rather the problem lies in how to best manage ideas through the innovation pipeline to become innovation.

Another prominent question this study aims to address is how ideas are managed in reality within an organisation and the nature of the processes used to source and generate ideas. External ideas are most likely to be off-strategy and the organisation has to manage submitted ideas with pre-set criteria, otherwise the amount of ideas of too overwhelming to evaluate. There is the need to balance the broad search for new and creative ideas whilst still aiming to find implementable ideas. These results suggest that internal searches are highly specific and focused when compared to looking outside the organisation for more broad ideas or inspiration.

From these preliminary findings substantiated from the literature, it was decided that the focal area would attempt to address the issue of how to effectively manage the integration of external ideas though idea management. This issue is addressed in the final innovation framework was developed using literature findings and industrial influencing factors.

3.5 Data Analysis

Multiple approaches were adopted to visualise and present the resulting data from the study. To illustrate the literature reviewed several diagrams were created: proportional circles illustrated the number and topic of the papers read, a timeline showed the key emerging themes identifying years of high publishing, and literature type. Frequency distribution methods were also used along with bar chart visualisation tools.

There are multiple ways to analyse different types of data. The statistical analysis of the survey results was conducted using SPSS, an established statistical tool used in numerous studies. SurveyGizmo performed the initial visual representations of the data from the main survey. This facilitated analysis by allowing instant access to incoming data and providing features to organise and label data to generate relevant reports.

This study focuses on determining the most common or most frequently occurring values in the data (i.e. mode). It also takes into account that other values are of importance to analyse the data as objectively as possible. This study therefore also measures how well the mean represents the data (i.e. standard deviation). Standard deviation measures the variability or spread of a set of scores and is commonly used in studies. It is calculated as the square root of the arithmetic mean of the squares of the deviations from the arithmetic mean (Robson, 2011). Large standard deviations typically indicate that the mean is not an accurate representation of the data.

To ensure accuracy of results, the study was designed to optimise stability and consistency of data analysis by using SPSS, software designed to support descriptive statistical analysis. Therefore the findings will present descriptive statistics relating to the mode, mean and standard deviation of data derived from SPSS software. The data was imported into SPSS format via export from SurveyGizmo. This process required manual changes to reporting values in order for SPSS to perform analysis procedures correctly. Results were then exported from SurveyGizmo in Excel and PDF formats. These summary reports were refined and fed-back to industry.

In terms of the survey population size, to achieve a confidence level of 95% there must be a margin of error (also referred to as confidence interval) of plus or minus 5% (Lee and Baskerville, 2003). The main survey was sent to a population of 953 users and received 159 responses, a 16% response rate. This translates into a confidence level of 93% with a margin of error of approximately 7%. This indicates the level of precision and that with 93% certainty the data reflects the view of the true population.

Both complete and partial survey entries were used in the final data analysis for this survey. A completed response is when the survey taker reaches the last 'thank you' page of the survey. Partial responses are when the survey taker might have left the survey part way through, or might have intended to come back later to complete. The completed responses were analysed separately from partial responses to compare and identify differences in results.

Open text analysis was carried out with the comments given in order to report findings to P&G directors. In these calls, the likes / dislikes, emerging issues and recommendations were summarised and presented. The call discussed key issues whilst engaging with P&G practitioners on their views of the data and reaction to results. It also provided ideas for how to further analyse the data and answer emerging questions.

Validation Interview Analysis

There were a total of seven interviews completed in order to a) confirm search and select practices, and b) validate Inno360 survey outcomes. Two internal P&G tool owners selected participants. The participants were P&G employees working (or had previously worked) within C+D and had experience in the company search and select practices. Four participants were non-Inno360 users and three were Inno360 users.

Table 14 summarises participant background information and years of experience each interviewee had within P&G. Participant names and personal information were excluded to preserve anonymity and protect business confidentiality.

Table 14 Validation Interview Participant Summary

Source: Author (2016)

Participant	Inno360 User / Non-User	Country	Training / Background	Experience in Company (years)
A	**User**	Singapore	Materials Science	12
B	**User**	US	Mechanical Engineering	20
C	**User**	US	Biochemistry	9
D	**Non-user**	US	Molecular Biology	9
E	**Non-user**	Belgium	Biochemistry	10+
F	**Non-user**	Germany	Organic Chemistry	14
G	**Non-user**	Germany	Chemistry	9

The interviews were conducted on a one-on-one basis via international audio conference call. All seven interviews were tape-recorded with explicit participant agreement and subsequently transcribed verbatim by this researcher. Notes were also taken during each call incase technical problems arose with the recording equipment. The transcribing process allows for researchers to gain an in-depth understanding and greater familiarity with the raw data (King and Horrocks, 2010).

The completed transcripts were then e-mailed to participants for individual review. Allowing the participants to review the transcript prior to analysis gives them an opportunity to clarify or expand on any issues discussed. This also allows for a period of reflection which can provide a valuable exercise in honouring the research process and participant's voice (Oliver *et al*., 2005).

The raw transcripts were analysed using thematic coding analysis as described by Robson (2011) and Liamputtong and Ezzy (2005). This helped to summarise key emerging themes from a large amount of qualitative data. This is also known as a process called clustering where concepts are grouped with similar concepts (Davila *et al*., 2006). Analysis was completed digitally by creating question tables in Word and collating all the answers from each transcript and structuring them via question number (see Figure 35).

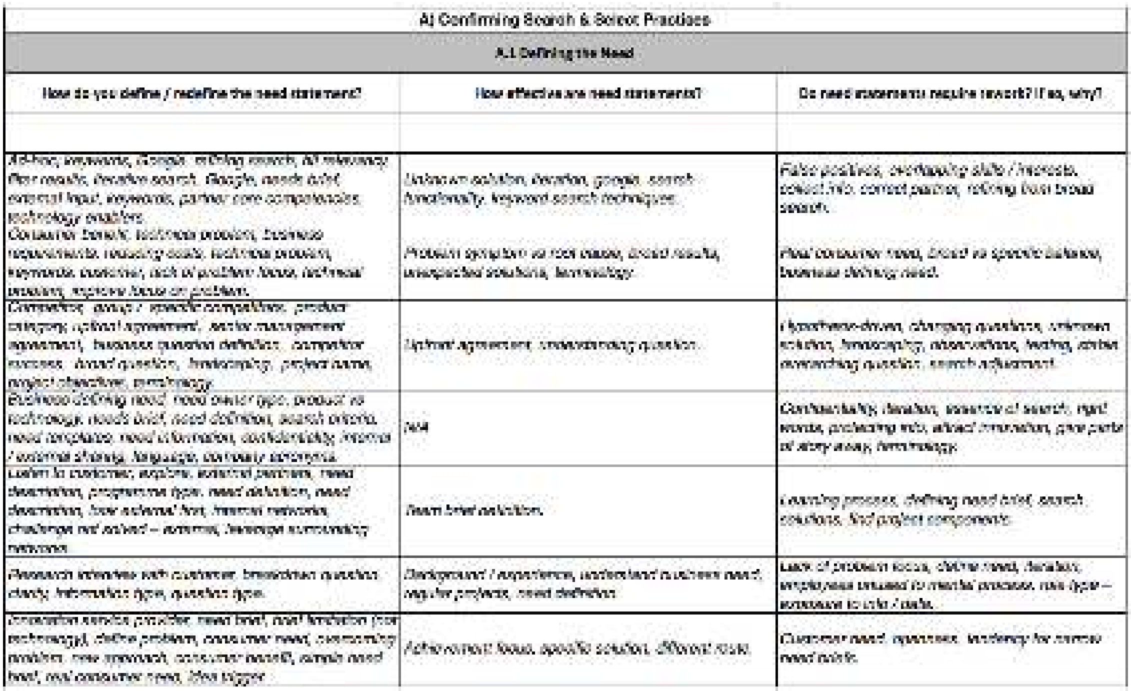
The way I practice it so again, this is from my daily work which is modeling and simulation and most of my models are physical processes so physics and engineering-based, so the need statement boils down to three components; why does the consumer care about solving the technical problem or simulating the technical problem, why does the business care and you know, how does it reduce costs those kinds of issues. Then the actual meat and potatoes or bones physical elements of the technical problem itself what are the keywords and sentences about that. I don't know if that helps, but that's what I do when I go through it.	**Consumer benefit, technical problem, business requirements, reducing costs, technical problem, keywords,**
CC: Okay, so do you actually redefine them then according to those three areas? : Yeah, especially when if I'm working with a customer they may start on one vector and may not realise that it's really a cost savings or may not realise what the exact consumer aspect of it is or more often than not it's in the technical arena where they're really looking for here.	**customer, lack of problem focus, technical problem,**

Figure 35 Validation Interview Analysis Sample - Identifying Keywords

Source: Author (2016)

In order to calculate the frequency of the discussed areas from the 134 papers reviewed, an Excel database was created (see Appendix D). This addressed an identified disadvantage where reports have claimed to have used thematic coding analysis but provided little or no details of the procedure used (Robson, 2011).

This then allowed for keywords to be extracted and summarised for each question topic within an Excel database (see Figure 36). An Excel database was then created to collate the keywords and structure them in a more easily viewed format for cross-comparison. This facilitated the identification of issues per question as well as comparing issues across all of the qualitative data. These tables formed the foundation for the summaries included as Figures 38 to 45.



A) Confirming Search & Select Practices		
A.1 Defining the Need		
How do you define / redefine the need statement?	How effective are need statements?	Do need statements require rework? If so, why?
Ad-hoc, keywords, Google, refining search, fit relevancy, filter results, iterative search, Google, needs brief, external input, keywords, partner core competencies, technology enablers.	Unknown solution, iteration, google, search functionality, keyword search techniques.	False positives, overlapping skills / interests, collect info, correct partner, refining from broad search.
Consumer benefit, technical problem, business requirements, reducing costs, technical problem, keywords, customer, lack of problem focus, technical problem, improve focus on problem.	Problem symptom vs root cause, broad results, unexpected solutions, terminology.	Real consumer need, broad vs specific balance, business defining need.
Competitive, group / specific competitors, product category, upfront agreement, senior management agreement, business question definition, competitor success, broad question, timeboxing, project name, project objectives, terminology.	Upfront agreement, understanding question.	Hypothesis-driven, changing questions, unknown solution, timescoping, observations, testing, stakes, overarching question, search adjustment.
Business defining need, need owner type, product vs technology, needs brief, need definition, search criteria, need templates, need information, confidentiality, internal / external sharing, language, company acronyms.	N/A	Confidentiality, iteration, essence of search, right words, protecting info, attract innovation, give parts of story away, terminology.
Listen to customer, explore, external partners, need description, programme type, need definition, need description, how external fits, internal networks, challenge not solved – external, leverage surrounding networks.	Team brief definition.	Learning process, defining need brief, search solutions, find project components.
Research interview with customer, breakdown question, clarity, information type, question type.	Background / experience, understand business need, regular projects, need definition.	Lack of problem focus, define need, iteration, employees unused to mental process, role type – exposure to info / data.
Innovation service provider, need brief, need limitation (for technology), define problem, consumer need, overcoming problem, new approach, consumer benefit, sample need brief, real consumer need, idea trigger.	Achieve correct focus, specific solution, different route.	Customer need, openness, tendency for narrow need briefs.

Figure 36 Validation Interview Analysis Sample - Extracting Common Issues

Source: Author (2016)

The most frequently addressed areas were identified using a filtering process. The areas remaining after this filtering process were clustered into five higher-level, overarching themes. The median year was calculated and the most published years were identified for each theme. Over 300 areas were grouped without using this filtering process ensuring no areas were rejected. This was done to increase the validity of the identified themes as the data was analysed using two different processes producing the same outcome.

3.6 Discussion and Conclusions

The purpose of these chapters is to discuss in more detail the emergent themes from the results and to discuss how they are consistent with previously published knowledge on the topic. The discussion will highlight that the organisation sample use many tools and methods to achieve business success, but they struggle to orientate and refine their searches to find the best opportunities and ideas. It will articulate the types of issues characterised in front-end search and select activities and how this research is proposing to add new knowledge in enhancing idea management practices.

3.7 Limitations

This chapter detailed the mixed methods approach used in this research. As with any piece of research there are limitations associated with the undertaken methodologies. The study adopted a self-completion sample method for the main survey. For electronic surveys in particular, this is associated with lower response rates (Simsek and Veiga, 2000) and could impact the validity. This is why efforts were made to increase response rates as much as possible as described previously.

The tool used to conduct the main survey was web-based. The advantages of time saving and efficiency when analysing large amounts of data are weighed against the time and effort taken to gain familiarity with the data (Robson, 2011). However, tool capabilities should not be overestimated, since computers are unable to perform an independent rational process to substitute the analyst's capacities (García-Horta and Guerra-Ramos, 2009).

A conscious effort was made to ensure that the online tool was used to facilitate data gathering, initial reporting and visualisation of results. Summary reports were printed, analysed and connections made by this researcher and supporting industrial partners. Triangulation via the use of quantitative and qualitative questions within the survey identified similar patterns of findings, as well as avoiding the use of a single method where limitations are more pronounced.

The survey was tested and applied in one organisation and it could be argued that it is therefore limited in its generalisability. The survey used in this research included P&G company language in order to communicate easily with employees to identify opinions and perceptions, as suggested by Miller (1989). To address potential limitations of transferability and applicability, the study was designed to adopt a focused and detailed approach rather than broad and shallow study (Guba and Lincoln, 1994). This lends itself to gaining richer data that would be hard to extract using other methods.

The vast majority of participants were in the US and therefore results mainly reflect the views of P&G personnel in this country. It could be argued that the other countries do not get equal representation, however the survey was open to all registered Inno360 users and participation was completely voluntary. It is important that this research reflects as accurate a picture of how Inno360 is used which involves the reality that it is currently more adopted within certain countries than others.

There is a risk of researcher bias occurring when the researcher has personal biases or prior assumptions that he/she is unable to bracket (Onwuegbuzie, 2003). This poses a very common threat to the internal and external credibility within all qualitative research (Onwuegbuzie and Leech, 2007). Due to this threat, actions have been taken to minimise its effects by a) having no prior knowledge of participants, b) making the researcher's intentions clear, c) triangulating data, and d) continually keeping research questions in mind (Miles and Huberman, 1994).

Summary

This chapter illustrated how primary and secondary data was collected and analysed to support the aim of this research. It also explained the thinking and front-end innovation models behind the delivery of this study. An in-depth FE framework analysis influenced the research context to ensure that the phases are grounded in existing literature and effective practice. The rationale behind choosing the 4D model and the need for an establishing phase were identified from this investigation.

The analysis methods were explained for the quantitative (SPSS) and qualitative data (thematic coding analysis). The primary data collection was conducted in three data sets: qualitative scoping interviews, a quantitative and qualitative main survey, and qualitative validation interviews. Most of the empirical data was collected from P&G with several scoping interviews with Sky which added the industrial context required for this research.

A discussion reflected on the results gathered through synthesis of the identified issues. The limitations were identified and methods in which they were addressed. The literature issues were selected in order to answer the four research questions regarding idea generation, idea quality, idea management practices, and search and select strategies.

The thesis will now address the previous issues described and are discussed in the following order: findings, discussion and conclusion.

4 FINDINGS

Introduction

In this chapter, the results from the survey data and interviews will be introduced and briefly discussed. This chapter comprises of four key sections following the employed methodology and address the research questions of the study as outlined on page 18. The sections are structured as follows: i) scoping interviews, ii) main survey, iii) validation interviews, finishing with a summary of findings. Each section will summarise key findings, discuss emergent themes and issues resulting from the analysed responses and utilise both quantitative and qualitative data. The findings will then be directly aligned in order to answer the research questions.

Each section includes tables which communicate the quantitative findings in terms of mode, mean and standard deviation. As a means to emphasise the important findings, key figures within tables have been put in bold within each table. Some tables summarise overall results whilst others detail the specific qualitative issues within broad areas. Issues within such tables have been given a frequency within a set of brackets. This means that issues can be given a slight weighting in terms of importance in relation to other issues.

A series of related sub-issues were established to address each research question. The issues found from the literature are linked to Inno360 via three channels: 1) a growing importance of evaluating effectiveness of ideation practices in industry, 2) increasing popularity of digital tools in integrating innovation and 3) the need to provide empirical evidence for the formalisation of idea management. The main study therefore focused on evaluating the effectiveness of Inno360, an open innovation tool used with P&G, to provide empirical evidence and insights into idea management practices.

The outcomes of the survey specifically addressed the frequency of use of Inno360, what embodies success in its use, the effectiveness of its capabilities, identifying barriers, identifying other landscaping tools and why they are used, the usefulness of site attributes and finally areas liked as well as improvement areas. The development of an internal and external innovation model based on the literature and empirical survey data is proposed within the Conclusion chapter.

4.1 Scoping Interviews

Initial scoping interviews were conducted at the start of this research forming the pilot study, in order to gain a general context around the key research themes. Interviews with P&G external innovation managers were completed and held in-person in both America and China. Several exploratory interviews were also held with Sky in the UK (see methodology chapter). The findings revealed current industrial practices, internal language, issues and challenges. Table 15 below summarises the main findings from the scoping interviews.

Table 15 Qualitative Data Summary - Scoping Interview Findings

Source: Author (2016)

Current Practices	Issues	Challenges
• Pre-FEI – Discover, Invent, Demonstrate	• Linking a found innovation to appropriate BU	• Multi-level high complexity – network of networks, global connections
• SIMPL – Success, Initiative, Management, Planning, Launch	• Interdepartmental miscommunication	• IP and copyright restrictions – unsolicited ideas
• Solicited and unsolicited search processes	• Identifying leads	• Inter-departmental communication
• Iterative processes – search criteria adjustment, customer feedback	• Time constraints	• Scalability of technologies - global
• Strategic partnerships	• Network establishment	• Setting the right challenge
• Quick opportunity evaluation	• Early problem definition	• Communication strategies
• Up-front understanding of customer needs	• Confidentiality	• Innovation culture – silo structure
• Success criteria – defined by particular role	• Human resources retention	• Cross-functional knowledge sharing
• High volume of internal acronyms	• Harnessing connectivity	• Conflicts - cross-contamination of information
• Idea diversity – look to other industries	• Appropriate data handling	• Tracking of needs, threats, trends, network productivity, assessments

Some of the major challenges included: 1) very high complexity in existing networks and partners, 2) information contamination across business units, and 3) confidentiality issues within unsolicited idea submissions. Other challenges from the scoping interviews were process complexity, high external idea volume (unsolicited ideas), language / terminology, confidentiality, and data organisation particularly with tracking network responsiveness. A trend towards automation of idea and network management was overarching and identified in the qualitative interviews. Automation of these activities would in theory save managerial time, evaluate submissions, identify leads, and track responsiveness of numerous networks. This primary research will address the reasons why this is currently not being done frequently in organisations.

P&G appeared to have two main external search drivers: uncertainty and lack of capability. Uncertainty mainly revolves around the definition of the initial need. Lack of capability can regard capabilities such as knowledge, skills or manufacturing. A multitude of idea sources are used by the organisation including venture capitalists, R&D community, inventors, academic research, conferences, databases, incubators, national labs, suppliers, and trade organisations. This diversity of idea sources re-enforces the fact that ideas can come from many different industries and people.

Scoping interviews with Sky were composed of several preliminary meetings and discussions with the concept development director and team members. This allowed for a better understanding of the company's culture, processes and terminology. Several semi-structured interviews with employees then explored their current external relationship management processes. This helped refinement of the research questions and added greater understanding to how companies currently shape their idea pipelines. The main issues from this input was that it supported the complexity involved with managing ideas, confirmed several ideation processes used internally and brought to life several challenges faced such as manging the project pipeline and finding time to evaluate ideas.

A few issues emerged from the qualitative scoping interviews around searching practices. Search strategy is essential as the strategic decision whether to search internally or externally drove the search and which sources would be used. They identified this as a key success factor as often companies do not make this decision upfront and do not take the most effective route at the beginning of the search.

Search type in terms of solicited or unsolicited management of ideas encompassed a big challenge with unsolicited ideas. Solicited searches are known and prioritised by the company directed at specific business needs. Unsolicited ideas come in from the external world where evaluating a high volume is the main barrier. Managing unsolicited ideas was one of the main challenges faced by external innovation managers. The majority of ideas are rejected mostly due to IP issues, not enough information and a lack of strategic fit. A need to make sure that work is not repeated within the company.

The above findings are supported by the work of Alexy *et al*., (2012) who identified two challenges with managing the unsolicited idea process: low quality and high quantity of ideas, and IP protection and ownership. There is a tension between an organisations' desire to welcome unsolicited ideas and its fears of dealing with too many. This illustrates how idea management processes involve a high degree of complexity and must be organised efficiently (Brem and Voigt, 2007).

Evaluating the search effort is a balance between the beneficial outputs of a search versus the effort expended conducting it. Companies need to reach the right balance otherwise they could be spending time and resources on a search which may not provide a sufficient level of benefit. This is linked to whether an area is familiar or unfamiliar and would affect how search and select practices are implemented. This can be in terms of risk, change of expertise, lack of information, or greater uncertainty within unfamiliar search areas. Existing knowledge of opportunities for known versus unknown areas was also identified in the interviews.

Innovation type emerged as an issue due to incremental innovation requiring less sources of innovation compared to radical innovation. Issues such as IP and confidentiality were emphasised as of upmost importance to their select practices. This is a core selection criterion which every incoming external idea is evaluated against. Another key criterion is strategic fit and therefore relevancy to the business needs at the time of idea submission.

Summary of Key Insights

It was found that external search drivers are either uncertainty and / or a lack of capability. Looking externally is something which practitioners did automatically, but used their own methods in order to do so quickly. Uncertainty revolved around definition of the initial need and it is often mitigated through discussions with colleagues or external experts. A lack of capability can relate to capabilities such as knowledge, skills or manufacturing. For idea generation and addressing research question 2, this uncertainty is highest with radical innovation and as previously discussed, incremental and radical ideas may need to be managed differently. This therefore links to the initial definition of the need.

All of these challenges and issues are led by the organisational culture and barriers such as bureaucracy and structures. Leveraging capabilities for innovation and facilitating internal and external connections increases the likelihood of informal serendipitous ideas which was also mentioned as a success factor. These issues helped to position the main survey in terms of areas to focus on and helping to define the key questions for investigation.

Digital tools are commonplace but it is how they are used to find solutions to the need that is important. One challenge included the management of unsolicited ideas due to high volume, leaving an opportunity for evaluation to become more focused in order to save time and money. IP / confidentiality were not cited anywhere as key idea quality success criteria in the literature, however, in organisations these are the first barriers for external ideas. This means that idea evaluation and quality is critical to search and select practices. Specifically the outputs of digital tools such as Inno360, as asked in research question four, are evaluated by practitioners by how well it meets the need.

4.2 Main Survey

The purpose of this section is to communicate the findings from the main survey into the effectiveness of Inno360. The use of this open innovation tool impacts the search and select practices employed within the organisation. This investigation into the effectiveness of a digital tool will help with orientating the recommendations and contribution of this research for how tools can best facilitate search and select practices. This section will provide insight into the level and length of tool use, success measures, activity effectiveness, adoption barriers, other tools used and effectiveness of site attributes. It concludes by detailing the areas liked and disliked within Inno360, identified through clustering open text given by participants.

The rationale for this mainly quantitative survey is to address the importance of evaluating the effectiveness of current digital tools to improve innovation performance. The web has done much to make existing projects accessible and search engines like Google help innovators quickly find what they want (Shneiderman, 2007). This is supported by work which aims to select knowledge management tools to sustain innovation, described as system quality (Grimaldi and Rippa, 2011). This survey therefore supports issues from the literature review which are discussed in more detail within the Discussion.

There are few quantitative studies which analyse the use of global tools within front-end innovation activities (Verworn, 2009). In particular, this survey adds knowledge to the actual search and selection practices used in industry for leveraging external ideas and knowledge for innovation. The survey was sent to 953 users with a final response rate of 16%: 113 complete responses and 46 partial responses. This section has been sub-divided into five sections covering all 11 questions included in the Inno360 effectiveness survey:

(1) **Participant Sector & Country**

(2) **Level of Use & Measures of Success**

(3) **Activity Effectiveness & Adoption Barriers**

(4) **Session Length & Other Tools**

(5) **Site Attributes & Recommendations**

The literature and exploratory interviews on idea management practices identify the importance of defining the need and how search and select practices impact the quality of innovation outcomes. Therefore, it is important to better clarify the nature of search and select practices using tools such as Inno360, in order to address how idea management practices can be improved. This helps answer the research questions specified in Chapter One (pages 17 – 18). The following results are presented through the use of a summarised cross-tabulation format.

Once the data was statistically analysed four key questions were asked in order to synthesise and make sense of the data:

A: **What is the data telling us?**

B: **What questions is it helping us to answer?**

C: **What are the emerging issues? Both generic and specific?**

D: **What are the emerging themes?**

4.2.1 Participant Sector & Country

Sector / Corporate Function

The survey started with two introductory questions asking which company sector or corporate function, and country participants were based. This question was both quantitative and qualitative in nature as the respondents were able to input their own text (referred to as open text) for specifying their 'other' answers. This is also the case with survey questions 3 (defining success), 5 (barriers), 8 (other landscaping tools), 10 (areas liked), and 11 (improvement areas).

The participants were asked to identify their company sector or corporate function (see Table 16). Company sector refers to the main sectors within P&G such as Global Beauty, Global Health & Grooming etc. (see Table 16). This was done to see whether there were any differences in the experiences of the tool between users in these different company sectors. The majority of participants are within a company sector at 55%, followed by the 'other' category at 14%. The rest identified as within a Global Capability Organisation (GCO), involved with

Transformational Platform Technology (TPT) or another Corporate Function (CF).

Table 16 Quantitative Data Summary - Survey Participant Sector / Corporate Function

Company Sector / CF	Frequency (valid %)
Company Sector	88 (55.3)
Other	23 (14.5)
Global Capability Organisation (GCO)	19 (11.9)
Transformative Platform Technologies (TPT)	18 (11.3)
Corporate Function (CF)	11 (6.9)
	Total: 159

Table 17 shows that the participants within a company sector are mainly within ‘Global Beauty’ (35%) and ‘Global Health & Grooming’ (28%). This was not surprising as these were some of the bigger sectors.

Table 17 Quantitative Data Summary - Survey Participant Sector

Sector	Frequency (valid %)
Global Beauty	31 (35.2)
Global Health & Grooming	25 (28.4)
Global Fabric & Home Care	19 (21.6)
Global Baby, Feminine & Family Care	13 (14.8)
	Total: 88

The open text answers provided by respondents in an ‘other’ category are detailed in the Appendices as Table 51. These were for practitioners to identify the business function they were in that was not listed in the above options. The most frequent answers were GBS (29%), followed by Corporate / Upstream R&D (16%) and Global Engineering (12%). The rest of the sector answers were given by one respondent each and included Infolytics, Cost Engineering and Purchase.

The vast majority of corporate function participants are in Connect + Develop (C+D) at 77% (see Table 18). Only one participant identified themselves as within Legal and one within Packaging. This brings about the question as to why certain corporate functions, such as Packaging, are not typically registered within Inno360. This may be because the tool is not relevant to their daily activities or a lack of communication about the tool.

Table 18 Quantitative Data Summary - Survey Participant Corporate Function

Corporate Function	Frequency (valid %)
Connect + Develop (C+D)	7 (77.8)
Legal	1 (11.1)
Packaging	1 (11.1)
	Total: 9

Country

The main country of response came from the United States (68%) followed by the United Kingdom (13%). This is consistent with expectations since Inno360 is mainly adopted in the US compared to other countries. The top five countries are where their main technical centres are located. Table 19 details the countries and frequency of respondents. Despite the vast majority of users being in the US, it is important to note what other countries are using the tool outside of the US. This illustrates the global reach of this survey and company.

Table 19 Quantitative Data Summary - Survey Participant Countries

Country	Frequency (valid %)
United States	109 (68.6)
United Kingdom	22 (13.8)
Belgium	9 (5.7)
Singapore	8 (5)
China	7 (4.4)
Japan	1 (.6)
India	1 (.6)
Germany	1 (.6)
Canada	1 (.6)
	Total: 159

This tells us that the location of the technical centres are driving where the tool is used and where the connections globally are being built from.

4.2.2 Level of Use & Measures of Success

Length of Registration

The respondents were asked to indicate the length of time that they had been registered to Inno360. This question helps to add context to the people using the tool and whether they are mostly new or long-term registrants to Inno360. The data captured for this question was quantitative only with three possible answers. Table 20 illustrates the SPSS analysis with the most common answer being '4 – 12 months' at 42%. This is consistent with the mean value of 2.12 and a low standard deviation score.

Table 20 Quantitative Data Summary - Length of Inno360 Registration

Length of Registration	Mode (valid %)	Mean	Standard Deviation
	4 – 12 months (42.2)	2.12	0.754
Scale: 1 = 1-3 months, 2 = 4-12 months, 3 = 1 year +			

This data tells us that most users have been registered for a long period of time. This however, does not necessarily mean that they use it frequently for searching.

Frequency of Use in Last Three Months

In this question, respondents were asked to indicate their frequency of use of Inno30 in the last three months. The primary purpose was to help indicate how frequently the registered respondents currently use the tool to aid their search and select practices. The data was quantitative in nature for this question. The findings indicated that the most common frequency of use within the last three months is between '1 – 5 times' at 51%. The mean is slightly lower than this value indicating a slight average shift towards the '0 times' answer, however the standard deviation remains low (see Table 21).

Table 21 Quantitative Data Summary - Frequency of Inno360 Use in Last 3 Months

Number of Times Used	Mode (valid %)	Mean	Standard Deviation
	2 = 1-5 times (51.7)	1.79	.664
Scale: 1 = 0 times, 2 = 1-5 times, 3 = 6+ times			

The frequency of times used does not help answer how effective the tool has been on the occasions that it has been used. This does provide a general view that it is not used very often by practitioners registered to the site. If it is not being accessed frequently by users the reasons why need to be addressed in order to increase footfall and enhance the number of times it is accessed by users.

Rate of Successful Project Completion

Survey question 3 asked participants whether they had completed a successful landscape or research project within Inno360. They were given either a ‘yes’ or ‘no’ answer option which was quantitative in nature. The question was linked so that if participants selected ‘yes’ they were subsequently asked what success looked like. Those selecting ‘yes’ were also given an ‘other’ answer, where participants could enter open text. If they selected ‘no’ they were asked to briefly describe why it was not successful in an open text format. This question therefore used both quantitative and qualitative data. The majority of participants answered ‘no’ at 68% and 32% answered ‘yes’ (see Table 22).

Table 22 Quantitative Data Summary - Rate of Successful Landscape / Research Project Completion within Inno360

Successful Project Completion	Frequency (valid %)
No	102 (68)
Yes	45 (32)
	Total: 147

Of those sampled, the majority (68%) had not completed a successful project within Inno360. This was due to most practitioners having never tried to use the tool previously. The other main reasons are that users lack the time to learn to use or evaluate the real value of the tool, they find it hard to use and navigate and find it non-intuitive for searching. The rest of the reasons concerned confusion over search terms, lack of relevancy of results, and wanting to have more useful training.

The issue of defining the search terms (either with the use of the tool or training) was mentioned several times as important. The results appear to suggest that it is used in an exploratory fashion rather than for in-depth analysis, possibly due to time constraints and lack of understanding on how to use the tool most effectively. This will be discussed in more detail within the Discussion section. Low peer adoption is a factor with some users not knowing anyone else who uses it and therefore do not use project collaboration capabilities.

The sample's perception is that Inno360 has potential but is too complex, however others felt that they got more relevant results with more specific tools such as PubMed or Orbit. The complexity of the tool appears to be the overarching issue. It has been suggested that it should become more "*google-like*". This suggests something fast, simple and with a minimal interface. There are issues with its compatibility within Windows and the Internet Explorer browser. Reducing the number of functions and improving the effectiveness of the most popular features (such as visuals) could be a way to achieve this.

This question is further broken down into defining success if they have completed a successful project and if not, to input their reasons why it was unsuccessful.

Defining Success

The participants who indicated that they had completed a successful landscape / research project within Inno360, were then asked to describe what success looked like within their searching activities (question 3b). They were given a series of success measures detailed in Table 23. The most common definition of success was 'finding an innovative technology' (46%). This was followed by the ‘other’ answer (35%) (see Table 24) and ‘finding academia experts’ (25%). ‘Making internal connections’ (22%) was the next with ‘finding a supplier’ (6%) as the least common measure of success.

Table 23 Quantitative Data Summary - Definition of Success in Completed Landscape / Research Projects within Inno360

Defining Project Success	Frequency (valid %)
Found innovative technology	22 (45.8)
Other	17 (35.4)
Found academia experts	12 (25)
Made internal connections	11 (22.9)
Found supplier	3 (6.3)
	Total: 48

These findings suggest that finding an innovative technology, in terms of a solution, is the most important factor driving successful searches conducted within Inno360. The other project success factors focus on making connections with other people: academia experts, internal connection and suppliers. These were, however, rated lower as a success factor. The literature acknowledges the importance of building networks and connections in innovation (Ahuja, 2000). This suggests that the tool could be ineffective at connecting users with experts or other employees whilst conducting projects.

Finding suppliers may be rated low due to users not needing to identify suppliers as the tool is for very early stage searches. A concept would need to be at a sufficient level of definition for the right suppliers to be linked. The other category was rated under finding innovative technology, which suggests that other benefits of the tool are not necessarily being communicated. It was important to breakdown what these other success measures are for users to gain a more holistic view of how the tool is actually used. The ‘other’ answer was qualitative open text and is broken down in Table 24.

Table 24 Qualitative Data Summary - Definition of Success in Completed Landscape / Research Projects within Inno360 - 'Other' Answers - Open Text

Defining Project Success: Other	Frequency (valid %)
Understood Technology Landscape / State-of-the-Art	3 (17.6)
Found Prior Art for IP Landscape	3 (17.6)
Trends, Patents Art Search	2 (11.7)
Searched Literature	2 (11.7)
Internal and External Technology Search	1 (5.8)
Submitted Research Proposal and Received Feedback	1 (5.8)
Found Competitor Activities	1 (5.8)
Verified Whitespace and Filed IP	1 (5.8)
Researched Articles	1 (5.8)
Developed Technical Innovation Model	1 (5.8)
Connecting the Dots	1 (5.8)
	Total: 17

There were 17 responses to this question in total. Two success measures were mentioned three times: understood the technology landscape and found prior art for IP landscape. Most of the success measures were about patents and searching literature. This could be due to the highly technical nature of the searches being conducted within the company in this particular industry. Other answers include finding competitor activities, verifying whitespace and submitting research proposals with feedback. Connecting the dots was an interesting answer and suggests that the tool helps users to see the point of interest within an area and enables them to connect either with the analysis features or set-up of the site.

Reasons Why Not Successful

The participants that indicated they had not completed a successful landscape / research project within Inno360, were then asked to briefly describe why it was not successful. This was so that the reasons behind why projects are not being completed within the tool could be identified directly from participants. This answer was qualitative in nature with open text analysis. The reasons for non-completion of projects are summarised and listed in Table 25.

Table 25 Qualitative Data Summary - Reasons for Non-Completion of Projects within Inno360 - Open Text

Why Unsuccessful	Frequency (valid %)
Have Not Used It (at all)	29 (29.2)
Complicated / Hard to Use	14 (14.1)
Time Constraint	10 (10.1)
Exploratory / Learning Use Only	10 (10.1)
Lack of Relevant Results / Search Too Broad	8 (8)
Other or Changing Priorities / New Assignment	7 (7)
Use Other Databases	6 (6)
Difficulty Defining Search Terms	6 (6)
Project On-going	5 (5)
Not Used Since Training	5 (5)
Not Intuitive	4 (4)
No Project Setup / Scope	3 (3)
No Need to Use	3 (3)
Patent Family Duplicates	3 (3)
Uncertainty over Applicability to Job	3 (3)
Need Training	2 (2)
Overwhelmed by System / Too Many Results	2 (2)
Low Peer Adoption	2 (2)
Slow	2 (2)
Too Narrow	1 (1)
Not On-Boarded	1 (1)
Unsatisfactory Website	1 (1)
Difficulty Finding Experts	1 (1)
Built Landscape	1 (1)
Missed Key Papers	1 (1)
Landscaping Tools Unhelpful	1 (1)
	Total: 99

The most common answer for not successfully completing a project within Inno360 was simply because they have not used the tool (29%). The next most common answer was because it is too complicated / hard to use (14%). Time constraints (10%) and using the tool for exploratory or learning use only (10%)

were the next two answers. The other answers are spread with fewer participants naming a specific issue, however they gave an overview of tool perception. Issues such as a lack of relevant results (8%), being unintuitive (4%), low peer adoption (2%), and need for training (2%) were identified.

The issues cross over from technological capabilities of the tool and human factors such as collaboration. 5% of participants said that they had an on-going project at the time of the survey and 7% said that their priorities have changed. This suggests a fast-paced working environment where people and roles are constantly changing. This might be an influencing factor for the success of a tool that needs to cope with frequently changing assignments and projects. This question supports the last main survey question asking for improvement areas for Inno360.

4.2.3 Activity Effectiveness & Adoption Barriers

Activity Effectiveness

Question 4 asked participants to firstly state which activities they used Inno360 for and secondly asked them to rate how effective the tool is at each activity. The effectiveness of 11 Inno360 activities were measured on a five point likert scale from 1 meaning ‘not effective’ to 5 meaning ‘very effective’. This question was quantitative in nature and had 124 responses. As detailed in Table 26, the results immediately suggest that none of the activities are effective as the mode value for all 11 activities is 0 meaning ‘not applicable’. However, when comparing against the mean values, some activities are more effective than others and the mode value is not necessarily reflective of the results.

Table 26 Quantitative Data Summary - Inno360 Activity Effectiveness Stats 1

Inno360 Activity Effectiveness	Mode (valid %)	Mean	Standard Deviation
Internal Searches	0 = Not Applicable (37.1)	2.06	1.918
External Searches	0 = Not Applicable (28.2)	2.40	1.903
Internal Collaboration	0 = Not Applicable (50)	1.40	1.647
Benefit Landscaping	0 = Not Applicable (51.6)	1.47	1.819
Expert Identification (Internal)	0 = Not Applicable (55.6)	1.30	1.725
Expert Identification (External)	0 = Not Applicable (55.6)	1.31	1.736
Competitive Intelligence / IP	0 = Not Applicable (38.7)	2.02	1.955
Market Data	0 = Not Applicable (73.4)	.66	1.262
Claims Support	0 = Not Applicable (73.4)	.72	1.353
Personal Development	0 = Not Applicable (62.9)	1.17	1.761
Trend Identification	0 = Not Applicable (66.9)	1.09	1.739
Scale: 1 = not effective, 3 = moderately effective, 5 = very effective, 0 = not applicable			

There was a general lack of awareness of Inno360 activities, with only three out of eleven activities rated as 'effective'. It is apparent that most of the Inno360 activities are not used by participants, as eight out of the 11 activities were rated by over 50% as 'not applicable'. Claims support and market data were the two least used activities with 73% rating them as 'not applicable' (see Table 27). This could be due to low awareness of the full tool capabilities or low relevance to their search needs.

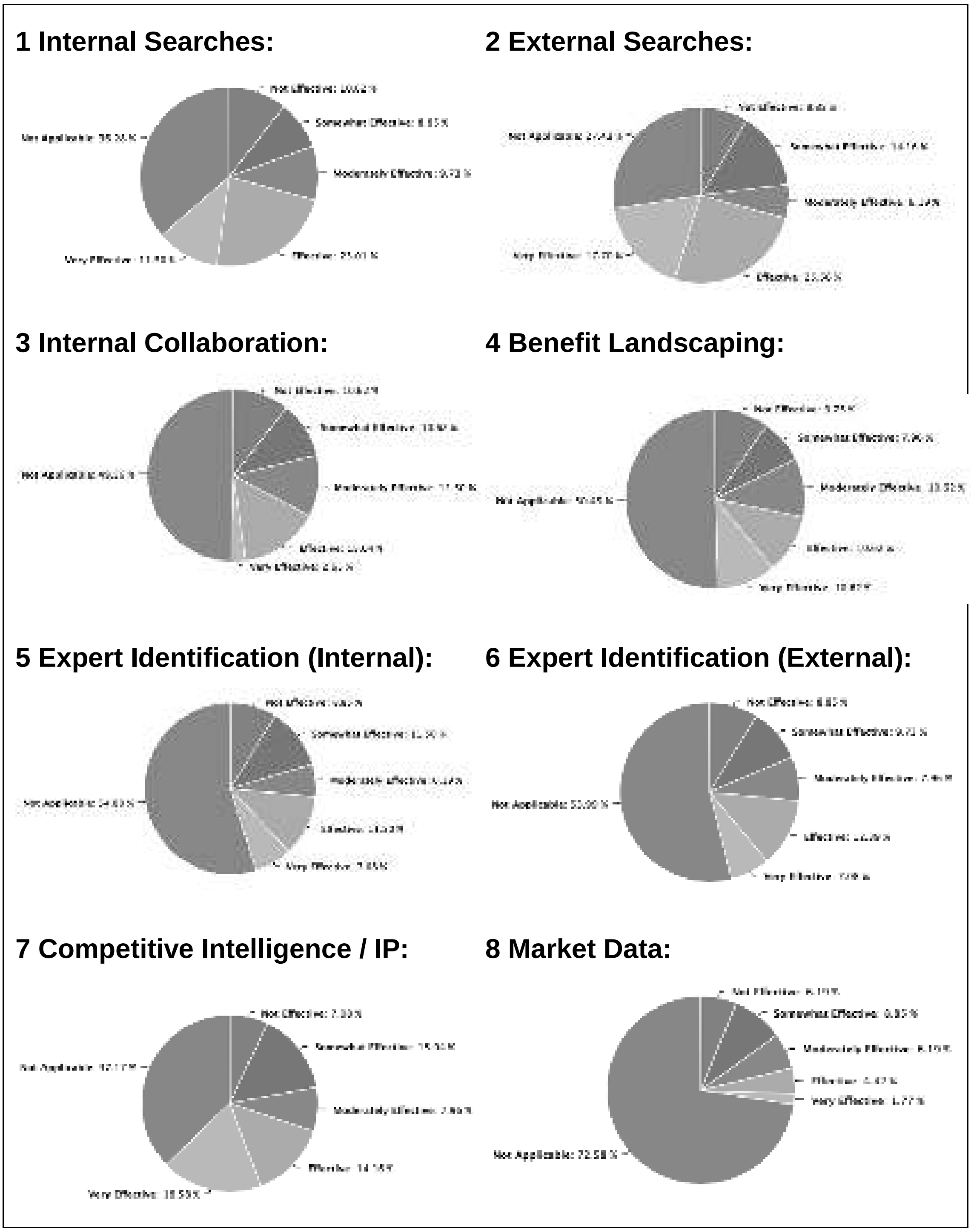
Three activities are used most frequently by users: internal searches (SLR, TechReports), external searches, and competitive intelligence / IP. Accordingly, these activities were rated highly as being either 'effective' or 'very effective'. These are all scanning activities where knowledge is sourced either internally or externally. Competitive analysis / IP was the most effective activity with 21 users identifying it as 'very effective'. This was closely followed by the activity of external searches with 20 users and the third activity internal searches had 15 users identifying it as 'very effective'. A greater percentage rated internal and external searches as 'effective' at 21% and 25% respectively compared to 13% for competitive intelligence / IP. This suggests that conducting searches is a more common activity utilised by the majority of Inno360 users rather than competitive intelligence activities.

A grouping of four activities were rated as effective ranging from 10% to 15% as 'effective': internal collaboration (15%), expert identification (internal) (12%), expert identification (external) (12%) and benefit landscaping (10%). There was no difference between the effectiveness of Inno360 for identifying internal versus external experts. The main finding is that most of the activities are not used frequently. The three activities rated as 'effective' centre around scanning activities for conducting internal and external searches and viewing intelligence from competitors or finding IP.

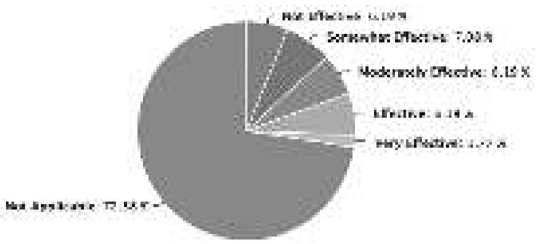
Table 27 Quantitative Data Summary - Inno360 Activity Effectiveness Stats 2

	Not Effective		Somewhat Effective		Moderately Effective		Effective		Very Effective		Not Applicable		Total
Internal searches (SLR, TechReports)	13	10.5%	10	8.1%	13	10.5%	27	21.8%	15	12.1%	46	37.1%	124
External searches	12	9.7%	17	13.7%	9	7.3%	31	25.0%	20	16.1%	35	28.2%	124
Internal collaboration	13	10.5%	12	9.7%	15	12.1%	19	15.3%	3	2.4%	62	50.0%	124
Benefit landscaping	13	10.5%	9	7.3%	13	10.5%	13	10.5%	12	9.7%	64	51.6%	124
Expert identification (internal)	11	8.9%	13	10.5%	8	6.5%	15	12.1%	8	6.5%	69	55.6%	124
Expert identification (external)	11	8.9%	11	8.9%	10	8.1%	15	12.1%	8	6.5%	69	55.6%	124
Competitive intelligence / IP	10	8.1%	17	13.7%	11	8.9%	17	13.7%	21	16.9%	48	38.7%	124
Market data	8	6.5%	10	8.1%	8	6.5%	5	4.0%	2	1.6%	91	73.4%	124
Claims support	7	5.6%	8	6.5%	8	6.5%	8	6.5%	2	1.6%	91	73.4%	124
Personal development	10	8.1%	4	3.2%	11	8.9%	11	8.9%	10	8.1%	78	62.9%	124
Trend identification	6	4.8%	6	4.8%	8	6.5%	12	9.7%	9	7.3%	83	66.9%	124

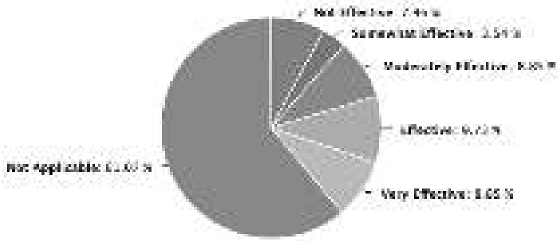
This data is illustrated in pie charts to more easily communicate the range of effectiveness of Inno360 activities in Figure 37. In general, it appears that Inno360 is seen as most effective at external searches and competitive intelligence / IP. The fact that the majority of activities were rated as not applicable might also relate to the sector they are from. For example, someone in the legal department would not necessarily need to use Inno360 for activities unrelated to finding and analysing patents. This means that there may be key activities, which are used more often by particular company departments.



9 Claims Support:



10 Personal Development:



11 Trend Identification:

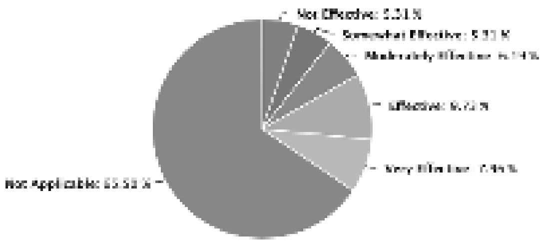


Figure 37 Quantitative Data Summary - Inno360 Activity Effectiveness Piecharts

Barriers

The main barriers (question 5) experienced by the sample were complexity and a lack of time for integrating the tool into their daily activities. Struggling with complexity and / or having difficulty understanding how to use Inno360 was selected by 45% and a lack of time to integrate into activities by 39%. Difficulty getting relevant results (36%) was the third most experienced barrier (see Table 28 and Table 29). This could be because practitioners can receive an overwhelming number of results and find it difficult to pinpoint the most promising leads. Achieving hits that are relevant and appear quickly is a key factor for improving adoption rates of search tools. This links to issues such as search term definition, search sources (i.e. databases), evaluation and selection / filtering of results, and data visualisation.

Table 28 Quantitative Data Summary - Barriers Experienced when using Inno360 – Barchart

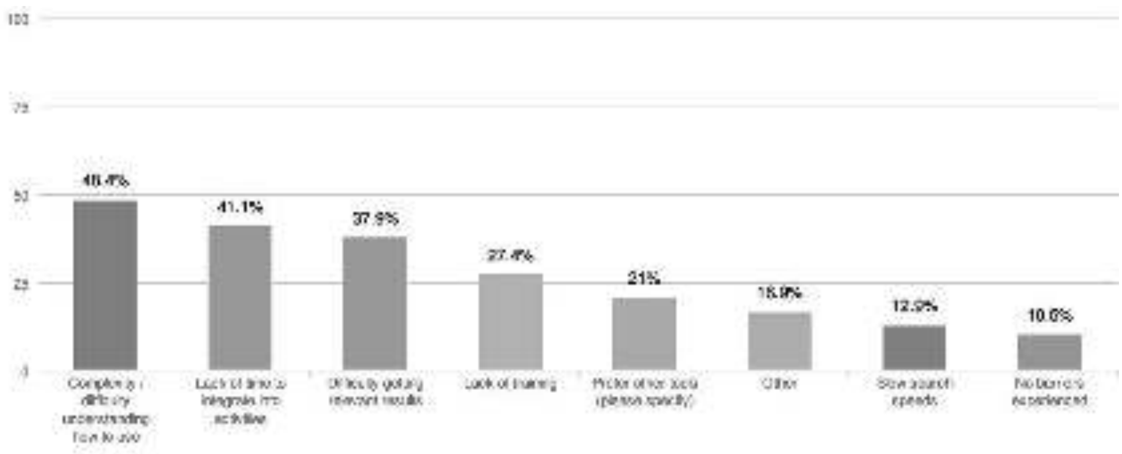


Table 29 Quantitative Data Summary - Barriers Experienced when using Inno360 – Frequency Table

Barriers	Frequency (valid %)
Complexity / difficulty understanding how to use	60 (45.5)
Lack of time to integrate into activities	51 (38.6)
Difficulty getting relevant results	47 (35.6)
Lack of training	34 (25.8)
Prefer other tools	26 (19.7)
Other	21 (15.9)
Slow search speeds	16 (12.1)
No barriers experienced	13 (9.8)
	Total: 132

A lack of training was experienced by a quarter of respondents as a barrier. This could be due to the users being unaware of training on offer, do not attend training sessions or feel that attended training is ineffective. The open text analysis reveals insights into why current training is seen as ineffective and could therefore lend itself to ineffective training as the most plausible answer.

Participants that selected ‘prefer other tools’ were then asked to give an open text response to specify which tools they did use instead of Inno360 for front-end innovation search and select activities. Table 30 shows that Orbit is the most frequently used tool (44%) followed by Google (32%) and Scopus (20%).

Table 30 Qualitative Data Summary - Barriers Experienced within Inno360 – 'Prefer Other Tools' Answers – Open Text

Other Tools Used	Frequency (valid %)
Orbit	11 (44)
Google	8 (32)
Scopus	5 (20)
Virtual Library	4 (16)
PubMed	3 (12)
SLS	3 (12)
SLR	2 (8)
IP.com	2 (8)
Internet Searches	2 (8)
SciFinder	2 (8)
IQC	1 (4)
Euromonitor	1 (4)
Knovel	1 (4)
Team Spaces	1 (4)
Working with Suppliers	1 (4)
Illumin8	1 (4)
WPIX	1 (4)
Chemical Abstracts	1 (4)

It is apparent that a range of tools are utilised by C+D practitioners. These tools are publicly available to other companies, including competitors, to use for their innovation searches. The databases are mostly based on technical and scientific information for identifying patents within an area. It appears to be the case that the effectiveness of particular databases for search practices may be influenced by the nature of the company and type of employee background. For this survey, P&G is the case study example and these particular databases would therefore not necessarily be the most effective sources for other companies and their search needs.

Participants, who identified that they experienced other barriers within Inno360 that were not included in the provided answers, are summarised in Table 31. Out of the 21 participants who selected this option, four stated that they simply have not used Inno360, two stated that they experienced a barrier in terms of their peers not adopting the tool, two stated they experienced IT issues and one participant each stated other barriers including lack of capability awareness, not easily accessible, lack of expertise and low sensitivity.

Table 31 Qualitative Data Summary - Barriers Experienced within Inno360 –'Other' Answers – Open Text

Other Barriers	Frequency (valid %)
Have Not Used It	4 (19)
Slow / No Adoption by Peers	2 (9.5)
IT / Access Issues	2 (9.5)
Project Start Non-Intuitive	1 (4.7)
Poor Analytics & Visualisation	1 (4.7)
Uncertainty over Search Terms	1 (4.7)
Lack of Capability Awareness	1 (4.7)
Not Easily Accessible	1 (4.7)
No Structure Search	1 (4.7)
Unable to Download SLRs	1 (4.7)
Searches One Database at a Time	1 (4.7)
More Training	1 (4.7)
Lack of Expertise	1 (4.7)
Clunky, Non-Smooth Reading	1 (4.7)
Need Right Project	1 (4.7)
Automatic Default Search Source	1 (4.7)
Low Sensitivity	1 (4.7)
	Total: 21

The other identified barriers span multiple different issues: some are practical based (accessing reports, default searches), some are about establishment within FEI teams (low peer adoption, need right project), and personal barriers (search term uncertainty, lack of capability awareness) and display of results (poor analytics, clunky reading). One barrier in particular, 'searches one database at a time' is not the case within Inno360, however it raises an interesting question as to why users are unaware that they can select multiple sources (effectively the offering of Inno360) and whether this is communicated. This element of miscommunication is common with tools new to a company, however, Inno360 has been adopted in the US for four years at the time of the survey. This means that there are gaps in how the benefits and capabilities are reaching (or indeed not reaching) target users.

In order to overcome these barriers, efforts need to be made to improve the experience of users over and above the search performance. All of these barriers can be addressed to varying degrees as some are more complicated compared with practical barriers within the software functions. Aiming to raise the overall adoption of the tool by FEI teams for example, would require solutions which addressed enhancing and communicating tool benefits more effectively, providing incentives for teams use within daily activities and targets, and making it easier to use, particularly with starting and managing current projects.

4.2.4 Session Length & Other Tools

Length of Time for Single Session

Question 6 asked how long the sample typically spent during one session on Inno360. The majority (55%) of users typically spent 0 - 30 minutes using whilst 32% spent between 31 - 60 minutes (see Table 32). An emerging question here is whether participants are using Inno360 to perform deep dive searching or using the time to work out how to use the tool effectively. It is clear that the speed of analysis is essential with one participant stating that they need answers within 10 - 30 seconds of entering a search.

Table 32 Quantitative Data Summary - Length of Time for Single Inno360 Session

Typical Session Length	Mode (valid %)	Mean	Standard Deviation
	1 = 0-30 minutes (54.9)	1.60	.757

Scale: 1 = 0-30 minutes, 2 = 31-60 minutes, 3 = 1-2 hours, 4 = 2 hours +

The reason behind this figure incorporates the fact that many of users do not actually use Inno360 at all, meaning that they selected this answer to reflect their 0 minute answer. However this answer gave a range from 0 - 30 minutes only. It may therefore have been useful to separate the answers for this question, providing a ‘0 minutes’ and ‘1 - 30 minute(s)’ selection alongside the other answers.

Usefulness for Project Needs

Inno360 was seen as halfway between ‘somewhat’ and ‘moderately’ useful as a tool for R&D project needs (question 7). This data suggests that perceptions of the usefulness of Inno360 on the whole is mixed, with some finding it useful and some holding the opposite view. The mean value sits almost exactly between the answers of ‘somewhat useful’ and ‘moderately useful’, at 15% and 17% of respondents respectively. The mode sits within the ‘not useful’ answer at 18.9%, however, the second most common answer was ‘useful’ at 18% which is less than 1% lower (see Table 33). This reflects that users have differing experiences with the tool and may or may not see it as useful for project needs.

Table 33 Quantitative Data Summary - Usefulness of Inno360 for R&D Project Needs

Usefulness of Inno360	Mode (valid %)	Mean	Standard Deviation
	0 = Not Applicable (13.9)	2.58	1.695
Mode	**1 = Not Useful (18.9)**		
Mean	2 = Somewhat Useful (14.8)		
	3 = Moderately Useful (17.2)		
	4 = Useful (18)		
	5 = Very Useful (17.2)		
Scale: 1 = not useful, 3 = moderately useful, 5 = very useful, 0 = not applicable			

If you were to group and add the percentages into three groups of two (i.e. 0 and 1, 2 and 3, and 4 and 5), the three groups are fairly similar in their totals as a useful comparison. The 0 and 1 (not useful) grouping is 32.8%, 2 and 3 (somewhat and moderately useful) grouping is 32% and the 4 and 5 (useful and very useful) grouping is 35.2%. The 4 and 5 grouping is the highest percentage over the other two by 3% which could be used to argue that Inno360 is seen to be useful or very useful for the majority who use it. However, this researcher argues that the mean value of 2.58 more accurately reflects the distribution of data around all six answers.

Other Landscaping Tools & Why

Question 8 asked participants to state what other search and landscaping tools they used and why for their searching activities. Google, Orbit and Scopus were the most popular alternative search tools. The primary purpose was to help indicate exactly which other tools participants found useful to their search needs and why. Orbit, Google and Scopus were identified as the most commonly used tools. 11% identified that the question was not applicable and therefore suggests that they either do not use any search tools at all, including Inno360, or only use Inno360. The interview results suggest that rarely do practitioners use solely one tool for search and select practices, but rather multiple tools with more informal methods included. Involving multiple tools in practices does heighten the risks involved (Pentland and Feldman, 2007). It is therefore likely that the 'not applicable' respondents do not use Inno360 or any other tools.

The other tools identified are detailed in Table 34 and include various scientific databases for patent searches, product databases (GNPD), learning reports, internal sources (P&G Virtual Library), and other non-digital methods (external companies / contacts). These tools are less commonly used but are more specific to address certain search needs.

Table 34 Qualitative Data Summary - Other Landscaping / Research Tools Used and Why – Open Text

Other Tools Used	Reasons Why (Frequency - Times Mentioned)	Tool Frequency (valid %)
1 Google	Easy to use (18) Quick / Fast (10) Relevant Hits / Results (6) Broad (3) Habit (3)	40 (21.8)
2 Orbit	Detailed patent data / search (9) IP searches (6) Easy to use (3) Patent analysis features (3) Intuitive IP filtering (2)	27 (14.7)
3 Scopus	Literature search (8) Alert capability (2) Citation search capability (2) Review & select articles easily (1) Good sub-search (1)	16 (8.7)
4 SLS	Easy to search SLRs / patents (4) Easy to use (3) Internal R&D learning (2) Familiar (1) Up-to-date learning (1) Useful results (1) Reliable list of experts (1)	16 (8.7)
5 SLR	Internal data (1) IP (1) Relevant (1) Easy to use (1) Know how to use (1)	9 (4.9)
Not Applicable	N/A	20 (10.9)
		Total: 183

Note: full table included in Appendix as Table 52

Participants were asked to identify the reasons why they use the other landscaping tools they identified. Results suggest that they were used because they are intuitive, fast, and narrow down results easily. Google was referred to 40 times (22%) with the main reasons as being easy to use, quick / fast searches, gives relevant hits, and performs a broad search. An interesting issue identified is that Google is simply a part of people's default search habits. This links to other reasons given such as people knowing how to use it (familiarity), find it effective, accessible and reliable. This emphasised the importance of effectiveness of tools within industry.

Orbit was used by 15% of practitioners and Scopus by 9%. Orbit and Scopus are key tools for patent searches and the overall view from participants is that they are more intuitive to use when narrowing down results. Orbit is also recommended to employees internally for conducting patent searches and contributes to answering why this tool is adopted frequently by P&G practitioners. Specifically Orbit offers detailed patent data which was the main reason it is used, followed by IP searches, the ease of use and patent analysis features. Intuitive IP filtering was the next most popular answer for Orbit, followed by it being a company preferred tool and its search syntax. Orbit appears to be successful as an alternative tool because it gives the desired patent data required for the searches performed by users and is regarded as intuitive and easy to use.

Scopus is mainly used for literature searches, stated by eight out of the 16 users: two mentioned the alert capability and two mentioned the citation search capability. The other reasons mentioned by participants are the review and selection of articles, good sub-search, easy to use, links to full text and easy to spot work by unknown authors. These reasons are all driven by the ability of Scopus to search and access scientific literature for search and select needs. The ability of a tool to quickly narrow down results is emerging as a key success factor for innovation search tools.

The SLS (Standard Learning System) and SLRs (Standard Learning Reports) were the next most frequently used alternative tools. SLS was on par with Scopus at 9% and SLR at 5%. These systems are internally based within P&G and contain learning reports from internal projects. The top reasons the SLS system was used was because it is easy to search for SLRs / patents, easy to use, and to extract internal R&D learning. It is familiar, has up-to-date learning, and gives useful results and a reliable list of experts. These reasons were given by one participant respectively. The reasons for using SLRs were similar focusing on ease of use, internal data and participants knowing how to use it.

Google Scholar was used by 4% of participants with similar reasons to the previous tools. The main reasons why it is used is because it makes it easy to search, conduct literature searches, is easy to navigate and find relevant reports. At this point onwards in the table of tools, there is less agreement on certain issues as to why certain tools are used. This is likely due to the more specific nature of the additional tools. This research avoided grouping issues together that addressed different aspects of a similar issue in order to maintain originality. It is argued that it is more useful and insightful to keep attributes within similar issues separate.

The Virtual Library is another internal resource for P&G practitioners used by almost 4% of those surveyed. It is used for internal searching and is identified to be easy to use, relevant, contains market data, is comprehensive and users are able to download articles. Other reasons given were that you can search multiple databases at one time and that it saves time and builds knowledge. These reasons were not identified by many participants, however, it is important to include these responses as they help to build a holistic picture of the benefits of search and select tools on a generic and specific level. This is an emerging theme which relates to the generalisability of the survey findings.

An interesting category emerged from the open text analysis for other methods used as many of these were non-digital tools mentioned by almost 4% of participants. This included standard internet searches (which may or may not be tools such as Google), thought-leader questionnaires, external companies, personal file management, internal contacts for expert networking, and GBS Infolytics (internal librarian type resource). Many of these other methods involve networking with others, either to source companies to utilise or access expert knowledge or research capabilities.

It is acknowledged in the literature that methods for opportunity identification occur through formal and informal creativity tools and techniques (Koen *et al*., 2001). They go on to state that brainstorming, mind mapping and lateral thinking can be used alongside more informal techniques, such as ad-hoc sessions, water cooler / cyberspace discussion, individual insights or senior management edicts.

Numerous other tools were mentioned with benefits such as intuitive searching, broad scope, simple and reliability. The use of internal P&G tools such as the Virtual Library appear to be especially useful for some participants. This may be related to the issue of trusting the data, as data from external sources may not be as trusted as internal data (NIH syndrome).

The remaining tools are highly specialised, such as ScienceDirect, PubMed, and SciFinder with participants recognising tool specialism as an asset. Additional reasons given by users focus on key tool success factors such as: being intuitive to use, easy to find relevant results, and specific patent identification. It is apparent that several key emerging issues are present in the data. This helps to identify what generic and specific issues or functions participants find most important when using innovation search tools. These emerging issues are summarised at the end of this chapter.

One comment said that they did not realise Inno360 did all of these activities at all, which suggests a lack of awareness of what is available and what might be useful for their needs. The need for more training and more peer adoption were identified. Some words such as ‘effective’ were not included in this list as the actual meaning is ambiguous and could refer to any number of reasons (search speed / result relevancy etc.).

The ‘other’ category had several issues that were covered by the other areas, however they were not all included (thought-leader questionnaires and personal file management). The aim of this question was about addressing which digital search tools practitioners use and why. These other methods are therefore included in the analysis of the validation questions in Section 4.3, which covers the additional methods and practices used more broadly.

A disputed issue is the breath of search, in regards to which is the most useful: whether it is broad versus narrow or specific. Some argue that they used the tool because it gives a broad search which helps when they are using it in an exploratory way. This is often the case when users are just starting out with learning how the tool works and they ‘play around’ with it in the first few attempts. However, some users find a broad search to be a disadvantage as they are looking for specific answers to a particular need. It was stated that they want specific results from their searches. Therefore the type of search that is being performed will likely impact how effective the search is perceived by users.

Several more comments by users stated that the tool was useful for when the search concept is ill-defined. This suggests that the tool may be regarded as more useful within the early exploratory phase of an innovation search rather than when a search is fully defined. Making this distinction for search phase positioning could be linked to how effective users see a tool. Instances where there is a misalignment in search phase and tool capabilities could have the tool not functioning at its full potential.

4.2.5 Site Attributes & Recommendations

Usefulness of Site Attributes

Question 9 asked participants to identify how useful nine attributes of the Inno360 website were. It addressed the specific digital aspects of search tools (such as navigation, layout, visualisation features etc.) as well as aspects related to the user experience of the tool (such as training and project collaboration). This question was purely quantitative in nature and included likert scales in order for users to rate the level of usefulness of each site attribute. Table 35 summarises the results.

Table 35 Quantitative Data Summary - Usefulness of Inno360 Site Attributes Stats 1

Usefulness of Site Attributes	Mode (valid %)	Mean	Standard Deviation
Ease of Site Navigation	2 = Somewhat Useful (23.7)	2.23	1.523
Ease of Searching	2 = Somewhat Useful (21.9)	2.38	1.631
Relevance of Search Results	4 = Useful (24.6)	2.41	1.734
Ease of Project Collaboration	0 = Not Applicable (43)	1.62	1.737
Relevance of Databases for Searching	0 = Not Applicable (28.1)	2.32	1.827
Usefulness of Foam Trees/Circle Clusters/Explorer	0 = Not Applicable (24.6)	2.5	1.883
Layout/Design	0 = Not Applicable & 4 = Useful (22.8)	2.33	1.686
Usefulness of User Guide/Wiki	0 = Not Applicable (48.2)	1.36	1.552
Usefulness of Webinars/Training	0 = Not Applicable (51.8)	1.34	1.596
Scale: 1 = not useful, 3 = moderately useful, 5 = very useful, 0 = not applicable			

Overall 55% identified that the site attributes were ‘not applicable’. Five out of the nine attributes were identified most frequently as ‘not applicable’, although the percentages vary for each attribute, two attributes were ‘somewhat useful’, one was rated as ‘useful’ and one attribute had two equal answers of ‘not applicable’ and ‘useful’. When looking only at the mode values, the most useful site attribute is the relevance of search results with 25% rating it as useful. 23% rated the layout / design as useful but the same amount also rated it as ‘not applicable’. This implies that the not applicable attributes are either not used or users are unaware of them.

The mean values reflect a different picture of the results. If going by the highest mean value, usefulness of foam trees / circle clusters / explorer is the most useful attribute, followed by relevance of search results and ease of searching. These attributes and the following are on a similar mean range, represented as slightly higher than just ‘somewhat useful’ and midway between ‘somewhat’ and ‘moderately useful’ at 2.23 (ease of site navigation) to 2.5 (usefulness of foam trees / circle clusters / explorer). This suggests that these activities are on a similar level of usefulness to users however on a fairly low level.

Ease of project collaboration, user guide / wiki and webinars / training were rated as the least useful site attributes. These three attributes had a mean that was lower than the range which suggests that these were the least effective for Inno360 users. The highest percentage rating of an attribute as ‘not applicable’ was for usefulness of webinars / training (52%) followed by usefulness of user guide / wiki (48%) and ease of project collaboration (43%). These percentages are also shown in Table 36.

Table 36 Quantitative Data Summary - Usefulness of Inno360 Site Attributes Stats 2

	Not Useful	Somewhat Useful	Moderately Useful	Useful	Very Useful	Not Applicable	Responses
Ease of site navigation	13 11.4%	27 23.7%	22 19.3%	24 21.1%	5 4.4%	23 20.2%	114
Ease of searching	11 9.6%	25 21.9%	22 19.3%	21 18.4%	12 10.5%	23 20.2%	114
Relevance of search results	11 9.6%	21 18.4%	15 13.2%	28 24.6%	13 11.4%	26 22.8%	114
Ease of project collaboration	11 9.6%	20 17.5%	12 10.5%	12 10.5%	10 8.8%	49 43.0%	114
Relevance of databases for searching	10 8.8%	15 13.2%	19 16.7%	22 19.3%	16 14.0%	32 28.1%	114
Usefulness of team trees/circle clusters/explorer	12 10.5%	16 14.0%	14 12.3%	21 18.4%	23 20.2%	28 24.6%	114
Layout/design	11 9.6%	24 21.1%	16 14.0%	26 22.8%	11 9.6%	26 22.8%	114
Usefulness of user guide/wiki	12 10.5%	14 12.3%	20 17.5%	10 8.8%	3 2.6%	55 48.2%	114
Usefulness of webinars/training	8 7.0%	13 11.4%	21 18.4%	9 7.9%	4 3.5%	59 51.8%	114

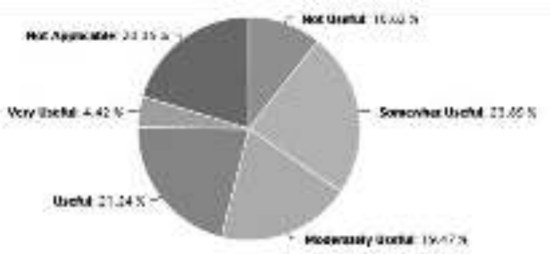
Webinars / training and user guide / wiki are both supporting activities aiming to increase the understanding of how Inno360 can be used effectively. This raises the question as to why they are being rated as not applicable to users. There are several reasons why this could be the case: i) users are unaware of their availability, ii) users are not accessing the support / training by choice, iii) users have accessed the support but do not believe they are useful, or iv) users just do not use Inno360 making the training redundant for them. Each of these reasons should be addressed with a different approach.

Ease of project collaboration is a site attribute that is linked directly to the number of active tool users. Simply put, there is a limit to how effective a tool can be for collaboration if not many FEI project teams have adopted it in their practices. One aspect may not be improved without the other also having to improve. Figure 38 displays the quantitative results for site attribute usefulness in piechart format. This is so that a more holistic view of the results can be seen which takes into account the range of responses for each attribute.

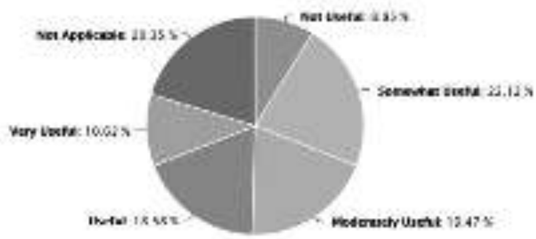
In contrast, foam trees / circle clusters / explorer and relevance of databases for searching were rated as the most useful site attributes. The attribute with the highest rating of ‘very useful’ was foam trees / circle clusters / explorer (20%), followed by the relevance of databases for searching (14%) and relevance of search results (11%). The rest of the results for attribute usefulness are fairly similar across the board.

It appears that the databases and sources integrated within Inno360 are useful and the connection mapping feature is identified as helpful. Results imply that the user guide / wiki and webinars / training are not used or are not perceived to be useful. This is another area where improvements can be made. As supported by the previous findings on the level of use and low peer adoption, ease of project collaboration was rated by 43% as ‘not applicable’. Of the users that do use the tool for project collaboration 17% rated the attribute as only ‘somewhat useful’.

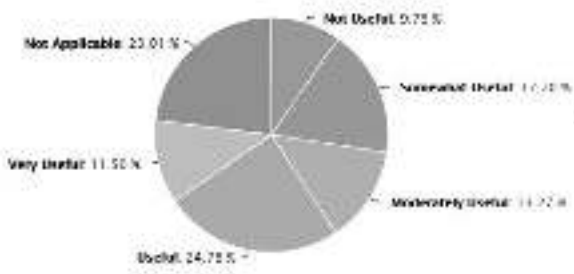
1 Ease of Site Navigation:



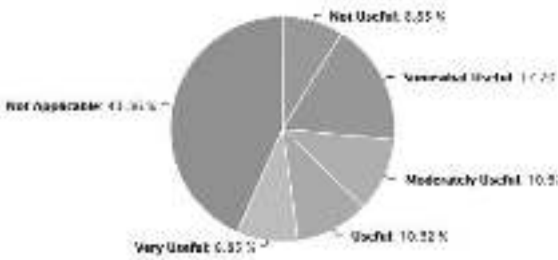
2 Ease of Searching:



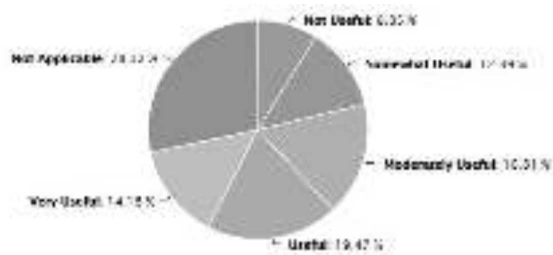
3 Relevance of Search Results:



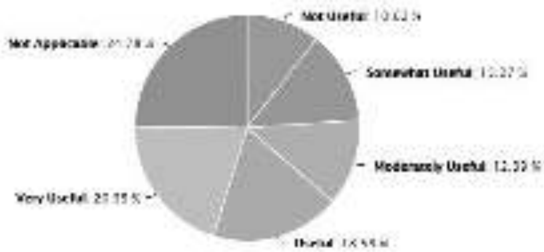
4 Ease of Project Collaboration:



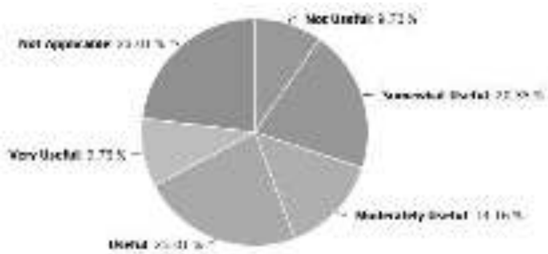
5 Relevance of Databases for Searching:



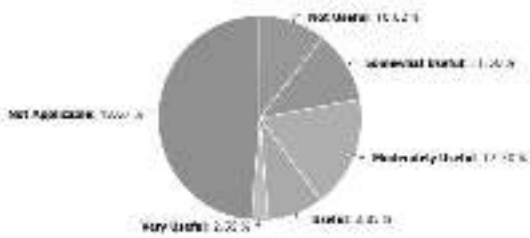
6 Usefulness of Foam Trees / Circle Clusters / Explorer:



7 Layout / Design:



8 Usefulness of User Guide / Wiki:



9 Usefulness of Webinars / Training:

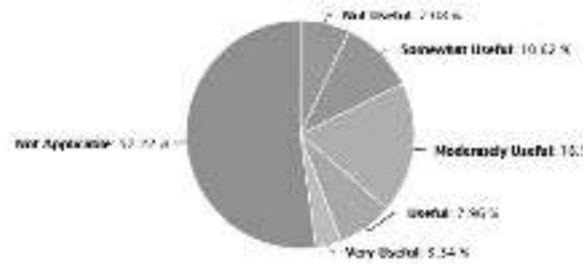


Figure 38 Quantitative Data Summary - Inno360 Site Attribute Usefulness Piecharts

Ease of site navigation had the highest rating of ‘not useful’ at 11%, however all of the attributes had a similar range between 11% - 9%. Only usefulness of webinars / training fell slightly below this at 7%. This implies that Inno360 is difficult to navigate which is supported by the qualitative open text data detailed in the following questions.

When adding together the ‘useful’ and ‘very useful’ data for each attribute four attributes came out on top: 1) usefulness of foam trees / circle clusters / explorer (39%), 2) relevance of search results (36%), 3) relevance of databases for searching (33%), and 4) layout / design (32%). This implies that users find the visualisation features and relevancy of databases and results as the most useful site attributes. However the results clearly show that there is much room for improving the usefulness of all the attributes.

The overall picture that emerged in relation to the usefulness of the nine site attributes was that the majority were not applicable to users. The validation interviews in the next section support this as the type of search and information that needs to be found has a significant impact on which tools or databases are most suited to carrying out the search. It also came out that users do not tend to stick to only one tool but rather use a variety for specific tasks, whether it is to do with finding patents or understanding the state-of-the-art within a particular field.

Data visualisation and the relevance of databases and search results were the most useful site attributes for Inno360. The ability to visualise a lot of complex data from different sources in various ways is a key attribute of Inno360 that appeals to users. This is linked to being able to share analysis results within teams or to facilitate individual understanding. Within industry there is a constant time pressure to finish projects and being able to find relevant results to the search need is critical. For this, the right databases need to be included according to needs for relevant results to be accessed and ultimately visualised for analysis.

These findings are aligned with the responses from the semi-structured interviews. These revealed that visualisation helps with gaining a more rapid understanding of a search area (see methodology section for Inno360 description). Very often when searching for innovation there is a mixture of formal and informal methods.

Areas Liked & Why

This question asked participants to identify what aspects of Inno360 they liked and to give their reasons why. The data was qualitative in nature utilising open text analysis. This enabled insights to be uncovered into the effectiveness of certain capabilities and other capabilities that were not asked about in the survey.

The visualisation of results was the most liked Inno360 attribute, with 35% identifying it positively in their comments. Table 37 gives a summary of the key areas liked from the open text. The sample in particular referenced the circle clusters and foam trees with several additional reasons branching from them. This is followed by users liking the Inno360 website (22%) and the ‘one-stop-shop’ concept (20%). The emerging theme from this area is that users like to see data and ideas in relation to other similar ideas as some users referenced clustering ideas, connection maps and viewing data in different configurations. This in turn gives the user the opportunity to have other ideas or other search terms triggered which may be more useful.

Table 37 Qualitative Data Summary - Areas Liked in Inno360 and Why – Open Text Summary

Area Liked	Area Frequency (valid %)
Visualisation	39 (34.8)
Inno360 Website	25 (22.3)
The Concept	22 (19.6)
Search Capability	19 (17)
Search Results	18 (16)
Search Sources	18 (16)
Collaboration	16 (14.3)
Integrated Search	14 (12.5)
Search Storage	12 (10.7)
Intellectual Property / Patents	11 (9.8)
Making Connections / Contacts	7 (6.2)
None	6 (5.3)
Not Used	5 (4.4)
Not Applicable	15 (13.4)
	Total: 112

There is a sense of mistrust over the generated visuals as one user in particular stated that they were unsure about how the visuals are generated and where the data came from. The landscaping tools appear to be promising a great deal but users are often finding them harder to use than expected.

The fully detailed areas and specific issues are shown in Table 38. This helped to identify and order not only the broad areas but also the specific issues within these areas. This ensured that the issues naturally formed the basis of the named areas. This was done by extracting the issues from the user comments in the survey and ordering them via frequency. Issues that were very similar within one area were grouped together, however if issues addressed a different point within one area then they were kept separate.

The fact that Inno360 is integrated with internal and external sources is a well liked aspect. The concept of the tool itself, that it sells itself as a "*one stop shop*" combining all sources together was the third most appealing area and was identified by 22 users. In contrast, some users expressed the view that one tool cannot do everything and should rather focus on a few aspects that it does very well in order to be effective. One comment summarised this view by stating that it is a good idea to have a single tool but that it is not better than other tools available.

Surprisingly, project collaboration is an aspect that is popular despite results proving that it is currently seen as ineffective with not enough users. Projects are completed within project teams and within departments within a company. Implementing innovation, even internally require multi-disciplinary activities that may be occurring in a different department. Tools that can facilitate and help manage collaboration between departments is a highly useful activity, but is difficult to put into practice. This implies that improvement of this aspect in particular, will help boost the adoption rates of Inno360. In contradiction, the broad searches are seen by some as a good thing but by others as not focused enough. This may link to how users define their terms (search definition) in the first instance which impacts result relevancy.

Looking at data differently was found to be important to users, however the execution of some features was lacking. Features such as saving report PDFs and searches, and being able to share them was well received. Inno360 was seen as a comprehensive yet too complex a tool. The ability of the tool to make users look at data differently is what they found useful. Users identified that clusters speak more than a list, bring about new word ideas and helps filter results. Digging into the data, having various ways to view the data, new adjacent ideas, sharing capabilities, clustering and facilitating the understanding of results were additional reasons into why visualising results in tools is so important. Visualisation has benefits in that it aids understanding, triggers new ideas and facilitates communication of information by providing a richer stimulus base (Wagner and Hayashi, 1994).

On a more practical level, there are issues with the tool being hard to access. Users like that they can use their internal company intranet password to log on to the system and not have to switch browser, however some comments iterated that it should be available on the P&G homepage.

Table 38 Qualitative Data Summary - Areas Liked in Inno360 and Why – Open Text Detailed

Area Liked	Reasons Why (Frequency - Times Mentioned)	Area Frequency (valid %)
Visualisation	Circle clusters – speaks more than list / new word ideas / filter results (12)	39 (34.8)
	Foam trees – dig into data (7)	
	Visualisation of results (4)	
	Graphical interface / visual display (4)	
	Explorer visualisation (3)	
Inno360 Website	Easy to use / user interface (4)	25 (22.3)
	Easy to access (3)	
	Cool / modern (3)	
	Use intranet password – simplified (2)	
	Site layout / design (2)	
The Concept	Federated / all in one search (5)	22 (19.6)
	One stop shop (4)	
Search Capability	Different searches / areas (4)	19 (17)
	Wide / broad search net (4)	
	Good / ultimate search engine (2)	
	Search basic technologies in other categories (1)	
	Smart ability – word proximity (1)	
Search Results	Excellent / relevant search results (3)	18 (16)
	Can analyse / narrow search results (3)	
	Easy to screen (1)	
	In-depth research (1)	
	Search with specific tool gives better results (1)	
Not Applicable	N/A	15 (13.4)
		Total: 112

What was significant about the findings was that out of the 11 areas (not including the not applicable groups) two areas were about visualisation and the website, one was about the concept, five areas were about the search (capability, results, sources, integration and storage), one about collaboration, one regarding IP and finally one on making connections. From this it is clear that the searching capability is critical to users and spans multiple areas that are important during daily activities. There was a strong view that users liked the potential of the tool which suggests that it is not performing at the level it could be. They used phrases such as ‘appears to be integrated’, ‘intent is easy to search and navigate’, and ‘potential to be great research tool’. These comments suggest that the tool is going in the right direction however it is not fully exploiting its capabilities and the functions users need.

Several descriptive words for Innno360 appeared within the comments and included: *innovative*, *powerful*, *eye-catching*, and *streamlined*. These words give a positive impression of the tool and its capabilities. Overall, the users that use Inno360 find they like the concept but the execution of certain key elements appears lacking. It should be noted that 20% of users did not list anything for what they liked about the tool.

Improvement Areas & Why

This question asked participants to identify what areas of Inno360 they think could be improved and to give their reasons why. This was asked in order to gain an understanding of the specific issues that users struggle with when using the tool. The data was qualitative in nature utilising open text analysis. Table 39 summarises the improvement areas suggested by users and non-users.

Table 39 Qualitative Data Summary - Improvement Areas in Inno360 and Why - Open Text Summary

Improvement Area	Area Frequency (valid %)
Usability	40 (35)
Search Results	29 (25.4)
Training	27 (23.6)
Search Capability	27 (23.6)
Collaboration	19 (16.6)
Inno360 Website	17 (14.9)
Intellectual Property / Patents	6 (5.2)
Visualisation	5 (4.3)

Learning to Use	4 (3.5)
Search Sources	4 (3.5)
Access	3 (2.6)
Integrated Search	2 (1.7)
Search Storage	2 (1.7)
None	9 (7.8)
Not Used	3 (2.6)
Not Applicable	9 (7.8)
	Total: 114

Users recommended improving the usability, relevance of search results and quality of the training for Inno360. The top improvement area stated by 35% was usability, particularly in regards to the intuitiveness and navigation of the tool. The next most popular improvement area was search results at 25%. The top issue within this area was that users were having difficulty getting relevant results or were getting no results to their searches. The next issue within search results was faster data narrowing as users want to find promising leads very quickly. Some stated that they found it difficult to refine their results. The other issues within this area spanned the organisation of results, exporting search results, repeating searches, quick answers, broadness of results, specific sources needing reworking.

Training was identified by 24% covering main issues such as a simple lack of training, having to re-learn how to use the tool if left for a long period and needing to learn full capabilities for effective usage. The other issues were about gaining in-person and online training, offering simple training, clearly stating the benefits and limitations of the tool, a need for access to training opportunities, guides for narrowing results and users having no time for training (see Table 40).

Search capability spanned multiple issues in regards to search speed, improving engine quality and narrowing the search. Other issues covered simplification of conducting a search, adding the ability to customise the default search, improving the intuitiveness and project initiation. Issues seemed to portray an importance placed on simplicity, methods to help search term definition, executing structured searches more effectively and the ability to customise defaults. Whether a search is exploratory or more in-depth also emerged as an issue as there is a view that Inno360 is in-depth so users tend to use it for those types of searches. However, findings also point to exploratory use by users trying to learn the software or searching with an ill-defined concept.

Performing faster data narrowing from searches was also a popular improvement issue. This could be about the functionality of the tool or be addressed by training users on refining their search terms. It is apparent that some of the areas are linked together closely. The speed of the site is viewed by some as slow and "*clucky*". This could be linked to users getting too many results and not knowing how to filter them effectively.

More in-person training is needed on defining initial search terms. Several recommendations were given to provide more in-person training. This suggests that current training sessions are not being attended or are unfit for potential user purposes. Users are keen to know how to use the tool effectively, without spending a long time trying to learn or relearn how to use it. Quick start-up online tutorials were suggested by one user. Similarly, a broader adoption of the tool is needed to boost user volume and therefore the potential for collaborative activities.

Table 40 Qualitative Data Summary - Improvement Areas in Inno360 and Why - Open Text Detailed

Improvement Area	Reasons Why (Frequency - Times Mentioned)	Area Frequency (valid %)
Usability	Ease of use (11)	40 (35)
	More user-friendly interface (7)	
	Easier navigation – non-intuitive (4)	
	Make more Google-like (4)	
	Less complicated - workflow (2)	
Search Results	Irrelevant / no results (6)	29 (25.4)
	More quickly filter results / promising lead (4)	

	Difficult to refine results (3)	
	Literature results poor (1)	
	Better organisation of results (1)	
Training	Lack of training / awareness (5)	27 (23.6)
	Need to relearn if not used often (2)	
	Need to learn full capabilities (2)	
	Facilitate effective usage (2)	
Search Capability	Speed – slow to search (10)	27 (23.6)
	Improve quality of search engine (3)	
	Narrow / focused search (2)	
	Speed and search command (1)	
	Does not return many relevant results (1)	
Collaboration	Uncertainty over purpose of tool (2)	19 (16.6)
	No enough people use for it to be effective (2)	
	More use of P&G team collaboration (2)	
	More sharing – not many use it (2)	
	Advertise it more (2)	
Not Applicable	N/A	9 (7.8)
		Total: 114

The interface is clearly seen as complex, hard to use and navigate. A key need is that users want relevant results and quickly. Numerous other suggestions are made to improve usability such as making start-up easier, reducing the number of computer clicks required to assess files and eliminating clutter etc.

Recommendations were made to increase the amount of advertising for the tool as not many people know about it. This links to the lack of awareness of the tool and potential to increase adoption. 15% of users did not list any improvement areas. Overall, users identified numerous issues where improvements could be made to Inno360. Importance was placed on communicating success stories and case studies with Inno360 benefitting a project directly.

4.2.6 Summary of Results

Inno360 Headline Findings

The importance of communicating the real value of a tool is not to be underestimated. Currently it is not seen as being communicated successfully within P&G. The tool itself was seen as too complex in terms of its interface and navigation by users, and by the fact that it was difficult to even access the tool. This barrier proves to be too much when fighting against easier options of fast searches within Google, which are users' typical default search behaviours.

Not enough employees use the tool and this means the uptake and adoption within teams is low. This is perpetuated by low awareness of tool capabilities and perceptions of its relevancy to project needs and deliverables. The practitioners who do use Inno360, said that some capabilities are not very effective, such as collaboration. Another contributing factor is a sense of uncertainty over the company's own expectations of the how the tool should be adopted in their search practices. Although the visualisation capabilities of the tool was the most well liked aspect, there was slight mistrust over data produced within the diagrams.

Another key area identified regarded the level of training required and effectiveness of current training. The majority of participants indicated they don't have time to learn how to use the tool and that the initial learning barrier was too high. Some identified that they tried it out of curiosity but they found that training was needed in order to engage with it in the long-term. Current training was not seen as effective with users wanting targeted sessions on defining search terms to find solutions.

Landscape projects were not typically completed within the tool as it was used mainly in an exploratory fashion. Faster filtering of promising leads would be most beneficial due to time constraints. The biggest improvement areas were identified to be usability, results and training. The main driver of success with innovation searches with to find an innovative technology which meets the need. Visualisation was the most well liked aspect of the tool.

Emerging Generic and Specific Issues

From the analysed data that there were two types of issues emerging with search and select practices: generic and specific. The generic issues are broad and relevant to other search and select innovation tools whereas the specific issues are narrow and related directly to Inno360. This distinction helps to determine which issues are useful for tool owners using other or multiple tools in their innovation search efforts. The specific issues are useful to those who use Inno360, but may also give insight to those using other similar tools.

Generic Search & Select Issues

During the course of the survey, multiple issues emerged which were generic in nature and applicable to other tools. Design activities are often undertaken under sever time constraints which acts as a barrier to innovation (Salter and Gann, 2003). This came through in the survey as practitioners cited lack of time as one of their main barriers to learning to use the tool, as well as time required to actually complete tasks. Lack of time to learn and understand benefits and self-evaluate a tool is recognised in the literature (Salter and Gann, 2003). To overcome this, effective training needs to be in place for practitioners to get the most value from the tool in a short space of time. Investment in training has a great impact on innovation (Lundvall, 2007) in reducing the learning curve.

In terms of enhancing the effectiveness of a tool, perceptions may need to be lighted in order to increase adoption. In this case, the low levels of adoption impact how effective it can be in terms of collaboration capabilities. Peer adoption has been shown to effect diffusion (Moreland-Russell, 2013), essentially the more connected a tool is then the more likely it is to be used within internal teams.

An interesting issue was that of the search habits of users and search tool familiarity. Many competitive tools are widely available such as Google which influences the approach for tools such as Inno360. The view is that it is currently seen as non-intuitive in comparison with time required re-learning if away from the tool for too long. Users like to use tools that are familiar and Inno360 is not currently seen as familiar to many registered users.

In order to enhance perceptions there is a need to clearly communicate the advantages of the tool over default user search habits. In addition, participants suggested using success cases of where the tool added real value to a project which can be communicated to others. This type of communication is important in order to engage potential users and clarify tool value. This in turn will impact awareness of the tool overall about capabilities and relevance to projects.

The level of expertise of users has been identified with novice users versus expert users (Lester, 1998) at two extremes of the spectrum. This also links to the background of users as anyone who is familiar with similar interfaces or digital tools are likely to pick up and use the tool more easily compared to someone who doesn’t use digital tools and prefers to make other forms of connection.

Expertise will also affect the usability of the tool, particularly search term definition and the filtering of relevant results were important in this survey. If a tool is complex, it will lend itself more to those who are experts rather than novice users, in terms of navigation and use of features and how they link to projects. Another issue identified was one of trust of the data, making sure that the visual data is transparent in terms of how it is generated increases the reliability.

The main benefit of tools such as Inno360 is that it is about integration, both internally and externally. Accessing databases that may otherwise be unavailable to users in different departments. This is facilitated by making connections through linking internal and external experts (Bercovitz and Feldman, 2007).

Basic functional attributes of a tool must be made user friendly. Making sure that it is accessible by a company link on an intranet or company homepage. The importance of connecting people to work on projects, without the complexity of the system as a barrier is important in the literature but not effectively facilitated in Inno360. Integration and effective execution of importing patent data from other tools is essential for technical searches (Bonino *et al*., 2010).

There is a high importance placed on being able to quickly filter a lot of results to identify the most promising leads. This raises the question as to how much of the process can be automatic rather than pure human judgement. Human versus digital searching (Turoff and Hiltz, 1996) is a theme related to this because interaction between the two must occur. It links to trust and familiarity with the tool and human judgement on relevancy.

There appears to be a lack of awareness of full tool capabilities, however survey participants acknowledged it is not possible to do everything in one single tool. Not all capabilities will be applicable so there might be a case for reducing capabilities in order to make it more targeted for a particular type of search. The role of the user impacts which capabilities are seen as effective for search needs. A user within the packaging function may not need to find many patents, however, a user wanting to find out which molecules interact with a certain polymer would need specialist sources.

Similar broad areas for what is liked and disliked about Inno360 emerged, suggesting that there are core areas of importance relevant to innovation search tools. Users like to see data and ideas in relation to other similar ideas as some users referenced clustering ideas, connection maps and viewing data in different configurations as helpful. Examples are included within the Inno360 description.

Specific Inno360 Issues

In addition to generic issues, there were specific issues that relate to Inno360. Access to Inno360 was difficult due to the link not being readily accessible on the P&G homepage. Having this link quicker to access in daily activities would help in integration and visibility. In terms of compatibility, there were issues using the tool within Windows and Internet Explorer which had yet to be solved at the time of the survey.

Search customisation was an issue as the ability to change the default search criteria from IP was not currently available. Searches tend to be technical in nature in this industry which affects the relevancy of highly specialised search sources and databases. Many users stated that the tool needs to be even simpler than it currently is. Result relevancy is contested in terms of broadness of search, some stated that results are not as relevant as results from other tools. This is likely linked to the type of search that is being performed. Practitioners wanted more targeted, in-person training for specific search tasks as well as guidance on how to make the best use of visualisations. The quick online training was either not easily accessed or not communicated to users. A key benefit communicated in the training sessions was the added search security that Inno360 provided over Google or other search engines, this was mentioned by one participant.

An Inno360 training session attended prior to the main survey reiterated the issues from the quantitative survey. Interestingly, the presentation of Inno360 during that session was that it gives fewer results than Google, but gave higher relevancy of results and added security to searches. The security of searches was a clear selling point during the Inno360 training session in Beijing, however was only mentioned by one user as a benefit in the survey. This benefit was clearly not enough to overcome usability issues.

Project collaboration was a key capability tool aspect which was popular despite results suggesting that collaboration within the tool is not effective due to low adoption of the tool. These specific issues highlight the need to visualise and link internal and external issues in complex or uncertain processes. Visualisation of data was found to be a valuable method of interpretation and development by practitioners. The number of interconnections, degree of uncertainty and dependency characterise these interfaces (Scott, 1981). The purpose of external scanning is therefore to identify key events and trends, and consequently envisage the impact and the opportunities for innovation.

Ideas require deep dives into relevant areas to reduce uncertainty and increase knowledge through learning. The outcome of one such iteration creates further ideas, which necessitates additional deep dives to reduce uncertainty and increase knowledge. This is particularly relevant when tools are supporting activities which are collaborative and uncertain in nature, key characteristics of innovation activities.

4.3 Validation Interviews

In order to validate the findings from the mainly quantitative Inno360 survey, in-depth semi-structured interviews were conducted with seven C+D practitioners. The main survey focused on identifying the relevant issues (the 'what') and touched on some of the reasons behind answers (the 'why). However, these validation interviews enabled the study to go into further depth with the 'why' behind these answers and allow for cross-comparison of issues. The qualitative analysis was conducted using Excel and thematic coding analysis (see methodology chapter).

There were two main goals aligned to two sections (labelled A and B) with eight sub-topics in total to address them. Table 41 gives the overall question structure used to analyse the responses. The validation interviews have been structured as follows:

- to confirm search and select practices used in industry (sections A.1 to A.4), and
- to validate the Inno360 effectiveness survey findings (sections B.1 to B.4).

Section A includes four sub-categories of questions: A.1 defining the need, A.2 search & select practices, A.3 tool integration, and A.4 measuring success. This section uses more general questions regarding search and select practices and methods. Structuring the questions in this way allowed for greater clarity of the main topics addressed.

Section B also has four sub-categories: B.1 tool usage, B.2 managing complexity, B.3 barriers / challenges, and B.4 R&D value. This section focused on Inno360 and how it is used as a tool within search and select practices. The last question asked for any further comments or reflections from practitioners on the topics discussed. This gave practitioners the opportunity to add any additional insights or issues that were not addressed by any of the questions.

These sub-categories were chosen due to relevance to the analysed literature and insights gained from the scoping interviews. These also aligned to the industrial requirement to analyse the effectiveness of Inno360.

Table 41 Validation Interview Question Structure

A) Confirming Search & Select Practices			B) Validating Inno360 Survey Outcomes		
A.1 Defining the Need			B.1 Tool Usage		
How do you define / redefine the need statement?	How effective are need statements?	Do need statements require rework? If so, why?	Do you typically use Inno360 in your search and select activities?	If yes, how and why do you use Inno360?	If not, why do you not use Inno360?
A.2 Search & Select Practices			B.2 Managing Complexity		
How do you search and select external capabilities?	Do you use formal or informal methods?	Why do you use these formal / informal methods?	Does Inno360 help you manage complexity?	If yes, how and why does Inno360 help with complexity?	If not, what tools / methods do you use to manage complexity? How and why?
A.3 Tool Integration			B.3 Barriers / Challenges		
What tools / practices do you use to fulfill the need statement?	Why do you use these tools / practices?	How do you use these tools / practices?	What barriers / challenges do you face when using Inno360?	How do you address these barriers / challenges?	
A.4 Measuring Success			B.4 R&D Value		
What activities / factors help your search and select practices?	Why do these activities / factors help your search and select practices?	How do these activities / factors help your search and select practices?	What are the most important factors for building a landscape?		
Further comments / reflections					
Any further comments on your search and select practices / value of Inno360?					

Each sub-category topic has a summary table at the start of each section to give an overview of the results in the relevant questions. Each question and the practitioner responses are then discussed in further detail under the subsequent headings. At the end of each sub-category the key issues that emerged are identified.

These interviews allowed for further discussion of emerging research issues and gathered additional insights into search and select practices. The purpose is to gain insight into the actual nature of methods used. In particular, to also gain a greater understanding of how tools such as Inno360 can facilitate and in some ways constrict searching practices used in industry.

4.3.1 Importance of Defining the Need

In order to gain an understanding of the effectiveness of need statements, the practitioners were asked how they defined the need statement, how effective the need statements are and if they required any reworking. This addresses section A.1 in Table 41. Table 42 below gives a summary of the qualitative results from the validation interviews.

Table 42 Validation Interview Summary - Defining the Need

Source: Author (2016)

A) Confirming Search & Select Practices		
A.1 Defining the Need		
How do you define / redefine the need statement?	How effective are need statements?	Do need statements require rework? If so, why?
Needs brief	Effective with upfront agreement	Changing questions
Customer engagement / benefit	Team defined	Broad versus specific balance - refinement
Keywords	Iteration of statement	Define customer need
Breakdown question	Must include understanding of business need	Confidentiality
Information type	Experience insights included	Iteration - learning process
Language	Allow for unexpected solutions	Openness
External networks		

The importance of defining the need is well established in the literature, however more understanding is needed on how the need is defined in practice. The effectiveness of need statements is fundamental to search and select practices as ideas generated to satisfy an opportunity search are more valuable because they fulfil a need (de Bono, 1978). Whether or not statements need reworking is an aspect linked to effectiveness, however iteration and re-definition is common within front-end stages (Artto *et al*., 2008; Poskela and Martinsuo, 2009). This question therefore aids understanding of the importance of defining the need correctly to drive searches for innovation.

Defining the Need Statement

A variety of methods were described within the responses on how practitioners defined the need statement. Some indicated that the business defined them and therefore they are not directly involved in defining it, whereas others stated that they were continuously trying to understand and define the need statement. The latter was the more pronounced view. A focus was on exploring options at this stage and in particular, keeping a focus on the customer benefit rather than the technology. The need statement was sometimes referred to as the business question, emphasising the difference of language as an issue even within the same company. There were varying concerns between practitioners according to their role in the company, for example someone in competitive intelligence focuses on searching for activities of competitors, and an information specialist focuses on finding the right data. The importance of collaboration during need definition was identified in almost all interviews, as illustrated in the quote below:

> "*When we do a project I agree upfront with my business unit partner, I mean corporate that means I work with lots of different business units, and we agree on what the business question is before we do anything. We're very careful to do that*" (Interview transcript B)

The needs brief is a tool used within P&G and is the starting point to all search and select activities. Breaking down the question and gaining a deep understanding of it was described as a key success factor. Often the process of searching itself facilitated the definition of the need statement via keyword searches. This suggests that there is an element of flexibility on practitioners interpreting the brief in creative ways. External networks and the tendency to look externally first was another common practice.

Core partner competencies and alignment to the need directly emerged as an important selection criteria. Overall gaining a broad understanding of the need, knowing the type of information needed, and approaching relevant external networks came out strongly. Activities also centred on discussion of the need with other parties such as colleagues, other business units and customers.

Effectiveness of Need Statements

The response to how effective current need statements are was largely positive. Teams are often involved in interpreting and defining the statements in terms of root cause rather than problem symptom. Iteration is expected within this phase of assessing the need and searches are largely kept broad to be narrowed down as the search continues. Regular projects often seem to feed off practitioners' existing experience within the area. This tacit knowledge is an important contributing factor for front-end innovation (Erden *et al*., 2008) and can impact how ideas and partners are selected. However, often solutions are unknown with these searches and practitioners can use keyword search techniques to refine their understanding of the need statement. One participant discussed how the root causes of a particular business problem often need further investigation:

> "*They're usually pretty good at describing what I would call the symptom, perhaps, or the issue that they face and what I typically do is help them penetrate that and see what the route-cause may be especially with regards to the physical mechanisms that are driving what they're observing.*" (Interview transcript F)

The effectiveness of need statements was stated by practitioners to be high due to their own part in defining it. This acknowledgment of their contribution is a conscious one, which could be argued to be bias. Upfront agreement and understanding the question were identified specifically as success factors. There was a focus on the achievement of the search and what the specific solution would be. One participant emphasised the need to look for unexpected solutions in different domains using different search routes.

These responses support the importance of defining and understand the driving need in-depth. Collaboration and working within teams appears to be common during this phase and the emphasis is on assessing what the outcome of the search will be and using iterative processes.

Refinement of Need Statements

Due to the high frequency of required iteration to the need statement, practitioners consequently stated that they do often rework the need statement (if it is not given pre-defined). The reasons why this is the case was identified to be due to having to find the real customer need, that it is a learning process with an unknown solution, the need to protect information whilst attract innovation, a lack of a problem focus and the tendency for narrow need briefs. Within these processes, there is a balance between being open enough to encourage solutions whilst not giving away confidential information.

The reworking process involves collecting new information to inform and improve the statement, whether it's from searches or personal interaction with others. Due to the technical nature of the company, searches tend to be driven by technical needs. One practitioner in particular identified it as "*hypothesis-driven*" involving taking observations and testing the overarching question. Addressing the real customer need was the focus of some participants which suggests that this is not always included in need briefs.

From analysing the data relating to the above three questions on how need statements are defined / redefined and their effectiveness the following key issues emerged:

- lack of problem focus: technical-driven process,
- reworked need statements: question iteration / uncertainty,
- search breadth / extensiveness: broad versus narrow, and
- search type: tactical versus strategic / technical need versus knowledge of space.

These findings suggest that during front-end innovation in relation to this sample, need statements are frequently reworked with an emphasis on clarifying the real problem or question. This indicates that real needs are not necessarily known at the start of the searching process and therefore effort is spent figuring out if the need is the correct one. This lack of problem focus is technical-driven rather than customer need driven. Overall there appears to be more informal activities and collaboration which helps define technically-based need statements.

A balance in terms of search breadth was acknowledged between keeping the search broad to include the most possible solutions and the desire to keep it narrow to find the most relevant results only. The need briefs were described as too narrow by one practitioner suggesting that a broad search is the most useful with rapid filtering applied. The other issue was about the search type, whether it is tactical or strategic which can impact which sources should be searched to achieve the best outcome.

4.3.2 Nature of Search and Select Practices

Practitioners were asked how they search and select external capabilities, if they use formal or informal methods and their reasons why they use those methods. This gave a detailed view of the various methods and processes involved and the issues faced within search and select practices. This addresses section A.2 in Table 41. Table 43 gives a summary of the qualitative results from this question.

Table 43 Validation Interview Summary - Search & Select Practices

Source: Author (2016)

A) Confirming Search & Select Practices		
A.2 Search & Select Practices		
How do you search and select external capabilities?	**Do you use formal or informal methods?**	**Why do you use these formal / informal methods?**
Dependant on type of need / info needed	Formal and informal methods (mainly informal)	Lack of knowing formal process
Combination of sources & accessibility	Uncertainty over definition	Solving problems
Divergent search	Tacit knowledge (experience)	Understanding field
Patent & literature searches	Establishment of relationship impacts formality	Sense of urgency
Internet searches (Google, GNPD, LinkedIn)	Cost efficiency	Different approaches to question
Networks & strategic partners	Personal networks	Meaningful connection
Sector specific databases		Latest information
Assess core capabilities		Confidentiality
Building knowledge		
Research institutions		

The responses included many different methods, tools and relevant issues faced by practitioners. Some gave very detailed answers and provided insight into their main considerations when searching and collaborating externally. The main survey sample included Inno360 users and non-users. It became clear there was a separation between those who were used to using digital search tools and those who preferred more informal methods, such as personal interaction. The details are discussed further below.

Identifying Search and Select Practices

Overall it was clear that searches are dependent on the type of need which impacts which information is needed. This in turn impacts which sources are most effective at addressing the need directly. One participant summarised this by saying that there is a different search for a different need. All practitioners stated that they used a combination of sources, some with a strong emphasis on seeking external sources first. A mixture of needs and experience was apparent. A key factor when selecting sources was how accessible they were with the most accessible being prioritised.

Conducting a divergent search and looking at all the options was common. A key source for most practitioners was finding patent information and literature searches, supporting the technical nature of the searches within this company. Filtering papers via citation or relevance using standard internet searches are also common within tools, such as Google, frequently supporting search efforts. Interestingly, the concern over security of their searches was not identified by any participants. In contrast, the limit of resources such as time and funding for searches was clear.

Utilising personal networks and strategic partners was another key method. Linked to this is the assessment of core capabilities, not only of the company doing the searching but of the potential or existing partners at their disposal. Research institutions were also mentioned frequently as an important resource for industrial searches which are country specific.

Sector specific databases were mentioned by several participants mainly due to their role and type of data they often deal with. This illustrates that languages used within certain domains are highly specialised and rarely accessed by those outside of the area of expertise. This could be creating a barrier making the knowledge less accessible to others. The search process requires building knowledge of the person conducting the search and the knowledge of the company as a whole. Entertaining a number of collaborative and wider networks has been identified as positively related to innovation (Shan *et al*., 1994). Conversely, closed networks appear to act as a more effective conduit for innovation than open ones (Coleman, 1988). Nohria (1992) suggested that this is because close contacts are more willing to support and encourage innovative ventures, giving managers the confidence to turn ideas into successful projects.

Nature of Search and Select Practices

Participants all agreed that they use a mixture of formal and informal search and select practices, with an emphasis on mostly informal methods. One practitioner stated that they use 90% informal methods. There was uncertainty over the definition of whether tools such as Inno360 are formal or informal with some siding each way. The types of tasks that are carried out in the tool appear to drive formality definition.

Methods such as brainstorming with clients and gathering opinion versus objective data were also included. The below quote illustrates the contradiction present in searches within innovation:

> "*It's a mix between science and art, so you can't really define step-by-step instructions*" (interview transcript F)

This might be why factors such as tacit knowledge or experience were also identified as an informal method employed. This method links to the issue of search tool familiarity with more familiar tools being preferred over unfamiliar new tools. This can be due to limited time where results are needed very quickly or a reluctance to learn a new tool that may or may not be of benefit. Cost efficiency is an issue which can limit the types of Innovation Service Providers (ISPs) which can be used for example. Making smart use of funds available for the most impact benefits the bottom line of companies.

Personal networks again came out as a main method which can be both formal and informal. This places greater importance on business activities such as networking. The level of establishment of partner relationships can also impact formality. New partners can require a formal approach whereas existing partnerships often have a more informal approach. This could be due to levels of confidence in the partners, knowledge of their capabilities and an element of added flexibility (Sieranoja, 2013).

Reasons for Nature of Search and Select Practice

This question explored the reasons why practitioners used these mainly informal methods in their search and select practices. Similar issues appeared such as the iteration required and achieving project understanding. Tools used were Google Scholar for "*pedigreed content*" as well as NineSigma. Practically practitioners use phone call and e-mails regularly to conduct their searches for information and reach out to existing contacts to address the question. Search breadth was mentioned with the argument that if a search is too broad it is not helpful.

Simply a lack of knowing the formal process within the company and lack of training were reasons given by one practitioner. The level of 'newness' to the role was a reason why this was the case but raises the question as to why the formal search process is not necessarily adopted by all employees. A constant thread through the responses was that it was about solving problems and using different approaches to the business question or need.

There was a need to find what was described as "*meaningful connection*". This comes from understanding not only the field but who the important players are within. Multiple sources are used such as official reports, project teams, and brainstorming. Gaining comfort with partners and displaying empathy to their busy time schedule were additional issues for facilitating collaboration. Addressing the need was stated to be difficult and barriers such as language affected search efforts.

There was a strong sense of urgency for completing searches across responses. This emphasises the need for quick interaction to perform searches swiftly and effectively in everyday practices. Finding the latest information was also stated to be of importance and was argued that this could most likely be found with external partners, such as Professors. However, an issue was stated with collaborating with universities as there is a tendency for work to start without a formal contract, something which is well practiced within industry. This also has an affect linked with reputation in some cases and may affect any future chances of reconnecting with the same individual.

This search urgency also means that there is a limit to the amount of detail that can be examined within the time allowed. It was stated that searches can last anywhere from a few weeks, months or even years for long-term projects that are of constant interest to the company. This in particular is why the ability for tools to easily save results and project progress is valued.

As identified in the scoping interviews, confidentiality was discussed but in relation to why practitioners use informal methods. Already existing relationships were most likely to have informal communication methods due to the shared level of understanding between parties. Facilitating informal relationships are a strong basis for the development of network relationships (Cooke, 1996). The validation interviews highlighted this different approach for innovation depending on the status of the relationship:

"*If I want to start a new project with an existing partner, it's a little bit more informal because I already have an established relationship with somebody at that company that I can discuss new things. If I'm going to be contacting a new company, a little bit more formal because there is no established relationship*."

(Interview transcript A)

This means that confidentiality agreements are already put into place and therefore there is much less of a concern than when dealing with new partners. Therefore established confidentiality is an advantage to using informal methods over formal.

There is also a propensity for C+D practitioners to look externally first, rather than internally. This was acknowledged as the way things are done in the function with practitioners assuming that for a need to reach them, the company has looked internally first. They stated that rewards such as recognition was received if someone found a solution externally. However, this might not always be the case in practice despite the scoping interviews stating that they look internally to avoid repeating the same work.

From analysing the data relating to the three question responses on the nature (formality) of search and select practices the following key issues emerged:

- Data-driven search: formal, partner knowledge (informal), this primary search method implies that informal partnership knowledge supports data acquisition.
- Type of relationship: new (formal) versus established (informal), which suggests formality decreases when trust increases between partners.
- Availability of resources: time / money / people / equipment, adds extra pressure on FEI teams to deliver the right results quickly.
- Incentives: tendency to look externally first / rewards / recognition, the research supports that recognition for sourcing external innovation is a factor which influences decision-making.
- Search urgency: weeks / hours versus years, linked to the above time pressures, this search urgency suggests searches are dynamic and impacts the types of relationships that can be utilised in this time frame.
- Search breadth: broad versus narrow, results suggest that there is a balance where searching too broadly is unhelpful to solving the need and not dismissing possible solutions outside of a specific domain.

These findings indicate that there are multiple components to a search that impact how effective they are such as the type of search, urgency, and breadth. Issues that may not be in the power of the searcher to influence such as funds or amount of time are constantly present. Suggestive of a data-driven search is the propensity to find technical knowledge. Some acknowledgment of the real customer need was expressed, however, the stated search methods focused on patent searches, sector-specific databases and networks. Customers can provide first-hand information regarding their needs and provide feedback from concepts and prototypes (Bruce and Biemans, 1995).

4.3.3 Tool Integration within Search and Select Practices

The practitioners were asked to specify which tools and practices they used to fulfil the need statement. In determining why certain tools are useful in practice helped to identify generic success factors applicable to other tools. This addresses section A.3 in Table 41. Table 44 gives a summary of the qualitative results for which tools are integrated into search practices and why and how they are used.

The practices do suggest that the majority of work is in preparing for the search in terms of defining the need, deciding where to search, who to contact and what data needs to be found to address the need. Finding external expertise through using experts, searching patents, and product information are common search and select practices. It is clear that using digital means to reach other people is useful to help accelerate finding the correct information.

Table 44 Validation Interview Summary - Tool Integration

Source: Author (2016)

A) Confirming Search & Select Practices		
A.3 Tool Integration		
What tools / practices do you use to fulfill the need statement?	**Why do you use these tools / practices?**	**How do you use these tools / practices?**
Inno360	Mining data	Keyword searches
Google / Scholar	Finding knowledge / personal education	Internal searches (including unknown)
GNPD	Search efficiency: interrogate hundreds databases	Patent search access
Orbit	User background affects aptitude for digital tools	Filtering landscape
Scopus	Structuring & analysing data (folders)	Bucketing data
MS Suite	Search filtering – via time / characteristics	World experts
ScienceDirect	Product lines	Product information
NineSigma	Knowing the network (not necessarily individuals)	Sharing searches (direct links via e-mail)
Ilumin8	Search literature	Old-style searching (paper exercise)
Euromonitor		
Industry / sector specific databases		
Country specific institutes		
Ad-hoc methods (radio / informal networks)		
Manuals		

Identifying Search and Select Tools

From the summary of results it is apparent that there are many databases practitioners use to fulfil the need. The tools that were identified align to the tools detailed in survey question 8. Other than Inno360, GNPD, Orbit and Scopus are used among others. Most of the searching tools are highly technical with a focus on finding scientific information and patent or product data. Commonly used tools that are non-specialised are mainly Google and Microsoft Suite. Sector-specific databases were also stated to be used by most of the sample practitioners.

These results suggest a need for highly specialised solutions which appear to be the most promising for practitioners. It is also clear that practitioners use multiple tools in their searching practices and each for specific tasks. An insight into why this may be the case was expressed as users wanting to get a different take on the data. These tools are also available to competitors. Having multiple perspectives on the same data, similar to the process of triangulation, can help rule out competing hypotheses and prevent premature acceptance of plausible solutions. Abrahamson (1991) suggested that one way to overcome the barrier of limiting the scope of inquiry is to combine multiple perspectives so that each captures some aspect of the complex innovation process.

Using institutes that are located in certain countries was a factor important to one practitioner. This links to the selection criteria for certain partners or ideas and where they will need to be employed. Other practices were mentioned as ad-hoc such as listening to public radio for reports on science or technology and following up scientific websites. Leveraging informal networks was another factor employed aside from formal tools.

Reasons for Using Search and Select Tools

This question was asked in order to gain an insight into the reasons why practitioners used these tools and practices. The Inno360 users specified some of the reasons why they use Inno360: they were personally trained, have a tolerance for computer tools, connect to internal resources, download databases, and mine and analyse data. There was an emphasis on the structured approach of the searches which was appealing, as was features such as searching across a timescale and via certain characteristics. It appeared that some current users did have to sell the tool to colleagues, with one in particular taking the responsibility to consult and teach the tool to others outside of daily activities. This lack of awareness of the tool is an issue which emerged clearly from the survey.

Non-Inno360 users stated reasons to do with the need, different types of networks, timing, and role specific databases other than Inno360. Both groups talked about finding knowledge in different ways. In terms of networks, one practitioner stated that it was more efficient to know a limited number of people within a network and to know many different networks, rather than knowing everyone within a single network. An important emerging key issue is that the external search drivers are a lack of capability internally, such as investment in an area, and a lack of knowledge. This is why external partners are so vital to this process, particularly if practitioners do not use tools like Inno360 to support the search.

Tools such as Google and Excel are universally accessible, familiar and simple to use hence making the search process more efficient. This was a finding from the survey portion of this research methodology. Interestingly, the ease of usability of tools did not emerge from the validation interviews as anywhere near as strongly as it did from the main survey. Search efficiency, searching literature and product lines and organising data were the common reasons. The emerging issue of user background has to do with a more personal level of user perception of tools more generally. This is something which appears to be difficult to change as users' will already have assumptions about new tools, some of which are negative due to past experiences.

Integration of Search and Select Tools

An understanding of what tools are used in the search process and the reasons why, have been discussed so far for the validation interviews. The how behind the use of these tools will provide additional insight into which aspects or capabilities are the most helpful during the searching process in industry.

Keyword searches and classification were mentioned by almost all practitioners as the first steps in their search practices. One stated that they first treated the search as a paper exercise and establishing the criteria before filtering down a landscape. Many users collect large amounts of data from different sources and filter the landscape by relevance to the need. Using graphical tabulation features, bucketing data, working within their teams and sharing searches were common. The ability to share searches via e-mail link is limited to the level of adoption of the tool to some extent. One user stated that sometimes sending a link to a colleague who is unaware of Inno360 can peak their interest in the tool, but that this does not really drive people to use it.

Internal search was an aspect that was rated as one of the most effective in the main survey. Access to patent data and on-market product information was also used within Inno360 and other tools such as Global New Products Database (GNPD). In particular users can download all competitor products in the past 10 years within GNPD. Practitioners also use Excel for text-mining and creating pivot tables to analyse data. The ability to access world experts easily is an additional benefit of using digital tools.

An interesting issue was one of practitioner search style preference. For example, one participant conducts multiple searches at one time describing their daily searching experience as leaving browser windows constantly open for ease of access throughout the day. In contrast, another was very much in favour of using "*old-style*" searching, a process that was described as being informal where you pick up a phone and have a discussion with someone:

> "*It's just simply a matter of being fast and it's way more fun! I don't like to screen and read on the computer screen. I simply don't, and then the other one is way more fun, it's personal interaction. I like that*"
>
> (Interview transcript G)

They went on to state that this also triggers other ideas and ways of approaching a problem. This suggests that using digital tools is a relatively new method of searching for innovation compared to in the past which would have been a much more ad-hoc and personal connection way of working. There may be a conflict of practices or indeed an opportunity to integrate both methods more effectively. Gathering evidence and data for these technically-driven searches for decision-making processes appears to be the primary goal. Overall a sense of robustness of data seems to be required in all of these methods.

From analysing the data relating to tool integration within search and select practices the following key issues emerged:

- External search drivers: a lack of capability for skills and / or knowledge tends to drive external search practices.

- Multiple tools: there is no single tool that is perfect for every aspect of search and select practices, rather practitioners use multiple tools for specific tasks.
- Making sense of data: many practitioners like the fact that digital tools offer a structured searching process where they can control which sources to use and how to view the results.
- User background: results suggest that a practitioner's own exposure to information and / or data within their training background may impact how intuitive they find using digital tools to perform searches.
- User role: similarly to the above point, the real benefit of practitioners within innovation search activities is their ability to form connections between people and data rather than simply performing a search with a tool.

These emerging findings indicate that the external search is about finding knowledge and data and making sense of it. There are many ways to achieve this and digital tools such as Inno360 are just one method. Factors at play are the background of the user and their role within the organisation. Understanding how these tools are integrated in practice is crucial to gaining insights into how their use can be enhanced.

4.3.4 Measuring Search and Select Success

The practitioners were asked which activities or factors helped them to achieve success in fulfilling the business need. They were then asked why and how they helped them achieve success. This addresses section A.4 in Table 41. This was about general success factors and not focused on Inno360 or digital tools in particular. This was asked to see if the same factors appeared as in the survey and to identify any new issues that have not already been included. Table 45 gives a summary of the qualitative results for how certain factors help practitioners in their search and select processes.

Table 45 Validation Interview Summary - Measuring Success

Source: Author (2016)

A) Confirming Search & Select Practices		
A.4 Measuring Success		
What activities / factors help your search and select practices?	**Why do these activities / factors help your search and select practices?**	**How do these activities / factors help your search and select practices?**
Defining business question	Creativity of decision	Driving behaviour
Objectives	Fastest way to info	Decision-making info
Time	True relevance to need	Innovation by analogy
Internet tools	Evaluation	Combination of elements
Organisational clusters	Simple & meaningful sharing	Aids precision
Company name / reputation	Specialist knowledge	Helpful sharing
Talking to others (triggers)	Lot of capability in one place	
Search criteria		
Customer engagement		
Right search strings		
Unexpected results		

What is clear from the above table is the importance of the search objective, connecting with other people, and being able to filter down and share information which is highly relevant to the business question. Methods within this facilitate this either through using innovation analogies, accessing specialist knowledge in one place or leveraging the company name.

Similar issues did appear with additional factors related to the success of search practices. Some practitioners did focus on tools for their answers whereas others were broader in nature and approach. They also range from general to specific factors depending on the reason for implementation.

Identifying Search and Select Success Factors

This question asked specifically which factors helped in search and select practices in a general sense. The factors identified for success ranged in scale from broad to specific. Specifically several internet search tools were mentioned (LinkedIn, Google, Scopus). Identifying organisational clusters, finding recommended papers and the tool's ability to anticipate relevant results were reasons given.

Using the right search strings or search criteria has been highlighted as a factor with search and select tools. A key issue is the tool acts as a way to facilitate the finding and organisation of data but will bring up results according to the inputted keywords or need statement. Whether these results are relevant or not, are up to the user's judgment in assessing them according to the need. This consideration and facilitation of the human element of evaluation with digital tool results is common to many tools. There is therefore a need to make the evaluation and filtering of search results as efficient and accurate as possible.

Five broader activities facilitating success were: 1) defining the business question, 2) having clear objectives, 3) allowing sufficient time, 4) leveraging P&G's company name and reputation, and 5) talking to others about the need to trigger ideas. These practices were all acknowledged as important and are integrated into individual everyday processes. The issue of allowing for unexpected results to surface is also an acknowledged factor for successful innovation (Casakin and Kreitler, 2006) and was expressed by one practitioner as important to their searching practices.

Customer engagement was a success factor identified in a previous question. This is linked to the strategic orientation emphasis of a company (i.e. customer-orientated, technology-orientated or competitor-orientated) which impacts how they search the market (Spanjol *et al*., 2011). The results indicate that P&G overall has a technology-orientated emphasis with individuals within the company expressing a customer-orientation and competitor-orientation with their search activities.

Reasons for Search and Select Success Factors

This question was about understanding the reasons behind why certain practices are classed as success factors. Not surprisingly, finding information was the main reason that encompassed a lot of reasons why certain practices were used. Incorporating a lot of capability in one place was another reason why tools are used and some consider it the fastest way to information, whereas others argued that using personal networks was faster and less complex.

The creativity of the decision was an interesting factor identified. This factor is not well documented within the literature but it is mentioned in terms of systems decision-making (Elam and Mead, 1990). The support of senior management has been a well acknowledged factor (Chesbrough and Crowther, 2006) as well many decision-making factors. Involving creativity within the decision itself is a less recognised aspect, possibly because of it invoking the perception that it is a less reliable method of evaluation, involving more subjective evaluation. This could mean that new ways are needed to evaluate needs and ideas in a more creative way within the bounds of an organisation.

In terms of evaluation of results, finding information having a true relevance to the need was another reason behind practices such as using the right search strings. Efficient evaluation of results is a key capability in tools that are successful and in other methods. Selection criteria were identified including searching via country that can be decided early on in the process.

One participant identified the importance of simple and meaningful sharing behind sharing searches via e-mail links. This helps build a shared understanding of the need and possible solutions. The capacity to drive behaviour in some of these search activities may be valuable. Accessing specialist knowledge is another external search driver and one of the primary motives. Practices to do so included using well known methods in looking within other domains for innovation to find unexpected connections.

Verifying Search and Select Success Factors

Extracting how these practices are used is important to understand to make further sense of the findings. The responses incorporate the purpose of helping to drive behaviour and help people to connect. This was stated to be done by helpful sharing of graphics and searches via e-mails or screenshots. This supports the idea of a collaborative tool for visualisation, however with areas for improvement.

Information for decision-making was the overarching theme of the responses, due to participants having to report to senior management or managers their findings. The element of structured searching was also clearly identified in many of the qualitative answers. The reasoning behind these factors aiding successful searching practices may be due to combining different elements. This mixed approach was identified by most of the validation interviewees. In addition, it was stated that tools aid with the precision of conducted searches.

The issues identified reveal the importance of clarity on the search area, leaving enough time for search and select practices with issues on effective and quick filtering, and how the tool can be more collaborative and drive searching behaviour more proactively. Two threats to the searching process emerged as finding false positives in the information, which links to mistrust over where the data comes from but also personal interpretation, and competition from other organisations.

4.3.5 Level of Use of Inno360

The second half of the validation interview questions focused specifically on Inno360. It asked practitioners to identify why they either did typically use Inno360 in the search and select practices and why, or if they did not to identify the reasons why. This addresses section B.1 in Table 41. Table 46 gives a summary of the qualitative results for why practitioners do or do not use Inno360 in their search and select processes.

Table 46 Validation Interview Summary - Tool Usage

Source: Author (2016)

B) Validating Inno360 Survey Outcomes		
B.1 Tool Usage		
Do you typically use Inno360 in your search and select activities?	**If yes, how and why do you use Inno360?**	**If not, why do you not use Inno360?**
Yes	Capture project info (projects from scratch)	Analysis issues
Yes	Search via need	Lack of familiarity
Yes	Access different databases	Faster results in other tools
No	Visualisation / landscaping	Personal interaction preferred (fast / fun)
No	Collaboration (sharing / commenting)	Senior management politics
No	Filtering data	Patent duplications
No	Search string refinement	Lack of time
	Competitor tracking	Poor peer reviews

The results gave insight into two differing experiences of practitioners who used Inno360 and those that do not. The reasons can then be compared to further understand the reasoning behind their choices in regards to searching for innovation. Similarly, some issues were common and identified in previous questions.

Level of Use of Inno360

This was a very straightforward questioning simply confirming whether the practitioners used inno360 in their search and select practices or not. The answers were as expected and in accordance with the split of four non-users and three users. The next questions asked why this was the case for both positions. One participant stated:

> "*We depend more on being able to search through tools like these and analyse the data*" (interview transcript C)

This illustrates the growing need for methods to facilitate the searching process, whether that is in digital or other means.

Methods and Reasons for Using Inno360

Practitioners stating that they typically use Inno360 were asked to identify their reasons why. One of the reasons was to capture project information as it was stated that search projects mostly start from scratch within the company, with one participant stating 90% of projects do. This suggests that work may be repeated despite current efforts. Projects can also restart and being able to go and search for what has already been done is valuable. The ability to save papers within folders was also stated as useful. This is possibly due to users being afraid of throwing away potentially good data.

Practical reasons were given to search via the need and access different databases which was identified in the main survey. However this is present with almost all other search tools. Users want to search for what is available. Visualisation and landscaping capabilities are also used by practitioners engaged with Inno360. The collaboration issue was identified again as Inno360 allows users to share and comment on projects, as well as track C+D fields.

In terms of filtering data, one practitioner stated that Inno360 is unique compared to Google in that it allows users to read across the top 250 results rather than reading down a long list. This appeared to be a more effective way of analysing data on an individual basis. Playing with search strings and refining them as well as competitor tracking were additional reasons given for the use of Inno360. Competitor understanding within a category specifically was mentioned as important, however this might be linked to user role.

Some users gave an insight into why other peers might not use Inno360. One stated social behaviour factors such as people are slow to change and that younger people tend to be more adept using new tools such as Inno360. New tools need leadership and employees do not see value in work that does not contribute to them directly. This suggests a broader cultural barrier within the company with a focus on the individual rather than a team dynamic. Having to use the tool frequently in order to keep current with how to use it was another issue.

Reasons for Not Using Inno360

Practitioners that did not use Inno360 in their practices were asked why this was the case. This question was about extracting the reasons why Inno360 is not aligned with their searching practices. Similarly to other questions, the identified reasons were mostly broad with some specific issues experienced.

One of the reasons was issues within the analysis features of the tool. This included irritations such as duplications of patents and difficulty in exporting data. Duplications needed to be sorted out manually which was described as "*not worth the time*". This was followed by the reasoning that there are many other tools available that do not have these practical issues with analysis. A long-term user did point out that Inno360 has improved dramatically with these issues in recent years, however, if non-users do not revisit the tool to see such improvements then it is a redundant factor for them.

Interestingly, the point was made that the tool is good for people who are not fully dedicated to C+D. This again raises the question of what the impact of a user's role within the company is to the usefulness of tools like Inno360. There are conflicting views with a participant stating that Inno360 is only for R&D people whereas a non-user stated that it is best for non-R&D people. The other practitioner stated that Inno360 was a tool for collaboration, and was therefore not relevant to their searching needs. This was stated to be directly due to their role within the company. Therefore the reputation of tools seems to be an emerging issue impacting how potential users view the value of a tool before even using it.

In a similar vein, a lack of familiarity with the tool and lack of time were identified by non-users. The view is that faster results can be obtained using other tools at their disposal. This emphasises the importance of new tools to become familiar to users as quickly as possible, and to overcome barriers such as complexity which interrupts this process greatly.

Search style again came out as one non-user preferred the personal interaction method over digital searching. Issues to do with company culture were also identified, such as senior management politics with high level people in the company having a high interest in the tool doing well. Word-of-mouth as a form of communication has been identified as useful to a tool's success. For Inno360, some practitioners had poor peer reviews from those that have tried to learn it.

From analysing the data relating to the level of use of Inno360 from users and non-users, the following key issues emerged:

- Level of expertise: novice versus expert
- Lack of clarity: value / benefit of tool
- Information management: search and results storage
- Search habit: tools / outcome dependent

The main issue is that of level of expertise of users. This was an important finding as it linked to several other issues from the interviews such as the role and background of the user, tolerance for digital tools, work habits, and human interpretation of need brief and / or search results. There appears to be a lack of clarity about the real benefits of the tool, particularly to non-users. The main advantage of the tool is for organisation and management of information such as storage of results. This was identified as important due to the nature of working searching practices where projects stop and restart often.

The main survey also identified the last issue of search habits, which was supported by the validation interviews. However the interviews revealed another aspect to this in that users are very focused on what outcome of a search and typically will not engage with activities directly linked to producing the results they need. This was described as the user's aptitude for searching.

4.3.6 Managing Complexity

The issue of managing complexity is a very broad issue as a barrier to raising the adoption level of tools. This addresses section B.2 in Table 41. In this context, the reasons behind why Inno360 is seen as complex as identified in the main survey, was analysed in greater depth. Table 47 gives a summary of the qualitative results for how Inno360 helps current users with managing complexity, and if not what other tools are used.

Table 47 Validation Interview Summary - Managing Complexity

Source: Author (2016)

B) Validating Inno360 Survey Outcomes		
B.2 Managing Complexity		
Does Inno360 help you manage complexity?	If yes, how and why does Inno360 help with complexity?	If not, what tools / methods do you use to manage complexity? How and why?
Yes	Save themes	Personal interaction easier to find right partner
N/A	Organising search tabs	Local network (one touchpoint)
Yes	Clustering	Learn tricks from experts
No	Multiple tasks	Beginning setup (defining question)
No	Stored results	Digital contact convenience
No	One tool access multiple sources	Network combinations
No		Volume of data handled in tools
		Categorisation & visualisation
		Excel / Google Scholar

The results again gave opposing insights into two differing experiences of practitioners who use Inno360 and those that do not. It is clear that users who use other methods for managing complexity do so using others, and if they do use tools, it is for organising large volumes of data rather than discovering insights. For that purpose, these networking and making connection activities are seen as more effective.

Impact of Inno360 on Managing Complexity

There was a mixed reaction as to whether Inno360 helped with managing complexity for searches. The users for the most part agreed however using terms such as it has '*potential'* to, they '*think'* it does help and that they only use 10% of the search features. This casts doubt over whether users truly believe that it does in practice, or if it does that there is more improvement to be done. This supports the main finding from the survey that the tool is seen as highly complex.

Non-users stated that they use other searching methods which cut out complexity, that complexity lies within the beginning processes and not the tools, and that other tools are used. It may be the case that other tools are simply easier to use and avoid adding to complexity of use. Certainly complexity does lie in the beginning processes to focus and define the need and what information is needed. Using alternative searching methods all together was another argument where efficiency of finding information could be more important than storing digital results for future reference.

Reasons Inno360 Helps Manage Complexity

The practitioners who identified that Inno360 did somewhat help with managing complexity, were asked how and why it helped. The main reason given was that of organising data through saving themes, organising search tabs, and clustering data. The ability for users to customise tabs into the relevant sources for example (i.e. internal, external, patents etc.) appears to be useful as users can track what they have done. The issue of clustering was identified but that it could be made to be more automatic. This links to the significance of visualisation features in facilitating these activities.

Storing results again came through as a reason Inno360 helps with complexity. Users want to be able to directly access contact information and search results quickly from their search history. Completing multiple tasks within one tool was another identified reason as well as accessing data sources from one tool. This aids managing complexity as users do not have to individually search within the known databases. This should save time and effort within a challenging business environment.

One user stated that Inno360 is not appreciated even though it "*aspires*" to help users. A general trend of instant gratification of users (Tang *et al*., 2005) in the current society may be playing a part here, facilitated with tools such as Google offering instant results. Digital tools have to be fast and offer results that users want in order to stay relevant. One user also stated that Inno360 should have a fewer number of mouse clicks required to reach files or give permission which would help address complexity.

Inno360 is seen as a tool with the potential to help with managing complexity but it is apparent that only a fraction of search features are being used. This suggests that most features do not help users manage complexity. Typically practitioners use a small fraction of features to meet needs and not in an expert way. This links to the emerging issues of level of expertise in users' practices.

Other Tools for Managing Complexity

If users stated that Inno360 did not help with managing complexity, they were asked what tools or methods they used instead to manage complexity. It was argued that personal interaction makes it far easier to find the right partner. This is due to using local networks and one touch point, consequently taking out a lot of the complexity. The practitioner stated that this was a conscious decision because it is less of a complex process to get to the right partner. This brings up an interesting theme of digital contact versus in-person relationships.

Interestingly, one practitioner took a different route to dealing with complexity and stated that it was the setup at the beginning of the searching process rather than the tools. This involves properly defining the question through interviews and setup prior to starting a search. A valid argument is that much of the complexity reduction efforts would have the most impact within this preparation stage (Martinsuo and Poskela, 2011). Tools help in that they can manage a huge volume of data and aid in categorisation and visualisation after this preparation has occurred.

With using digital tools, there is the immediate advantage of contact convenience with being able to contact anyone in any part of the world and at any time. Utilising different network combinations was another method to manage complexity. Tools specifically mentioned that help with complexity were Excel, Google Scholar, MS project and OneNote. One comment was that these were not more intelligent than Inno360. This suggests that perhaps the reason users tend to use multiple tools is that they need differing levels of intelligence or comprehensiveness. This capability may not be available within a single tool.

In addition, more personal methods were identified such as learning tricks from experts for tactical and quick ways to search for information as well as active listening. These abilities are just as valuable as using tools effectively. It may also be a more rapid way of learning how to efficiently conduct a search.

From analysing the data relating to how Inno360 and other methods help with managing complexity, the following key issues emerged:

- pre-search preparation: reducing complexity of question can help with searching processes.
- search features: small amount of features used and typically not in an expert way.
- professional tools: require training on how to use, requiring regular use.
- managing data: large volume of data adds to complexity.

Most of the features for users believing that Inno360 helps with managing complexity are based on the organisation and visualisation of data. This appears to be where the value is in terms of using the tool regularly within search and select practices. The issue with professional tools such is that they do need to be used regularly and training is required on different levels. Practitioners identified in the survey and validation interviews that they need to re-learn the tool if they are away from it for a period of time. The identified emerging theme is that of the level of expertise of the user. Even users who identified themselves as tool experts, did not use all the features of Inno360. This gives some insight into why novice users see the tool as overwhelming if experts only use a small number of features.

4.3.7 Barriers and Challenges

This question aimed to understand more about the barriers and challenges associated with searching over and above what was found from the main survey. Participants were asked what barriers or challenges they faced, and then how they went about addressing them. This addresses section B.3 in Table 41. Table

48 gives a summary for the qualitative results identifying relevant barriers and challenges and methods to address them.

Table 48 Validation Interview Summary - Barriers and Challenges

Source: Author (2016)

B) Validating Inno360 Survey Outcomes	
B.3 Barriers / Challenges	
What barriers / challenges do you face when using Inno360?	How do you address these barriers / challenges?
Slow response time	Algorithms behind search engine / progress bar
Interface complexity	Quick routes / specific training / manual
Focusing business need	Back to question / review / different strategy / clarity / upfront needs
Too much information	Quickly narrow results / criteria
Academia versus industry partners (contracts)	Use intermediaries / experts / personal network
Cultural barriers	Engrained search mindset (company) / check assumptions
Need changing	Refer to trusted others / needs analysis / directly landscape
R&D aptitude (urgency / interrupt-driven)	Training / time for searching / thought-leaders
Conducting search	Intuitive search bar / simple
External site mistrust (IP)	Internal server host
Time constraint / irregular use	Blocks of time dedicated / benefits for immediate leverage

The interview results gave some different outcomes than the ones from the main survey. The main survey identified complexity / difficulty understanding how to use, a lack of time to integrate into activities, and difficulty getting relevant results as the top three barriers. Time constraints and high complexity were barriers identified in both methods. The description of the additional barriers and challenges are described below.

Identifying Barriers and Challenges

Many barriers were identified by both Inno360 users and non-users. This question again was broader than just the application to Inno360. The initial barrier for novice users was identified as simply conducting a search. This is linked to tool interface complexity which was a main barrier in the main survey and is also being expressed in the interviews. Making the entire search process more streamlined and approachable seems to be the overarching view.

The slow response time was another barrier on a more practical level related to Inno360. One practitioner stated about having to wait for feedback. There are also potential frustrations with access to the tool. Results are often required almost instantly which suggests that finding in-depth results may not be a priority. Similarly, getting overwhelmed by too much information was also a barrier.

The challenges of focusing the business need and the need changing whilst in the search process were identified. This is directly linked to the preparation conducted prior to the search. Work needs to be done which is sufficient to the size of the project being carried out (effort versus size of project). Where there is a disproportionate balance between effort and project size problems in scale as well as timing and funding issues can occur.

Communication and collaboration barriers exist between academia and industry partners. A practitioner described one bad experience with a discussion and stated that they were missing opportunities. This may also be linked to a lack of agreement on language or core competencies. Every company will have certain cultural barriers and there was a view that R&D practitioners can get impatient with the urgency of searches. They were described as having a different aptitude where the time constraints are due to the pace and domain of work.

There was uncertainty over where to turn to for help when needed, either to use a tool manual or ask someone else who would be able to solve the problem. There was a level of mistrust over external sites with one practitioner stating that Inno360 should be hosted internally, where users may feel more comfortable using the tool.

Addressing Barriers and Challenges

Practitioners had answers for how they approached addressing these identified barriers and challenges, although one practitioner stated that the barriers were improving. For the experienced slow response times, it was suggested that algorithms behind the search engine could be improved. Alternatively, showing a progress bar would be helpful in better engaging and informing the user that the search is going on.

Interface complexity could be addressed by specific training providing very quick routes to data as well as a manual. Focusing the business need and the need changing are directly linked to the preparation stage prior to the search. This can be addressed by allowing more time for the proper definition of the need which also made it less likely for the need to change at a later stage. Referring to trusted others, conducting a needs analysis and doing a landscape were additional recommendations.

Being clear and upfront with needs was suggested along with reviews and assessing strategy. However it is unlikely this could be mitigated completely as front-end stages do have a level of uncertainty that can be difficult to manage. The lack of time could be combated with dedicating small blocks of time to get the most out of the tool and communicating the benefits for immediate leverage of its users. Some forms of incentives to encourage Inno360 users to regularly keep using the tool might help with many current barriers. The quote below clearly illustrates this point:

> "*I forget that it [Inno360] could be exceedingly helpful but it's carving out the time to use it*…" (interview transcript B)

Having too much information to manage is a common challenge for tools such as Inno360. Practitioners suggested that quickly narrowing down results and using clear search criteria is a way to try and find the most promising information quickly. Collaborating with academia from an industrial perspective can be challenging, and a means to deal with this is to use intermediaries who know who and how to talk to the relevant parties. Finding experts and utilising their own personal networks can also help with this challenge.

An interesting barrier was cultural with the searching mind-set of a company. This is not only referring to the stated R&D aptitude but leaves itself open to the mind-set of all other employees and how senior management supports the importance of time dedicated to searching for innovation. Methods like checking your own and company assumptions were suggested in order to combat this. Addressing the R&D aptitude barrier is difficult as they are individuals trained to be as efficient as possible with finding innovation and thinking strategically about information. Encouraging specific training and time for searching with thought-leaders for example, may be a way to combat the high urgency of search practices.

Conducting a simple search was identified as a barrier for novice users. Developing a very simple interface, similar to Google, may help in encouraging new users to use the tool more freely and get comfortable with basic search features. Perhaps having different novice and expert interface versions would help users wean themselves gradually into using the tool.

The level of mistrust over external hosting sites is another cultural barrier. It could be simply addressed by moving Inno360 to an internal host, however, it may be more effective in the long-term to tackle the company's perceptions since the culture of open innovation is widely accepted in P&G. Dealing with issues of security of information will be important to those using the tool.

From analysing the data identifying and methods to address the barriers and challenges, the following key issues emerged:

- cultural barrier: searching mind-set,
- lack of time to evaluate / use tool,
- search effort versus benefit balance, and
- the need to minimise tool complexity.

This indicates barriers related to culture of the organisation and considerations of user role and leverage of tools. A key question is 'how do you really present the benefits in a compelling way that people can leverage immediately?' This should be a primary concern and a way to better engage potential and current users in the value of Inno360 for searching. Allowing time to use and evaluate the tool should be encouraged and incentivised. The search effort needs to be at balance with the achieved results of a search, making the definition of need even more important. Minimising tool complexity can only help improve its adoption within the company and multiple ways to do this have been identified in this chapter.

4.3.8 R&D Project Value

Lastly the practitioners were asked to identify the project value for R&D in terms of the most important factors for building a landscape. This addresses section B.4 in Table 41. This question was kept broad to allow for a variety of answers from practitioners. Table 49 details the qualitative answers given for the most important factors for search and select.

Table 49 Validation Interview Summary - R&D Value

Source: Author (2016)

B) Validating Inno360 Survey Outcomes
B.4 R&D Value
What are the most important factors for building a landscape?
Getting the data right / filtering
Relevance to need / topic
Look outside domain / span areas (unexpected solutions)
Understand need & criteria correctly
Capture progress
Use industry associations / build network
Become expert in area
Keep close to customer
Provide teams with technical info
Time
Distinguish between project and product
Know what is needed to achieve
Kind of info & decisions
Trusted partners / screen companies

Some of the factors identified are the same as the issues already discussed in previous questions. This open-ended question allowed further expansion on the issues brought up by practitioners.

Important Factors for Building a Landscape

The issue of getting the data right and employing effective filtering of results was identified throughout the validation interviews. This is primarily done via relevance to need or the topic. Another factor identified was to look outside of the current domain and span different areas. This was about finding unexpected solutions for innovation and interrogating why similar areas are using similar keywords:

> "*You expect to find stuff here but it's also healthy to see if you can find pockets that are unexpected that force you into driving analogies*…" (interview transcript B)

Understanding the need very well and identifying the search criteria correctly came out strongly, the same as in previous questions. The process of capturing search progress for current and future projects was also reiterated during daily searching activities. Industry associations and building a network becomes even more important when digital tools are not utilised by practitioners. It was stated that reaching out verbally was useful in the first instance and use intermediaries to vet partners. Identifying whitespots is often a key activity in innovative organisations.

Finding important companies and global partners is facilitated by meeting potential collaborators at events such as fares and tradeshows. The practitioner stated that this makes it easier to contact suppliers you have talked to after the event. It was emphasised that screening companies on the internet is not enough and that other methods such as involving intermediaries can be a reliable means to select partners.

In some roles, becoming an expert in one area is more effective whereas other roles are focused on making connections between many areas. One practitioner emphasised the need to keep close to the customer throughout the searching process in order to address the real need. Providing teams with as much technical information as possible was stated in order to conduct the right evaluation and make better judgments. Employing multi-functional teams helps to span a greater number of areas that may be relevant to the need.

Simply allowing enough time for conducting searches emerged as a critical issue. In order to develop a proposition, there is a need to understand if a call is for a new project or product. It was clear that the search outcome and knowing what needs to be achieved drives a lot of the search activities. This is linked to the kind of information needed and types of decisions that need to be made with that information. Having the right information to use when needed is also key as stated in the following quotation:

> "*If they don't have the right information then there's a lot of continuous uncertainty*." (interview transcript D)

These factors were identified as being important by practitioners as well as being able to figure out how you know the need has been answered (i.e. criteria). Using trusted partners and screening companies is also important for building an innovation landscape particularly if focusing on interaction activities.

From analysing the data relating to R&D project value the following key issues emerged:

- deep understanding of the need and selection criteria,
- multi-disciplinary: spanning networks and boundaries, and
- results-driven: decision-making with right info.

Overall the results for important factors and activities for building an innovation landscape for searching were consistent with previous findings. It emphasised the technical nature of searches, the requirement to understand the need, use teams that span networks and uncovering the right information to facilitate decision-making within front-end activities.

4.4 Summary of Findings

This section sets out to communicate the key findings derived from the empirical studies conducted within this research. It is structured in the order of the research methodology employed. It concludes with a synthesis summarising the common emergent issues across three data sets: 1) scoping interviews, 2) main survey and 3) validation interviews.

4.4.1 Scoping Interviews

Several challenges and issues emerged after the analysis from the scoping interviews with external innovation managers in P&G. The key emerging challenges were high process complexity and high volume of unsolicited ideas. This was identified as particularly prevalent when leveraging different networks for innovation. Complexity expands to multiple levels to incorporate differing need priorities between departments.

Language and terminology issues were also common internally as well as externally in searching practices. This is particularly the case when controlling IP and confidentiality while communicating to the external world. Essential documents such as needs briefs have to be re-translated for external use. This involves removing confidential information and making the need approachable to garnish a level of interest. Therefore a balance needs to be achieved between IP versus attracting innovative solutions. This risk to confidentiality must be held to some degree in order to gain the benefits of external solutions.

It can be argued that the focus in large organisations is on IP and strategy over the creativity of ideas. There was not a view that the organisation did not have enough ideas, in contrast it was the opposite. The challenge is in evaluating the huge volume of ideas that are submitted externally and the time involved in the selection process. This might help explain why large organisations need to be very decisive with their idea selection as there is purely not enough manpower or time to analyse ideas based solely on their creativity or benefit.

A trend towards the digital application of idea management processes was overarching, with benefits in saving time, money and effort. Searching within a diversity of idea sources was identified as common in searching practices in industry. This diversity re-enforces the fact that ideas can come from many different people and industries. This involves leveraging existing contacts and the use of gatekeepers who facilitate the creation of a ‘network of networks’ (Hara and Kanai, 1994).

Search strategy was identified as essential due to the strategic decision whether to search internally or externally. This drives the search and impacts which sources would be the most effective. Managers organise transactions through three decisions regarding knowledge: 1) acquisition, 2) integration, and 3) exploitation (Lichtenthaler and Ernst, 2006). Companies do not always make this decision upfront and risk not taking the most effective route at the beginning of the search.

An important and relatively new challenge is to do with data organisation in tracking network responsiveness. This is linked to search urgency, which facilitates using the most effective networks first for solutions. A trend towards automation of idea and network management was overarching in order to address these challenges. Automation of these activities would in theory save managerial time and cost, speed up the evaluation of submissions, help identify leads, and track responsiveness of numerous networks.

External innovation managers stated that unsolicited idea management was one of the main challenges faced. It appears that selection criteria for unsolicited (external) ideas is managed by a few people, and the majority are rejected mostly due to IP issues, not having enough information and a lack of strategic fit. These issues do not affect solicited searches by definition as the business believes that these needs are strategically aligned. This emphasises how important it is that selection criteria are clear.

Leveraging existing knowledge of opportunities for known versus unknown areas was identified in the scoping interviews. An area which is familiar to the company would involve higher reliance on existing relationships, whereas with an unfamiliar area, new relationships would need to be forged. Search has been stated to be more productive when it uses both familiar and unfamiliar elements (Katila and Ahuja, 2002). External knowledge exploitation is usually pursued less actively and less systematically than internal innovation (Arora *et al*., 2001). This is understandable as external knowledge exploitation contains substantial risks, particularly if the project is more disruptive.

All of the challenges and issues are managed by the organisational culture. Open communication is intertwined within these influencing factors, as informal serendipitous activity is a success factor for innovation (Desouza *et al*., 2009). This is facilitated through methods such as company dinners or spontaneous conversations between key players.

4.4.2 Main Survey

A key objective of the study was to determine how organisations go about searching and selecting for ideas for innovation. This included the use of a digital tool called Inno360, which was assessed via a mainly quantitative survey. This assessment focused on the effectiveness of the Inno360 platform with results relating to: complexity, usage, barriers and R&D value. The survey found that 68% of users have not completed a successful project within Inno360. The main reason was a lack of practitioners actually using the tool due to issues with lack of time to evaluate its value, difficulty navigating the site and non-intuitive searching.

The main survey revealed that project and priority change occurs frequently in industry. Employees either change roles within departments or change departments or projects altogether. Projects get moved up or down in priority which is often decided by senior management of the business. It gets even more complex as it was identified that priorities also vary between different departments. It is easy to recognise how this multi-level complexity for need priorities can cause issues when searching internally for project information.

A summary of the key findings from 12 questions included in the main survey is shown in Figure 39. This has been developed to help visualise the main findings from the survey, which included qualitative answers. Each question topic has been given either a ‘what’ or ‘why’ label which indicates the context of the question. The top results have been listed for each question in the table. The top answers were listed if they were far enough apart from the other answers. This was done so that it is a fairer representation of the results for each question. In addition, each question topic was labelled with either ‘quant’ indicating that the data is quantitative in nature, or ‘qual’ indicating that the data is qualitative in nature.

Interestingly, user background came out strongly as an issue related to search behaviour. Inno360 is seen as an R&D tool for performing technical searches, and therefore there is a propensity for users with a technical background. This added to the view that it is too complex, could help explain why it can be off-putting for practitioners in other areas of the business.

Some informal methods used by practitioners were thought-leader questionnaires and personal file management. There appears to be a large component of personal choice when selecting methods, rather than senior management instigating set methods. This is supported by the literature in that networks of the individual take prevalence over organisational norms (De Brentani and Reid, 2012). This flexibility of choice could be important within search practices to adapt to an ever-changing business landscape.

There is a lack of awareness of Inno360 activities offered, as only three out of 11 were rated as ‘effective’. It was apparent from the survey that participants do not use most of the Inno360 activities, with eight activities not being applicable to users’ needs. Claims support and market data were the two least used activities. There are two reasons why this could be the case, 1) this could be due to low awareness of the full tool capabilities or 2) a very low relevance to user’s search needs or role. Some practitioners asked for online training, a capability which is already present. This indicates that a low level of awareness of current capabilities might be the reason behind this finding.

PROJECT SUCCESS	**WHAT:** SUCCESS MEASURES	QUANT	**1: Found innovative technology** 2: Other 3: Found academia experts 4: Internal connections 5: Found supplier	**WHY:** REASONS FOR NON-COMPLETION	QUAL	**1: Have not used Inno360** 2: Complicated / hard to use 3: Time constraint 4: Exploratory use only 5: Lack of relevant results
BARRIERS	**WHAT:** BARRIERS	QUANT	**1: Complexity / difficulty understanding how to use** 2: Lack of time to integrate into activities 3: Difficulty getting relevant results 4: Lack of training 5: Prefer other tools	**WHAT:** OTHER BARRIERS	QUAL	**1: Have not used Inno360** 2: Slow / no peer adoption 3: IT / access issues
TOOLS	**WHAT:** OTHER TOOLS	QUAL	**1: Google** 2: Orbit 3: Scopus 4: SLS	**WHY:** OTHER TOOLS	QUAL	**1: Easy to use** 2: Quick / fast 3: Detailed patent search 4: Literature search
INNO360 ATTRIBUTES	**WHAT:** MOST USEFUL SITE ATTRIBUTES	QUANT	**1: Foam trees / circle clusters / explorer** 2: Relevance of search results 3: Ease of searching 4: Layout / design 5: Relevance of databases	**WHAT:** LEAST USEFUL SITE ATTRIBUTES	QUANT	**1: Usefulness of webinars / training** 2: Usefulness of user guide / wiki 3: Ease of project collaboration
INNO360 ACTIVITIES	**WHAT:** MOST EFFECTIVE ACTIVITIES	QUANT	**1: External searches** 2: Internal searches 3: Competitive intelligence / IP	**WHAT:** LEAST EFFECTIVE ACTIVITIES	QUANT	**1: Market data** 2: Claims support
INNO360 FEEDBACK	**WHAT:** INNO360 AREAS LIKED	QUAL	**1: Visualisation** 2: Website 3: The concept 4: Search capability	**WHAT:** INNO360 IMPROVEMENT AREAS	QUAL	**1: Usability** 2: Search results 3: Training 4: Search capability 5: Collaboration

Figure 39 Main Survey Result Summary (Inno360)

4.4.3 Validation Interviews

The importance of defining the need statement was prevalent in the validation interviews. In particular, search terms entered by the user have an importance in influencing the relevancy of results. A lack of a need focus (technology versus consumer benefit) was also apparent in industrial practices. The main external search drivers were confirmed as a lack of capability and / or knowledge or uncertainty. Searches are mainly technical in nature within this organisation and there is an emphasis on finding the right data to meet the need.

One of the main emerging insights is the need to breakdown the complexity of the question. There is a move towards a focus on the consumer need rather than the technology, despite searches remaining highly technical. Search term effectiveness is dependent on how well the need has been defined. Search tools are only as effective as the keywords input into the system and hence there will always be human interpretation of results.

A main barrier that came from the validation interviews was a lack of time and high search urgency. Search activity is highly time dependent, often with searches having differing timelines according to priority level. There was a view that other tools can do search tasks better or faster, mainly due to users being more familiar and comfortable with how to use them.

An emerging issue from the validation interviews was the preference of the user in terms of their search and select methods. Some users appeared to have a pre-determined preference for how they conduct their searches. This means that they tended to either prefer using digital tools or more ad-hoc personal interaction techniques to gather data and insights. It appears that most practitioners use a mixture of both formal and informal methods, although all agreed that they use more informal methods overall.

Understanding the nature of the search processes employed was one objective of the validation interviews. The formality of methods used was identified as a mixture of formal and informal with an emphasis on informal search methods. The issue of informality of processes is acknowledged in the literature as a common characteristic during front-end activities (Markham *et al*., 2010; Salomo *et al*., 2003). This is driven by search urgency and the need to find solutions quickly, seemingly counter-intuitively to the data-driven searches, which require objective scientific data.

This leads to the informal issue of the role of tacit knowledge in search and select practices. This dependency on past experiences learnt over time can impact practices used in the future. Alongside informal methods was the issue of iteration. The reasons given for iterative practices within front-end innovation were that often there are false positives given in data and the fact that searchers do not always know the solution. This observation is supported as there is a need for uncertainty to be viewed as a sign of the beginning of learning and creativity (Huber, 1998). Searching within unexpected areas or domains for solutions came out clearly in order to find creative solutions.

When seeking solutions for a targeted need, the sampled practitioners tended to look externally first before searching internally for solutions. However, some in C+D explicitly stated that they assumed others have looked internally first or they know they do not have capability internally and so they always look externally. This is linked to the search focus as it was identified in the scoping interviews that making the decision to go internal or external, was made explicitly early on in the process, which was linked to success.

It is therefore possible to state that gaining technical information, either via digital tools or personal networks, is of the highest value to search and select practitioners. Several practitioners identified the level of customer benefit, however, this did not translate into tangible day-to-day practices other than holding customer interviews.

4.4.4 Synthesis: Common Emerging Issues

A clear insight that emerged from all of the findings is that organisations do not have clarity on what is a good idea. This research argues that organisations do want to find good quality ideas but are unaware of how to best search for and select them. Some form of orientation framework would help for more effective use of practitioner time, funds and energy to targeted sources.

There does appear to be a difference in opinions when comparing the external innovation manager responses (scoping interviews) with the responses of other employees (main survey and validation interviews). One difference in particular is about whether they look internally or externally first. The managers stated that they always look internally first to make sure that work is not repeated before looking externally for solutions. In contrast, the validation interviews revealed that most practitioners automatically look externally for solutions first.

An insight into why there is this difference of opinion was pointed out in the validation interviews as a case of reward and recognition. If a need can be solved internally then credit and rewards are split internally between multiple people, whereas if someone finds a solution externally then one person tends to get the credit and recognition. This issue of intrinsic versus extrinsic incentives plays an active role in the innovation process with authors stating that intrinsic motivations are more important than extrinsic motivations (Griffiths-Hemans and Grover, 2006; Soukhoroukova *et al*., 2012). Motivating employees with intrinsic incentives in particular has been linked to higher performance in terms of idea submission (Kristensson *et al*., 2004).

There is an engrained assumption that was expressed by one practitioner, that before a need reaches them in C+D the business knows that they cannot solve the need internally. That is why they turn to C+D to search externally. This has the potential for miscommunication if a need can indeed be solved internally but the way of doing things is set to look externally only. This may lead to missed opportunities for internal development.

Evaluating the search effort was identified as a balance between the benefits of a search versus the effort expended conducting it. Companies are constantly battling to reach the right balance in order to avoid wasting resources. This encompasses a need to make sure that work is not repeated within the same company. This is an issue that is not typically faced by SMEs due to the smaller number of people involved.

An underlying theme associated with idea management was finding the right data and information to support the sourcing and generation of ideas. The view was that there would be continuous uncertainty, particularly among FEI teams, without the right data feeding into search and select processes. Methods to help address this uncertainty over which sources are most effective could help better position searches. This can help with the filtering of results which was a common concern for practitioners, as well as identifying promising leads.

An interesting emergent finding was that transparency of data seemed to be an important factor for the visualisation features for Inno360. Some users were uncertain over where the data came from that is used in the visual diagrams. However, others disagreed and pointed out that you can deep dive into the data by clicking onto a topic area. This seems unclear to users with some stating that they mistrust the data and are therefore less likely to use it in their decision-making practices. A way to improve the offering could be to help users understand their current position for what they know, what they do not know, and what they need to obtain to move forward.

Figure 40 illustrates the common issues across all three data sets. Six issues were present across all techniques, two issues were common among eight issues, and eleven were identified in one technique. Only the issues that were included in two (coloured light grey) and all three (coloured dark grey) data sets were included in this synthesis. This could be due to the differing seniority levels of the participants involved, where concerns and challenges faced may not be the same. Creating this diagram helped to identify emerging insights that are discussed further in the following Discussion chapter.

	Defining the Need	Search and Select Practices	Tool Integration	Measuring Success	Tool Usage	Managing Complexity	Barriers / Challenges	R&D Value
Scoping Interviews	Need definition Confidentiality	Time constraints Need definition Confidentiality Identifying leads Data handling Connectivity Avoiding duplication		Time constraints Filtering results Connectivity Avoiding duplication		Time constraints Confidentiality Identifying leads Data handling Filtering results Connectivity	Time constraints Need definition Confidentiality Data handling Avoiding duplication	Confidentiality Identifying leads Filtering results
Main Survey	Filtering results Iteration Search terms Right data	Need definition Confidentiality Identifying leads Data handling Search habit Iteration Search terms Right data	Time constraints Identifying leads Data handling Filtering results Search habit Right data Specialism	Identifying leads Data handling Patents Right data Specialism	Time constraints Need definition Confidentiality Identifying leads Filtering results Search habit Patents Specialism	Need definition Identifying leads Data handling Search habit	Time constraints Need definition Identifying leads Filtering results Search terms	Need definition Identifying leads Patents
Validation Interviews	Time constraints Need definition Confidentiality Connectivity Iteration Search terms Right data	Time constraints Confidentiality Identifying leads Data handling Filtering results Connectivity Search habit Search terms Specialism	Need definition Data handling Filtering results Connectivity Search terms Right data Specialism	Need definition Identifying leads Filtering results Avoiding duplication Patents	Time constraints Identifying leads Data handling Avoiding duplication Search habit Iteration Specialism	Time constraints Need definition Identifying leads Connectivity Iteration	Time constraints Need definition Identifying leads Data handling Filtering results Avoiding duplication Search terms Right data	Time constraints Need definition Data handling Filtering results Patents Right data

Legend:
Common across all three data sets
Common across two data sets

Figure 40 Data Set Issue Synthesis

4.4.5 Reflection of Findings

To conclude, this sub-section will reflect on what the emerging issues from the findings mean in practice. A linear discussion of each question in relation to search and select practices has been outlined in the previous text within this section. The following information will seek to make sense of the emerging insights from a cross-category perspective (i.e. the interrelationship of issues between categories).

Symptomatic of a data-driven search is the propensity to find technical knowledge. Some acknowledgement of the real customer need was expressed however stated methods focused on patent searches, sector-specific databases and networks. This seems to be preferred over direct contact with the customer. Practitioners appear to want to know the customer's real needs but are not stating how they go about extracting the needs, other than in informal ways such as customer interviews.

Another prominent factor was the importance of defining the need correctly prior to starting search processes. Results suggested four factors that the majority of work is involved in when preparing for the search i) defining the need properly, ii) deciding where to search, iii) who to contact and iv) what data needs to be found. These preparation activities prior to searching can help overcome issues by helping to reduce uncertainty over innovation sources to be used, developing key search terms, as well as forming a strategic plan. Allowing enough time for this pre-search preparation seems to be one of the main areas for enhancing the search process.

For idea selection, there is an over-reliance on filtering ideas due to IP and confidentiality, particularly with external idea submissions. This raises a new question as to how external ideas that are creative but do not fit strategically are treated in an organisation. Additionally, ideas that are very disruptive would also be filtered out due to lack of fit or lack of capability to deliver them.

Findings suggest that the use of digital tools is a relatively new method of searching for innovation compared to in the past. It could be argued that much more ad-hoc methods and reliance on personal connections as a way of searching and selecting was used. Practitioners often described that they had no time to become an expert using a tool. There is a need for tools to fit within the fast-paced and varied nature of searches, and align to user behaviours. Tools must make searching: 1) more efficient and 2) prove themselves to be value for money for the business.

Changing behaviour is difficult within organisations there is a level of inertia involved with changing existing patterns (Majaro, 1992). This is why factors such as familiarity of tools play an important role in explaining how searches are conducted and search habits. What is needed is a way to kick-start this process rather than re-learning it, aiding the practices that facilitate the definition of the need and finding the right data to address it.

These findings help to answer one of the fundamental questions of why organisations are not fully adopting tools to aid with idea management in the form of search and select practices. The results indicate that there is a misalignment of the level of expertise of tool users, which leads to an ineffective use of the tool. Other factors such as a lack of time to learn how to use a new complex tool and lack of familiarity influence this process. Cultural barriers within the organisation overarch all of these issues as many can be addressed by giving practitioners more confidence in how to search strategically.

5 DISCUSSION

Introduction

The purpose of this chapter is to further discuss the emergent themes from the survey and interview findings to examine whether they are consistent with previously published theory on this topic. This discussion suggests that the complex front-end processes involved in integrating external ideas and knowledge, supported by platforms such as Inno360, needs to be refined and developed to reflect internal project needs and usability. In turn, this will improve innovation capabilities internally. An internal innovation platform will be of little use to an organisation if it does not have enough employees who use or rate it as effective for it to be globally adopted.

The focus of this research was to identify the factors affecting idea management and how they can enhance innovation capabilities in front-end activities within organisations. In order to gain in-depth background knowledge on the topic, an exploratory literature review was conducted across several theoretical domains. The cross-disciplinary literature review revealed a substantial number of factors which encompass idea management and related search and select activities. An empirical study followed to confirm and elaborate the literature findings within a large FMCG organisation.

This chapter will outline the emergent findings in relation to the literature review before moving onto the impact of Inno360 on idea management practices. It sets out the context and drivers behind the proposed framework as a contribution from this research in the following Conclusion chapter.

5.1 Key Findings

Table 50 below summarises the main emergent insights synthesised from the overall study. It gives an overview of findings supported by the literature and gives some of the problems correlated with current front-end search practices.

Table 50 Emergent Study Insights

EMERGING INSIGHTS
• **Search mind-set:** tactical (short-term) versus strategic (long-term) • **Outcome-driven:** search effort versus benefit balance • **Pre-search preparation:** understanding question complexity • **User background:** expertise / exposure to data • **Informal method preference:** personal networks / boundary spanning • **Level of expertise:** novices using expert tools • **Lack of clarity:** benefit / value of tool • **Lack of problem focus:** search term definition • **Redefining the brief:** interpretation of need

Specific Issues to Inno360

Several issues emerged which were specifically related to Inno360 itself, rather than more generic broader issues. The transparency of data was important within the tool as practitioners need to know where the data comes from and evaluate the credibility of the source. The complexity of the tool interface has a direct impact on how practitioners both perceive and use the tool and is the main barrier to its adoption. Being able to find and contact other experts or colleagues working in a similar area was useful and convenient for users of the tool.

The efficiency of reading through results was critical in how fast users could gather the information they needed. The most popular feature was visualisation of results for collaboration. This not only made analysis quicker and more appealing, it helped to encourage practitioners to look at the data from different levels and see it from different perspectives. Databases are mostly sector-specific due to highly specialised roles of practitioners. Often, these are the ones utilised first before trying to look more broadly.

Development of a Framework

In order to address the lack of integrated models illustrating key idea management effective practices and sources for innovation, a framework has been developed to visualise the capabilities for organisations. This also addresses a lack on IM models which focus on external factors and their relationships to internal processes.

The first step of this framework is illustrated in Figure 41 which shows the interplay between internal innovation activities and an external search. These processes are linked and feed into each other through search and select processes. Searching externally into the environment and taking knowledge and ideas internally to evaluate and select the most promising ideas is a more holistic and integrated idea management process.

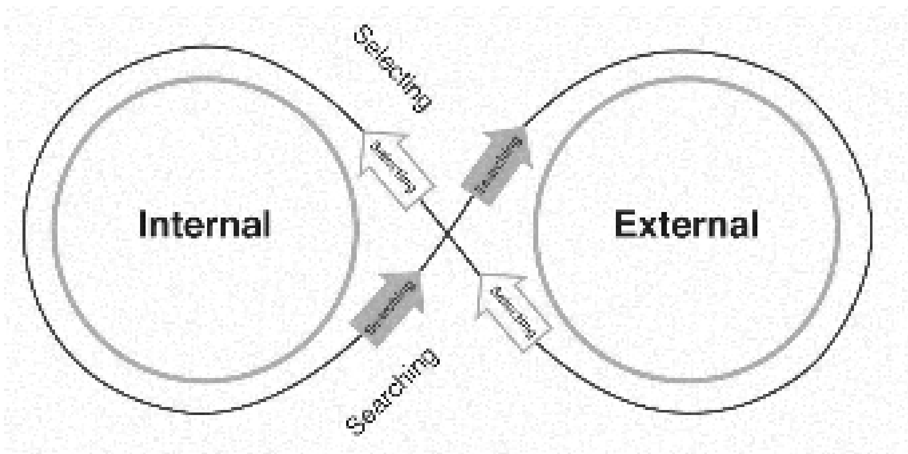


Figure 41 Framework Development: Internal & External Interaction

Source: Author (2016)

It is important to visualise both internal and external processes and issues because effective knowledge sharing both internally and externally is a key driver for NPD. McAdam *et al*., (2008) stated that it is essential that knowledge from multiple sources is effectively integrated within the NPD process, and Tidd *et al*.,

(2013) identified both internal and external sources that are used for innovation in organisations. The interaction between internal and external integration has been identified as being significantly related to market share and financial performance (Droge *et al*., 2004).

This framework highlights the importance of integration between internal innovation processes and external knowledge search and select practices. In order to develop this framework into a more realistic depiction of the complexity of influencing factors, further levels of detail will build upon this theoretical foundation. The aim is to visualise the key factors for integrated IM within this research in order to address the unmet or unsolved need, called the Idea Infinity Framework (IIF).

5.2 Response to Research Questions

This section presents how the key findings directly relate to the four research questions as follows:

- RQ1: Idea Generation Effective Practices
- RQ2: Idea Quality and Evaluation
- RQ3: Idea Management Effective Practice
- RQ4: Search and Select Strategies and Tools (Inno360 survey)

5.3 Research Question 1: Idea Generation Effective Practices

(RQ1) **Idea generation:** How are ideas generated internally and externally and what are the effective practices for idea generation within front-end activities in organisations?

Idea Generation Techniques

Theories of cognitive psychology especially relate to innovative and creative thinking (Sebastian, 2005). It has been found that greater cognitive distance tend to yield opportunities for highly novel solutions (Brunswicker and Hutschek, 2010). There is a current lack of substantial research identifying the most effective sources of ideas (Cooper and Edgett, 2008) and how they link to front-end stages and search activities. Innovation activities focus primarily on the creation of ideas and less on the perception of problems and opportunities (Košmrlj *et al*., 2015). Idea generation is therefore one of the most well-established front-end activities. It is important to acknowledge that idea generation is not an exact science as it utilises such cognitive processes, but the product of creative thinking, ideas, are valuable to businesses.

Numerous idea generation techniques are present within the literature as detailed in the Literature Review chapter, however much less is written on how effective these techniques are in practice. It was found that there is not a sole best idea generation technique, rather the best techniques are applicable to the type of industry the organisation is operating in and what types of ideas they are looking for (Glassman, 2009). The case study research here showed that there is no set ideation process used consistently throughout the organisation. Rather, each function and each country had its own methods and best sources of innovation to leverage. It is the knowledge of the innovation landscape at their disposal and their personal contacts which can make innovation happen. This opens up complexities in ideation design and methodologies which should be employed and somewhat explains the lack of agreement within the literature.

Ideation can occur with an individual or within group situations. Group ideation methods were found to be ineffective due to group creativity dynamics however they still have a place in identifying user needs. Another important factor is the absorptive capacity of the organisation in order to realise the benefits of a new external idea (Cohen and Levinthal, 1990). This is a key capability to develop if organisations wish to integrate the few external ideas that do align strategically with the organisation.

In one study, only half of companies had a formal strategy and idea generation was undertaken on an ad-hoc basis (see Kelly and Storey, 2000). Ideas are generated through formal and informal means. Idea generation has been described as a chancy process where ideas can be detected on hunches, observations, discussions or accident (Stasch *et al*., 1992). These intangible factors play an important role in allowing for creativity and serendipity (Desouza *et al*., 2009), however this also allows for opportunities to make sense of what is occurring on in practice. This factor came out strongly in the validation interviews as a key method for fostering innovation.

Internal ideas are generated within the walls of an organisation, however they tend to be less innovative. In contrast, organisations can also source external ideas rather than generating them internally. The study supported this finding as there is a strong focus on sourcing ideas externally. However, strict criteria on which external ideas will make it through initial screening are present. Idea management systems need to change to meet the new demands on ideation by the changing nature of innovation.

There is an ongoing shift in IM from workflow-driven approaches towards community-driven evaluation (Sandstörm and Björk, 2010). This involves multiple search and select processes, hence research question four regarding these concepts. An important source of innovation is companies from other industries as most innovation is based upon a recombination of existing knowledge, concepts, and technology (Enkel *et al*., 2009). This was supported by the validation interviews as being open to unexpected solutions was stated to be a key success factor in practice.

Idea Generation Effective Practices

Idea management processes involve informal and formal knowledge exchange and it is argued here that this process needs to incorporate internal and external sources and practices more effectively. The study revealed that in practice, this is the case with many complex knowledge processes occurring between different external parties as well as internally between department sectors. Making analogies, using related and unrelated stimuli as well as setting quantifiable goals help with innovative idea generation (Crawford, 1994).

King (1990) noted a diffusion bias towards innovation being imported from outside of the organisation compared to internally generated innovation. This was supported in the validation interviews as an important driver in terms of praise and recognition as a reward in the decision-making process. This comes under intrinsic motivation which has been found to be more important than extrinsic or monetary incentives (Griffiths-Hemans and Grover, 2006). Flynn *et al.,* (2003) suggested that another reason is that it is easier to adapt the creativity of someone else, rather than develop and maintain a creative organisational environment internally. The qualitative research supports this as finding external innovation that is relevant to the company was a way to earn credit internally and on an individual basis.

Idea generation involves many conscious and unconscious activities and processes. While using a challenge-based approach to innovation delivers more focused results, it is important to remember that ad-hoc innovation can still deliver valuable ideas (Hornitzky, 2009). This was certainly the case within the case study as the organisation thrives and encourages practitioners to forge informal and ad-hoc relationships with people outside of their domain. In fact, the role of informal events, such as company dinners with awards, was quoted during interviews as an opportunity for different people to sit around the same table and chat. This often brings about new opportunities for innovation in a serendipitous fashion. The rewards for successful partnerships are a prime example of building on employee’s intrinsic motivations.

Greater tacit knowledge can be generated through experimentation and problem solving and learning should occur as experts of diverse fields collectively solve problems. Issues such as trust, empowerment, open communications, and a greater degree of freedom become essential in encouraging innovative activity through collaboration and individual satisfaction. This works in contrast to barriers such as NIH syndrome and suggests that internally, P&G have a very different culture surrounding their attitude towards sourcing ideas.

Novel issues emerged from reviewing the literature on idea generation as well as reflecting on how practitioners described their idea management processes. One of these is the level of maturity of the idea within idea generation. This came about due to the varying levels of familiarity of certain search fields with practitioners and the ideas found within them. Differences in the depth of search can lead to varying degrees of familiarity with the knowledge (Katila and Ahuja, 2002). This seems particularly true if an area is unfamiliar to the searcher. This in turn links to the type of innovation, incremental or radical, and therefore may impact on the relevance of ideas.

If an idea has a high level of maturity (i.e. it is sufficiently well developed within a team) then this idea has differing requirements for growth compared to a low maturity idea. These low maturity ideas would require nurturing and development on a broader scope in order to allow for greater innovative potential. The level of maturity of an idea also affects how it is documented since early, immature ideas tend to not be reported and therefore dismissed, whereas well-tested ideas are reported (Karlsson and Törlind, 2013). These varying levels of idea maturity were stated as common with ideas submitted both internally and externally.

Several factors affecting idea generation include ideation volume and novelty, idea type (incremental versus radical), idea feasibility and transfer, market search behaviour, strategic orientation, internal idea sources (employees), external idea sources (customers, suppliers), knowledge dissemination, definitions and barriers to diffusion. Most of these factors were supported and discussed in the study findings.

In summary, this research question was primarily addressed by synthesising existing idea generation methods from the literature as well as insights from scoping interview discussions. Developing an understanding of idea generation methods enabled the discovery of the importance of idea quality as a key factor for ideation methods. A trend is that idea generation methods are now measured in their effectiveness according to the quality of ideas delivered over and above the number of ideas. It was both identified within the literature as well as being confirmed in practitioner interviews that large organisations do not struggle with finding or generating ideas. Hence the following research question on identifying idea quality criteria and idea evaluation practices.

5.4 Research Question 2: Idea Quality and Evaluation

(RQ2) **Idea quality:** What is a good quality idea and what criteria are used to evaluate idea quality within front-end activities in organisations?

Idea Quality Criteria

Idea quality is often overlooked in favour of generating a high number of ideas within current front-end literature. Various studies have investigated the criteria for evaluating idea quality such as the "average quality" approach: novelty, relevance to technology, relevance to company, and consumer benefit (Reinig *et al*., 2007). One of the key insights of this research study is that organisations do not seem to have clarity on what is a good idea. This is supported by the various definitions of what is an idea present in the literature (see MacCrimmon and Wagner, 1994; Dean *et al*., 2006; Reinig and Briggs, 2008).

What emerged from analysing the existing literature on idea quality was that there is a variety in the level of specificity of the criteria used. For example, some propose very broad categories and allow for individual interpretation (Van der Lugt, 2001), whereas some break it down into a vast number of criteria and subcriteria in order to mitigate as much subjectivity as possible. This debate is present within the case study organisation, where external idea criteria differ from internal criteria.

There was support for the concept that successful ideas are often a mixture of multiple older ideas put to a good use for another purpose, referred to as recombinant innovation (Weitzman, 1998). Core partner competencies and how they align to the need directly emerged was an important selection criteria from the empirical results. This implies that quality of ideas runs alongside the fit of the innovation partner to the organisation, and the nature of their relationship. This brings about a much broader perspective which highlights not only idea quality, but the quality of partnerships to grow and develop these ideas.

This study argues that idea quality is a fundamental aspect of innovation which can and should be measured due to the importance of quality ideas to business success. The study brought to light several insights through literature analysis which addresses this research question on idea quality:

- Mixture of definitions on what is an idea / concept / opportunity - instigating the development of a framework in this research,
- Revealed debate over level of 'newness' required from an idea
- Four defined metrics are broadly identified as the novelty, variety, quality, and quantity of designs (Shah *et al*., 2003) yet many more criteria are proposed in other research
- Organisations can still favour number of ideas over quality within their processes, yet favour idea quality during decision-making stage-gates

Although idea quality in the creativity literature is commonly assessed with the dimensions originality and feasibility, this does not mean that participants will always use these criteria when making their selection (Rietzschel *et al*., 2010). It is therefore essential to consider alternative criteria and other intangible processes that occur during idea evaluation. This research revealed that large organisations need external ideas to meet stringent intellectual property criteria even prior to receiving any evaluation regarding idea quality further along the development process. This is where most ideas are rejected outright and holds the risk of rejecting great ideas that haven't been protected. IP is a very important concern for organisations as there is an ever-present risk of legal action with implementing external innovative ideas.

Idea Evaluation

Idea and concept evaluation is an established activity within effective front-end innovation phases (Balachandra and Friar, 1997). Many informal factors come into play alongside the actual criteria used, such as idea selling, internal politics, gut feel, and time given for evaluation. Previous research promotes the use of formal and flexible evaluation systems to evaluate ideas and concepts for project selection, and the use of strategic, marketing, and technology-based criteria in evaluating ideas and concepts (Martinsuo and Poskela, 2011).

The challenges involved with unsolicited idea management have previously been discussed quality and quantity and, IP protection and ownership (Alexy *et al*., 2012). This research has confirmed that these issues are on-going within industry. This brought about the insight that merely increasing the number of incoming submissions is of no value to the firm if good ideas cannot be identified because the entire process is overwhelmed. There is a tension between an organisations' desire to welcome unsolicited ideas and its fears of dealing with too many. Profiting from these ideas requires as much attention to the external face of the firm as it does its internal face.

Dean *et al*., (2006) examined 90 studies on creativity and idea generation and described a method for evaluating ideas in terms of novelty, workability, relevance and specificity (MacCrimmon and Wagner, 1994). In practice, this research found that novelty for instance, is rarely a key decision-making criteria which ideas pass through. In terms of unsolicited idea evaluation, this research supported existing literature on the importance of IP, confidentiality and fit to need as primary concerns to filtering external ideas. This study contributes by identifying new factors such as adequate idea description for understanding and supports organisational strategic fit. The vast majority of unsolicited ideas are ruled out due to these criteria making the biggest initial impact on the success of ideas within an organisation.

Firms will need to find an appropriate balance between lowering the resource burden through shaping and being open to finding novel ideas through a costly selection process, depending on their needs. A potential solution to this dilemma is expanding the task of filtering beyond the system itself. Approaches exist where the idea submitters as a community, can vote about the value of an idea, although there are problems associated with community voting. It seems important to include further contextual factors in the analysis of creativity at work, or employee creativity, such as the work environment, pointed out by Dul and Ceylan (2011).

In summary, this research question was also primarily addressed by synthesising existing literature on idea quality criteria and idea evaluation practices. This was an important question as idea quality criteria are incorporated into the proposed framework and forms part of the contribution of this research. Since idea generation, idea quality and evaluation were addressed, the next question had the purpose to take a more overarching review of idea management effective practices, focusing on the integration of internal and external ideas.

5.5 Research Question 3: Idea Management Effective Practices

(RQ3) **Effective IM practices:** What internal and external idea management practices and sources enhance innovation capabilities in organisations within front-end activities?

The results from this study emphasise the importance of defining the need as a key preparation activity. Pre-search preparation was an emerging insight from this research, which incorporated activities such as reducing question complexity. This also links to the decision made of whether to search internally or externally. The literature review found that idea management is often formalised in large organisations, yet rarely are these processes supported with appropriate and sustainable activities (Košmrlj *et al*., 2015).

According to a global study by management consultant, Arthur D. Little, effective idea management results in an extra 7.2% of sales from new products (2005). Studies that advocate the importance of idea management to business success identified that it is currently poorly managed (Barczak *et al.,* 2009) and also provide insights into the purpose of idea management and how companies conduct these processes. However, this study was designed to go a step further and examine and understand how internal and external idea management occurs in front-end activities, with a focus on external connections. This study also sought to provide insights into how idea management practices can be improved in terms of search and select practices and the adoption of idea sourcing tools that facilitate idea management.

From the systematic literature review, a number of issues for idea management were identified as important to large organisations. Identifying the purpose of any idea management system makes sure that the system allows for the right type of ideas to be prioritised for evaluation. Allowing the ideator to take part in idea development and evaluation has been a weakness of previous IMS. Structured and high-quality pre-development planning or up-front homework is also proven effective practices in front-end activities (e.g. Cooper and Kleinschmidt, 1996).

Studies have shown that managers rely on important information from other people in order to help with projects (Cross *et al*., 2001), and that software tools, although helpful, are not the primary source of information in practice. This could help explain why personal networks and interaction with others came out as highly important in this study’s main survey. Collaboration is particularly important during the idea management phase involving critically evaluating, refining and prioritising ideas using multiple perspectives and modes of thinking (Hornitzky, 2009). This research supports these studies on collaboration and adds richness in terms of how digital innovation tools can aid in idea sourcing.

Idea Sourcing Tools

Several methods to enhance the effectiveness of Inno360 can be split into two groups: 1) functional and 2) emotional (see IDEO, 2015). The functional group includes technical issues to do with streamlining search features, such as visualisation tools, customisable search settings, and making the website easier to navigate. The emotional group is about enhancing effectiveness for the user's experience with the tool such as feedback on search progress, simple and accessible training, and the heightened communication of practical benefits to users. The results indicate that the emotional group of issues is more pronounced in user's perceptions than the functional issues. Functional issues are continually being improved over time whereas the emotional barriers users have experienced with the tool are much harder to change.

Practitioners mentioned that they would give the tool another chance but only with recommendation to do so by trusted peers within the company. This issue of peer interaction is recognised by Murphy-Hill and Murphy (2011) who break down peer interaction into two categories: peer recommendation and peer observation. These methods are effective as the learner has respect and trust in their teacher so they can take it seriously, the learner can reflect on the teacher's use and apply it to their own needs. In addition, the learner and teacher share a common background so the tool is more likely to be relevant.

Integrated idea management is a holistic and complex concept involving multiple external idea sources and actors. The results reiterated these factors, particularly the high complexity involved. Achieving a balance is a common struggle between being open to new ideas without being overwhelmed with low quality ideas that do not fit to company strategy.

Often companies spend millions of dollars on tools that fail to deliver on their promise, and the culprit is typically not the technology itself but the use of that technology (Thomke, 2006). The earlier a more integrated idea management system is implemented, the greater the probability of high numbers of successful innovations (Brem and Voigt, 2007).

The issue of handling rejected ideas is important and can be addressed with digital idea management systems, by being kept in an “idea bank” as suggested by Cooper (1993). This should be conducted concurrently with providing feedback to the idea submitters (Gorski and Heinekamp, 2002). Communicating success stories and measuring success well helps to integrate idea sourcing tools and introduce them to current and potential users.

In summary, this third research question was answered using both primary and secondary research. The main survey addressed how practitioners search and select ideas and knowledge as part of idea management and therefore revealed several new insights to the field.

5.6 Research Question 4: Search and Select Strategies

(RQ4) **Search and select strategies**: How can the effectiveness of internal and external search and select strategies and tools be improved within industry and what challenges are associated within front-end practices?

This research question was addressed directly through the Inno360 survey as an example search and select tool and provided recommendations and identified challenges. This research argues that organisations do want to find good quality ideas but are unaware of how to best search for and select them. Related to this, is a failure to properly define the need or problem is a primary concern for search and select practices. The issue of a lack of a problem focus, verified by the validation interviews, can lead to all-encompassing, overly complex models within organisations (Jetter and Kok, 2014). This was surprising as other practitioners prioritised how important the need is to their searches.

Not asking the right questions that help frame the design and scope of initial research and investigations is a common symptom of front-end failure (Mootee, 2011). In addition, work by Sieg *et al*., (2010) verifies this as ensuring a problem is framed at the right tactical or strategic level impacts how it is perceived by the external world. This was a key factor which influences how organisations search and select ideas.

One tension regarding preparation activities is that designers need deeper reflection on the actual design problem, what data they would need to solve it and how they were going to collect it (van Veggel, 2005). Designers can fail to distance themselves from the data making it difficult to perceive the underlying insight opportunities. The survey supported this finding as the searches are highly based on found data and it appears that some practitioners expect the insight finding process to be complete by the time a need reaches them.

Closely related to need definition is the issue of question complexity relating to the level of ambition in goal setting (i.e. is it perceived as realisable or impossible). Understanding the complexity of the question itself was an insight raised from the validation interviews. Does reaching for an almost impossible goal encourage or discourage people to try and solve such a problem? Goal setting is a widely used activity in organisations (Locke and Latham, 1990). The presence of a creativity goal has been found to have a positive, significant effect on creative behavior (Shalley, 1991) suggested to be due to encouraging intrinsic motivation to perform. This can indeed act as a success factor as well as a barrier.

Question complexity has not been articulated in previous research in regards to idea management, however research focuses more on defining a problem more generally for successful innovation. It has been raised in terms of business intelligence where questions can range from simple and involving few information sources and procedures, to complicated questions requiring integration of diverse information from a number of sources, functions and usually number of people (Skyrius, 2015). This concept of a question complexity spectrum may be able to be handled by appropriate software.

Another issue identified was the importance of making an explicit decision whether to search internally or externally. As previously discussed, the search for information can be internal based on consumer knowledge or external directed to the environment (Pham and Higgins, 2005). Theory stated that practitioners should make this decision, however, this study found that in practice that decision is not always made in an objective manner.

The findings indicated that the level of seniority of the practitioner within the company can impact their answer: whether they always look internally first to make sure that work is not repeated, or always looking externally first for solutions. In contrast, the validation interviews revealed that most practitioners automatically look externally for solutions. However, this may be due to the fact that the study used practitioners who are within a function that is known for finding external innovation.

Scanning boundaries as well as depth of analysis within these boundaries are important considerations for scanning teams. The explanation of this issue was identified to be about intrinsic and extrinsic incentives, in terms of rewards for finding external solutions within the company. Intrinsic motivations, such as peer recognition, have been identified in other studies to be more important than extrinsic (i.e. monetary) motivations (Griffiths-Hemans and Grover, 2006; Soukhoroukova *et al*., 2012). Incentives emerged from the validation interviews in relation to search and select practices, as practitioners who found ideas externally tend to get more credit. These political factors play a key part in the success of ideas turning into successful innovation.

Using outcome-driven processes was another key insight as balancing search effort was revealed to be a struggle between the benefits of the search versus the effort expended conducting it. This is explained in more detail in the Conclusion chapter.

Search and Select Practices

In summary, the principle search and select methods identified by practitioners emerged as:

Search methods:

- Default digital search tools: Google
- Sector specific scientific databases: Orbit
- Personal networks and interaction, mainly informal discussion
- Leverage existing strategic partnerships / key touchpoint organisations
- Use of innovation intermediaries, such as ISPs
- Serendipitous meetings around the office / during events
- Scan tradeshows for suppliers and future opportunities
- Listening to radio reports and follow-up websites

Select methods:

- Investigate existing channels before searching for new channels
- Referral of partners from trusted peers
- Unsolicited idea selection:
  - IP / confidentiality issues
  - Level of fit to priority need
  - Lack of adequate idea description
  - Lack of strategic fit
- Filtration of high risk companies
- Match of core capabilities and interests

Making sense of the brief was an important activity during the front-end is that of meaning-making (Frishammar *et al*., 2011) or sense-making (Seligman, 2006; Mootee, 2011). Re-defining the brief is an activity undertaken as practitioner interpretation, on an individual and team level, is involved with any project. This affects what selection criteria are put into practice to filter ideas, opportunities or solutions. Finding the right data to meet the need drove all of the search practices described by practitioners in this study. The view was that there would be continuous uncertainty, particularly among FEI teams, without the right data feeding into search and select processes. This issue of uncertainty is common among front-end stages (de Brentani and Reid, 2012) and can be a main barrier to innovation.

Organisations such as InnoCentive, YourEncore, etc., advocate the importance of making connections with external individuals to solve organisational problems. However, this study is designed to examine and understand how organisations can orientate their search and select processes for ideas, what processes organisations adopt, and what issues and factors are associated with success for design business practice.

From the literature, a number of issues were identified as being of importance. It is argued that managing innovation is a dynamic capability (Tidd *et al*., 2013). Transparency of data was articulated as important which allows users to feel more secure with the reliability of results, particularly when using visualisation tools.

The results supported the view that a mixture of formal and informal methods is used for searching. This finding is not a new one as it has been identified in several other studies (see Tidd *et al*., 2013; Koc and Ceylan, 2007; Thomke, 2006). However, the study did go into more detail asking about the specific nature of search and select practices. It was found that the majority of practitioners used informal methods more often than formal methods in their activities. This finding is supported by Koen *et al*., (2001) as the front-end is uncertain and informal methods are beneficial when information is yet to become clear. Koc and Ceylan (2007) argued that using formal and informal idea generation systems enhance the number and the quality of ideas.

The scoping interviews revealed that certain searches are planned over a course of months or even years depending on the level of interest from the business. The main survey revealed that performed searches in Inno360 were typically less than 30 minutes in length. This attribute of tool users performing quick fire searches seems to be beneficial to R&D activities, translating to a sense of search urgency. This issue of search urgency appears to be a new issue discovered by this research, however it seems to be a critical factor in the minds of practitioners performing time-constrained search activities. The value to be gained from utilising innovation sources needs to be high enough to warrant the time spent searching within them. Time constraint was one of the main barriers identified in this study.

Interestingly, the use of suppliers was not an issue identified as important by practitioners, with the exception of meeting suppliers at tradeshows as a source of future connection possibilities. This appears to suggest that interaction with close peers and digital tools serve as primary sources of ideas with suppliers playing a role only once the need is defined and preliminary searches and refinement has taken place. This is in contrast to other research that identifies suppliers as one of the foremost innovation sources for organisations (Un *et al*., 2010). However, other studies have found that companies feel very strongly that they should be involving suppliers at an earlier stage in NPD efforts (Ragatz *et al*., 1997).

Overall there appeared to be a struggle between four distinctive variables within the search and select process: value, time, depth and expertise (see Figure 42). Value refers to the beneficial outcomes of the search, time refers to the time available to perform and complete a search (often including reporting back to superiors), expertise refers to the level of expertise of the practitioner performing the search (i.e. novice or expert), and finally depth refers to the search depth and level of detail required in search results. Rather than acting as spectrums, they are represented as a grid due to the interrelationships between these four distinct variables.

This research argues that all four of these variables are at play with an individual performing search and select activities. In particular, the level of expertise when using a platform such as Inno360 tends to be high due to the complexity involved with the system which impacts the effectiveness of tools such as these. This links directly to a key insight from this study regarding user background and their expose to data. This poses real problems to novice users wanting to learn how to use an expert search tool. Firstly, a novice user may be intimidated by the tool due to lack of knowledge of how to use it and a preference for default tools such as Google which perform tasks simply and quickly. Secondly, an expert user has a background in using similar tools and therefore has a greater tolerance to learning how to use it effectively. These issues were confirmed from the validation interviews following the main survey.

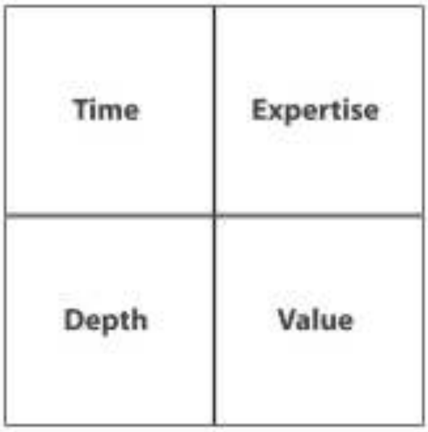


Figure 42 Search and Select Variable Grid

Source: Author (2016)

The study supports this as practitioners identified this tolerance for using computational tools due to the alignment with their training and background (see Murphy-Hill and Murphy, 2011). This also poses a problem to organisations as the studied tool was open to all R&D and employees have varied backgrounds and different roles within the company, therefore users are likely to not have this complementary background which facilitates their learning. The level of expertise of the user appears to affect the depth of search that can be conducted to a certain extent.

In addition, it was found that users, who considered themselves as experts, carried out quick and highly specific tasks within the tool. This translates into experts preferring short time frames (quick turnaround) and high value search activities. The novice users aspire to quick, high value task completion within a tool but have a much greater learning curve to overcome than experts, which implies that they tend to give up due to a lack of time. This was also supported in the study and validation interviews, including new learning curves when they do not use the tool regularly. Allowing time for individual exploration of a tool prior to conducting active search tasks was an activity mentioned by novice users. This problem can be overcome with simple, effective and accessible training by peers.

Patent mapping in particular was a very common source of finding and generating solutions in this study, supported by Cooper and Edgett's (2008) findings. The issue of expertise of user links to database specificity and therefore impacts which databases are the most effective for the need. Linking back further still, the specific language of the need itself precedes these factors and illustrates its importance to the effectiveness of a search.

Search and Select Barriers

A number of barriers emerged from the study including time constraints, need definition, confidentiality, identifying leads, data handling and filtering results. All of these factors were identified in each of the three data sets of scoping interviews, main survey and validation interviews.

A main barrier for innovative ideas to survive is due to organisational culture, with large organisations known to be resistant to change as many resist embracing new tools due to fearing a disruption to the established and proven ways of doing things (Thomke, 2006). A lack of a consistent language in terms of ideas, solutions, opportunities, issues, and the need was discovered and is supported by Koen *et al*., (2001).

There is a tension related to the communication of findings and creating engagement with employees based on the problem of over simplification versus complexity (van Veggel, 2005). Long *et al*., (2010) suggested that in order to decrease the quantity of uncertainty in the product innovation process, market research should provide as much information as possible to understand the customer. This was amplified by not enough practitioners regularly using the tool, bringing about issues with having to relearn how to use the software after a period of non-use.

The main barriers identified from the survey about the use of Inno360 was complexity and a lack of time to integrate its use into their activities. The principle reasons associated with tool complexity, within the sample in the front-end of innovation, are mainly attributed to: (i) poor usability, (ii) lack of tool familiarity, and (iii) ineffective training. Poor usability relates to users finding it hard to navigate the website itself, users were more familiar with simpler tools such as

Google for their needs and Inno360 was found to lack this level of familiarity, and current training efforts appear to be ineffective as practitioners attend but do not return to the tool.

Firms have different aspects of focus so this indicates that companies may wish to focus on particular areas of concern or relevance to themselves (Chiesa *et al*., 1996). This approach can reduce complexity however, this also holds the risk of a company not investigating areas that may become of interest. This can be combated by using innovation or technology scouts for example, to cross-fertilise knowledge across boundaries.

Three specific strategies are proposed to deal with emerging complexity in innovative digital technologies. These three strategies are i) building an open problem space, ii) constructing partial models to efficiently search open problem space, and iii) anticipating multiple futures by contrasting different models (Dougherty and Dunne, 2012). Inherent risks and complexities are acknowledged when using digital tools for complex, science-based product innovations.

There appears to be a critical mass level required with landscaping tools such as Inno360 in terms of peer adoption. It emerged that not enough users actually used the tool despite being registered or having attended training. Most of the validation interview participants had attended training once but then did not go on to use the tool afterwards. This problem of low peer adoption affects the effectiveness of certain tool capabilities such as collaboration and sharing of searches, as well as hurt internal reputation via poor word-of-mouth recommendation. The results suggest that such internal politics play a large role in affecting how tools are perceived and used in practice.

Literature supports the importance of peer adoption not only about tools but also for ideas. Trial adoption, for example, can be done vicariously by observing or asking about a peer’s adoption experience (Seligman, 2006). Achieving voluntary support or buy-in of one’s peers is often also treated as an acid test for a new idea’s merits (McGuinness, 1990). Similarly, Tsai (2001) stated that organisational units require external access and internal capacity to learn from their peers if they are to obtain and apply knowledge for their own use.

The issue of company reputation was raised in the validation interviews with a practitioner acknowledging that the name of a big company helps to open doors. Company reputation (Lewellyn, 2002), also referred to as corporate reputation, has a broader influence as it is linked with the organisation's values, vision and purpose (Cretu and Brodie, 2007). Intangible reputational assets have a main external value and enable a firm to achieve various goals in the market (Teece *et al*., 1997). Often a large company name brings about trust with the other party and this increased level of trust and openness lends itself positively to innovation.

Companies have been shown to struggle with selecting problems that a) can be solved by outsiders and b) can be revealed to the outside world (Sieg *et al*., 2010). This relates to the challenges with specialist language in formulating problems and degree of relevance to those outside of an expertise area (Alexy *et al*., 2011). A way to address this challenge is by breaking down complex and commercially valuable problems into manageable elements. In addition, selecting problems early on in the research phase alleviates biases due to employees not having worked on the problem for a long period of time.

Overcoming the steep learning curve can be done by allowing and facilitating peer observation as it is effective due to: 1) the learner seeing the value of the tool while in use on a real problem / need, 2) the teacher imparts minimal tool information allowing the learner to feel like they discovered it and looking up information later, and 3) the learner can associate the tool with its context of use making it memorable (Murphy-Hill and Murphy, 2011). These best practices in orientation of the training could be employed in order to increase adoption of Inno360.

All of these factors can encourage current and potential users to take up a new tool more easily as well as helping build new relationships between employees from different company functions. Overall, there appears to be a lack of clarity on the real value of Inno360, despite the efforts of the internal training. As mentioned previously, communication of benefits and peer adoption is fundamental to gathering support and users for tools.

Although numerous IM systems are available, the case study illustrates that organisations can struggle with getting these tools adopted globally and aligned to their day-to-day project activities to add real value. This is supported by the findings of this research in the low level use of the tools, a lack of awareness of its capabilities, an unclear view of purpose or real value, and a view that it is too complex to use etc.

Multiple lessons have been learned from developing tools for industry including: performance measures related to depth and breadth of tool use, and testing requirements including functionality, usability and usefulness. Additional issues were supported in this study as identified in Chiesa *et al*., (1996) as:

- companies focused on particular areas rather than all in use of the tool,
- all found difficulty in collecting data for metrics,
- focus differed depending on nature of the company,
- too complex,
- language problems,
- championing of the tool by senior management,
- an indicator of usefulness is whether it leads to effective action plans to improve innovation,
- and adaptability of the tool to fit organisational needs.

It became clear from interviews that organisations have a large amount of front-end tools to facilitate idea generation, sourcing and internal and external connection building. What is lacking is a clear view of how effective their current tools are and whether they can be enhanced to better align to their day-to-day activities. Internal idea generation and external idea submission are carried out globally and on a large scale, it is therefore of greater importance that tools managing these ideas are efficient, fast, reliable and easily accessible. This therefore led to the triangulation between three main areas of concern: need definition, search practices and selection criteria (see Figure 43).

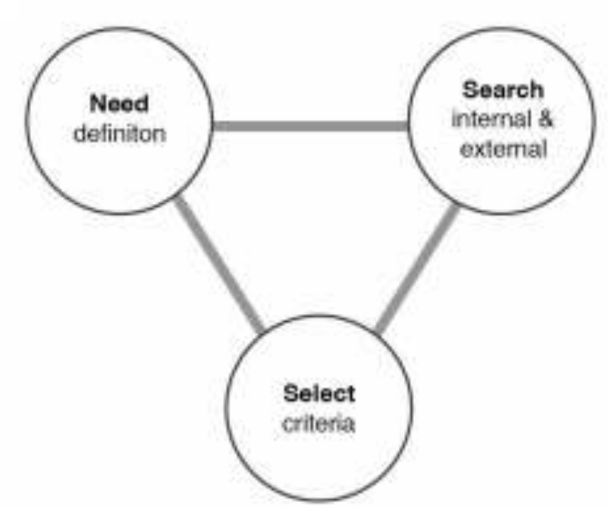


Figure 43 'Need - Search - Select' Triangle

Source: Author (2016)

These summarise the main areas for investigation and improvement within idea management practices. This formed the foundation and key building blocks of the developed IIF detailed in the Conclusion chapter. The need should be defined properly prior to commencing a search and select strategy, however iteration between the problem and potential solutions is commonplace. This unmet need-driven search utilises internal and external capabilities in order to address the need. The found solutions or companies then need to be filtered via selection criteria defined at the start of the process.

It was clear that more focused training is needed which is much more targeted for specific searching tasks in tools. For example on search term definition, security of searches as a benefit over Google (but more user-friendly), less results given but more relevant (similar to low volume of ideas at greater quality trend), in-person training versus online help / guides (rated as not applicable to users in survey). More targeted training is starting to take place relating to search term effectiveness but this message appears to not yet have reached the user base. In fact, practitioners felt that the real tool benefits are not communicated within the company.

As firms leverage more standardised tools to design, produce, and support products and services throughout an organisation, they share more data and processes across organisational boundaries (Yoo *et al*., 2012). The sharing of data and processes with digital tools challenges conventional norms of ownership, roles, and rules. Risks can become more heightened when individuals draw on multiple tools simultaneously to enact their practices (Pentland and Feldman, 2007). A strong factor that emerged was that spanning boundaries can produce unexpected solutions which are important to innovation efforts, supported by other research (Salomo *et al*., 2003).

Alternative tools which are more familiar to a practitioner are often preferred over newer or unknown tools. This issue emerged from the validation interviews with practitioners stating that they have certain ‘default’ search engines to hand. The appeal is that users are aware of their value and the tool performs the desired task quickly. Inno360 users revealed that they also use Google, Orbit and Scopus to support their search and select practices. Intuitive tools are beneficial in reducing the initial inertia in learning a new tool and are regarded as easier and faster to use.

In summary, research question four addressed search and select practices and tools used to support these processes, specifically Inno360 as a landscaping tool. It also covered barriers to adoption of Inno360. Definition of the problem and the search for a solution are not linear activities, but rather occur iteratively and are refined to better align to the real problem or need. It also addressed the increasing popularity of digital tools to support idea management. Increasing the effectiveness of such tools is therefore of direct interest to researchers and practitioners.

5.7 Summary of Discussion

This discussion chapter proposed the synthesis of research findings by directly addressing each of the four key research questions.

Research question one focused on examining how ideas are generated internally and externally and effective ideation practices. It revealed that ideas are generated in formal and ad-hoc ways, involving differing methods to increase the likelihood of generating quality ideas that are aligned with strategy. Organisations do not struggle with generating enough ideas and can often source thousands of ideas externally from customers and suppliers, rather it is now about quality over quantity of ideas. They therefore need appropriate mechanisms to help manage this process and increase idea quality i.e. increase effectiveness of idea management. This research finds that internal and external sources should be made more visible and partners and knowledge exchange are prioritised according to the appropriate stage of the searching process.

Research question two investigated the related topic of idea quality and evaluation. Often idea quality criteria are project-specific according to the required goal of an idea and are broad in nature. Feasibility, strategic fit, alignment to technological capabilities and customer benefit are frequently used for evaluation. However, intangible factors such as gut feel also play a part. By enhancing the performance of idea evaluation, there is the opportunity to save managerial time and money as it can be a highly labour intensive process particularly with the high volume of external ideas organisations can receive on an annual basis.

Research question three explored idea management effective practices identified from the literature and main study. Several factors were confirmed along with the role of idea sourcing tools, with confirmation from the main survey, were explained. Recommendations to overcome identified tool adoption barriers were also given. The purpose of an IMS and the importance of personal networks in particular came out strongly. There is a balance between being open to all ideas and providing appropriate resources in order to find and implement the most promising ideas.

Research question four aimed to identify existing search and select strategies as well as sources and barriers found from the research. This had an emphasis on evaluating Inno360 and identifying barriers and recommendations to its adoption. A contribution was made in the form of four interrelated variables of time, expertise, value and depth which helped to synthesise the interaction between the users and the landscaping tool. The importance of defining the need, selecting the right problems, company reputation and differing search style preferences of the user were identified along with other relevant issues. Barriers from the Inno360 survey included complexity and lack of time to use tools in-depth, as well as level of expertise which impacts how useful practitioners see Inno360.

The factors have been validated either via literature or empirical research efforts within this study. The factors discussed all relate and give further insight into how organisations can improve external innovation capabilities in front-end activities through idea management practices. This specifically relates to the use of landscaping tools such as Inno360 or any other tool integrating internal and external sources for innovation.

The key outcomes from the survey are of importance to R&D practitioners and managers responsible for search and select innovation activities within an organisation. One of the anticipated weaknesses of the study is that it applies to large organisations, making the findings not necessarily generalisable to SMEs.

Achieving the right search mind-set overarches all of the discussed issues and insights. The results also indicate that the sampled search practitioners specifically considered themselves to have urgent search needs and tools often have to perform tasks efficiently. Results indicate that organisations find it difficult choosing, reviewing and adopting tools internally in an effective manner. Analysing the use of Inno360 greatly helped to contextualise this key finding, which in turn led to a framework being developed to help organisations better implement their external innovation tools.

6 CONCLUSION

This final chapter summarises the main research findings and discusses their implications, evaluates the adopted research methodology, demonstrates that the research questions have been answered and the research has contributed new knowledge to the field. It does this by proposing a new Idea Infinity Framework (IIF) that incorporates the issues and key constructs identified and validated from empirical data and literature in this study. Recommendations on how to improve tool adoption rates as well as providing an orientation tool for search and select processes are highlighted. It also provides recommendations for future research opportunities.

6.1 Contribution to Knowledge

The main contribution of this research was a framework which visualises the front-end search and select process and details key issues affecting idea management. The empirical study revealed that need definition, expertise, capability and capacity were critical to industrial practice. The need for better integration with external ideas and knowledge is well documented, however methodologies are less integrated within activities in practice and there is a reliance on digital tools to source ideas internally and externally. This therefore places more pressure on these tools to perform effectively and in a fashion which facilitates idea management.

This study is relevant and important because there is a great deal known (on the basis of a century of academic and professional research) about the R&D and new product development process: the routines, practices, protocols and success and failure factors associated with these activities. Much less is known, however, about three specific parameters: 1) idea generation, 2) selection and 3) development processes that provide the fuel for all innovation endeavour. This lacuna is an important one as idea generation and management have been specified as activities that are generally poorly managed (Barczak *et al.,* 2009), and fields that are not well-understood. Clearly a more detailed, exploratory study is required to provide an excavation of this territory, and to assist in the formulation of effective and practical responses.

The study set out to answer four research questions (see introduction and discussion). The purpose of answering these research questions was to develop a more in-depth understanding of idea management and external search practices used by global organisations to enhance front-end innovation capabilities. This was achieved via industrial interviews and a main survey on Inno360 in order to: (i) determine the sources of internal and external innovation, (ii) establish the activities organisations frequently use to collect ideas and knowledge internally and externally, (iii) determine the specific challenges and barriers faced by practitioners using a digital innovation tool and (iv) identify search and select strategies used to integrate ideas and knowledge within FEI processes.

Creating a step-change improvement in the usage, blending and processing of internally and externally generated ideas for innovation is a goal that can deliver savings and profits that are of huge value to global corporations such as P&G (the potential value is in the order of tens of millions of dollars per year). Getting idea sourcing and selection ‘right’ is essential. To support this aim, major companies must ensure they are optimally equipped to deploy, flex and adapt idea generation and sourcing tools that are available to them. Delivering the knowledge and understanding to underpin this tool-use and enhancing idea-building in innovation more generally, is the principal contribution of this research.

The bulk of idea management literature focuses on software and web programs which store, manage, and screen ideas (Glassman, 2009). The intention of this study was to build upon existing research and to provide a level of granularity that would contribute new knowledge and help identify new insights on how to bridge the gap between theory in academia and practice in industry. The research design therefore adopted a mixed methods approach and evaluated the effectiveness of an innovation tool within P&G as a case study example to address these questions, particularly Inno360 to address research question four.

The reliability of the study can be validated due to the alignment of findings with previous studies on the topic. For example, the surveyed practitioners confirmed that one key success factor was the definition of the need prior to the search taking place along with further iteration as the search continues, which supports the work of Helfat *et al*., (2007). The practitioners indicated that the effectiveness of open innovation tools in front-end projects is dependent on the: 1) intuitiveness of the tool, 2) how quickly it can be integrated into daily activities, and 3) its ability to deliver valuable, real-time results within organisational practices (Blessing *et al*., 1995; Chiesa *et al*., 1996).

The main issue was with high complexity with internal and external idea management, due to factors such as interrelated formal and personal networks, political dynamics, boundary spanning and confidentiality. The research outcomes are of interest to large organisations looking to enhance how they manage their internal and external ideas. This could be done through better understanding of the complexity surrounding idea management practices, and utilising search practices which help cope with this complexity. Enhancing the effectiveness of current landscaping / idea sourcing tools has great benefits for the tool users as well as the organisation as a whole. Addressing the identified issues with usability and communication should help increase the level of adoption and increase these benefits to search practices.

The findings from the practitioners highlighted the gap between theory and practice in terms of idea management practices. The analysis of the results indicated that the sample were mostly not adopting the tool meant to enhance front-end innovation principle concepts relating to: (i) integration of internal and external sector specific databases, (ii) collaborative sharing of saved searches for use in FEI teams, and (iii) a lack of communication about tool benefits and its position in the company. This raises the question why organisations do not appear to fully adopt digital tools in their practices. The main survey and validation interviews were completed in order to investigate the effectiveness of Inno360.

This study provided empirical evidence for the factors affecting idea management and the integration of external ideas in organisational front-end activities. The findings from the organisation sample on the effectiveness of the idea sourcing tool (Inno360) highlighted the gap between novice and expert tool users and their varying aptitudes for digital search tools. The process appears to still be governed by political and reputational perceptions. However, it was identified that these perceptions can be changed with positive trusted peer-to-peer recommendation.

The analysis revealed that the sample were not using the tool for several reasons: (i) it is too complex and hard to navigate, (ii) lack of communication about true value of tool to daily activities, (iii) not enough people use it which limits effectiveness for collaboration, and (iv) time constraints make setting aside time to learn how to use it difficult. Many of the factors can be overcome with improving the usability of the tool, to deliver a simple and intuitive interface as well as integration of internal and external databases.

Issues such as search urgency, transparency of data and finding the right type of data for searches were important to practitioners and early search practices. These findings revealed the insight that search and select practices and strategies are outcome-based and not process-based. Proven outcomes are the main judge of effectiveness rather than the process used to achieve them. This supports the findings where results and useful data drive decision-making in regarding to tool use. If tools are more aligned to practical benefits that are clear to users, they can become more effective at providing the right type of ideas and solutions to searching users.

An interesting finding was the importance of the political process in terms of building internal idea buy-in and financial support for an idea. This can be applied to tools as an underlying tone of political unrest was found with a view that tools often get introduced for employees to use due to the interests of senior management. This does not seem to be an issue when the tool is seen to work, however, when it is seen not to work or makes life harder for potential users, it appears very unlikely to succeed. This indicates how important it is that tool benefits are communicated clearly to practitioners, tools are championed by sponsors (Reid and de Brentani, 2004) at different levels within an organisation and that they are integrated into delivery reviews and outputs.

Looking at search practices more broadly, the validation interviews revealed that practitioners have a preference for a particular search strategy. For example, some prefer using digital tools due to their familiarity and background whereas others enjoy "*old school*" search methods, involving informal chats with peers and using intermediaries as touchpoints. The majority of users indicated that they mostly used these informal discussion methods early on in the start process, and then access search tools to bring data into these discussions as evidence for decision-making. This highlights how important search results are to justifying the methods employed.

The contribution of this research is to help answer why this is the case and provide recommendations on how tools, such as Inno360, can be better integrated into front-end search and select activities. The following information will highlight several contributions to new knowledge that this exploratory study makes to the field, in relation to four research questions. The information will articulate the emergent contributions within the context of the front-end of innovation literature, specifically during the 'Establish', 'Discover' and 'Define' stages detailed on page 132.

Firstly, the study set out to explore trends and factors affecting idea management within front-end activities in organisations, specifically how ideas are generated internally and externally and identifying effective practices. This was due to the research need to enhance idea management in organisations as studies have identified that ideas are currently poorly managed. It was confirmed that both quantitative and qualitative dimensions of idea generation are important aspects of idea management, supported by the work of Selart and Johansen (2011). Whilst unpacking idea generation factors, the trend between quality and quantity was clear along with how to improve individual and group ideation. Generating quality ideas early on in front-end activities has the potential to increase the chance of those ideas being adopted and turning into innovation.

Secondly, the investigation aimed to establish the criteria organisations use to evaluate idea quality within their front-end activities. The findings from this study have established that idea quality criteria are broadly grouped into novelty, feasibility, fit to strategy, fit to capabilities and customer benefit. Empirical research revealed that ideas and solutions have to address the need and criteria such as IP, confidentiality and lack of description filter out the majority of unsolicited ideas from the outside world. External ideas also tend to be off strategy as found in Cooper and Edgett's study (2008). These insights indicate that idea quality criteria can vary according to whether the ideas originate internally or externally.

Thirdly, the study embarked on identifying internal and external effective practices for supporting idea management in organisations within front-end literature. The findings support existing research showing that problem definition is critical (Helfat *et al*., 2007; Acklin, 2010), however, this study identified that often there is a lack of problem focus and effort is spent in reducing the complexity of the problem. This is why the establishing phase has been highlighted as a key phase which is argued in this research should be added to the innovation process, in order to reduce uncertainty and raise the quality of ideas. A clear focus of IMS in terms of the types of ideas an organisation wants to generate and source. This highlighted the finding that the most frequent idea management practices go into sourcing ideas, rather than efficiently filtering ideas with the appropriate criteria.

Fourthly, the objective of identifying search and select strategies and the challenges and barriers associated with these within idea management was achieved. In addition, it also addressed how these barriers can be overcome. This study identified that complexity and time constraints were the main barriers, validated in the Inno360 survey and supported by Rycroft (2007) and Salter and Gann (2003) respectively. The results from the analysis of Inno360 revealed that searches on digital tools often are typically under 30 minutes in length, that practitioners want relevant results to their need statement and to know where the information comes from.

The literature review identified three knowledge gaps that the study and developed framework help to address:

Gap 1: a lack of research on how ideas are sourced for idea management (Soukhoroukova *et al*., 2012) i.e. not just identifying internal and external innovation sources. The IIF provides a visual explanation of how organisations search and select ideas, internally and externally, and thus goes beyond simply identifying innovation sources. This research focused on the integration processes involved with sourcing and evaluating good quality ideas and feeding the idea pipeline.

Gap 2: a lack of academic literature on helping to understanding how ideas get going within organisations (McGuinness, 1990). This research explored several aspects of how idea are generated and transferred through the front-end phases with activities such as political idea selling, organisational criteria, fit to the need or problem and highlighting the nature of processes involved. It therefore helps to address this gap and adds to the field of idea management research.

Gap 3: a conceptual gap between the generation and the selection of ideas and their transformation into innovations. Although this study did not focus on idea implementation after the initial establish, discovery, define phases, it does contribute to the literature on idea generation and idea selection. This is difficult with other studies also establishing the importance of these front-end activities, such as a need to explore further methods, concepts and tools to support the processing of ideas into innovations (Blohm *et al*., 2011). However, this study delivers quantitative data, something which is lacking in similar studies, as well as a holistic understanding of the challenges and barriers involved with these activities in practice. This area is one which has further opportunities for research.

Some existing IM definitions focus on ideation and selection, but do not include how ideas are sourced (Soukhoroukova *et al*., 2012). This research addresses this existing limitation and conducted an in-depth empirical study on the effectiveness of an idea sourcing tool by comparing literature reviews factors to the use of Inno360.

6.2 Idea Infinity Framework

The Idea Infinity Framework (IIF) has been developed within this research in collaboration with Bolton who helped oversee this research. This framework visualises the core concepts and internal and external factors in order to address a gap in front-end innovation. The core insights taken from this research that inform the framework include:

1) the need for better integration between internal and external capabilities for innovation
2) a defined unmet or unsolved need drives search and select practices
3) organisations do not always understand what a high quality idea is
4) aligning the level of expertise to complex innovation tools impacts effectiveness
5) lack of capability and capacity also drive external searches - time, effort and tool adoption
6) alignment can be better achieved if tools are more outcome-driven and not process-driven.

The next level of the framework builds on the previously proposed Figure 41, which showed (i) the integration of internal activities and external sources and (ii) external search and internal selection processes. Figure 44 is composed of three interrelated elements: 1) search and select strategies (driven by unsolved needs), 2) internal innovation activities (driven by organisational culture and five innovation phases, inputs and outputs) and 3) external innovation sources (driven by search strategy). The search and select practices are in bold to highlight the contribution made by this author. The unmet need firstly flows through internal innovation activities and then external innovation search activities if it has not been solved internally. If leads have been identified from the search activities, then they are selected / filtered down into the most promising leads for the company to be taken for further development.

Five key innovation stages have been detailed surrounding the internal activities circle on the left. The first stage Establish was identified from a need in the literature for a preparation stage in organisations prior to discovery innovation activities and is a new contribution to the field (see pages 32-33). The following four phases of Discover, Define and Develop are established in existing literature (Design Council, 2005). This framework illustrates how organisations then search externally for ideas and knowledge. Each circle on the right hand side of the framework represents a different innovation source. Practitioners reach out to these external sources in order to find potential leads before bringing them internally for selection.

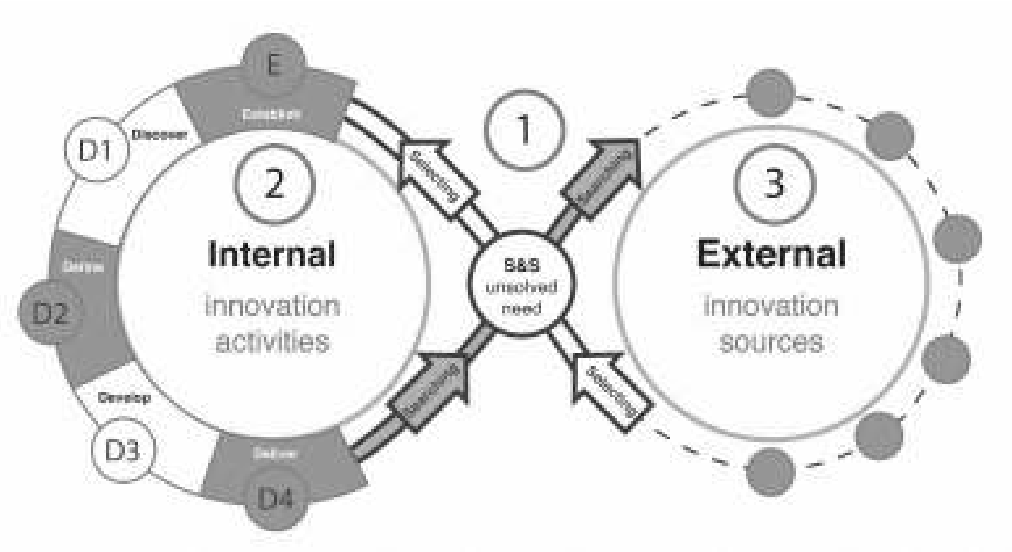


Figure 44 Idea Infinity Framework: Search & Select Emphasis

Source: Author and Bolton (2016)

Search and select practices are driven by an unmet or unsolved need at the start of the searching process, shown in the middle of the framework. This was supported by the empirical study with practitioners stating that this was the most important part of their searching process. McGuinness (1990) recommended that a study should describe, map and classify search activities and deal with questions of effectiveness and better management. This research addresses this gap by visualising search and select activities in organisations, encouraging the clear definition of the business need to allow for the search for ideas, and focusing their evaluation to increase idea quality.

The framework relates to organisations that search externally to source innovation from users and suppliers etc., and then bring ideas and knowledge back for development through internal activities. Internal innovation activities are related to the front-end innovation phases that a project moves through. This involves switching to a selection mind-set where ideas are filtered out according to certain selection criteria. These criteria broadly include IP, strategic fit, technical and economic feasibility, and customer benefit and reflect the research on idea quality.

Research shows that certain innovation activities are more important in certain phases. The framework therefore identifies the outcomes of each of these phases encompassed by the five stages of establish, discover, define, develop and deliver illustrated around the internal innovation activities on the left hand circle. The right hand circle identifies multiple external innovation sources for organisations. The highlighted external source is patents and literature for this research, as this was the emphasis of the searches conducted within the case study survey of Inno360. Highly specialised scientific searches meant that this was the source cited as the most useful to fulfil their unsolved needs, although other sources are utilised.

A clear trend that can be distinguished is a move towards a view of ideation as a collaborative practice (Leonard and Sensiper, 1998; Perry-Smith and Shalley, 2003). Inappropriate partner selection underlies many failures (Dev *et al*., 1996). Which particular sources are used and when should be chosen according to the type of innovation and ideas desired by the organisation to fulfil the business need. Particular sources will be more effective at delivering these ideas at different phases than others. For example, ordinary users generate more original ideas compared to ideas from professional developers (Kristensson *et al.,* 2004). This framework provides flexibility for organisations to add the sources they use and the type of outputs generated within the innovation phase.

The dynamics between a chosen phase (shown as establish) and effective related selected innovation sources (shown as patents and literature, and customers and users) can be linked together. Figure 45 illustrates the third level of the IIF which details the key phases and related issues explored in this research. The key outcomes are connected to each internal phase or external innovation source. This research focused on need / problem definition, ideas, and external patents and literature (shown in bold). Related issues for each of these outcomes are displayed surrounding each in a series of circles. These issues were identified from both the literature and the results of the main study and analysis.

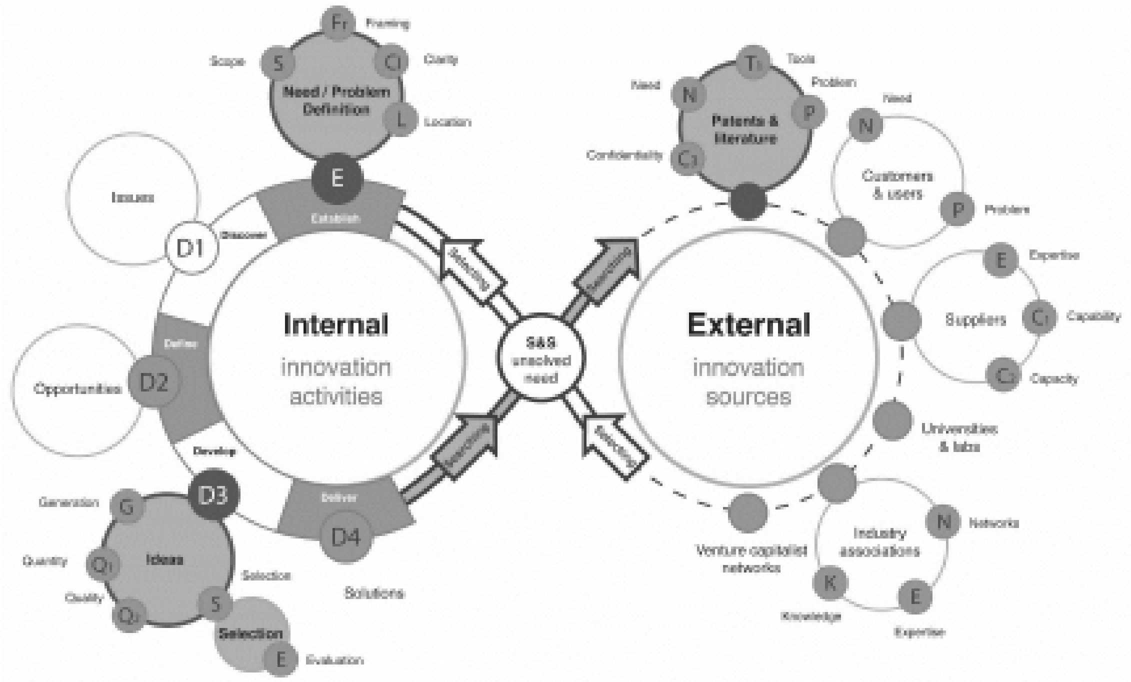


Figure 45 Idea Infinity Framework: Phase and Related Issues

Source: Author (2016)

The framework acknowledges the role of scanning, scouting and verification activities that would occur iteratively within the framework. It is not intended that the processes and phases shown are linear in nature, but in fact are interrelated dynamic capabilities which have to constantly adjust to a changing innovation landscape. Essentially, it helps organisations to develop search strategies that manage internal and external ideas to innovate more effectively. Iterative processes are common in front-end models, particularly in respect to problem definition (Artto *et al*., 2008; Poskela and Martinsuo, 2009), however little is written regarding effective practice in the transition between front-end stages.

Other frameworks illustrate the interaction between internal and external capabilities in this ‘infinity’ shape (see Acklin’s ‘Design-Driven Innovation Management Model’, 2010: 57). In a similar approach to this framework, she described that the stages are not necessarily executed in linear succession but can be carried out concurrently. An important aspect of front-end activities is that they are iterative as new knowledge and data feeds the process, the need or problem is refined along with potential solutions.

The primary focus is to help front-end practitioners orientate their internal and external searches and select the most effective sources and digital tools accessible according to the particular search phase they are in (e.g. finding issues, opportunities and / or ideas). This requires clarity in language between the definition of a problem / need statement, issue, opportunity, idea or solution.

The IIF has the potential to help reduce uncertainty by clarifying what tools or sources can be used and at what stage. It will not give all the answers or possible scenarios for innovation, however it is intended to help orientate searches and to visualise existing resources available to practitioners within organisations. The study identified that visualisation features of landscaping tools was one of the most liked aspects, this research therefore leverages this capability to help with searching practices more holistically.

Due to the integrative nature of the framework, scanning and scouting activities occur iteratively within the process itself, as well as within the front-end stages. As discussed earlier, digital tools can support serendipitous interactions that lead to valuable combined innovations. Figure 46 expands to show the final level of the IIF where further cycles of search and select activity occurs within certain phases in order to generate the desired outcome (e.g. fully defined need or issues). The issues are detailed which relate to three more linked issues: idea quality, framing (of the need / problem) and tools (linking patents and literature to project success). Again influencing factors are illustrated which were found to be of particular importance to innovation success in industry. The internal activities in front-end activities tend to be controlled by R&D departments and is also indicated.

In addition, several factors are linked shown as dotted lines surrounding the constructs. Idea quality relates to the framing of the need and vice versa, project success was found to link to need framing, and idea evaluation to idea quality criteria. This is due to the input of users in translating a need brief into search terms for a searching tool (Inno360). The framing of the need influences idea quality due to how open or closed the need statement is and what language is used. This was shown in the literature review to impact the quality of ideas generated. Idea quality criteria outlined are all linked to idea selection and evaluation and also are linked accordingly.

Lastly, several other factors are overarching and impact the effectiveness of internal and external innovation integration. Organisational learning, absorptive capacity and strategic orientation as well as boundary spanning (shown to the right of the IIF). Boundary spanning corresponds to the external sources and activities whereas the other three correspond to internal activities and phases. These were all found to be success factors for organisations wanting to learn and integrate external knowledge internally. Search depth affects external searches and is therefore included as this will vary according to organisation.

Essentially, this framework provides the basis for practitioners to orientate their search mind-set and pre-search preparation in order to make best use of the external sources available. There is currently a lack of an overall framework for how tools link to their formal and informal search activities. Another way that this has the potential to improve the tool offering is to help users understand their current position in terms of what they know, what they do not know, as well as what they need to obtain to move forward.

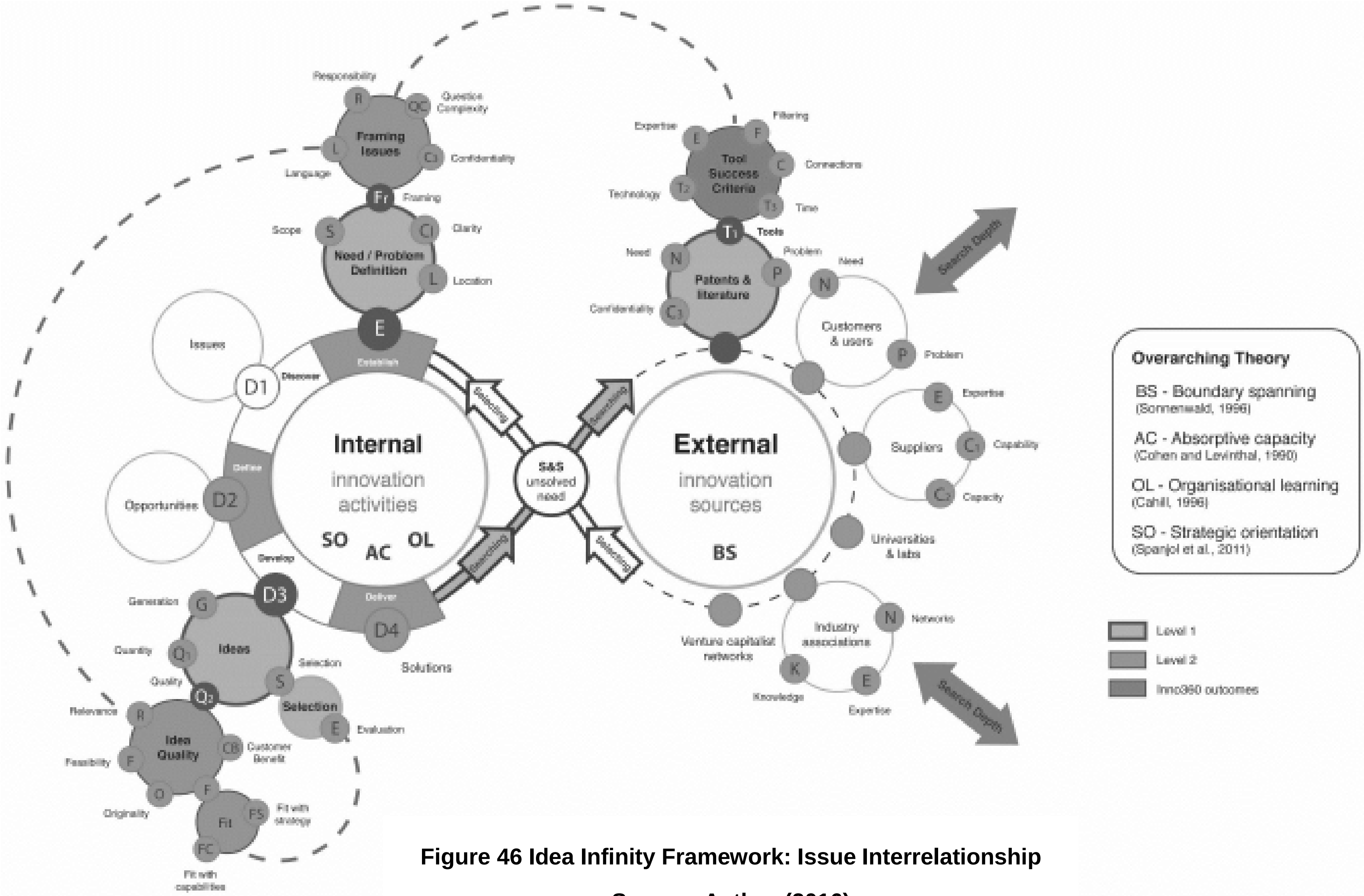


Figure 46 Idea Infinity Framework: Issue Interrelationship

Source: Author (2016)

The framework goes a further step in making the link between theory and practice. The research indicated the importance in allowing time and resources for preparing to conduct search and select practices. This includes activities such as need definition, the decision to search internally or externally or both, and what success criteria are needed. Other factors such as geographical location, scope, and responsibility are also used in organisations. These activities are within a process called ‘pre-search’, which uses similar terminology for pre-development stages in the work of others (Cooper, 1993; Cooper and Kleinschmidt, 1996) and includes the need for strong market and customer intelligence (Moultrie *et al*., 2007).

The tool success criteria section of the framework details the main influencing factors from the empirical Inno360 survey; technology, expertise, filtering, connections, and time. All of these factors emerged as critical to ensuring high quality innovation ideas are sourced.

Developing a clear idea of the business need so that the search for ideas can be more focused is the main argument behind the framework, supported by the work of McGuinness (1990). The IIF is driven by this unmet or unsolved need from customers in order to allow more targeted idea search and select practices. Uncertainty, risk and complexity emerged as critical issues in relation to front-end activities. New product screening decisions are associated with complexity, uncertainty and imprecision (Ahn and Dyckhoff, 1997).

In summary, the IIF does not add a new tool to an organisation’s existing toolkit, but instead aims to better utilise their current tools and innovation sources for a more focused and purposeful search strategy. The key insight relating to the IIF is that search and select practices are outcome-driven and not process-driven. This poses a fresh view of the idea management process. Providing explicit and implicit outputs from using a tool is supported by Blessing *et al*., (1995). A unique aspect of the framework is that it is outcome-driven and not process-driven in order to align with the requirements of industry, as well the direction of the literature.

Working alongside the main internal and external capabilities is a search and select strategy composed of three methods: 1) pre-search, 2) re-look, and 3) re-search (see Figure 47). All of the methods work under the assumption that the problem or needs is known, but then splits according to the level of definition. Pre-search is a known and undefined problem / need, re-search is a known and defined problem / need, and re-looking overlaps the two and is for known and partially defined problems / needs. This overlap highlights the transition between the two phases. Here it is argued that searching activities can begin before a problem or need is fully defined, as collecting data helps with refinement, however practices to define the problem or need should take place as soon as possible. This helps facilitate the rest of the searching practices to meet the need.

Figure 47 Pre-search and Re-search Diagram

Source: Author (2016)

A common underlying theme associated with idea management is finding the right data and information to support the sourcing and generation of ideas. The view was that there would be continuous uncertainty, particularly among FEI teams, without the right data feeding into search and select processes. Methods to help address this uncertainty over which sources are most effective can help position searches.

Allowing for serendipity identified from the scoping interviews, is an important factor when understanding how ideas are generated and transmitted in organisations. Therefore, application of the IIF can be more effective by encouraging activities in which these types of processes can take place alongside the framework. The orientation of search and select practices are dependent on: 1) the type of need, 2) type of innovation sought, 3) time frame in which to perform the search, 4) which idea and information sources are most effective to meet that need, and 5) the nature of the methods used (formal - digital technology, and informal - personal interaction).

To summarise, in addition to outputs designed to meet the expectations of the industrial sponsor, this study has implications for the wider practitioner and academic communities. These include:

- identification of idea quality criteria for idea evaluation,
- identification of key idea management trends and issues,
- identification of effective practices for idea generation, evaluation and selection,
- clear insights into idea management practices in organisations,
- enhanced alignment and integration of idea sourcing tools with industrial practice,
- development of an innovation framework that details key ideas / knowledge search and selection criteria,
- recommendations re: the improvement of idea-building and idea management, and
- surfacing areas for future research opportunity.

6.3 Implications for Knowledge

This study took a mixed methods approach, including quantitative methods which have been argued to be of great importance to FEI research (Reinertsen, 1999). It therefore conducted a case study with an international organisation to evaluate front-end innovation activities. The effectiveness of a landscaping tool employed by the organisation, Inno360, was selected in order to evaluate the role of digital tools in practitioner search and select practices.

Managerial implications include reframing how theoretical frameworks are promoted and used within industry from process to outcome-driven. This is more aligned with the needs of industry and ensures that the real value is more clearly defined and communicated. There is a possibility of saving managerial costs and practitioner time by better kick-starting search and select processes. This helps fill a knowledge gap where there is a lack of academic literature on helping to understanding how ideas get going within organisations (McGuinness, 1990).

The IIF was brought about due to the lack of knowledge, particularly on decisions for determining what organisations know and what they do not know. The difference in level of problem definition (i.e. defined and undefined) drives how a search is conducted. The search and select orientation framework has the potential to be turned into an interactive tool to help organisations position / orientate search practices and identify internal tools appropriate for particular search phases.

For organisations, making training more suited to user needs should be prioritised with new or existing tools where greater adoption is required to enhance effectiveness. Not only must training be simple and easy to follow, making it accessible to potential users, but also be highly targeted to completing specific tasks of high value to the practitioner. Knowing which tasks to base training (e.g. search term effectiveness) on will encourage more users to attend sessions and use the tool after the initial training. This supported with other facilitating methods such as word-of-mouth recommendation and support from senior management.

The specific purpose of front-end projects is to ensure a flow of feasible, novel and relevant ideas into the innovation pipeline (Boeddrich, 2004). Figure 48 illustrates three key objectives to ensuring this process takes place in practice. It is recommended that landscaping tools give feedback to users even whilst conducting a search, ensure the tool is fully integrated and interactive so that users know the data is coming from the right sources.

Figure 48 FEI Project Purpose

Source: Author and Bolton (2015)

Through ensuring tools are as simple and effective as possible helps to mitigate the identified factor of role of user background, as practitioners can perform search activities quickly. This research recommends that practitioners should align their chosen search strategy with the timescale for completing the search, since this can vary greatly. These factors all contribute to developing rapid innovation within organisations. It has been argued that rapid innovation should be recognised as a hallmark of broad competitive activity (Pleatsikas and Teece, 2001).

The gap between thinking and doing needs to be narrowed and needs systematic ways for innovators to take risks at all levels of activity. The biggest long-term gains from any technology come from its innovation and adaptation in use as well as reducing the gap between creative potential and practised creativity (DiLiello and Houghton, 2008).

Aligning innovation landscaping tools to real-time project activities and outcomes would help to increase adoption. Innovation tools need to incorporate the important factors identified from the literature and translate them into recommendations and stimulus useful in an industrial setting. The study found that the integration of landscaping tools needs to be achieved through effective alignment with industrial practices. These features will help practitioners to make sense of what actions are required for enhancing innovation capabilities and searching their innovation landscape. This is particularly true for organisations that have tight resource constraints, as they will find this more targeted approach a more economical and time efficient method of focusing valuable resources in their search and select efforts.

The Idea Infinity Framework has the potential to be adapted to suit the types of project scenarios surrounding the type of search-outcome desired by the user. This means that practitioners conducting a search can have a kick-start and visualise the possible sources aligned to that particular project scenario. This includes benefits to gaining a broad understanding of the landscape available, existing internal and external sources, and saving time and effort by helping them select appropriate search processes.

This research demonstrated the relevance of idea generation and external knowledge to improving idea management practices within organisations. By focusing attention on the important linkages between idea management and front-end phases, this research suggests new ways of conceptualising how external innovation tools and sources can link effectively with search processes. This brings about a new way of synthesising the issues as a merging process. This implies that what comes from external sources needs to be digested and implemented internally with knowledge and other capabilities. This new concept could pose an interesting one for further research.

There is a need for experts to use idea sourcing / open innovation tools rapidly, otherwise other search methods take precedence due to their efficiencies. The research illustrates an example case where an innovation tool is not used in-line with the pace of product innovation and is therefore less effective for industrial requirements. The issue of expert versus novice users is relevant as there are problems with complexity when novice users are using expert tools. Novice users need time to evaluate use of tool, run specific tasks and want immediate relevant results.

As discussed in the previous chapter, this framework is intended to be split by type of user implementing the tool (i.e. novice user and expert user). C+D practitioners can be considered experienced users using similar tools versus R&D practitioners who could be non-experienced with digital landscaping tools.

This is due to the different requirements that need to be fulfilled in order to gain the most value out of a landscaping tool, such as Inno360.

The effectiveness of Inno360 was found to depend on multiple factors: 1) user background, 2) tolerance for digital techniques, 3) preference of searching technique (personal interaction verses technology), 4) time, 5) peer recommendation, 6) tool reputation within company, 7) effectiveness of training, 8) alignment to project need, 9) role of the user (e.g. information or R&D), and 10) ease of collaboration.

A comparison between 15 front-end innovation models revealed that models include a mixture of formal and informal activities and use different terminologies. There was an emphasis on user involvement throughout the stages but lacked agreed tools within each stage. Idea generation and opportunity identification were the most common front-end activities. It was also found that each stage has a different emphasis of need definition and positioning, identifying opportunities, generating ideas, refining a concept and delivering a solution and clear business case. The literature and empirical results stress the importance of a clear project / need definition during the establishing phase.

The literature idea management trends included (1) quantity versus quality: a shift of focus from generating as many new ideas as possible to maximising the number of good ideas that are fed into the NPD pipeline (2) internal versus external practices: an increasing importance placed on the identification and implementation of external ideas, particularly from collaboration with customers, suppliers and partners, and (3) ad-hoc versus systematic: companies are recognising the need to apply a more systematic approach to idea generation and evaluation which is aligned with corporate design strategy.

The research findings are also of value to potential idea submitters. Those who are considering submitting an idea to a large organisation externally, need to keep in mind the strategic fit of their ideas to the organisation. Criteria such as IP and confidentiality are priorities and mostly organisational idea pipelines are geared towards incremental innovation. Ensuring that patents are in place for inventions in particular are likely to get through to the next stage with their idea.

6.4 Limitations

This research design used a main survey within one large organisation, along with one other company within the initial exploratory stage. This could raise concerns over the generalisability of findings. To address potential limitations of transferability and applicability, the study was designed to adopt a focused and detailed approach rather than broad and shallow study (Guba and Lincoln, 1994). This lends itself to gaining richer data that would be hard to extract using other methods and allowed for greater control over the company specific language used to father this data. Many prefer to benchmark companies they admire and collect best practices to implement in their own processes (Reinertsen, 1999). However, utilising practices from several successful companies may not necessarily provide the best systemic approach that could be built within an individual company.

Another limitation is whether the results can apply to smaller companies rather than large organisations. Although the focus was on identifying factors affecting organisations and their idea management practices, there could be some findings which could apply to smaller companies. For example, idea generation effective practices along with some search and select strategies may be beneficial. However, it is acknowledged that SMEs would have different primary concerns, particularly over resources and fewer employees to conduct search and select activities. A benefit to smaller companies is their ability to adapt and be much quicker in their innovation pipelines than organisations, therefore this may lead to a different type of IIF for SMEs.

Most of the users were based in the US which meant that a meaningful comparison of practices in different countries was not possible. However, valuable insights were found with scoping interviews completed in both America and China. From those interviews, FEI-based search and select practices did vary in different countries due to cultural differences however, identifying specifically how they vary was not in the scope of this research.

6.5 Opportunities for Further Research

New trajectories, stimulated by developments in materials, ICTs and processes within idea management, provide fertile ground for further study. The current study opens up a number of exciting research opportunities. Several areas surfaced with the potential for further research opportunity from the literature review and empirical study results.

First, this study may be extended to several applications in various organisations in different countries. Cultural difference is an area with potential opportunities for further research as organisational innovation is global. It is expected that idea management and search and select practices would vary due to differing organisational culture, priorities and strategy. The sample case study of this research was mainly based in the US due to the high level of adoption of the tool investigated, however insights from other countries would bring to light some of the identified issues. This would also help verify the cross-cultural validity of the identified factors and elements for idea management during front-end activities.

The thesis adds to the field of front-end innovation literature regarding idea management and search and select effective practices, supported by quantitative data on a global scale within Fast Moving Consumer Goods (FMCG) scenarios. However, on a smaller scale, effective practices for internal idea generation are identified which could be of use to SMEs. Further research could therefore investigate how the findings of this study can apply to smaller companies. It may be the case that some factors have a bigger impact than experienced within large companies, or that the barriers are different or not experienced at all.

As well as addressing the stated research issues and gaps, there is a need for further research regarding the development of ideas in organisations (McGuiness, 1990). A need was found to better link and align clear inputs and outputs for each FE stage. This forms an important area for development due to the lack of literature written describing what occurs during the transition between front-end phases. Further research is needed on the informal methods that impact innovation search, particularly in relation to landscaping tools.

Spanjol *et al*., (2011) asked why large organisations generate a higher quantity of ideas that are less innovative compared to SMEs. It has been suggested that this is due to a larger amount of experience and cumulative learning present in large organisations (Koc and Ceylan, 2007) however, additional factors involving idea generation processes could also play a part. The reason for this difficulty has been suggested to be due to the transfer and translation of tacit design knowledge into explicit knowledge (Abecassis-Moedas and Mahmoud-Jouini, 2008). However, the use of formal systems during the front-end of product development has been debated within the literature, one of the concerns being that they may constrain creativity and radical ideas (Koen *et al*., 2001; Nobelius and Trygg, 2002).

The scope of this research includes the first three stages of establishing, discovering and defining (see Chapter One) and within the IIF also taps into the develop stage. Thus opportunities exist for research to investigate the role of idea management within the latter stages including delivery. Many models lack specific inputs and outputs for each stage or state a timescale for front-end activities. Nearly all of the models studied included a discovery phase due to the establishment of opportunity identification in front-end activities.

It is well-established that users are an important source of ideas for product development, however Magnusson (2009) found that users' knowledge of underlying technology has an effect on their ability to contribute with incremental or radical ideas. Therefore, a contribution would be to find out how much and what type of information should be given to users to maximise the generation of innovative ideas.

Strategic orientation has been found to have an impact on new product ideation volume and novelty (Spanjol *et al*., 2011). This presents an opportunity to investigate what the factors are which impact the generation of highly innovative ideas in technology-orientated companies. Another area for research is how to encourage employee's intrinsic motivations within an organisation to increase their rate of idea submission (Kristensson *et al*., 2004).

The systematically constructed Idea Infinity Framework suggested in this research is provided to aid comprehension of how the identified factors interact and relate with one another in front-end innovation. The proposed key concepts of pre-search, re-looking, and re-search that complement the framework require further validation by empirical research. Hence, future studies may benefit in developing consistent metrics to measure the interplay of these concepts in relation to idea management and how they influence front-end activities. There is also opportunities to further develop this framework by adding the various issues for different phases and external innovation sources.

The framework offers additional benefit than previous research studies. The research used a world-leading company as a case study to validate the data accuracy and targeted company practitioners for interviews to reflect the true view of the company on the effectiveness of a digital idea sourcing tool. The research classified which front-end activities are associated with which FE stage, identified common activities across fifteen models, and pulled out key insights from their comparison, e.g. a lack of consistent language, which supports work by Koen *et al*., (2001). The framework fulfils a need to externalise the integrated processes in searching and selecting external innovation. It does this by identifying the interrelationships and how they link with effective practices found from this empirical and secondary research on idea management.

6.6 Reflections and Summary

To conclude, the study successfully answered the four research questions and expanded on issues relevant to idea management within front-end activities in organisations. The key constructs of idea management, idea generation, idea quality and search and select strategies all interrelate and can be carried out systematically whilst also allowing flexible creative processes to thrive in idea pipelines. This was ultimately translated into a visual framework demonstrating some levels of complexity involved with landscaping tools within search and select strategies.

This research started from the author's desire to understand more about what is an idea and what makes it 'good' enough to survive the organisational idea pipeline. It was found that a lot of research exists around creativity and innovation and the sub-domain of idea management is a relatively new concept that has been gaining a lot of momentum in the last decade. The author was also keen to better understand how ideas are generated and managed within industrial projects, leading on to have an impact on people's lives if an idea is successfully implemented into innovation. Such an important and interesting topic has been a joy to research over the past few years and many other avenues for research still remain within this subject.

In this context, past scholarly work has had a somewhat narrow scope of idea management with the majority of studies on identifying sources of innovation and more recently, the role of digital IMS. In addition, idea sourcing strategies was an aspect not always associated with idea management. The presented innovation framework called the 'Idea Infinity Framework' helps explain the interrelationships of internal and external innovation capabilities: including phases, innovation sources and related issues as well as tool success criteria. This work may support front-end innovation practitioners as per research question four, it identifies common issues experienced along with recommendations on how to improve the effectiveness of digital tools, such as Inno360. It helps organisations visualise the resources available to them and to kick-start the search and select practices for ideas and knowledge to feed FE innovation processes.

A question that emerged mid-way through this study was whether the world needs more digital tools? This research started out with the objective of developing a new series of innovation tools for industry front-end practices. However, it was found that industry has plenty of tools, particularly online-based. This research therefore recognised that what is actually needed is an enhanced implementation and adoption strategy for existing tools to be better aligned to industrial real time uses. Inno360 served as the case tool example to demonstrate particular areas where a tool can be used more effectively by users and better aligned to their daily activities and interests.

Ultimately, this thesis was about understanding how to maximise internal and external innovation capabilities within front-end activities. The emphasis was on idea management and the search and select strategies and tools organisations use to integrate external ideas and knowledge. Organisational knowledge is a gathering of the knowledge of past and present organisational members and is important to integrate into existing landscaping tools in order for them to align to organisational practices. Overall, this study argues that an integrated search and select strategy is critical to front-end innovation practices as evidenced by the findings from the Inno360 survey.

To conclude, the study successfully answered the four proposed research questions. In the process of systematically investigating and resolving these questions, a number of important factors were highlighted and visualised in a framework that helps to fill current gaps in knowledge. The study also provided a real life perspective on what organisations do in practice with searching tools, such as Inno360, and explored its effectiveness for practitioners within front-end activities. Rather than simply evaluating a tool, this study went beyond that and made a visual model which externalised the understanding of the interconnectedness between idea management issues and the links with the tool. The challenge was not about evaluating just the tool, but rather how to embed the tool within a process. In turn, visualisation helped to explain how these influencing factors relate to each other and helps guide future areas for research.

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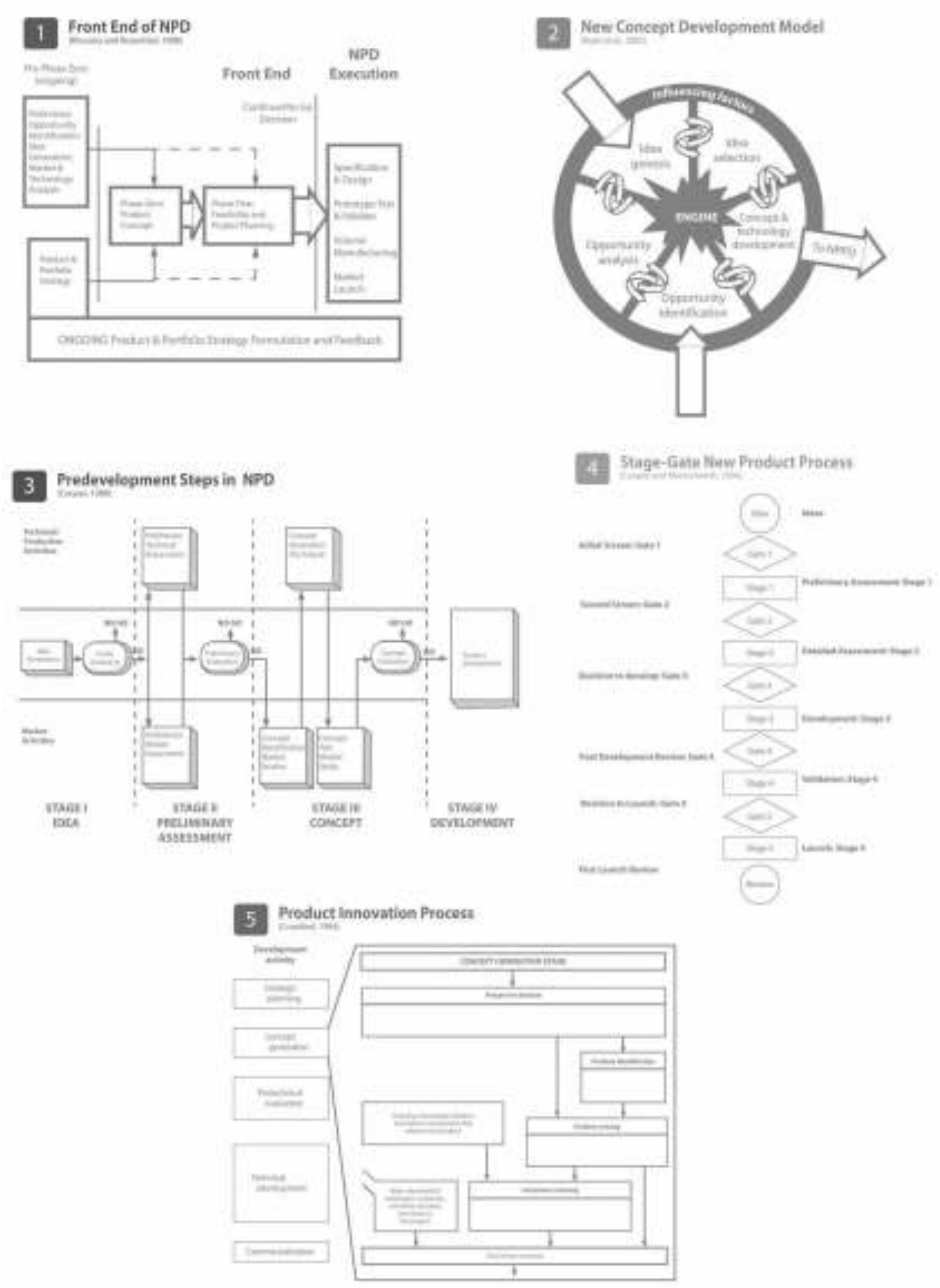
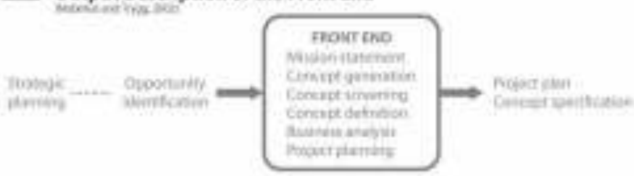
APPENDICES

A Front-End Model Comparative Analysis

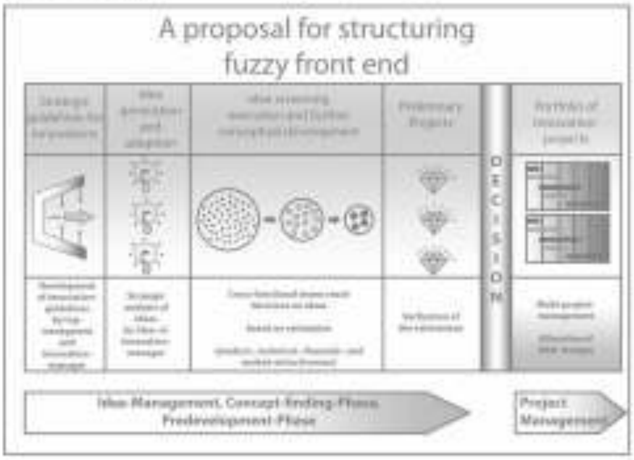
A.1 FE Model Comparison – Original Diagrams



6 Synthesized Input, Activities, and Output Description of the Front End



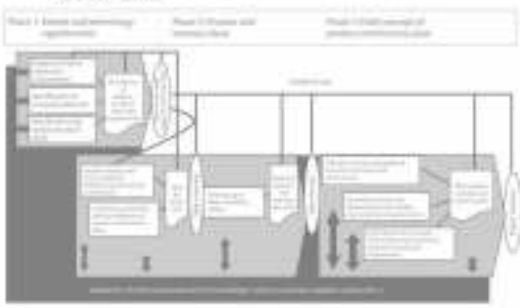
7 Front End Model Proposal



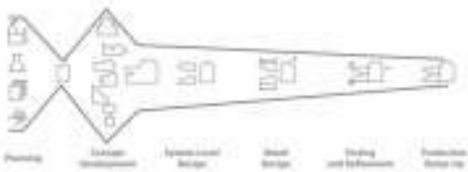
8 A Two Track Front-End Process

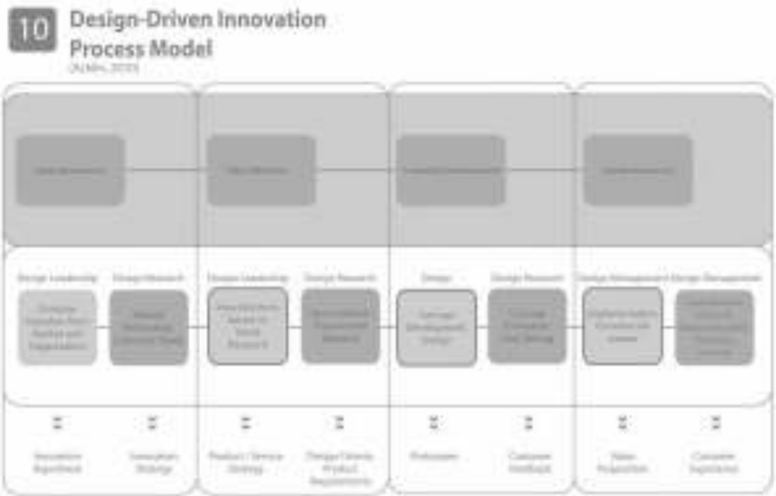
9 The Innovation Process

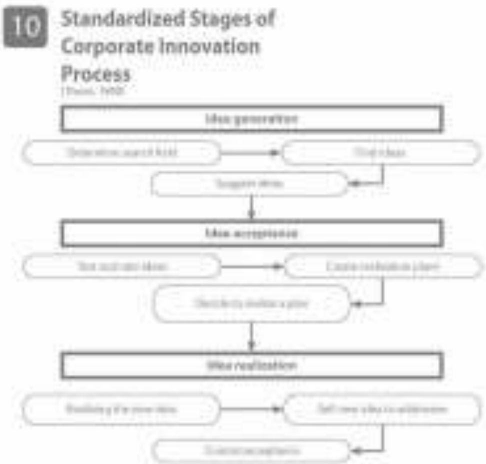
9 Integrated Front End Process Model



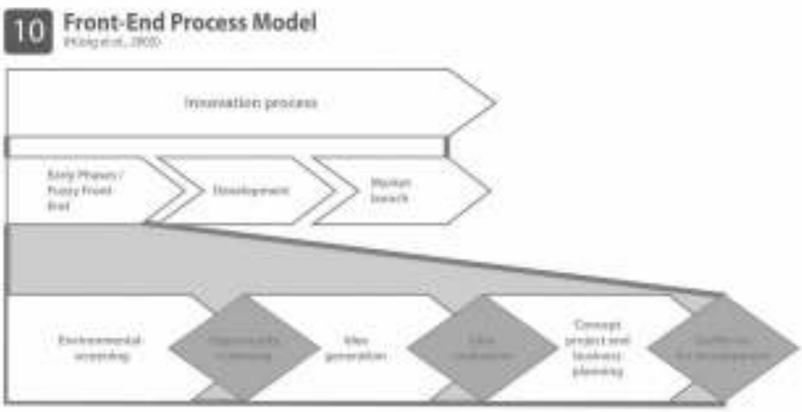
9 Generic Product Development Process



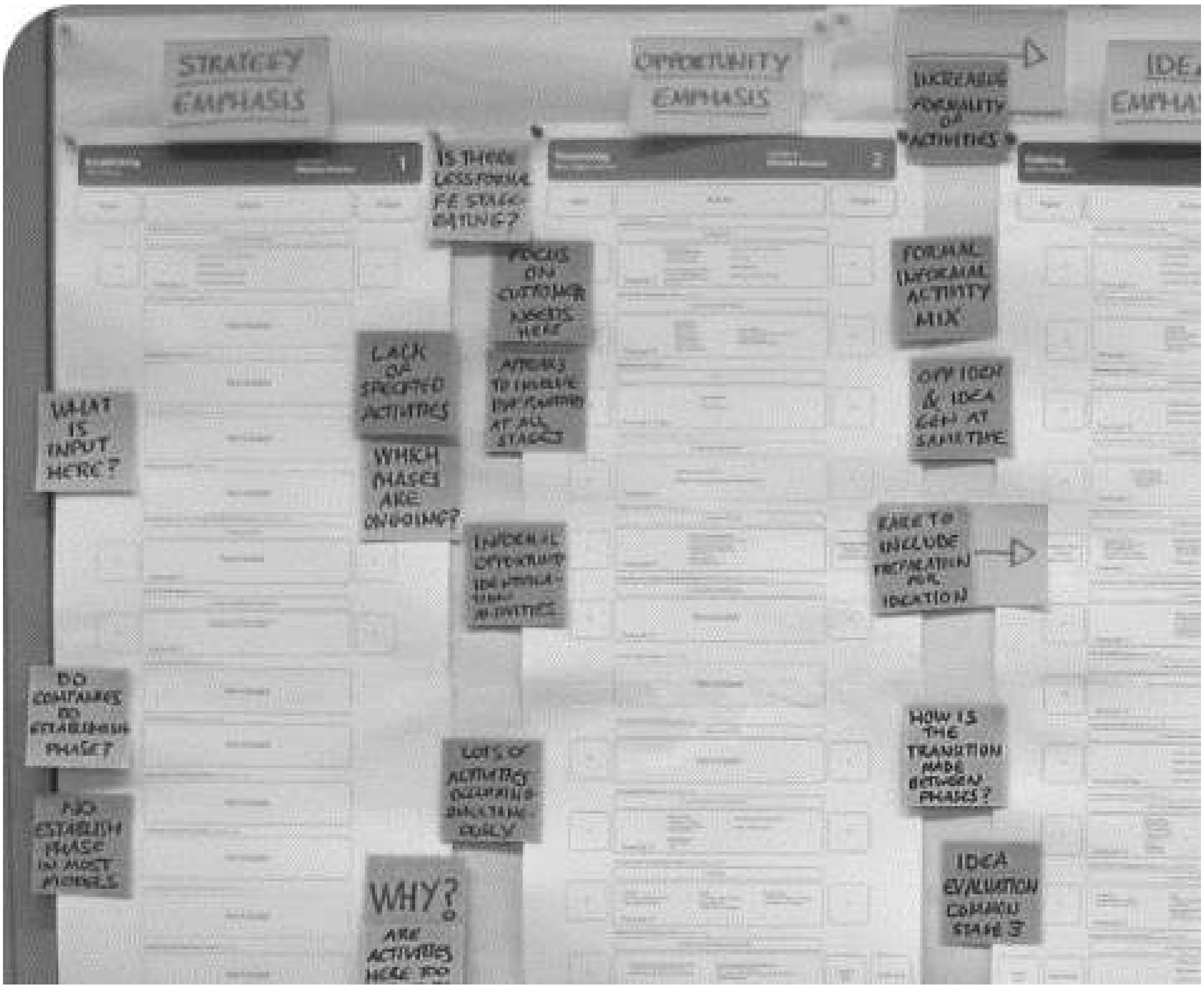

10
Design-Driven Innovation Process Model


10
Standardized Stages of Corporate Innovation Process
Idea generation
Idea acceptance
Idea realization

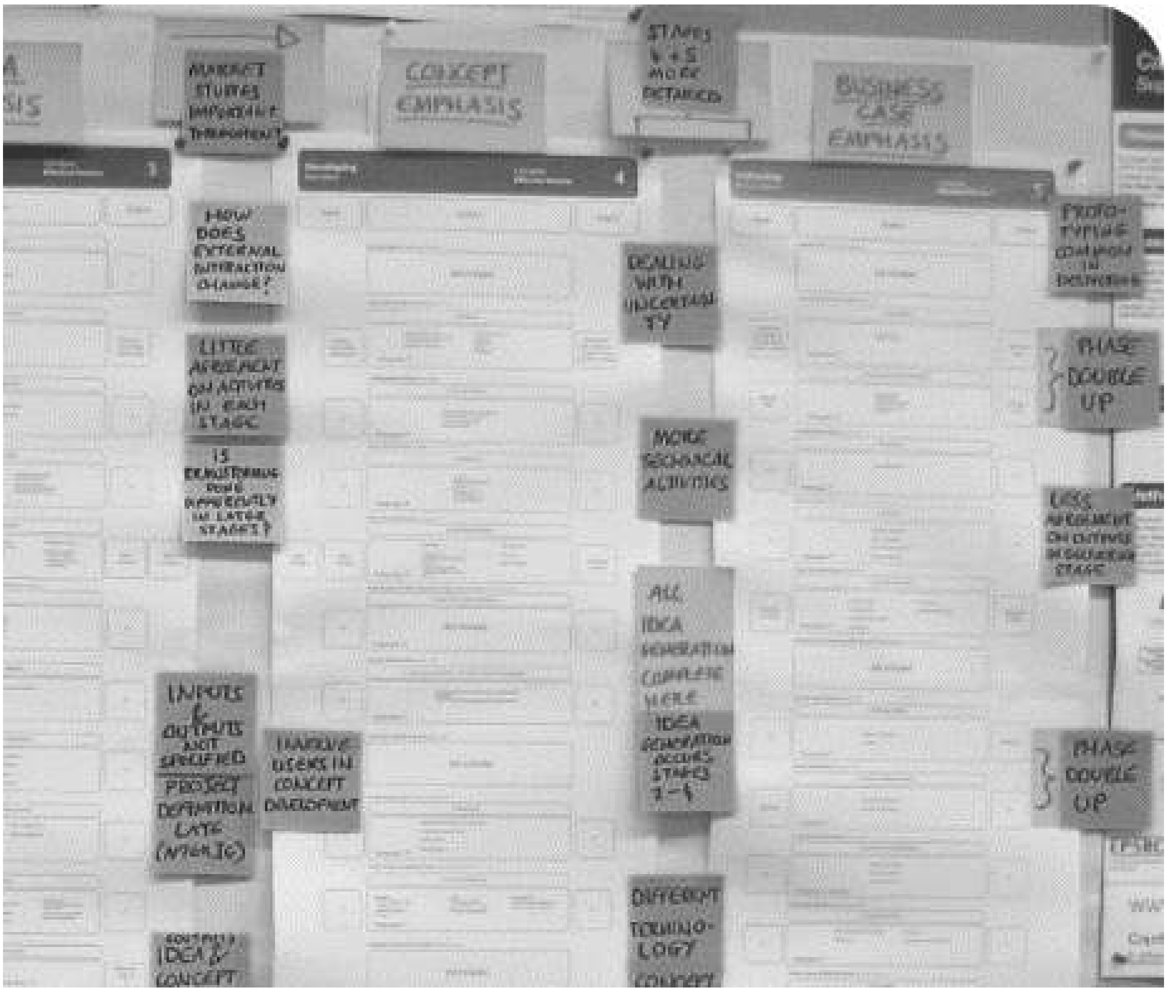

10
Lead User Research Method
Phase 1 - Project Planning
Phase 2 - Trend/Needs Identification
Phase 3 - Preliminary Concept Generation
Phase 4 - Final Concept Development
Project wrap-up


10
Front-End Process Model
Innovation process
Early Phases / Fuzzy Front End
Development
Market launch
Environmental scanning
Idea generation
Concept project and business planning

A.2 FE Model Comparison – Analysis Photos



Source: Author (2016)



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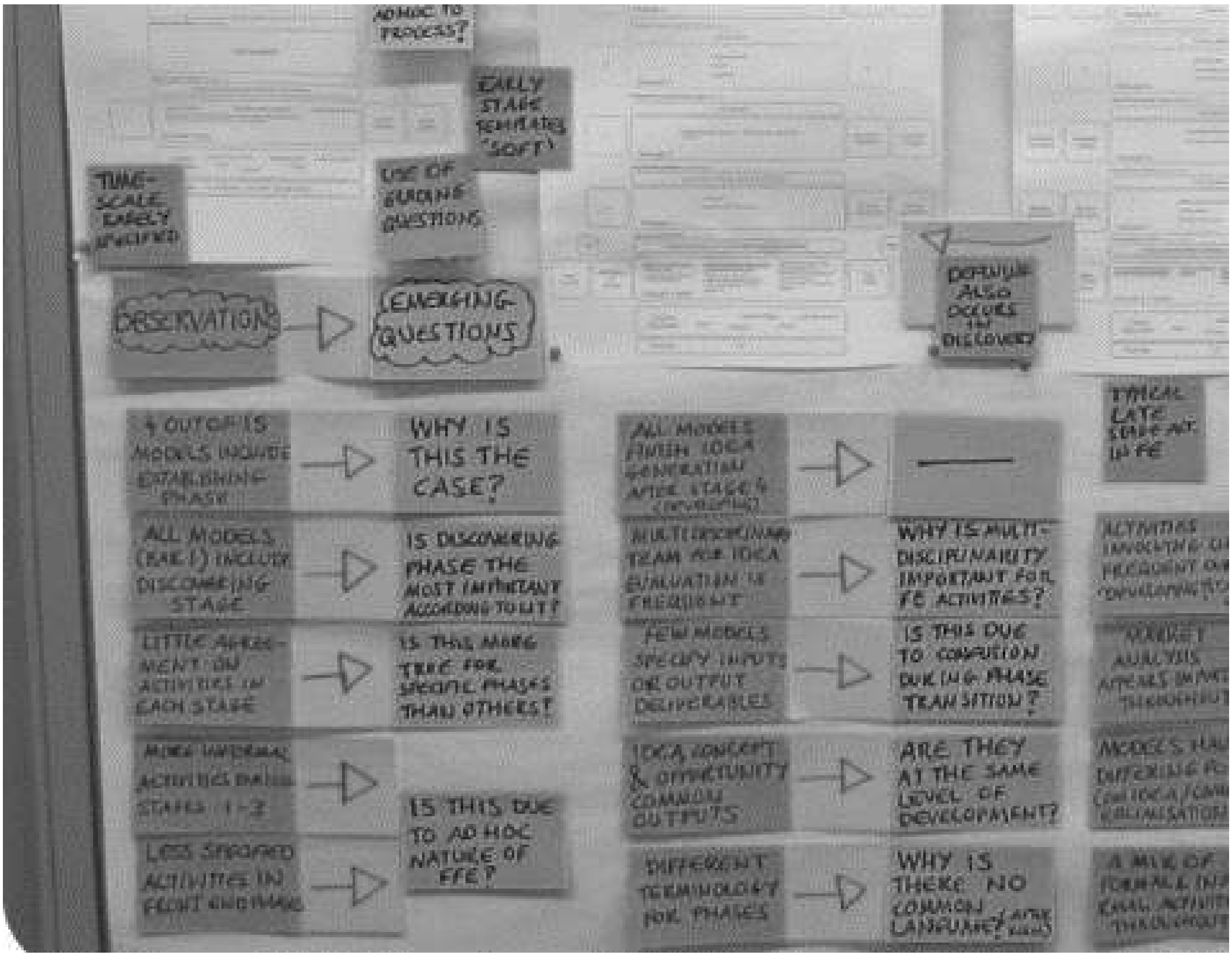

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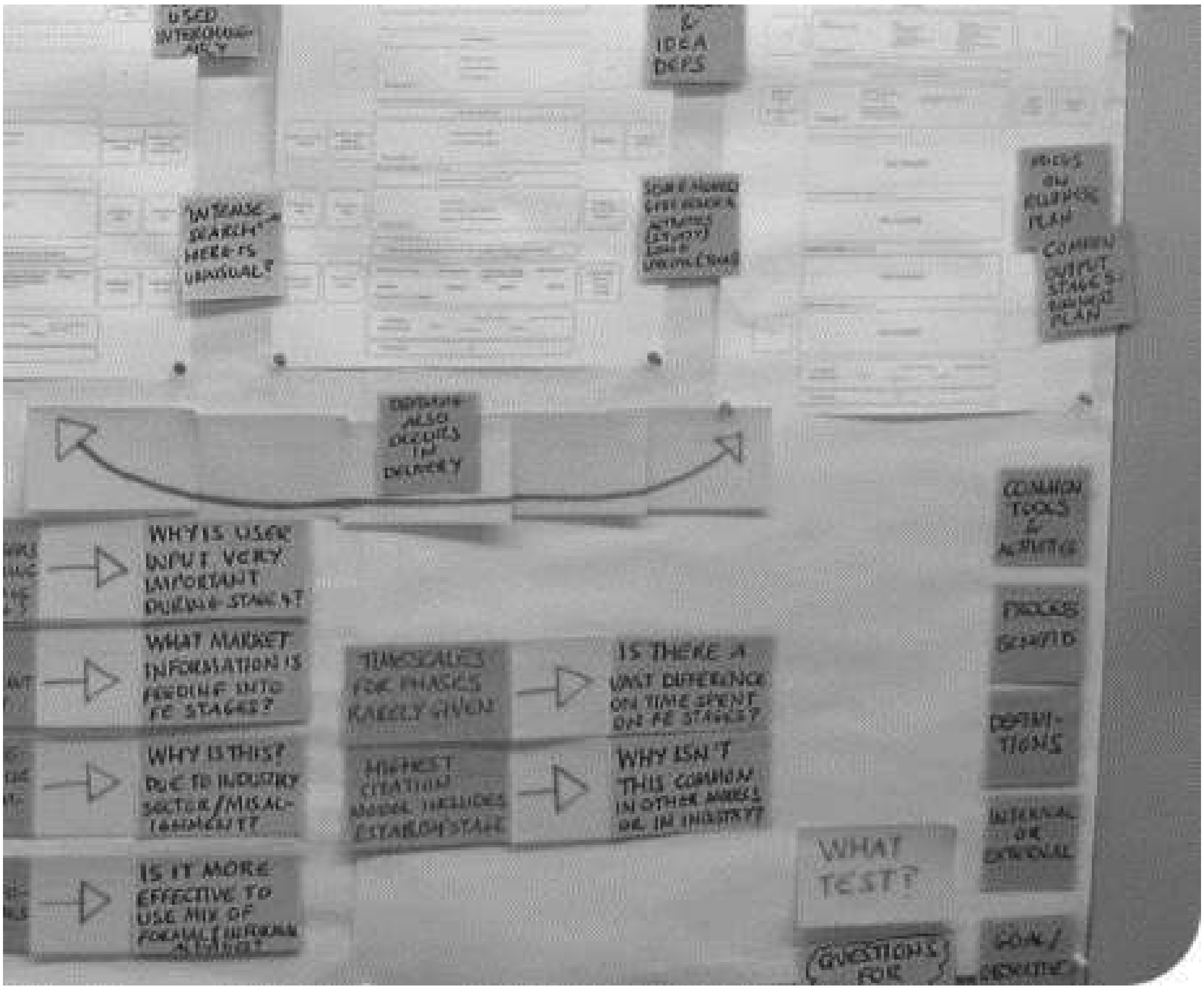
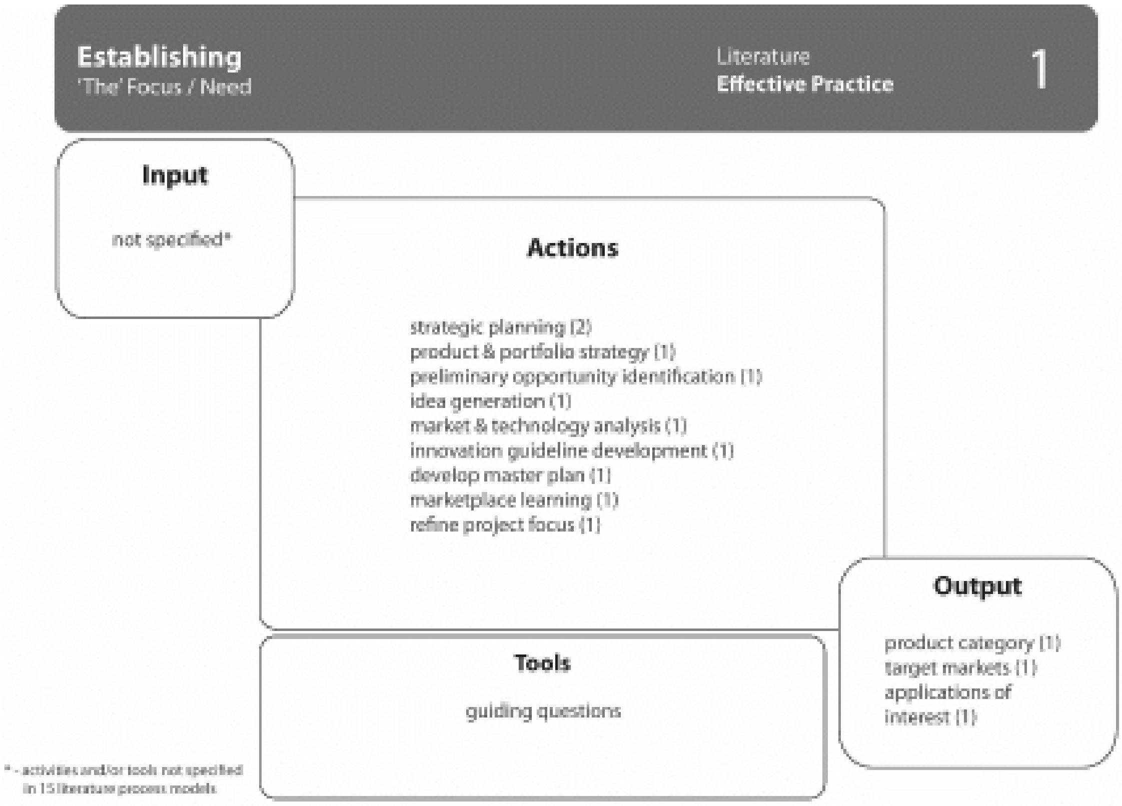


Source: Author (2016)

A.3 FE Model Comparison – Summary using 4D Model



Discovering
New Opportunities

Literature
Effective Practice

2

Input

product category (1)
target markets (1)
applications of interest (1)
business goals (1)

Actions

identify/frame/select customer needs (5)
idea generation (4)
opportunity screening (4)
project portfolio alignment (4)
market analysis potential (3)
identify market segments (3)
technical evaluation (3)
collect/sort ideas (3)
commercial/organisation
impulse analysis (3)
determine search field/area (2)
competitive offerings analysis (2)
opportunity analysis (2)
specify resources (2)
assess new technologies (2)
explore major trends (1)
identify key risks & challenges (1)
qualitative project scoping (1)
idea assessment (1)
problem definition (1)
ongoing corporate planning (1)
identify core product requirements (1)
future needs analysis (1)

Tools

Brainstorming
Mindmapping
Lateral thinking
Theory of constraints
Conduct literature searches
Ad hoc sessions
Water cooler
cyberspace discussion
Individual insights
Senior management edicts
Causal analysis
Fishbone diagrams
Process mapping
Trend analysis
Interview top experts

Output

new opportunity (3)
search area (1)
innovation strategy (1)
innovation hypothesis (1)
core need (1)
target customer group (1)
key attributes of need (1)

Defining
New Directions

Literature
Effective Practice

3

Input

new opportunity (3)
search area (1)
innovation strategy (1)
innovation hypothesis (1)
core need (1)
target customer group (1)
key attributes of need (1)

Actions

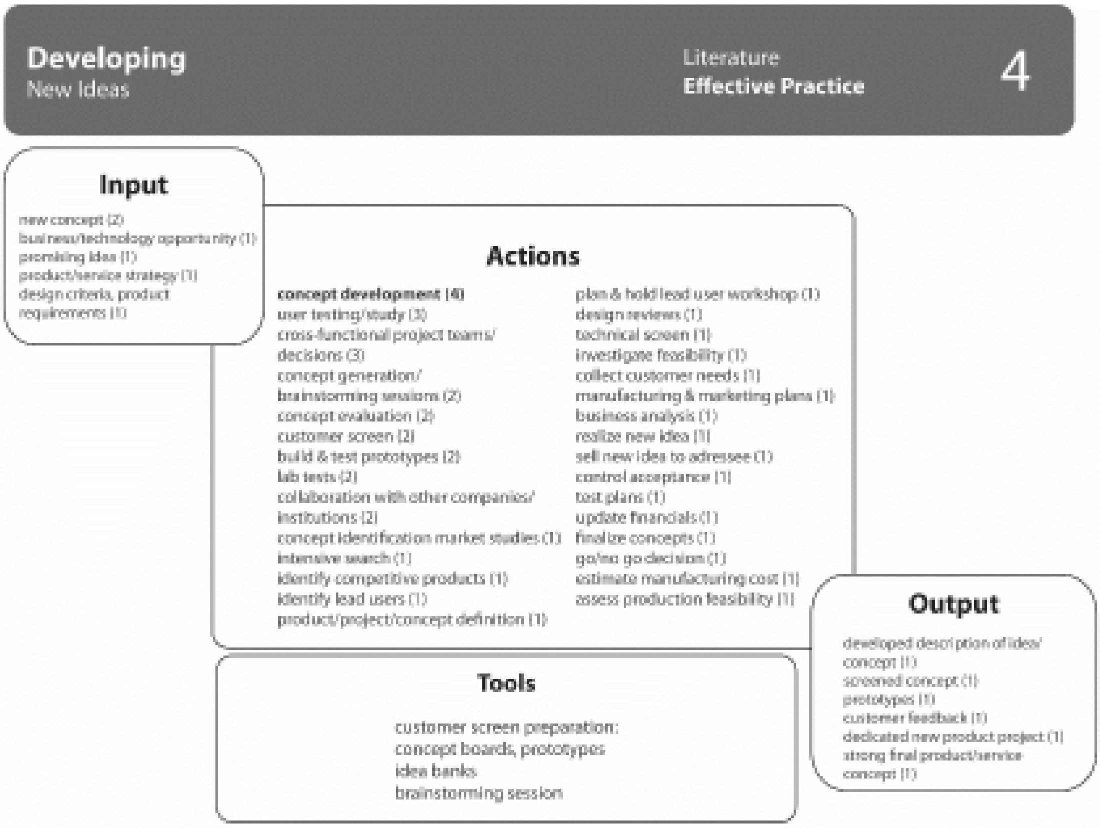
product planning/definition (5)
project planning/definition (5)
idea evaluation (3)
idea selection (2)
idea/concept screening (2)
preliminary technical assessment (2)
market assessment/analysis (3)
product architecture (2)
product specifications (2)
realization plans (2)
gather data for business plan (2)
idea technical feasibility (2)
problem identification (2)
strategic idea analysis (1)
concept generation (1)
concept definition (1)
proof of concept (1)
idea elaboration (1)
idea description (1)
specify key project participants (1)
specify functional support (1)
detailed market studies (1)
competitive analysis (1)
ideation preparation (1)
establish & train ideation team (1)
nonstrategic ideation (1)
problem solving (1)
routine market contacts (1)
credibility seeking (1)
explore preliminary concepts (1)
fortuitous scanning (1)
business analysis (1)
observational/experiential research (1)
interview lead users & experts (1)
mission statement (1)
plan for product portfolio (1)

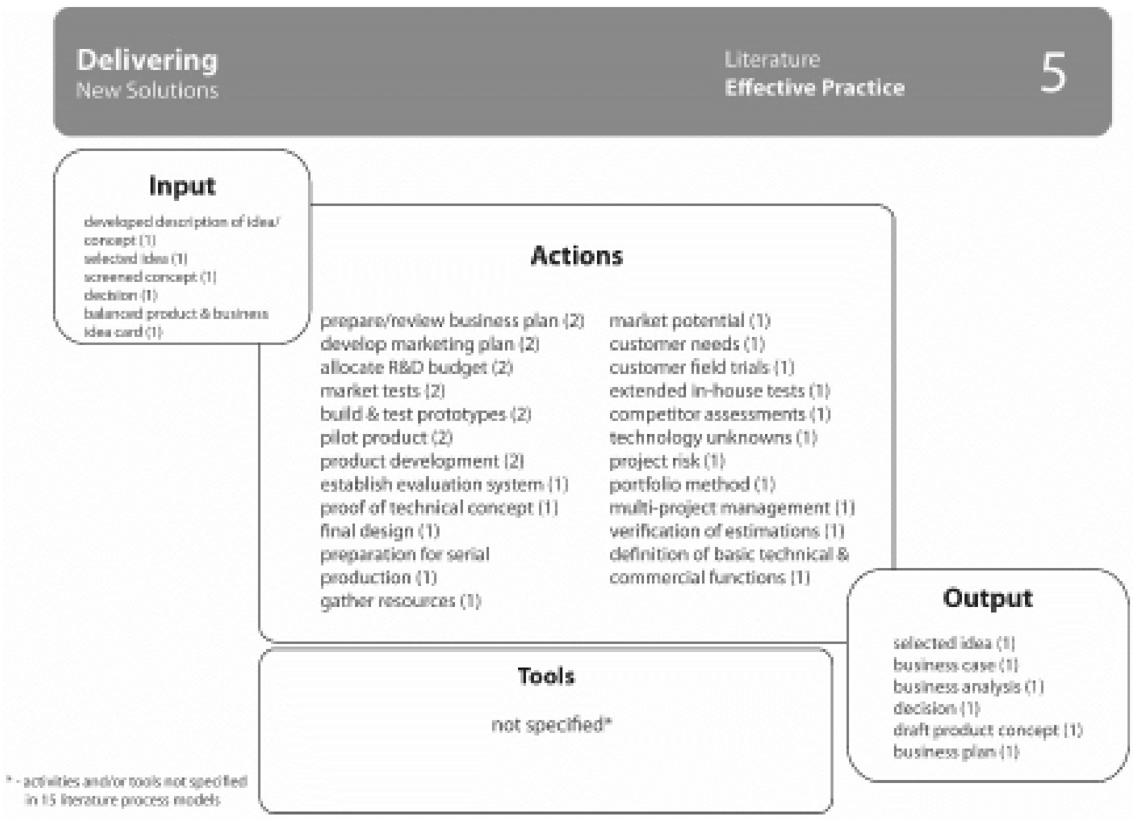
Tools

Focus groups
Market studies
Scientific experiments
What-if scenarios
Competitive intelligence
Trend analyses
Problem analysis
Scenario analysis
Attribute analysis
Relationships analysis
Lateral search

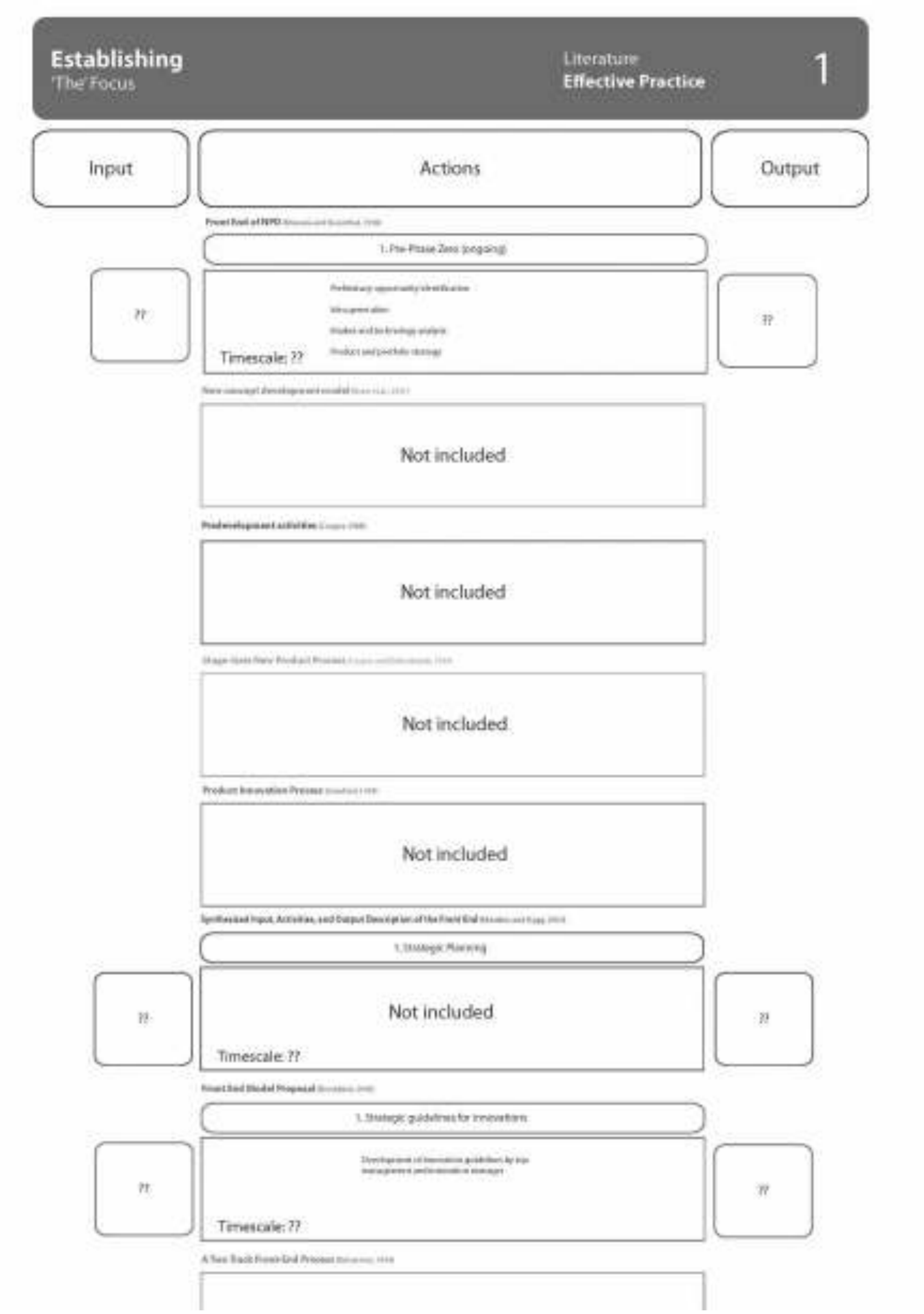
Output

new concept (2)
business/technology opportunity (1)
promising idea (1)
balanced product & business idea card (1)
product/service strategy (1)
design criteria, product requirements (1)

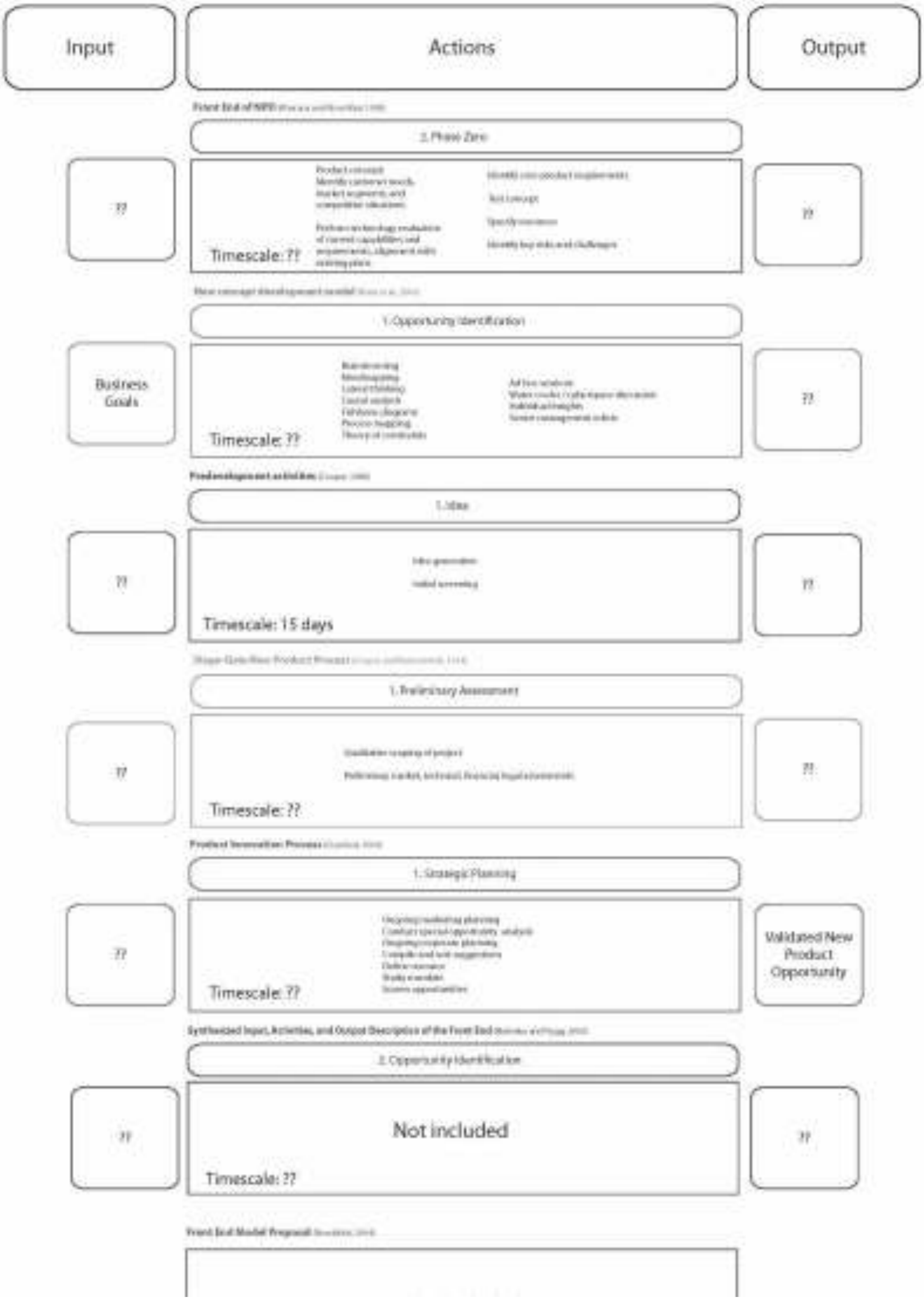

Developing
New Ideas
Literature
Effective Practice
4
Input
new concept (2)
business/technology opportunity (1)
promising idea (1)
product/service strategy (1)
design criteria, product requirements (1)
Actions
concept development (4)
user testing/study (3)
cross-functional project teams/ decisions (3)
concept generation/ brainstorming sessions (2)
concept evaluation (2)
customer screen (2)
build & test prototypes (2)
lab tests (2)
collaboration with other companies/ institutions (2)
concept identification market studies (1)
intensive search (1)
identify competitive products (1)
identify lead users (1)
product/project/concept definition (1)
plan & hold lead user workshop (1)
design reviews (1)
technical screen (1)
investigate feasibility (1)
collect customer needs (1)
manufacturing & marketing plans (1)
business analysis (1)
realize new idea (1)
sell new idea to adressee (1)
control acceptance (1)
test plans (1)
update financials (1)
finalize concepts (1)
go/no go decision (1)
estimate manufacturing cost (1)
assess production feasibility (1)
Output
developed description of idea/ concept (1)
screened concept (1)
prototypes (1)
customer feedback (1)
dedicated new product project (1)
strong final product/service concept (1)
Tools
customer screen preparation:
concept boards, prototypes
idea banks
brainstorming session


Delivering
New Solutions
Literature
Effective Practice
5
Input
developed description of idea/ concept (1)
selected idea (1)
screened concept (1)
decision (1)
balanced product & business idea card (1)
Actions
prepare/review business plan (2)
develop marketing plan (2)
allocate R&D budget (2)
market tests (2)
build & test prototypes (2)
pilot product (2)
product development (2)
establish evaluation system (1)
proof of technical concept (1)
final design (1)
preparation for serial production (1)
gather resources (1)
market potential (1)
customer needs (1)
customer field trials (1)
extended in-house tests (1)
competitor assessments (1)
technology unknowns (1)
project risk (1)
portfolio method (1)
multi-project management (1)
verification of estimations (1)
definition of basic technical & commercial functions (1)
Output
selected idea (1)
business case (1)
business analysis (1)
decision (1)
draft product concept (1)
business plan (1)
Tools
not specified*
* - activities and/or tools not specified in 15 literature process models

A.4 FE Model Comparison – Framework Phases

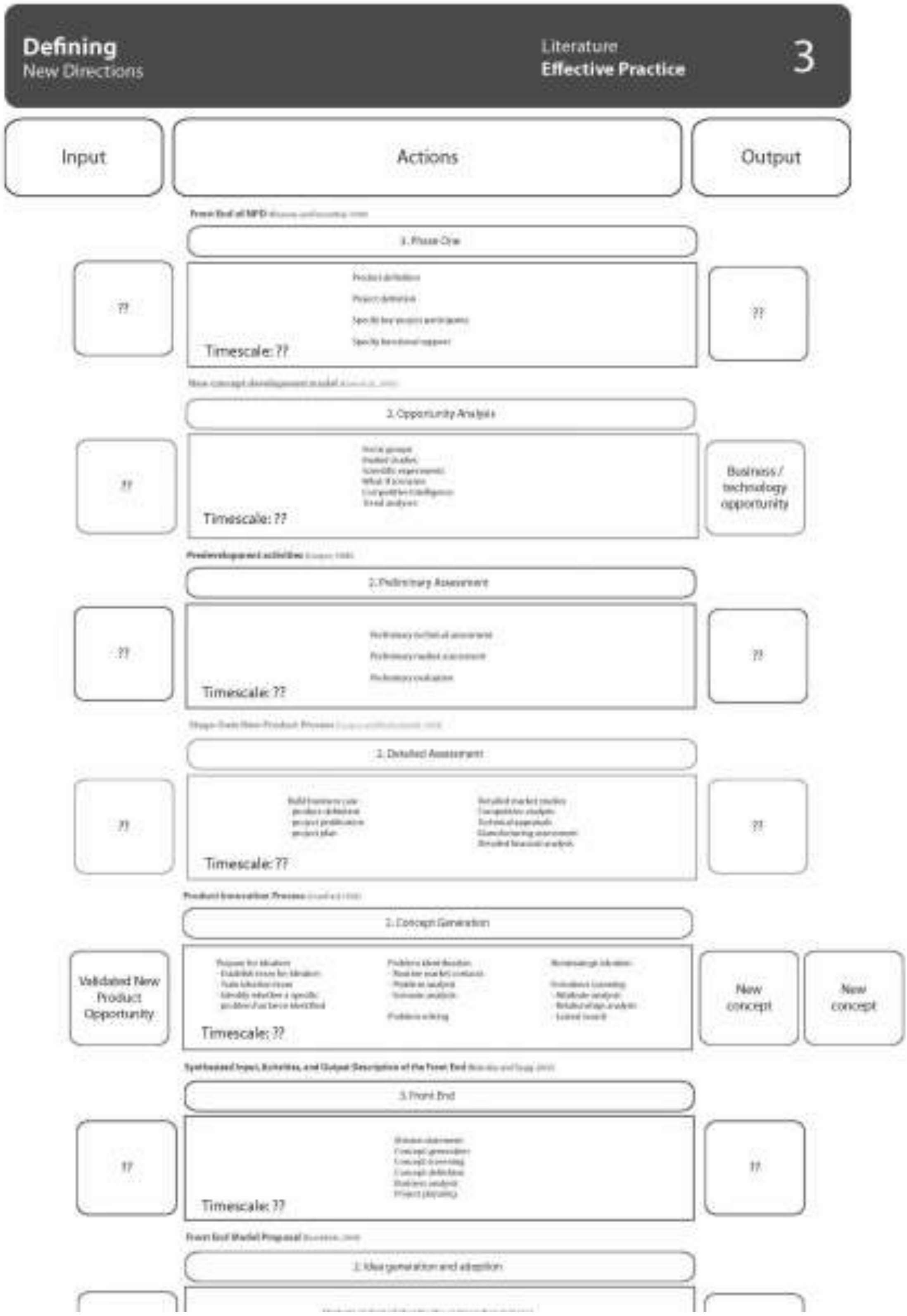



Not included
The Innovation Process
Not included
Generic Product Development Process
Not included
Integrated Front End Process Model
Not included
Standardized Stages of Corporate Innovation Process
Not included
Design-driven Innovation process model
Not included
Front-End Process Model
Not included
Lead-user research method
1. Preparing to Launch the Lead-User Project / Project Planning
Develop master plan
Learn about current marketplace
Further refine project focus
Timescale: 4 weeks
Product category
Target markets
Creative Approaches
Lead-user research method
Question formulation
Look at other industries
Iteration
Combination
Discovery
Timescale
6 - 8 months - 2 months max per phase

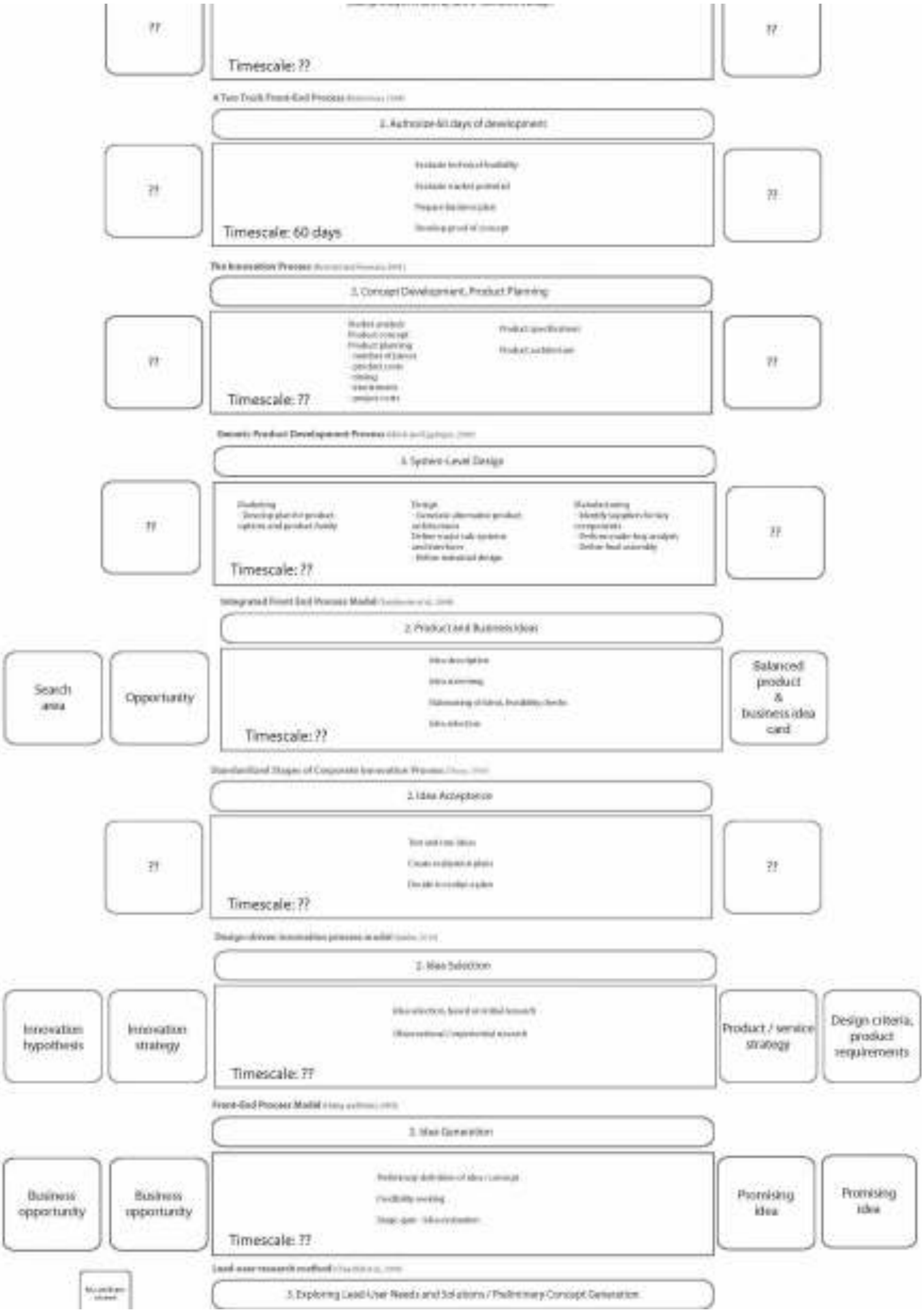

Input
Actions
Output
2. Phase Zero
??
Timescale: ??
??
1. Opportunity Identification
Business Goals
Timescale: ??
??
1. Idea
??
Timescale: 15 days
??
1. Preliminary Assessment
??
Timescale: ??
??
1. Strategic Planning
??
Timescale: ??
Validated New Product Opportunity
2. Opportunity Identification
??
Not included
Timescale: ??
??


Not included
1. Classify opportunity
??
Not included
??
1. Idea Generation and Assessment
??
Timescale: ??
??
1. Planning
??
Timescale: ??
??
1. Market and Technology Opportunities
??
Timescale: ??
Search area
Opportunity
1. Idea Generation
??
Timescale: ??
??
1. Idea Generation
??
Timescale: ??
Innovation hypothesis
Innovation strategy
??
Timescale: ??
Business opportunity
Business opportunity
2. Identifying Key Trends and Customer Needs / Trends/Needs identification

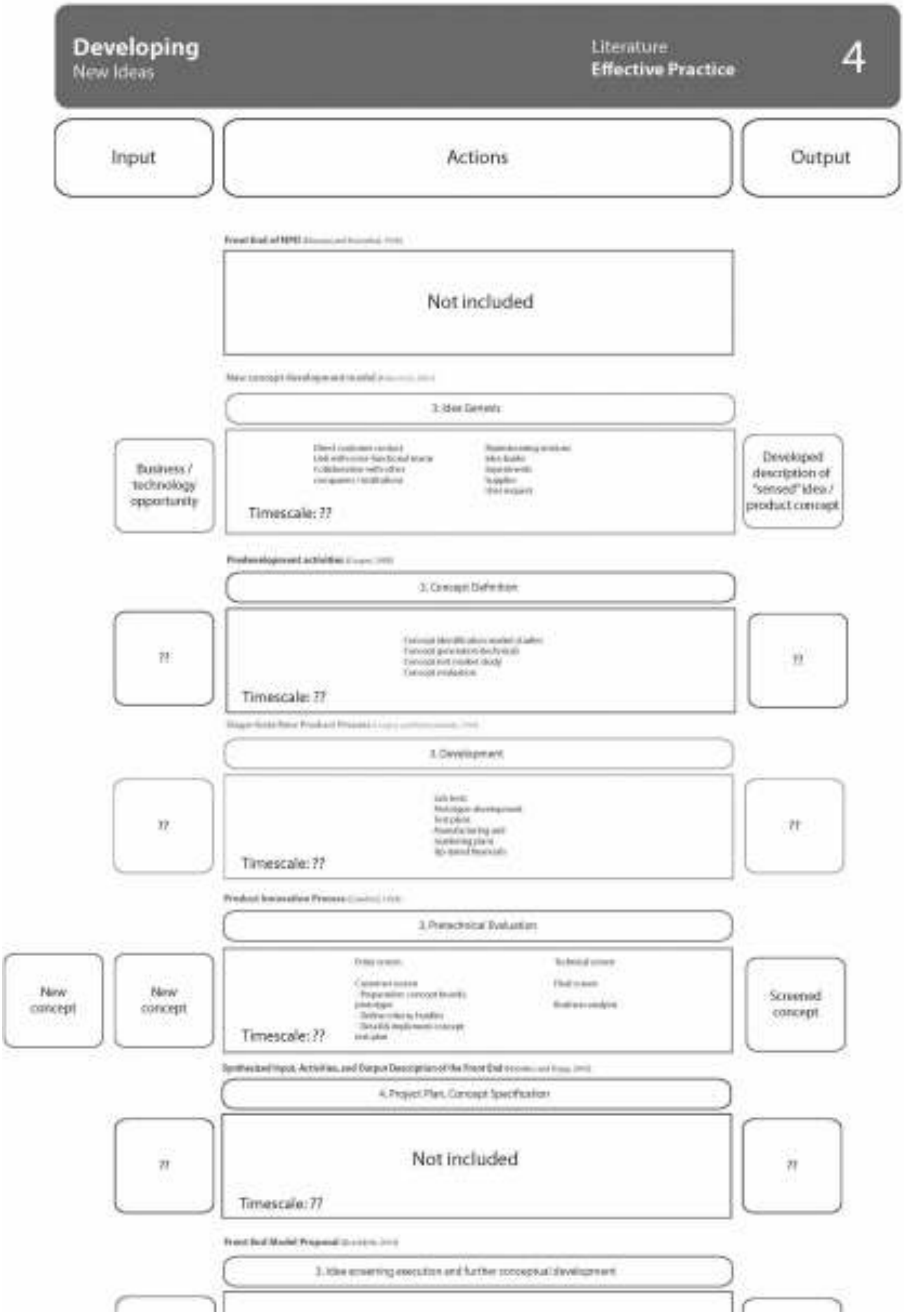

Target markets
Applications of Interest
Timescale: 4 weeks
Core need
Target customer groups
Creative Approaches
Timescale
???



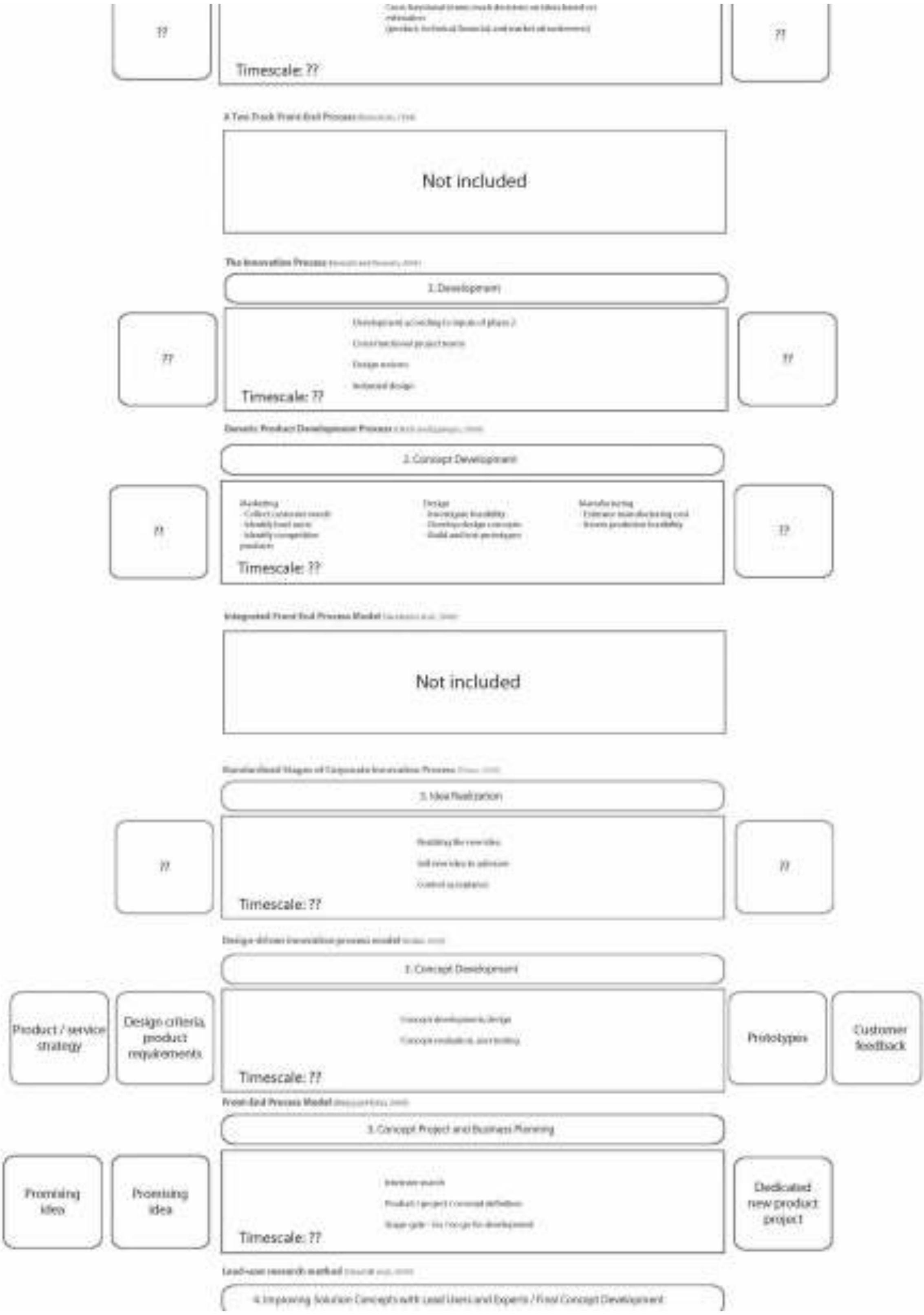
Defining
New Directions
Literature
Effective Practice
3
Input
Actions
Output
1. Phase One
??
Timescale: ??
??
2. Opportunity Analysis
??
Timescale: ??
Business / technology opportunity
2. Preliminary Assessment
??
Timescale: ??
??
2. Detailed Assessment
??
Timescale: ??
??
1. Concept Generation
Validated New Product Opportunity
Timescale: ??
New concept
New concept
3. Front End
??
Timescale: ??
??
2. Idea generation and adoption

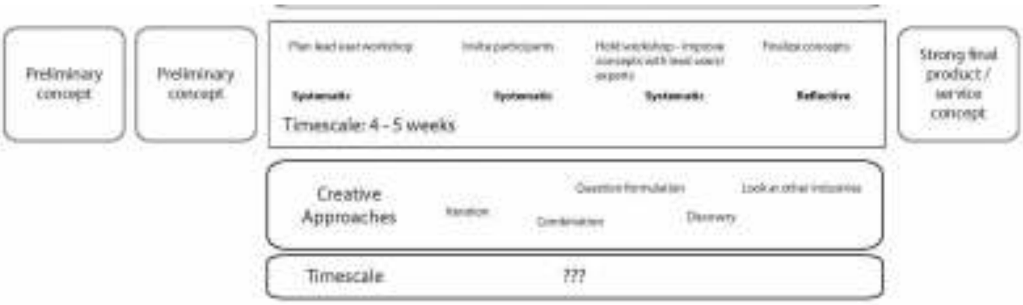

??
Timescale: ??
??
1. Authorize 60 days of development
??
Timescale: 60 days
??
3. Concept Development, Product Planning
??
Timescale: ??
??
3. System-Level Design
??
Timescale: ??
??
2. Product and Business Ideas
Search area
Opportunity
Timescale: ??
Balanced product & business idea card
??
Timescale: ??
??
Innovation hypothesis
Innovation strategy
Timescale: ??
Product / service strategy
Design criteria, product requirements
Business opportunity
Business opportunity
Timescale: ??
Promising idea
Promising idea
3. Exploring Lead-User Needs and Solutions / Preliminary Concept Generation


Core need
Target customer groups
Timescale: 4 - 5 weeks
Preliminary concept
Preliminary concept
Creative Approaches
Timescale
???

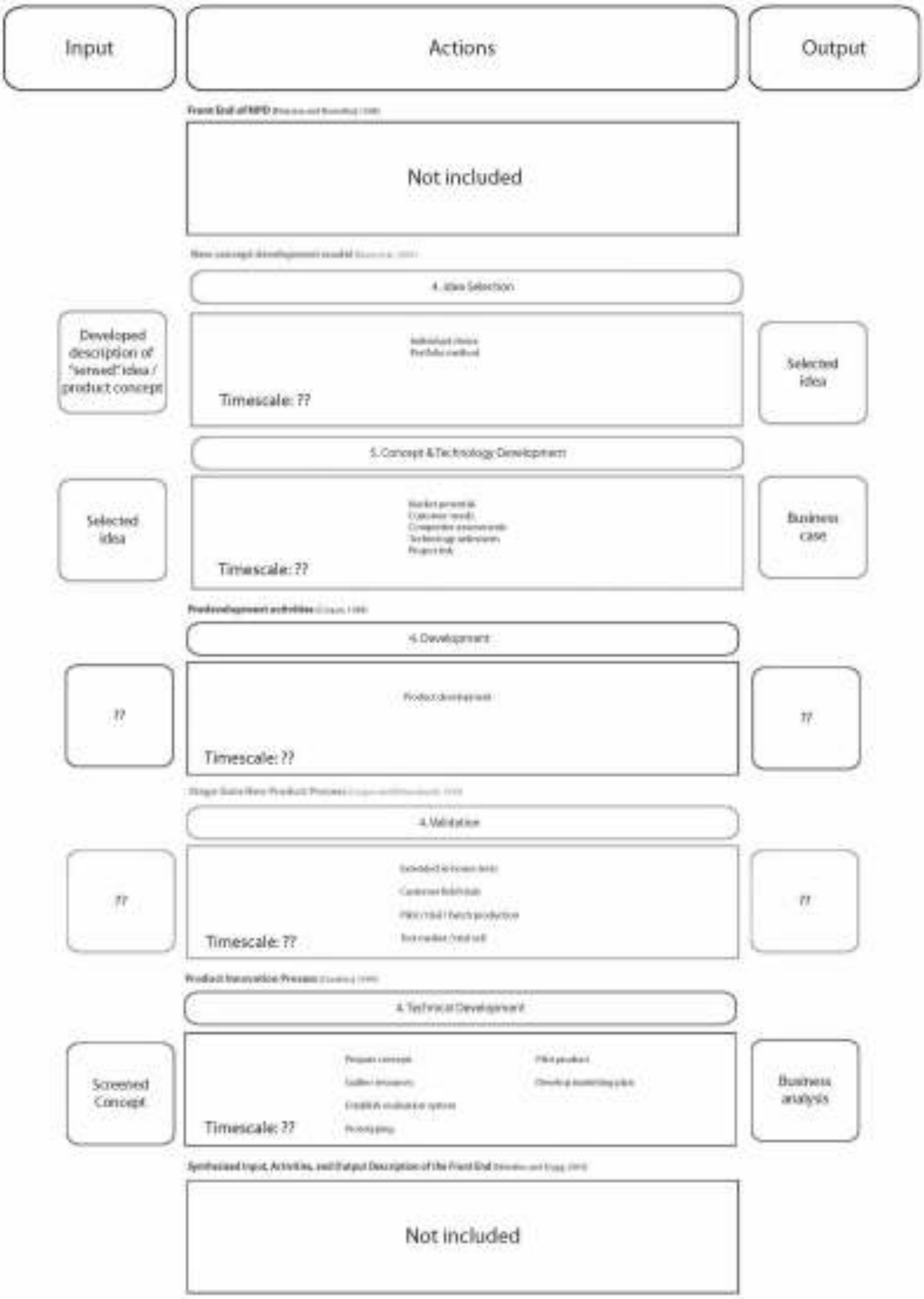


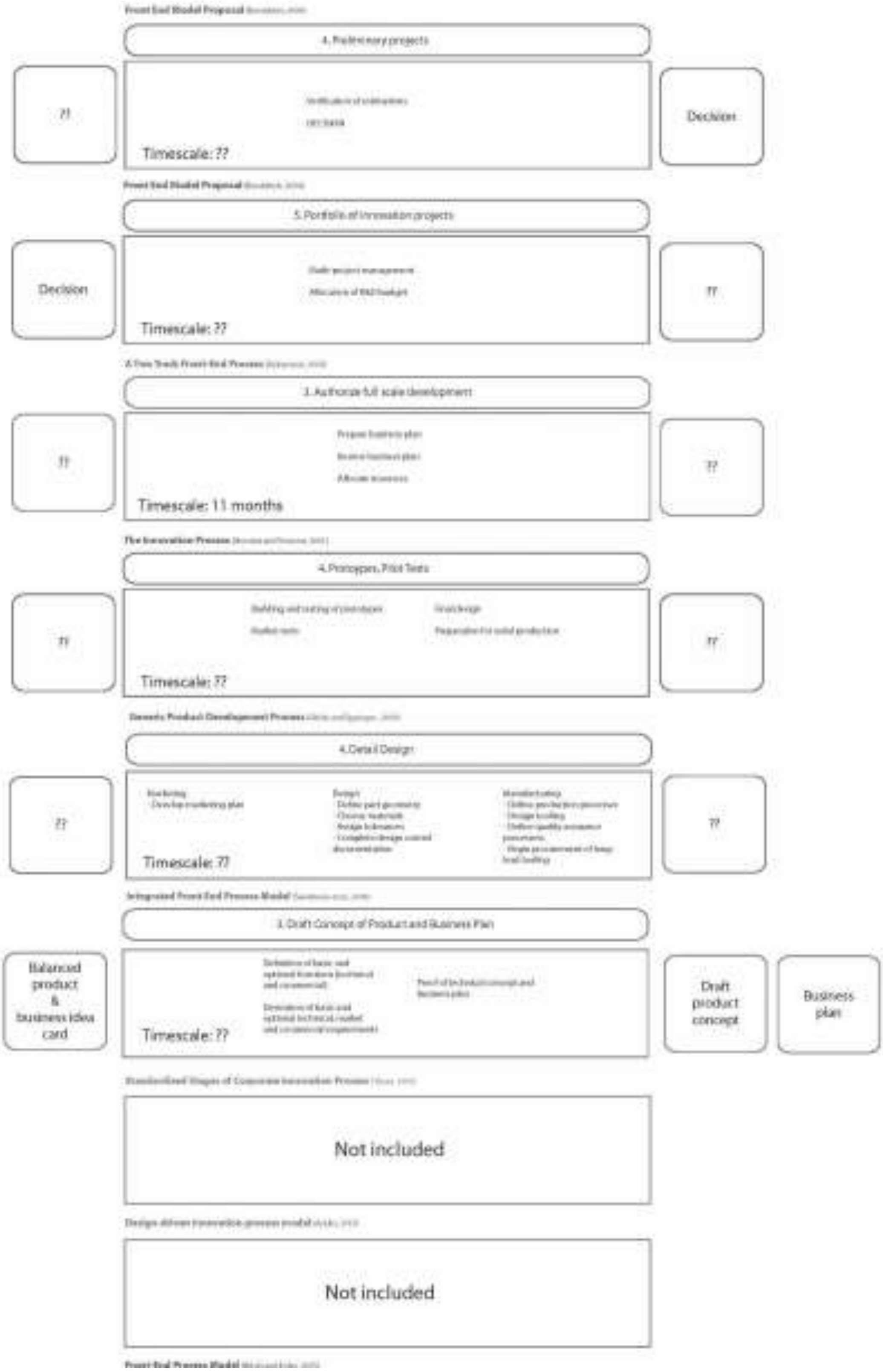
Developing
New Ideas
Literature
Effective Practice
4
Input
Actions
Output
Not included
Business / technology opportunity
Timescale: ??
Developed description of "sensed" idea / product concept
3. Concept Definition
??
Timescale: ??
??
3. Development
??
Timescale: ??
??
3. Pretechnical Evaluation
New concept
New concept
Timescale: ??
Screened concept
4. Project Plan, Concept Specification
??
Not included
Timescale: ??
??


??
Timescale: ??
Not included
1. Development
2. Concept Development
5. Idea Realization
Product / service strategy
Design criteria, product requirements
Prototypes
Customer feedback
3. Concept Project and Business Planning
Promising idea
Dedicated new product project
4. Improving Solution Concepts with Lead Users and Experts / Final Concept Development



Preliminary concept
Preliminary concept
Systematic
Systematic
Systematic
Reflective
Timescale: 4 - 5 weeks
Strong final product / service concept
Creative Approaches
Question formulation
Look at other industries
Combination
Discovery
Timescale
???

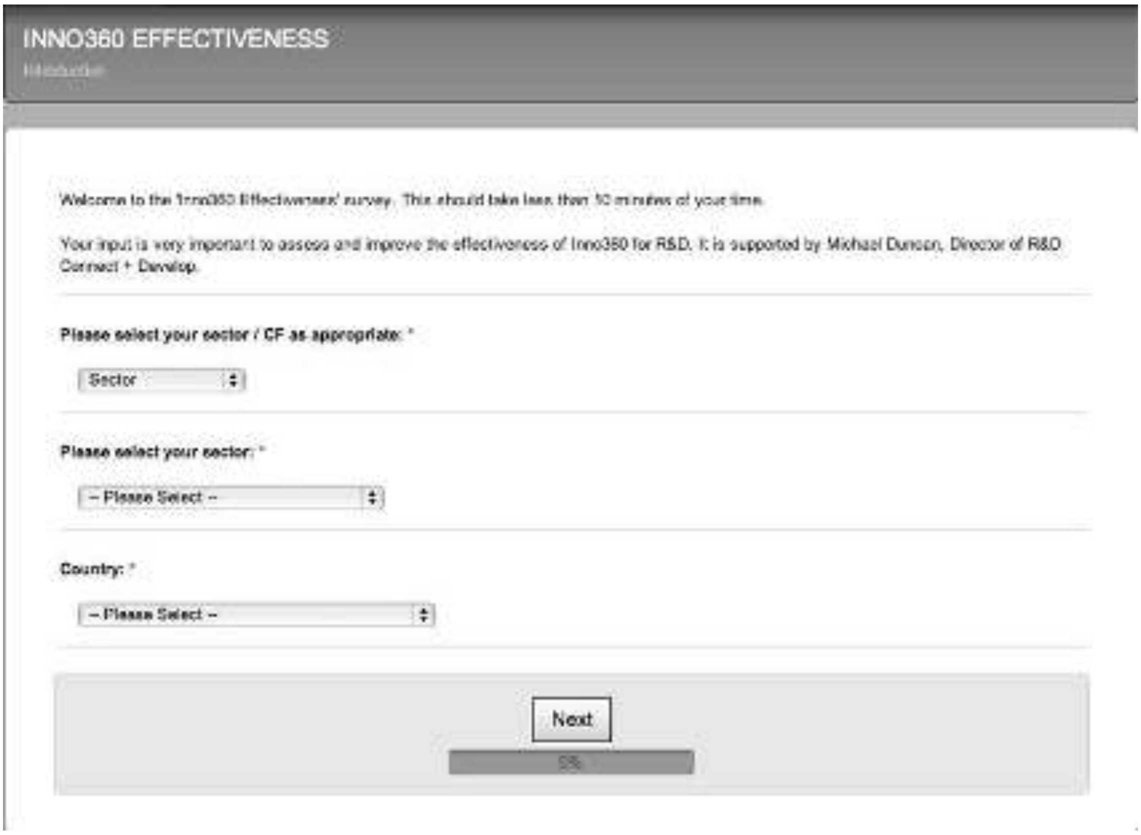

Input
Actions
Output
Not included
Developed description of "sensed" idea / product concept
Timescale: ??
Selected idea
5. Concept & Technology Development
Selected idea
Timescale: ??
Business case
6. Development
??
Timescale: ??
??
4. Validation
??
Timescale: ??
??
4. Technical Development
Screened Concept
Timescale: ??
Business analysis
Not included

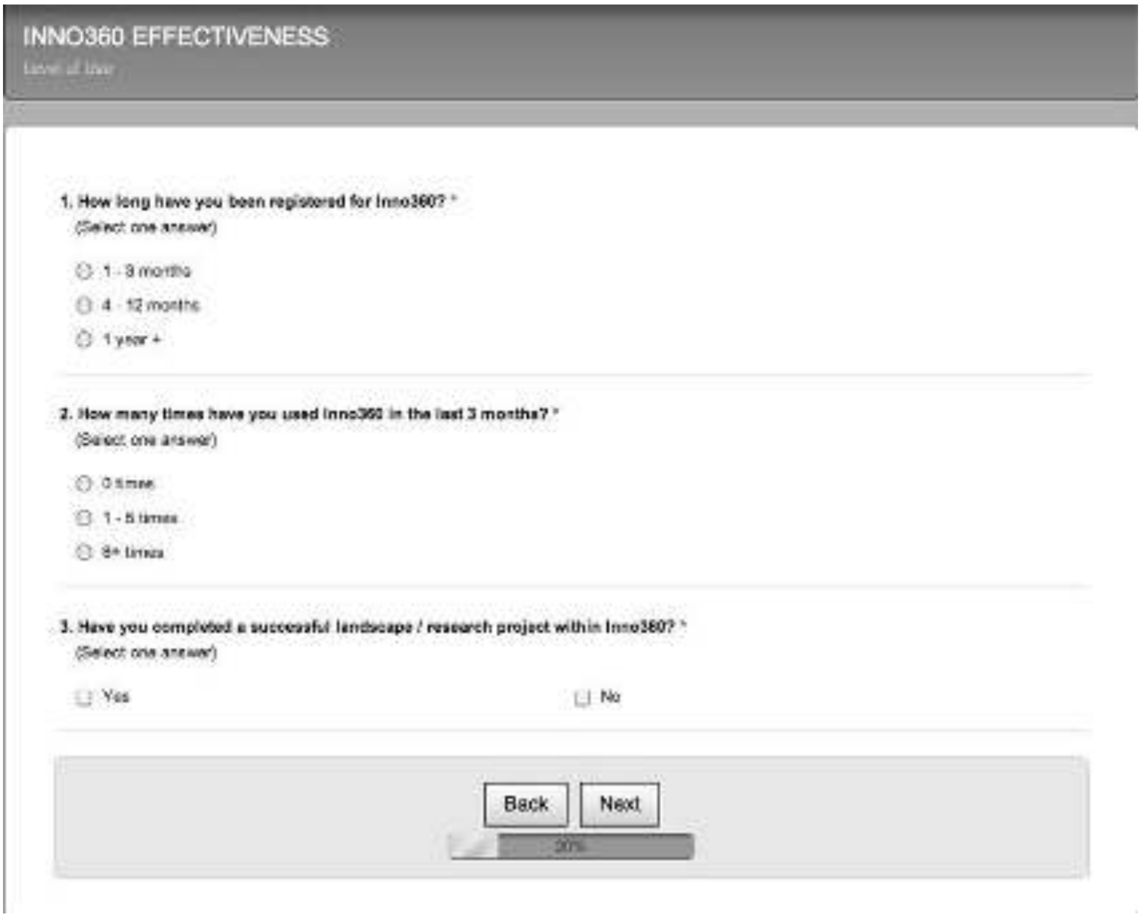

4. Preliminary projects
??
Timescale: ??
Decision
5. Portfolio of innovation projects
Decision
Timescale: ??
??
3. Authorize full scale development
??
Timescale: 11 months
??
4. Prototypes, Pilot Tests
??
Timescale: ??
??
4. Detail Design
??
Timescale: ??
??
3. Draft Concept of Product and Business Plan
Balanced product & business idea card
Timescale: ??
Draft product concept
Business plan
Not included
Not included


Not included
??
Not included
??
Creative Approaches
Question formulation
Look at other industries
Iteration
Combination
Discovery
Timescale
???

B Main Survey

Online Questionnaire Screenshots





INNO360 EFFECTIVENESS

Level of Use

1. How long have you been registered for Inno360? *
(Select one answer)

- 1 - 3 months
- 4 - 12 months
- 1 year +

2. How many times have you used Inno360 in the last 3 months? *
(Select one answer)

- 0 times
- 1 - 5 times
- 6+ times

3. Have you completed a successful landscape / research project within Inno360? *
(Select one answer)

- Yes
- No

Back Next

20%

INNO360 EFFECTIVENESS

Activity Effectiveness & Barriers

4. Which activities are you using Inno360 for and how effective is it? *

(Select one answer for each activity)

	Not Effective	Somewhat Effective	Moderately Effective	Effective	Very Effective	Not Applicable
Internal searches (SLR, TechReports)	○	○	○	○	○	○
External searches	○	○	○	○	○	○
Internal collaboration	○	○	○	○	○	○
Benefit landscaping	○	○	○	○	○	○
Expert identification (internal)	○	○	○	○	○	○
Expert identification (external)	○	○	○	○	○	○
Competitive intelligence / IP	○	○	○	○	○	○
Market data	○	○	○	○	○	○
Claims support	○	○	○	○	○	○
Personal development	○	○	○	○	○	○
Trend identification	○	○	○	○	○	○

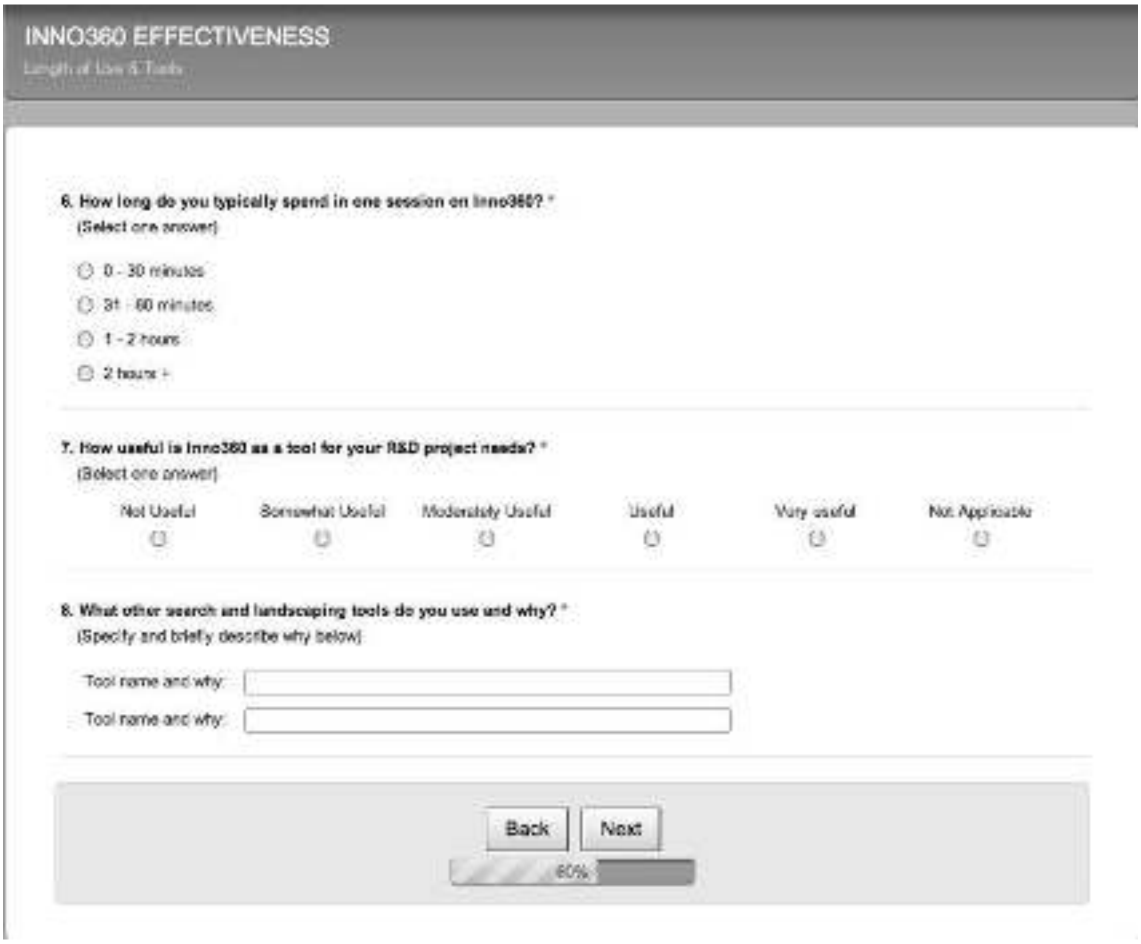
5. Which barriers do you experience when using Inno360? *

(Select all that apply)

- ☐ Complexity / difficulty understanding how to use
- ☐ Lack of time to integrate into activities
- ☐ Slow search speeds
- ☐ Difficulty getting relevant results
- ☐ Lack of training
- ☐ Prefer other tools (please specify) *
- ☐ Other *
- ☐ No barriers experienced

Back Next

40%



INNO360 EFFECTIVENESS

Length of Use & Tools

6. How long do you typically spend in one session on Inno360? *
(Select one answer)

- 0 - 30 minutes
- 31 - 60 minutes
- 1 - 2 hours
- 2 hours +

7. How useful is Inno360 as a tool for your R&D project needs? *
(Select one answer)

Not Useful	Somewhat Useful	Moderately Useful	Useful	Very useful	Not Applicable
○	○	○	○	○	○

8. What other search and landscaping tools do you use and why? *
(Specify and briefly describe why below)

Tool name and why:

Tool name and why:

Back Next

60%

INNO360 EFFECTIVENESS

Site Attributes & Recommendations

9. How useful are the following Inno360 site attributes? *

(Select one answer for each attribute)

	Not Useful	Somewhat Useful	Moderately Useful	Useful	Very Useful	Not Applicable
Ease of site navigation	○	○	○	○	○	○
Ease of searching	○	○	○	○	○	○
Relevance of search results	○	○	○	○	○	○
Ease of project collaboration	○	○	○	○	○	○
Relevance of databases for searching	○	○	○	○	○	○
Usefulness of foam trees/circle clusters/explorer	○	○	○	○	○	○
Layout/design	○	○	○	○	○	○
Usefulness of user guide/wiki	○	○	○	○	○	○
Usefulness of webinars/training	○	○	○	○	○	○

10. What are the top three things you like about Inno360 and why? *

1 __________

2 __________

3 __________

11. What are the top three improvement areas for Inno360 and why? *

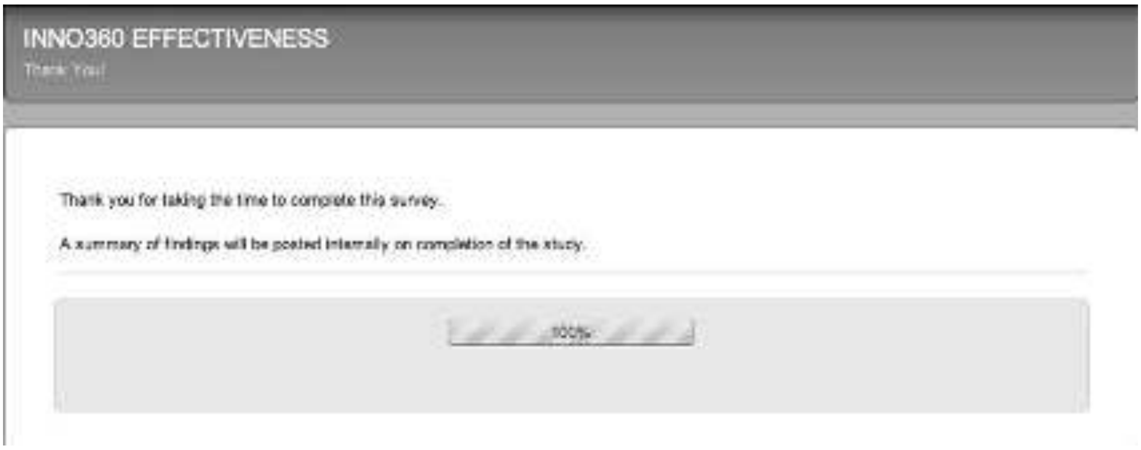
1 __________

2 __________

3 __________

Back | Submit

80%


INNO360 EFFECTIVENESS
Thank You!
Thank you for taking the time to complete this survey.
A summary of findings will be posted internally on completion of the study.
100%

C SPSS Data

Country:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Belgium	9	5.7	5.7	5.7
	Canada	1	.6	.6	6.3
	China	7	4.4	4.4	10.7
	Germany	1	.6	.6	11.3
	India	1	.6	.6	11.9
	Japan	1	.6	.6	12.6
	Singapore	8	5.0	5.0	17.6
	United Kingdom	22	13.8	13.8	31.4
	United States	109	68.6	68.6	100.0
	Total	159	100.0	100.0	

Please select your CF:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	C+D	7	4.4	77.8	77.8
	Legal	1	.6	11.1	88.9
	Packaging	1	.6	11.1	100.0
	Total	9	5.7	100.0	
Missing	System	150	94.3		
Total		159	100.0		

Please select your sector / CF as appropriate:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Sector	88	55.3	55.3	55.3
	GCO	19	11.9	11.9	67.3
	TPT	18	11.3	11.3	78.6
	CF	11	6.9	6.9	85.5
	Other	23	14.5	14.5	100.0
	Total	159	100.0	100.0	

Please select your sector:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Global Baby, Feminine & Family Care	13	8.2	14.8	14.8
	Global Beauty	31	19.5	35.2	50.0
	Global Fabric & Home Care	19	11.9	21.6	71.6
	Global Health & Grooming	25	15.7	28.4	100.0
	Total	88	55.3	100.0	
Missing	System	71	44.7		
Total		159	100.0		

How long have you been registered for Inno360?

N	Valid	147
	Missing	12
Mean		2.12
Median		2.00
Mode		2
Std. Deviation		.754
Skewness		-.195
Std. Error of Skewness		.200
Sum		311

How long have you been registered for Inno360?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 - 3 months	34	21.4	23.1	23.1
	4 - 12 months	62	39.0	42.2	65.3
	1 year +	51	32.1	34.7	100.0
	Total	147	92.5	100.0	
Missing	System	12	7.5		
Total		159	100.0		

How many times have you used Inno360 in the last 3 months?

N	Valid	147
	Missing	12
Mean		1.79
Median		2.00
Mode		2
Std. Deviation		.664
Skewness		.264
Std. Error of Skewness		.200
Sum		263

How many times have you used Inno360 in the last 3 months?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 times	51	32.1	34.7	34.7
	1 - 5 times	76	47.8	51.7	86.4
	6+ times	20	12.6	13.6	100.0
	Total	147	92.5	100.0	
Missing	System	12	7.5		
Total		159	100.0		

Found innovative technology:What did success look like?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unchecked	26	16.4	54.2	54.2
	Checked	22	13.8	45.8	100.0
	Total	48	30.2	100.0	
Missing	System	111	69.8		
Total		159	100.0		

Found academia experts:What did success look like?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unchecked	36	22.6	75.0	75.0
	Checked	12	7.5	25.0	100.0
	Total	48	30.2	100.0	
Missing	System	111	69.8		
Total		159	100.0		

Made internal connections:What did success look like?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unchecked	37	23.3	77.1	77.1
	Checked	11	6.9	22.9	100.0
	Total	48	30.2	100.0	
Missing	System	111	69.8		
Total		159	100.0		

		Found innovative technology: What did success look like?	Found academia experts:What did success look like?	Made internal connections: What did success look like?	Found supplier:What did success look like?	Other (please specify):What did success look like?
N	Valid	48	48	48	48	48
	Missing	111	111	111	111	111
Mean		.46	.25	.23	.06	.35
Median		.00	.00	.00	.00	.00
Mode		0	0	0	0	0
Std. Deviation		.504	.438	.425	.245	.483
Skewness		.173	1.192	1.331	3.732	.630
Std. Error of Skewness		.343	.343	.343	.343	.343
Sum		22	12	11	3	17

		Yes:Have you completed a successful landscape / research project within Inno360?	No:Have you completed a successful landscape / research project within Inno360?
N	Valid	150	150
	Missing	9	9
Mean		.30	.68
Median		.00	1.00
Mode		0	1
Std. Deviation		.460	.468
Skewness		.882	-.780
Std. Error of Skewness		.198	.198
Sum		45	102

Yes:Have you completed a successful landscape / research project within Inno360?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unchecked	105	66.0	70.0	70.0
	Checked	45	28.3	30.0	100.0
	Total	150	94.3	100.0	
Missing	System	9	5.7		
Total		159	100.0		

No:Have you completed a successful landscape / research project within Inno360?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unchecked	48	30.2	32.0	32.0
	Checked	102	64.2	68.0	100.0
	Total	150	94.3	100.0	
Missing	System	9	5.7		
Total		159	100.0		

Found supplier:What did success look like?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unchecked	45	28.3	93.8	93.8
	Checked	3	1.9	6.3	100.0
	Total	48	30.2	100.0	
Missing	System	111	69.8		
Total		159	100.0		

Other (please specify):What did success look like?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unchecked	31	19.5	64.6	64.6
	Checked	17	10.7	35.4	100.0
	Total	48	30.2	100.0	
Missing	System	111	69.8		
Total		159	100.0		

Personal development:Which activities are you using Inno360 for and how effective is it?

N	Valid	124
	Missing	35
Mean		1.17
Median		.00
Mode		0
Std. Deviation		1.761
Skewness		1.145
Std. Error of Skewness		.217
Sum		145

Personal development:Which activities are you using Inno360 for and how effective is it?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	78	49.1	62.9	62.9
	Not Effective	10	6.3	8.1	71.0
	Somewhat Effective	4	2.5	3.2	74.2
	Moderately Effective	11	6.9	8.9	83.1
	Effective	11	6.9	8.9	91.9
	Very Effective	10	6.3	8.1	100.0
	Total	124	78.0	100.0	
Missing	System	35	22.0		
Total		159	100.0		

Market data:Which activities are you using Inno360 for and how effective is it?

N	Valid	124
	Missing	35
Mean		.66
Median		.00
Mode		0
Std. Deviation		1.262
Skewness		1.851
Std. Error of Skewness		.217
Sum		82

Market data:Which activities are you using Inno360 for and how effective is it?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	91	57.2	73.4	73.4
	Not Effective	8	5.0	6.5	79.8
	Somewhat Effective	10	6.3	8.1	87.9
	Moderately Effective	8	5.0	6.5	94.4
	Effective	5	3.1	4.0	98.4
	Very Effective	2	1.3	1.6	100.0
	Total	124	78.0	100.0	
Missing	System	35	22.0		
Total		159	100.0		

Statistics

Expert identification (internal):Which activities are you using Inno360 for and how effective is it?

N	Valid	124
	Missing	35
Mean		1.30
Median		.00
Mode		0
Std. Deviation		1.725
Skewness		.957
Std. Error of Skewness		.217
Sum		161

Expert identification (internal):Which activities are you using Inno360 for and how effective is it?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	69	43.4	55.6	55.6
	Not Effective	11	6.9	8.9	64.5
	Somewhat Effective	13	8.2	10.5	75.0
	Moderately Effective	8	5.0	6.5	81.5
	Effective	15	9.4	12.1	93.5
	Very Effective	8	5.0	6.5	100.0
	Total	124	78.0	100.0	
Missing	System	35	22.0		
Total		159	100.0		

Statistics

Expert identification (external):Which activities are you using Inno360 for and how effective is it?

N	Valid	124
	Missing	35
Mean		1.31
Median		.00
Mode		0
Std. Deviation		1.736
Skewness		.924
Std. Error of Skewness		.217
Sum		163

Expert identification (external):Which activities are you using Inno360 for and how effective is it?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	69	43.4	55.6	55.6
	Not Effective	11	6.9	8.9	64.5
	Somewhat Effective	11	6.9	8.9	73.4
	Moderately Effective	10	6.3	8.1	81.5
	Effective	15	9.4	12.1	93.5
	Very Effective	8	5.0	6.5	100.0
	Total	124	78.0	100.0	
Missing	System	35	22.0		
Total		159	100.0		

Competitive intelligence / IP:Which activities are you using Inno360 for and how effective is it?

N	Valid	124
	Missing	35
Mean		2.02
Median		2.00
Mode		0
Std. Deviation		1.955
Skewness		.329
Std. Error of Skewness		.217
Sum		250

Competitive intelligence / IP:Which activities are you using Inno360 for and how effective is it?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	48	30.2	38.7	38.7
	Not Effective	10	6.3	8.1	46.8
	Somewhat Effective	17	10.7	13.7	60.5
	Moderately Effective	11	6.9	8.9	69.4
	Effective	17	10.7	13.7	83.1
	Very Effective	21	13.2	16.9	100.0
	Total	124	78.0	100.0	
Missing	System	35	22.0		
Total		159	100.0		

Claims support:Which activities are you using Inno360 for and how effective is it?

N	Valid	124
	Missing	35
Mean		.72
Median		.00
Mode		0
Std. Deviation		1.353
Skewness		1.730
Std. Error of Skewness		.217
Sum		89

Claims support:Which activities are you using Inno360 for and how effective is it?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	91	57.2	73.4	73.4
	Not Effective	7	4.4	5.6	79.0
	Somewhat Effective	8	5.0	6.5	85.5
	Moderately Effective	8	5.0	6.5	91.9
	Effective	8	5.0	6.5	98.4
	Very Effective	2	1.3	1.6	100.0
	Total	124	78.0	100.0	
Missing	System	35	22.0		
Total		159	100.0		

Statistics

		Internal searches (SLR, TechReports):Which activities are you using Inno360 for and how effective is it?	External searches: Which activities are you using Inno360 for and how effective is it?	Internal collaboration: Which activities are you using Inno360 for and how effective is it?	Benefit landscaping: Which activities are you using Inno360 for and how effective is it?	Expert identification (internal): Which activities are you using Inno360 for and how effective is it?
N	Valid	124	124	124	124	124
	Missing	35	35	35	35	35
Mean		2.06	2.40	1.40	1.47	1.30
Median		2.00	2.00	.50	.00	.00
Mode		0	0	0	0	0
Std. Deviation		1.918	1.903	1.647	1.819	1.725
Skewness		.206	-.037	.688	.803	.957
Std. Error of Skewness		.217	.217	.217	.217	.217
Sum		255	297	173	182	161

		Expert identification (external): Which activities are you using Inno360 for and how effective is it?	Competitive intelligence / IP:Which activities are you using Inno360 for and how effective is it?	Market data: Which activities are you using Inno360 for and how effective is it?	Claims support: Which activities are you using Inno360 for and how effective is it?	Personal development :Which activities are you using Inno360 for and how effective is it?	Trend identification: Which activities are you using Inno360 for and how effective is it?
N	Valid	124	124	124	124	124	124
	Missing	35	35	35	35	35	35
Mean		1.31	2.02	.66	.72	1.17	1.09
Median		.00	2.00	.00	.00	.00	.00
Mode		0	0	0	0	0	0
Std. Deviation		1.736	1.955	1.262	1.353	1.761	1.739
Skewness		.924	.329	1.851	1.730	1.145	1.238
Std. Error of Skewness		.217	.217	.217	.217	.217	.217
Sum		163	250	82	89	145	135

Statistics

InternalSearches

N	Valid	124
	Missing	35
Mean		2.06
Median		2.00
Mode		0
Std. Deviation		1.918
Skewness		.206
Std. Error of Skewness		.217
Sum		255

Internal Searches (SLR, TechReports): Which activities are you using Inno360 for and how effective is it?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	46	28.9	37.1	37.1
	Not Effective	13	8.2	10.5	47.6
	Somewhat Effective	10	6.3	8.1	55.6
	Moderately Effective	13	8.2	10.5	66.1
	Effective	27	17.0	21.8	87.9
	Very Effective	15	9.4	12.1	100.0
	Total	124	78.0	100.0	
Missing	System	35	22.0		
Total		159	100.0		

Statistics

InternalCollaboration

N	Valid	124
	Missing	35
Mean		1.40
Median		.50
Mode		0
Std. Deviation		1.647
Skewness		.688
Std. Error of Skewness		.217
Sum		173

Internal collaboration: Which activities are you using Inno360 for and how effective is it?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	62	39.0	50.0	50.0
	Not Effective	13	8.2	10.5	60.5
	Somewhat Effective	12	7.5	9.7	70.2
	Moderately Effective	15	9.4	12.1	82.3
	Effective	19	11.9	15.3	97.6
	Very Effective	3	1.9	2.4	100.0
	Total	124	78.0	100.0	
Missing	System	35	22.0		
Total		159	100.0		

Statistics

ExternalSearches

N	Valid	124
	Missing	35
Mean		2.40
Median		2.00
Mode		0
Std. Deviation		1.903
Skewness		-.037
Std. Error of Skewness		.217
Sum		297

External searches: Which activities are you using Inno360 for and how effective is it?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	35	22.0	28.2	28.2
	Not Effective	12	7.5	9.7	37.9
	Somewhat Effective	17	10.7	13.7	51.6
	Moderately Effective	9	5.7	7.3	58.9
	Effective	31	19.5	25.0	83.9
	Very Effective	20	12.6	16.1	100.0
	Total	124	78.0	100.0	
Missing	System	35	22.0		
Total		159	100.0		

Statistics

BenefitLandscaping

N	Valid	124
	Missing	35
Mean		1.47
Median		.00
Mode		0
Std. Deviation		1.819
Skewness		.803
Std. Error of Skewness		.217
Sum		182

Benefit landscaping: Which activities are you using Inno360 for and how effective is it?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	64	40.3	51.6	51.6
	Not Effective	13	8.2	10.5	62.1
	Somewhat Effective	9	5.7	7.3	69.4
	Moderately Effective	13	8.2	10.5	79.8
	Effective	13	8.2	10.5	90.3
	Very Effective	12	7.5	9.7	100.0
	Total	124	78.0	100.0	
Missing	System	35	22.0		
Total		159	100.0		

Trend identification:Which activities are you using Inno360 for and how effective is it?

N	Valid	124
	Missing	35
Mean		1.09
Median		.00
Mode		0
Std. Deviation		1.739
Skewness		1.238
Std. Error of Skewness		.217
Sum		135

Trend identification:Which activities are you using Inno360 for and how effective is it?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	83	52.2	66.9	66.9
	Not Effective	6	3.8	4.8	71.8
	Somewhat Effective	6	3.8	4.8	76.6
	Moderately Effective	8	5.0	6.5	83.1
	Effective	12	7.5	9.7	92.7
	Very Effective	9	5.7	7.3	100.0
	Total	124	78.0	100.0	
Missing	System	35	22.0		
Total		159	100.0		

Complexity / difficulty understanding how to use:Which barriers do you experience when using Inno360?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unchecked	72	45.3	54.5	54.5
	Checked	60	37.7	45.5	100.0
	Total	132	83.0	100.0	
Missing	System	27	17.0		
Total		159	100.0		

Lack of time to integrate into activities:Which barriers do you experience when using Inno360?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unchecked	81	50.9	61.4	61.4
	Checked	51	32.1	38.6	100.0
	Total	132	83.0	100.0	
Missing	System	27	17.0		
Total		159	100.0		

Slow search speeds:Which barriers do you experience when using Inno360?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unchecked	116	73.0	87.9	87.9
	Checked	16	10.1	12.1	100.0
	Total	132	83.0	100.0	
Missing	System	27	17.0		
Total		159	100.0		

Difficulty getting relevant results:Which barriers do you experience when using Inno360?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unchecked	85	53.5	64.4	64.4
	Checked	47	29.6	35.6	100.0
	Total	132	83.0	100.0	
Missing	System	27	17.0		
Total		159	100.0		

Lack of training:Which barriers do you experience when using Inno360?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unchecked	98	61.6	74.2	74.2
	Checked	34	21.4	25.8	100.0
	Total	132	83.0	100.0	
Missing	System	27	17.0		
Total		159	100.0		

Prefer other tools:Which barriers do you experience when using Inno360?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unchecked	106	66.7	80.3	80.3
	Checked	26	16.4	19.7	100.0
	Total	132	83.0	100.0	
Missing	System	27	17.0		
Total		159	100.0		

Other:Which barriers do you experience when using Inno360?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unchecked	111	69.8	84.1	84.1
	Checked	21	13.2	15.9	100.0
	Total	132	83.0	100.0	
Missing	System	27	17.0		
Total		159	100.0		

No barriers experienced:Which barriers do you experience when using Inno360?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unchecked	119	74.8	90.2	90.2
	Checked	13	8.2	9.8	100.0
	Total	132	83.0	100.0	
Missing	System	27	17.0		
Total		159	100.0		

Statistics

		Complexity / difficulty understanding how to use: Which barriers do you experience when using Inno360?	Lack of time to integrate into activities: Which barriers do you experience when using Inno360?	Slow search speeds: Which barriers do you experience when using Inno360?	Difficulty getting relevant results:Which barriers do you experience when using Inno360?	Lack of training: Which barriers do you experience when using Inno360?	Prefer other tools:Which barriers do you experience when using Inno360?	Other:Which barriers do you experience when using Inno360?	No barriers experienced: Which barriers do you experience when using Inno360?
N	Valid	132	132	132	132	132	132	132	132
	Missing	27	27	27	27	27	27	27	27
Mean		.45	.39	.12	.36	.26	.20	.16	.10
Median		.00	.00	.00	.00	.00	.00	.00	.00
Mode		0	0	0	0	0	0	0	0
Std. Deviation		.500	.489	.328	.481	.439	.399	.367	.299
Skewness		.185	.472	2.348	.608	1.122	1.541	1.886	2.726
Std. Error of Skewness		.211	.211	.211	.211	.211	.211	.211	.211
Sum		60	51	16	47	34	26	21	13

How long do you typically spend in one session on Inno360?

N	Valid	122
	Missing	37
Mean		1.60
Median		1.00
Mode		1
Std. Deviation		.757
Skewness		1.055
Std. Error of Skewness		.219
Sum		195

How long do you typically spend in one session on Inno360?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 - 30 minutes	67	42.1	54.9	54.9
	31 - 60 minutes	39	24.5	32.0	86.9
	1 - 2 hours	14	8.8	11.5	98.4
	2 hours +	2	1.3	1.6	100.0
	Total	122	76.7	100.0	
Missing	System	37	23.3		
Total		159	100.0		

Statistics

UsefulnessofInno360

N	Valid	122
	Missing	37
Mean		2.58
Median		3.00
Mode		1
Std. Deviation		1.695
Skewness		-.045
Std. Error of Skewness		.219
Sum		315

How useful is Inno360 as a tool for your R&D project needs?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	17	10.7	13.9	13.9
	Not Useful	23	14.5	18.9	32.8
	Somewhat Useful	18	11.3	14.8	47.5
	Moderately Useful	21	13.2	17.2	64.8
	Useful	22	13.8	18.0	82.8
	Very Useful	21	13.2	17.2	100.0
	Total	122	76.7	100.0	
Missing	System	37	23.3		
Total		159	100.0		

Relevance of databases for searching:How useful are the following Inno360 site attributes?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	32	20.1	28.1	28.1
	Not Useful	10	6.3	8.8	36.8
	Somewhat Useful	15	9.4	13.2	50.0
	Moderately Useful	19	11.9	16.7	66.7
	Useful	22	13.8	19.3	86.0
	Very Useful	16	10.1	14.0	100.0
	Total	114	71.7	100.0	
Missing	System	45	28.3		
Total		159	100.0		

Usefulness of foam trees/circle clusters/explorer:How useful are the following Inno360 site attributes?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	28	17.6	24.6	24.6
	Not Useful	12	7.5	10.5	35.1
	Somewhat Useful	16	10.1	14.0	49.1
	Moderately Useful	14	8.8	12.3	61.4
	Useful	21	13.2	18.4	79.8
	Very Useful	23	14.5	20.2	100.0
	Total	114	71.7	100.0	
Missing	System	45	28.3		
Total		159	100.0		

Relevance of search results:How useful are the following Inno360 site attributes?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	26	16.4	22.8	22.8
	Not Useful	11	6.9	9.6	32.5
	Somewhat Useful	21	13.2	18.4	50.9
	Moderately Useful	15	9.4	13.2	64.0
	Useful	28	17.6	24.6	88.6
	Very Useful	13	8.2	11.4	100.0
	Total	114	71.7	100.0	
Missing	System	45	28.3		
Total		159	100.0		

Ease of project collaboration:How useful are the following Inno360 site attributes?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	49	30.8	43.0	43.0
	Not Useful	11	6.9	9.6	52.6
	Somewhat Useful	20	12.6	17.5	70.2
	Moderately Useful	12	7.5	10.5	80.7
	Useful	12	7.5	10.5	91.2
	Very Useful	10	6.3	8.8	100.0
	Total	114	71.7	100.0	
Missing	System	45	28.3		
Total		159	100.0		

Ease of site navigation:How useful are the following Inno360 site attributes?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	23	14.5	20.2	20.2
	Not Useful	13	8.2	11.4	31.6
	Somewhat Useful	27	17.0	23.7	55.3
	Moderately Useful	22	13.8	19.3	74.6
	Useful	24	15.1	21.1	95.6
	Very Useful	5	3.1	4.4	100.0
	Total	114	71.7	100.0	
Missing	System	45	28.3		
Total		159	100.0		

Ease of searching:How useful are the following Inno360 site attributes?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	23	14.5	20.2	20.2
	Not Useful	11	6.9	9.6	29.8
	Somewhat Useful	25	15.7	21.9	51.8
	Moderately Useful	22	13.8	19.3	71.1
	Useful	21	13.2	18.4	89.5
	Very Useful	12	7.5	10.5	100.0
	Total	114	71.7	100.0	
Missing	System	45	28.3		
Total		159	100.0		

Layout/design:How useful are the following Inno360 site attributes?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	26	16.4	22.8	22.8
	Not Useful	11	6.9	9.6	32.5
	Somewhat Useful	24	15.1	21.1	53.5
	Moderately Useful	16	10.1	14.0	67.5
	Useful	26	16.4	22.8	90.4
	Very Useful	11	6.9	9.6	100.0
	Total	114	71.7	100.0	
Missing	System	45	28.3		
Total		159	100.0		

Usefulness of user guide/wiki:How useful are the following Inno360 site attributes?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	55	34.6	48.2	48.2
	Not Useful	12	7.5	10.5	58.8
	Somewhat Useful	14	8.8	12.3	71.1
	Moderately Useful	20	12.6	17.5	88.6
	Useful	10	6.3	8.8	97.4
	Very Useful	3	1.9	2.6	100.0
	Total	114	71.7	100.0	
Missing	System	45	28.3		
Total		159	100.0		

Usefulness of webinars/training:How useful are the following Inno360 site attributes?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Applicable	59	37.1	51.8	51.8
	Not Useful	8	5.0	7.0	58.8
	Somewhat Useful	13	8.2	11.4	70.2
	Moderately Useful	21	13.2	18.4	88.6
	Useful	9	5.7	7.9	96.5
	Very Useful	4	2.5	3.5	100.0
	Total	114	71.7	100.0	
Missing	System	45	28.3		
Total		159	100.0		

		Ease of site navigation: How useful are the following Inno360 site attributes?	Ease of searching: How useful are the following Inno360 site attributes?	Relevance of search results:How useful are the following Inno360 site attributes?	Ease of project collaboration: How useful are the following Inno360 site attributes?
N	Valid	114	114	114	114
	Missing	45	45	45	45
Mean		2.23	2.38	2.41	1.62
Median		2.00	2.00	2.00	1.00
Mode		2	2	4	0
Std. Deviation		1.523	1.631	1.734	1.737
Skewness		-.073	-.057	-.099	.631
Std. Error of Skewness		.226	.226	.226	.226
Sum		254	271	275	185

a. Multiple modes exist. The smallest value is shown

Relevance of databases for searching: How useful are the following Inno360 site attributes?	Usefulness of foam trees/circle clusters/explorer:How useful are the following Inno360 site attributes?	Layout/design :How useful are the following Inno360 site attributes?	Usefulness of user guide/wiki: How useful are the following Inno360 site attributes?	Usefulness of webinars/training:How useful are the following Inno360 site attributes?
114	114	114	114	114
45	45	45	45	45
2.32	2.50	2.33	1.36	1.34
2.50	3.00	2.00	1.00	.00
0	0	0[a]	0	0
1.827	1.883	1.686	1.552	1.596
-.015	-.065	-.044	.679	.712
.226	.226	.226	.226	.226
265	285	266	155	153

Table 51 Quantitative Data Summary - Survey Participant Sector / Corporate Function - 'Other' Answers - Open Text

Other	Frequency (valid %)
Global Business Sector	7 (29.1)
Corp / Upstream R&D	4 (16.6)
Global Engineering	3 (12.5)
Infolytics	1 (4.1)
Beauty Care – Hair Care	1 (4.1)
MS&T	1 (4.1)
CF F&A	1 (4.1)
GBU	1 (4.1)
NBC	1 (4.1)
Cost Engineering	1 (4.1)
Purchase	1 (4.1)
Corporate Process	1 (4.1)
FHC	1 (4.1)
NPD Materials	1 (4.1)
	Total: 24

Table 52 Fully Detailed - Qualitative Data Summary – Other Landscaping / Research Tools Used and Why – Open Text

Other Tools Used	Reasons Why (Frequency - Times Mentioned)	Tool Frequency (valid %)
Google	Easy to use (18)	40 (21.8)
	Quick / Fast (10)	
	Relevant Hits / Results (6)	
	Broad (3)	
	Habit (3)	
	Effective (2)	
	Readily available (2)	
	Reliable (1)	
	Intuitive (1)	
	Universal (1)	
	Patent PDF (1)	
	Know how to use (1)	
	Search local publication (1)	

	No log in / switch browser (1)	
	Multiple databases at once (1)	
	Images of current products (1)	
Orbit	Detailed patent data / search (9)	27 (14.7)
	IP searches (6)	
	Easy to use (3)	
	Patent analysis features (3)	
	Intuitive IP filtering (2)	
	Company preferred (2)	
	Good search syntax (2)	
	Fast access (1)	
	Country coverage (1)	
	Save searches for others (1)	
	Complementary info to Inno360 (1)	
Scopus	Literature search (8)	16 (8.7)
	Alert capability (2)	
	Citation search capability (2)	
	Review & select articles easily (1)	
	Good sub-search (1)	
	Easy to use (1)	
	Author unknown, easy to spot work (1)	
	Links to full text (1)	
SLS	Easy to search SLRs / patents (4)	16 (8.7)
	Easy to use (3)	
	Internal R&D learning (2)	
	Familiar (1)	
	Up-to-date learning (1)	
	Useful results (1)	
	Reliable list of experts (1)	
SLR	Internal data (1)	9 (4.9)
	IP (1)	
	Relevant (1)	
	Easy to use (1)	
	Know how to use (1)	
Google Scholar	Easy to search (3)	8 (4.3)
	Literature / academic search (2)	
	Easy to navigate (1)	
	Find relevant reports (1)	
Virtual Library	Internal searching (2)	7 (3.8)

	Easy to use (1)	
	Relevant (1)	
	Market data (1)	
	Comprehensive (1)	
	Download articles (1)	
	Search multiple databases (1)	
	Saves time, builds knowledge (1)	
Other	Standard internet searches – R&D (2)	7 (3.8)
	Thought leader questionnaires (1)	
	External companies (1)	
	Personal file management (1)	
	P&G contacts – expert networking (1)	
	GBS Infolytics – have librarian complete (1)	
ScienceDirect	Easy to get scientific info (1)	5 (2.7)
	Quick, specific searches (1)	
	Literature search (1)	
PubMed	Complete listing of literature (1)	5 (2.7)
	Deep, specific literature results (1)	
	Easy to use (1)	
	Comprehensive (1)	
	Central (1)	
Tech Reports	Know how to use easily (1)	4 (2.1)
	Internal data (1)	
	Access different reports (1)	
GNPD	Focused on products (2)	3 (1.6)
SciFinder	More accurate (1)	3 (1.6)
	Chemistry core knowledge point (1)	
	Structure search (1)	
Illumin8	Relevant results / leads (2)	3 (1.6)
	Easy to use (1)	
IP.com (Semantic Art Search)	Brand new (2)	2 (1)
	Amazing speed (2)	
	Relevant hits (2)	
IQC / IQP	Best for ill defined concept searching (1)	2 (1)
	Intuitive searching (1)	
URDIP	Beauty external search vendor (1)	2 (1)
	Patents (1)	
P&G Intranet	Convenient (1)	2 (1)
	Knew from day one (1)	

Aureka	Patent search (1)	1 (0.5)
MS Office	Intuitive (1) Know how to use (1)	1 (0.5)
Conference Websites	Easily find experts (1)	1 (0.5)
Compass	Landscaping products / formulas (1)	1 (0.5)
Baidu	Simple (1)	1 (0.5)
CSS	Specification location (1)	1 (0.5)
Not Applicable	N/A	20 (10.9)
		Total: 183

Fully Detailed - Qualitative Data Summary - Areas Liked in Inno360 and Why – Open Text Detailed

Area Liked	Reasons Why (Frequency - Times Mentioned)	Area Frequency (valid %)
Visualisation	Circle clusters – speaks more than list / new word ideas / filter results (12) Foam trees – dig into data (7) Visualisation of results (4) Graphical interface / visual display (4) Explorer visualisation (3) Mapping / clustering (2) Connection maps – unique (2) Various ways to view data (2) New adjacent ideas (1) Sharing with management (1) View results in different configurations (1) Cluster search results (1) Wheel - good (1) Efficient mapping tool (1) Easy to see and understand results (1)	39 (34.8)
Inno360 Website	Easy to use / user interface (4) Easy to access (3) Cool / modern (3) Use intranet password – simplified (2)	25 (22.3)

	Site layout / design (2)	
	Organisation by project (2)	
	Relatively intuitive layout (1)	
	Eye catchy (1)	
	Digital (1)	
	Powerful (1)	
	Anytime (1)	
	Architecture (1)	
	No subscription (1)	
	Streamlined (1)	
	Organisation structure (1)	
	Credible work source (1)	
	Lots of explanation within programme (1)	
The Concept	Federated / all in one search (5)	22 (19.6)
	One stop shop (4)	
	Search SLR / web / IP in one (1)	
	Search literature / web / intranet in one place (1)	
	Innovative (1)	
	Security (1)	
	Its potential (1)	
	One place to search P&G databases (1)	
	Holistic approach – polish thinking on innovation (1)	
	Good idea to have single tool - not better than others (1)	
	Potential to be great research tool (1)	
	Good first step if unfamiliar with area (1)	
	Intent is easy to search and navigate (1)	
Search Capability	Different searches / areas (4)	19 (17)
	Wide / broad search net (4)	
	Good / ultimate search engine (2)	
	Search basic technologies in other categories (1)	
	Smart ability – word proximity (1)	
	Ease of creating searches (1)	
	Category (1)	
	Breadth of scholarly work (1)	
	Find details others miss (1)	
	Internal search - useful for new area scoping (1)	
	Comprehensive (1)	
	Dedicated team project space (1)	
	Project management – several searches per project (1)	

Search Results	Excellent / relevant search results (3)	18 (16)
	Can analyse / narrow search results (3)	
	Easy to screen (1)	
	In-depth research (1)	
	Search with specific tool gives better results (1)	
	Quick lead return (1)	
	Can get to literature (1)	
	All the information (1)	
	Search report (1)	
	Never come up empty (1)	
	Decision analysis (1)	
	Articles available to download (1)	
	Quick and dirty output with simple keywords (1)	
	Interesting / different ways to find data (1)	
Search Sources	Many resources / databases at once (5)	18 (16)
	Search patents, articles, SLRs / research in one place – variety (3)	
	DeepWeb feature (2)	
	Number of databases (2)	
	Articles and patents – complete picture (1)	
	Claim (1)	
	Choose sources to search (1)	
	Searches internal P&G systems (1)	
	Internal search - useful for new area scoping (1)	
	Good databases for lit review (1)	
	Links research institutions and investigators (1)	
Collaboration	Share search with company people / team (2)	16 (14.3)
	Share articles with team - get notified (1)	
	Central stop for team (1)	
	Collaborative for SLR projects (1)	
	Collaboration tools (1)	
	Internal collaboration referencing (1)	
	Sharing results with partners (1)	
	Invite internal collaborators to view (1)	
	Ability to collaborate (1)	
	Cluster people to help (1)	
	Maintaining search criteria for team (1)	
Integrated Search	Many different internal and external databases (3)	14 (12.5)
	Internal coupled with external search (3)	

	External links (2) Integrates well (1) Brings all searches together (1) Appears to be integrated (1) Integrated SLR / Tech Report database (1)	
Search Storage	Stores search and articles (2) Read results later (1) Store paid journal papers (1) Everything can be stored in one place (1) Ease of selecting hits to save (1) Store searches for IP attorneys (1) Save progress in easily re-accessible way (1) Save and link internal and external reports (1) Records history (1) Store results (1)	12 (10.7)
Intellectual Property / Patents	IP landscape (3) Search IP / patents (3) Patent analysis (1) Find relevant IP (1) Good patent hits (1) Harder to find from other sources (1)	11 (9.8)
Making Connections / Contacts	Internal connections – very useful (2) Connect similar needs / knowledge globally (1) Recommended expert (1) Quickly find leaders in key areas (1) Connections between organisations (1)	7 (6.2)
None	N/A	6 (5.3)
Not Used	N/A	5 (4.4)
Not Applicable	N/A	15 (13.4)
		Total: 112

Fully Detailed - Qualitative Data Summary - Improvement Areas in Inno360 and Why - Open Text Detailed

Improvement Area	Reasons Why (Frequency - Times Mentioned)	Area Frequency (valid %)
Usability	Ease of use (11)	40 (35)
	More user-friendly interface (7)	
	Easier navigation – non-intuitive (4)	
	Make more Google-like (4)	
	Less complicated - workflow (2)	
	Complex search coding (2)	
	Start-up easier (1)	
	Navigation between project tabs not fluid (1)	
	Too many clicks for file – make one (1)	
	Make easier to separate project searches (1)	
	Many pages to go through to start (1)	
	Not all tools are obvious (1)	
	Difficult to use some analysis tools (1)	
	Copy in full text / images more easily (1)	
	Eliminate clutter (1)	
Search Results	Irrelevant / no results (6)	29 (25.4)
	More quickly filter results / promising lead (4)	
	Difficult to refine results (3)	
	Literature results poor (1)	
	Better organisation of results (1)	
	Not getting SLS results (1)	
	Time to learn and filter (1)	
	Repeat search results (1)	
	Limit number of results – hard to get down (1)	
	Add Boolean and semantic search (1)	
	Too broad – fail to get important info (1)	
	Means to access copyrighted content (1)	
	Find all products in P&G category (1)	
	More comprehensive covering area (1)	
	Need answers 10 – 30 seconds (1)	
	Ability to read SLRs without downloading – limit (1)	
	Ability to analyse and export search results (1)	
	More specific lit search results (1)	
	Web results need work (1)	

Training	Lack of training / awareness (5)	27 (23.6)
	Need to relearn if not used often (2)	
	Need to learn full capabilities (2)	
	Facilitate effective usage (2)	
	Unclear expectations – replace VL? (1)	
	In-person training needed (1)	
	Need simple training – people get messed up (1)	
	Give realistic promises – what is real value? (1)	
	Clearly state limitations (1)	
	Online training - get most out of tool (1)	
	More systematic training opportunities (1)	
	Without proper training, can't trust results (1)	
	Need help menu (1)	
	Need quick tutorial – no time to learn (1)	
	Guidelines on how to narrow results (1)	
	Not trained (1)	
	No time to self-train (1)	
	Easy-to-follow instructions (1)	
	Give case studies of success (1)	
	Need example-rich manual to get most out of it (1)	
	Not sure how to learn (1)	
	Training on effective search terms (1)	
Search Capability	Speed – slow to search (10)	27 (23.6)
	Improve quality of search engine (3)	
	Narrow / focused search (2)	
	Speed and search command (1)	
	Does not return many relevant results (1)	
	Non-intuitive search and project initiation (1)	
	Simplify search tools (1)	
	Execution poor (1)	
	Tools to help put together a search – non-Boolean (1)	
	Include structure search (1)	
	Default search is IP, want to customise (1)	
	Ability to alter defaults before search (1)	
	Need natural language processing search (1)	
	Landscape searches need to be done multiple times (1)	
	Need better search terms – IP search (1)	
	Too long – use in-depth only (1)	
Collaboration	Uncertainty over purpose of tool (2)	19 (16.6)

	No enough people use for it to be effective (2) More use of P&G team collaboration (2) More sharing – not many use it (2) Advertise it more (2) Few people in company aware of capability (1) Broader adoption – increase internal effectiveness (1) Find better ways for team collaboration (1) Want to use with external partners (1) Make other benefits clear beside search (1) Inability to choose what is shared with team (1) Ability to work as team and independently (1) Add collaborators more easily (1) No good example of collaboration tools (1) Patent import wizard / RSS / alert part of team space (1)	
Inno360 Website	Crashes lots / crashed IE (3) Clunkiness of system (2) Too big – no room on computer (1) Layout confusing – project submission (1) Focus on fewer tools – can't do everything (1) Have to use Google Chrome (1) Seems things go missing (1) Not windows friendly (1) Site speed (1) Site map (1) Rebuild system (1) Not familiar (1) Alert system (1) Other tools effective (1)	17 (14.9)
Intellectual Property / Patents	Launch patents in Orbit interface (1) IP search term choices (1) De-duplicate patent results (1) Add ability to export patents to Orbit (1) Viewing and comparing patent results (1) Irrelevant patent hits (1)	6 (5.2)
Visualisation	More refined clustering (2) Foam clusters appear helpful but don't trust data (1) Use visual tools on imported patent data from Orbit (1) Headings in foam trees / clusters not always helpful (1)	5 (4.3)
Learning to Use	Need time to explore (1)	4 (3.5)

	Need more experience (1)	
	Getting over hurdle to use (1)	
	Learning curve high (1)	
Search Sources	Connect to ScienceDirect (1)	4 (3.5)
	Databases miss key papers (1)	
	Better academic literature (1)	
	Lacks knowledge on my field (1)	
Access	Make easier to find (1)	3 (2.6)
	Difficulty accessing (1)	
	Asia could not access (1)	
Integrated Search	Download external documents from VL / Orbit (1)	2 (1.7)
	Better integration with external sources (1)	
Search Storage	Ability to save all results, not 10 at time (1)	2 (1.7)
	Add hyperlinks to project folders (1)	
None	N/A	9 (7.8)
Not Used	N/A	3 (2.6)
Not Applicable	N/A	9 (7.8)
		Total: 114

D Qualitative Data Analysis

A) Confirming Search & Select Practices		
A.1 Defining the Need		
How do you define / redefine the need statement?	**How effective are need statements?**	**Do need statements require rework? If so, why?**
Ad-hoc, keywords, Google, refining search, hit relevancy, filter results, iterative search, Google, needs brief, external input, keywords, partner core competencies, technology enablers.	*Unknown solution, iteration, google, search functionality, keyword search techniques.*	*False positives, overlapping skills / interests, collect info, correct partner, refining from broad search.*
Consumer benefit, technical problem, business requirements, reducing costs, technical problem, keywords, customer, lack of problem focus, technical problem, improve focus on problem.	*Problem symptom vs root cause, broad results, unexpected solutions, terminology.*	*Real consumer need, broad vs specific balance, business defining need.*
Competitor, group / specific competitors, product category, upfront agreement, senior management agreement, business question definition, competitor success, broad question, landscaping, project name, project objectives, terminology.	*Upfront agreement, understanding question.*	*Hypothesis-driven, changing questions, unknown solution, landscaping, observations, testing, stable overarching question, search adjustment.*
Business defining need, need owner type, product vs technology, needs brief, need definition, search criteria, need templates, need information, confidentiality, internal / external sharing, language, company acronyms.	*N/A*	*Confidentiality, iteration, essence of search, right words, protecting info, attract innovation, give parts of story away, terminology.*
Listen to customer, explore, external partners, need description, programme type, need definition, need description, look external first, internal networks, challenge not solved – external, leverage surrounding networks.	*Team brief definition.*	*Learning process, defining need brief, search solutions, find project components.*
Research interview with customer, breakdown question, clarity, information type, question type.	*Background / experience, understand business need, regular projects, need definition.*	*Lack of problem focus, define need, iteration, employees unused to mental process, role type – exposure to info / data.*
Innovation service provider, need brief, brief limitation (not technology), define problem, consumer need, overcoming problem, new approach, consumer benefit, simple need brief, real consumer need, idea trigger.	*Achievement focus, specific solution, different route.*	*Customer need, openness, tendency for narrow need briefs.*

A) Confirming Search & Select Practices		
A.2 Search & Select Practices		
How do you search and select external capabilities?	**Do you use formal or informal methods?**	**Why do you use these formal / informal methods?**
LinkedIn, Search method, finding people, descriptive, affiliation, personal networks, industry, institutional network, LinkedIn, Google, Inno360, analysing core capabilities, website, publications, equipment, clients, partner follow-up.	90% informal methods	Inno360, not full use of tool capabilities, informal tool, visibility internally & externally, lack of awareness of formal process, lack of training, newness to role, Informal due to lack of knowing formal process.
Inno360, Google Scholar, technical search, search habit, consulting role, connecting people to info / resources, keywords, Broad search, 2-3 keywords, Scopus, databases, professors, filter via citation, find source documents, most cited, peer-reviewed literature, solve problem, research institute connection, evaluating connection.	Informal methods, patent searches.	Urgency, meaningful connection, Multiple customers, solving problems, Inno360, Google Scholar, quick interaction (hour or less), right content, pedigreed content, iterative search, looping, in-depth look, consultant, connecting information, tactical vs strategic, time consideration.
Type of data needed, answering question, effectiveness of different sources at meeting need, source accessibility, efficiency of search.	Uncertainty over definition, formal tools, gather opinion vs data, search data as formal, Missions, Answer unknown, getting data, brainstorming with client, tacit knowledge, role specific – (comparative intelligence), data to aid decision-making.	Objective data, organisation of data, data-driven, Inno360, databases, tacit knowledge, too broad not helpful, informal methods (calling, e-mails), connecting rather than searching, competitor analysis, Unilever competitor, legal conditions, brainstorming, different to C+D.
Use existing capabilities, existing partners, databases, internet search, IP databases, Google, GNPD, FDA website, Health websites, product registration info, Sector specific databases - Medicines Complete.	Type of relationship affects formality (established = informal, new = formal) Discussion of new things with existing partner, Find contact with connection to company, Personal network, Mixture between formal and informal, dependant on company and relationship.	Existing relationship impact formality, asking questions, openness, innovation, ease, confidentiality agreements, open communication, limit to detail, gain comfort with company, collaboration, empathy to partner time, awareness, personal relationships, phone calls, e-mail for practical reasons.
Dependant on type of need, technical need vs knowledge of space, different search for different need, write need brief, assess capability, internet search, find right partners, informal meetings, build knowledge, ideation process, divergent search, Look at options and filter to one, divergence, needs: timing / funding, 2-3 month time limit, business need, deliver initiative, Type of solution, cost, Uncertainty of search, student projects, learning, Time, money, resources, people involvement motivation, infrastructure, equipment.	Combination, don't talk to competition, meet like-minded companies.	Latest information, feel what's going on, informal talks, put general info into perspective, Partners, search dependant, combining search and info, find direction, official reports, project team involvement, project understanding, understanding field, address need difficult, language, background, type of question, difficult nuances, NineSigma, Customer feedback / happiness.
Question dependent, information needed, own experience, training, key social info, mixture of needs and experience, books, theses, educate self, Wikipedia, patent searching, scientific, business searching, databases, direct to right sources, NTF, Castel, patent search, combination of sources.	Mixture, experience, training, more informal, Social space, operating procedures, Mix between science and art, can't define step-by-step.	Address question, different approach for question, Continuous learning, rules, suppliers, creating new products, outside world first.
Internal business development organisation, needs brief, external networks, finding solution, Innovation Service Provider, strategic partners, universities, country specific, global partners.	Uncertainty over definition, Mixture, need dependent, Innovation Service Providers, cost dependent, lack of money, smart use of funds, cost efficient.	Clients, need for external partner.

A) Confirming Search & Select Practices		
A.3 Tool integration		
What tools / practices do you use to fulfill the need statement?	**Why do you use these tools / practices?**	**How do you use these tools / practices?**
Inno360, internet, Excel, Word, Powerpoint	*Personally trained on inno360, background: consulting & programming, interface for computer tools, understand structure/strings, ScienceDirect, SciFinder – no single tool is perfect, business intelligence tools not all experts, ... discipline personal network*	*Inno360 internal searches, content inadequate other sources, gives overview, visualisation loved, look for info & people, help on needs brief, look external before internal, websites, patents, other data sources, not leveraged internal network, world expert, external link- due to credit, reward & recognition, social behaviour, sharing searches, low inno360 adoption, sharing doesn't drive others, support, conducting right work, opportunity to use more with external collaborators, reach research teams, use GoogleDocs*
Inno360, Google Scholar, Scopus	*Inno360 used first (7/8 out of 10 times), connect to internal library for literature and real article, one-stop shop, sell tool to colleagues, Google Scholar-get different take on it, ad-hoc methods-public tools, follow-up scientific websites*	*Inno360 – interaction with customers, Scopus-send direct hit link & e-mail, graphical tabulation helpful, landscape, sense of robustness, unknown internal work, find unexpected sources of info, citation tree, seeing backbone of hits, bucketing data, via year, tactical expert work*
Inno360, GNPD, EuroMonitor, trademark database - VantagePoint, Excel	*Downloading databases, mining data, structured, uniform fields, methods for extracting data, formatted consistently, search across timescales, search via characteristics, internet webpages not structured, making sense of different formats, inno360 groups and organises (folders)*	*Inno360 - gather info, long structured way, Questel Orbit - Patent search system, browser kept open, patent search access, powerful tool, GNPD - download all competitor products in past ten years, ease of access, EuroMonitor - financial data, VantagePoint & Excel-text-mining*
Google, WIPO, FDA website, health websites - Medicines Complete, reach out to other businesses, similar technologies, need dependent, C+D networks	*Always look externally first-given needs that can't do internally, internal to find external contacts only, lack of capability, not investing in capability internally*	*First search paper exercise, different criteria, filter landscape (15 to 2/3), work with project team, team establishes criteria, specific technology / product attributes, country specific, building portfolio, finding companies, product information, on-market products more info, geographies, assessing landscape, choose most attractive, align companies with problems – increases risk*
Contacts of students, consultants, informal networks, technical solutions / directions, industry specific, NineSigma, Google, Create, consortium, search engines, [illegible], Google used in parallel with inno360	*Need dependent, different approaches, always networks – virtual & physical, finding knowledge, combining people in field, knowing the network-not individuals, knowing limited people, interest and importance, timing, different networks, search efficiency*	*See previous answer*
STN, MedLine, PaperChem, [illegible], peer-reviewed sources, encyclopaedias, manuals, virtual library, Orbit	*STN-check & access databases, non specific ie chemistry patent index, interrogate hundreds of databases, role specific sources into specialist (STN & Orbit), peer-reviewed sources-gain basic understanding, personal education, decision affects resources, Orbit-product lines*	*Keyword & classification indexes, sector specific databases, market structured, keyword search one method*
Old-style searching, country specific key institutes & companies, global contacts	*See previous question*	*See previous question*

A) Confirming Search & Select Practices		
A.4 Measuring Success		
What activities / factors help your search and select practices?	**Why do these activities / factors help your search and select practices?**	**How do these activities / factors help your search and select practices?**
LinkedIn, Organisational clusters, personal networks, Google, Bing, Yahoo.	*(talks about Inno360 specifically – see Inno360 answers)*	*Keyword searches, background, creative with Google, precise searches.*
Scopus – recommended papers, anticipation of relevant results, associated info.	*Finding info, tricks to vet info, true relevance to need, sharing with others, simple & meaningful way.*	*Share graphics, e-mail, screenshots, tree structure, help people connect, relevance, helpful sharing.*
Defining business question, right search strings, search criteria, good results, curating results, organise results, build knowledge base, retrieve info.	*N/A*	*N/A*
	Finding a lot of capability in one place, finding information.	*N/A*
Bottom-up and top-down decisions, customers, senior management, engagement.	*Drive behaviour.*	*Drive behaviour.*
Objectives, time.	*Legal implications depend on type of info, decision taken with info, judgement, need dependent, no infinite budget, combining different elements, search time weeks to hours, evaluation, rough versus detailed, no one size fits all, creativity of the decision, personal network, consult with colleagues, field new, lack of expertise, consult with teams, R&D rely on connection more than info specialists, fastest way to get info, specialist scientific databases.*	*N/A*
Talking to others about need, deep understanding of the need, time for insights, trigger different approaches, go for the unexpected, look at different industries, Name of a big company – time to listen.	*Innovation by analogy, transfer technology to different domain, well known method.*	*N/A*

B) Validating Inno360 Survey Outcomes		
B.1 Tool Usage		
Do you typically use Inno360 in your search and select activities?	If yes, how and why do you use Inno360?	If not, why do you not use Inno360?
Yes	*Keyword searches, search by sentence / need, tool selected results not adequate by keyword search, use landscape tab, play with search-string, repeat different times, break words if results not relevant, jump off first page, between 3 – 500 hits, Google – changed social behaviour, don't mind reading pages and pages, afraid of throwing out good data, lack of trust of search engine, human judgement, storing and saving data could be improved, filtering and playing with data, individually check articles save and classify –tedious*	N/A
Yes	*Landscaping, visualisation, internal library, save things in folders, sharing folders often, drives collaboration, others aren't aware of Inno360, access via click, share relevant hits, ad-hoc training, showing techniques, consulting on tool, lack of awareness of tool, impressed by first exposure, gives info to solve problem – not clear, user background – not ingrained habit to see who solved problem before, mostly start searches from scratch, takes methodological approach – scares people, Man – Fri habits of practice, use weekly to keep current*	N/A
Yes	*Best thing we (P&G) has right now for searching what's available, better than Google or YellowPad, has different databases, hidden web, easy to access now, capture project information, restarting projects useful, projects can run for 20 years, 99% of the time people start from scratch, someone to pick up project, access to team folders, Slow for people to change, younger people more adept at taking new systems, new requires a leader, don't see value in work that does not contribute to themselves directly, deep-dive searching, competitor understanding in category, tracking competitors, RSS feeds built in, collaboration – commenting , track C+D fields, import patent data, analysis tools, IPExplorer visuals*	N/A
No	N/A	*Difficulty exporting data not in others, familiar with other databases, main problem in analysis, good for folks not 100% dedicated to C+D, C+D proficient people analysis hiccups was issue, lot of duplication – manual sort, not worth the time, a lot of other tools to use, not reliant on Inno360*
No	N/A	*Targeted for needs with less hits, results that are accessible, directed to needs, refine search string Faster targeted results in Google, most useful is patent search – but other engines give similar results, background patents not relevant (market not inventional), web crawling Google results better, reference tool, Illumin8 easy to use, stick to brief, machine interprets brief giving results, user makes choices, tool searched irrelevant part of brief, human interpretation of results*
No	N/A	*Tool for collaboration - doesn't help in searching phase, experience, access to different tools, info professional background*
No	N/A	*Bad past experiences, colleagues said it doesn't work, talking on phone is more exciting, triggers many things, very efficient method, Inno360 read through thousands papers, more successful to handshake, get a feel for how they can contribute, if open enough give other leads, reputation, potential collaboration opportunities, fast, more fun (personal method), don't like to screen computer, like personal interaction, peer reaction – nightmare, can't partner immediately via screen, listening bring me back to pilot, recommendations from trusted peers, true story of Inno360, high rank people have high interest in tool, idea of it works great but doubts, extending knowledge by talking to others, believe in personal conversations (engagement)*

B) Validating Inno360 Survey Outcomes		
B.2 Managing Complexity		
Does Inno360 help you manage complexity?	If yes, how and why does Inno360 help with complexity?	If not, what tools / methods do you use to manage complexity? How and why?
Potential; okay with complexity.	*Organising searches and tabs, save themes, 'internal – external – patent – human network', aspired to help, not appreciated, do multiple tasks, clustering helps – make more automatic.*	*Potential, Excel, MS project, OneNote, manual tools, not more intelligent than Inno360*
Use 10% of features of search tools.	*Use small fraction of features to meet needs, don't use all or in expert way.*	*Microsoft Excel – don't use all features, Google Scholar – tactical engagements, few techniques, listening, learn tricks from experts – tactical quick ways.*
Think it does.	*Data sources can be accessed from one tool, results are stored, ease of finding, know what I've done, internal sources of data, challenging business environment, things get postponed, new Sharepoint system, connections change in Inno360 [P&G], extra work fixing, maintenance of internal connections, data needs to be accessible, make easier to share with people, improve effectiveness, reduced number of clicks to reach data / give permission reduces complexity.*	*N/A*
Use other tools.	*N/A*	*No database is perfect – use multiple for same task, cross-checking data, databases organise and analyse data, capture data, familiar with other tool, quicker.*
No.	*N/A*	*About work, use combination of networks better, local network - one touchpoint, reduces complexity - only one interface, digital methods – however and whenever contact, both sides convenience, digital contact first.*
Beginning process not the tools.	*N/A*	*Question complexity, handle through interview and setup at beginning, huge volume of data handled through tools, categorisation & visualisation, visual elements good, professional tools require training and regular use, otherwise start from scratch – impractical, dependent on need and objective, landscape on topic, if need intermediary - won't help, defining the question better, specific then enlarge, search of info.*
No – use personal interaction…	*N/A*	*Easiest way [personal interaction], choosing because less complex to get to right partner.*

B) Validating Inno360 Survey Outcomes	
B.3 Barriers / Challenges	
What barriers / challenges do you face when using Inno360?	**How do you address these barriers / challenges?**
Response time – slow, wait for feedback, complexity of interface	*Search update progress bar needed, give results as coming in, Google – instant, simple interface for basic users, intuitiveness is subjective – background, seen as tedious, simple Google search bar, reduce barrier to conduct search – help adoption, internal server host – not external, trust issues with external websites – IP*
Time constraints (pace and time domain of work), potential frustration with access - not Chrome / Firefox, irregular use – twice month vs every few months, forget tool is helpful, making time to use it, conduct specific techniques, use during lunch break 30mins max, not overly intuitive, landscape terminology not everyone knows it, role of training – if cold, chat bubble feature, challenge underlying assumptions (training), interrupt-driven work, cultural barriers	*Block of time dedicated to using tool, counsel others – specific training, quick routes, how to identify keywords, use needs analysis and directly landscape, cultural barriers – worthwhile to take time to search for info?, engrained search mindset – what is mentally broadly in organisation?, identify thought-leaders (int & ext), check assumptions (training), represent benefits compelling way for immediate leverage, more purposeful about specific benefits – drive traction*
Areas improving but was extremely slow (20-30 secs), slow compared to Google, now quicker, search results could be more relevant, look across results rather than down, allows jumping, don't provide breakouts of data, duplicate patent results – miss key papers, 'is it worth it' debate, RSS feed, patent and faster search results, relevancy could be improved still. Algorithms behind search, ways to look across data (top 250 results)	*N/A (said barriers are improving)*
Early barrier – focus the business need, so much info – overwhelming, start broad and quickly narrow, landscape 10-20 companies vs 703 - filtering no. of companies, need changing whilst in search process – happens frequently	*N/A (need focus and definition, filtering number of companies)*
Initial search – contact people – follow-up is real work, work sufficient to size of project (small vs big), time spent searching for small improvement, IP questions, search criteria	*Being clear and upfront on needs, IP and confidentiality met*
R&D can get impatient – aptitude, training, unsure refer to manual or people to solve, mental question – back to question and review objective, different strategy to get info	*N/A*
Reputation of contacts – uncertainty, high rank mean nicer person, academia vs industry, missing opportunities in discussion, internet research prior, evaluate which to go to first, professors can start work before contract, don't create disappointments in people (reputation level), future contacts, use intermediary who deal with universities a lot is better, companies know contracts, academia is difficult	*Use personal network and contacts, intermediary done internet research, start with conversation, trusted others, talking, using expert organisations*

B) Validating Inno360 Survey Outcomes
B.4 R&D Value
What are the most important factors for building a landscape?
Collect all of the information, Excel spread sheets – filtering, organising data, finding connections, get data right, pivot tables, JMP (advanced Excel).
Relevance to topic, vet via citation, identify thought-leaders, find defendable commentary, look for unexpected in other areas, balance, pockets of unexpected drive analogies, look outside of domain, perceived importance of info, broad and unexpected, why similar words in other areas?
Understand question correctly, defining the question correctly and define criteria, what kind of info needed, how will you know it is answered?, conduct search, meet characteristics, find relevant results and curate into folders, capture your progress (MSWord / Inno360) to store.
Provide project team with as much technical info as possible, do right evaluation, multi-functional, spanning areas, relevant to needs, R&D functions, good judgments, not right info leads to continuous uncertainty.
Know the need very well, close to customer as possible to address it.
What to achieve, kind of decisions, understand if call for new project / product, proper proposition, depends on objectives, work in same area – become expert, different role [C+D] to researchers, time.
Find organisation within relevant area, reach out, use industry associations, contact verbally, identify whitespots, build your network, use ISP if got rss, go to fares for booklets, find most important companies, global partners, meeting potentials, easier to contact after, screen companies via internet, suppliers, trusted partners, don't do everything on your own, select differently, internet screening not enough.

E List of Publications

Brun, A., Bolton, S., and Chinneck, C., (2013), Benefits of aligning design and supply chain management, *International Journal of Engineering, Science and Technology*, 5(2): 49-64.

Bolton, S., and Chinneck, C., (2013), ‘Power of ideas in shaping and delivering design business success’, Paper presented at: *International Design Management Symposium*, Tsinghua University, Shenzhen, 1-2 December.

Cadena, A., Bolton, S., Chinneck, C., and Kim, S., (2013), ‘The impact of market research stimulus data on idea quality in radical innovation projects’, Paper presented at: *20th International Product Development Management Conference* (IPDMC), Paris Dauphine University, Paris, 23-25 June.

Chinneck, C., and Bolton, S., (2013), ‘Idea management: the importance of ideas to design business success’, Paper presented at: *4th International Conference on Research into Design* (ICoRD’13), Indian Institute of Technology Madras, Chennai, 7-9 January, Lecture notes in mechanical engineering, Springer India, 845-857.