THE EFFECTIVENESS, ADOPTION AND APPLICATION OF NEW SERVICE DEVELOPMENT (NSD) TOOLS AND TECHNIQUES

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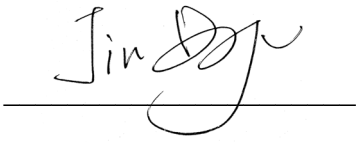
Declaration

I hereby declare that the thesis is my original work and it has been written by me in its entirely.

I have duly acknowledged all the sources of information which have been used in the thesis.

This thesis has also not been submitted for any degree in any university previously.



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Acknowledgement

Four years ago, when I boarded the plane destined for Singapore, I was uncertain about the journey that lay ahead of me. However, after four years' study in NUS, I shall say that the experience is the one I will never forget. I have not only learned the essentials of academic research, and more importantly, I have also developed the soft skills which will benefit me for the rest of my life. Here, I would like to express my gratitude to the following people who have provided me with unfailing love, support, and encouragement.

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Summary

A variety of new service development (NSD) tools have been used by service firms to develop new services. They facilitate development efforts in a number of ways, such as identifying customer needs and prototyping service offerings. However, NSD tools have received few attentions from academics and existent NSD tool studies are rather scattered. The lack of knowledge of NSD tools may hinder their diffusions in service firms, leading to ineffective applications. Therefore, the main focus of this thesis is to study tool-related issues so as to foster a better understanding of NSD tools.

The thesis has three objectives. The first objective is to investigate the usage pattern and the effectiveness of NSD tools (Study 2). Based on an integrative marketing and operations perspective, we have proposed a framework which illustrates the relationships between tool usage and NSD performance. The findings suggest that market tools are widely used among service firms and their usage improves operational performance, which in turn has a significant impact on product performance. However, development tools are underutilized and their influence on NSD performance has not been observed. Our study is the first to provide empirical evidence on how service firms use NSD tools and whether their use contributes to NSD success. This strengthens the understanding of NSD tools and helps firms decide when to use which tools.

The second objective is to identify the key factors that affect the adoption of NSD tools (Study 3). By integrating the Theory of Planned Behavior and the literature on organizational adoption of innovation, we have devised a theory-driven framework which clarifies important antecedents of the adoption intention of NSD tools. The results show that attitude, subjective norm, and perceived behavior control are significantly related to tool adoption intention. Perceived usefulness and perceived

ease of use are antecedents of attitude. Competitive pressure influences subjective norm. Perceived behavior control is determined by compatibility and resource commitment. This study has identified factors worth noticing when researchers and practitioners develop and implement NSD tools.

The third objective is to design a new tool that helps analyze and improve the NSD process (Study 4). By referring to the maturity model concept and findings from NSD success factor studies, we have developed the NSD Maturity Model, which assists companies in managing crucial NSD processes. Our study concludes that most NSD success factors can be categorized into four process areas: strategy management, process formalization, knowledge management, and customer involvement. Maturity dimensions and levels are further devised for each of these process areas. It is hypothesized that a higher capability to handle these process areas positively associates with higher NSD performance. Service firms can use the proposed model as a diagnostic tool to assess the current status of the development process, and they can also apply it as a guideline for continuous process improvement.

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List of Acronyms

AVE	Average Variance Extracted
CFA	Confirmatory Factorial Analysis
CMV	Common Method Variance
FMEA	Failure Modes and Effects Analysis
GoF	Goodness-of-Fit
KMMM	Knowledge Management Maturity Models
MDS	Multidimensional Scaling
MIMIC	Multiple Indicators and Multiple Causes
MTMM	Multi-Trait Multi-Method
NPD	New Product Development
NSD	New Service Development
NSDMM	NSD Maturity Model
PLS	Partial Least Squares
QFD	Quality Function Deployment
SADT	Structured Analysis and Design Technique
SEI	Software Engineering Institute
SEM	Structural Equation Modeling
TPB	Theory of Planned Behavior
ULMC	Unmeasured Latent Method Factor

Chapter 1

Introduction

1.1. Background

New service development (NSD) can be defined as the overall process of developing new service offerings, which spans various stages, from idea generation to launch (Edvardsson *et al.*, 2000; Johnson *et al.*, 2000). One practical example of NSD is the design of *Courtyard by Marriott* service by Marriott (Wind *et al*., 1989). In the early 1980s, Marriott felt that the lack of good sites had limited the development of typical Marriott Hotels, which target at the high-end market. Therefore, the company wanted to explore the lower-end market, and two a priori segments were identified: business travelers and pleasure travelers. In order to design new hotel services that cater to these two types of consumers, Marriott conducted a large-scale NSD project which underwent several stages—selecting target market segments, positioning services, and designing an improved facility in terms of physical layout and services. As a result, it decided to provide new hotel services with unique features such as guest rooms with large, well-lit work desks and ergonomic chairs, on-site business services, and invigorating fitness room. The *Courtyard by Marriott* chain has been a success, growing from three test hotels in 1983 to over 900 hotels in 37 countries nowadays.

With deregulation and globalization of service industry and advancement in technology, competitions among service firms are becoming harsh. This has placed NSD at the heart of a service firm's competitiveness (Stevens and Dimitriadis, 2005; Bitner and Brown, 2008; Fitzsimmons and Fitzsimmons, 2008). NSD provides service firms with numerous benefits such as enhancing the profitability of existing services, attracting new customers to the firm, and opening a market of opportunity (Storey and

Easingwood, 1999). However, developing new services successfully is not an easy task because it involves complex adaptive combinations of various key elements such as people, technology, and process (Ostrom *et al.*, 2010). Besides, the distinctive nature of services stresses the necessity to re-examine the applicability of traditional development practices for tangible products (Drejer, 2004; Nijssen *et al.*, 2006).

To tackle these challenges, a number of tools and techniques from various origins have been gradually adopted by service firms to develop new services (Edvardsson *et al*., 2012; Miles, 2012). By referring to Brady *et al.*'s (1997) definition of management tool, a NSD tool is defined as a precisely described framework, procedure, system, or method for supporting and improving the NSD process. It is argued that tools play enabling roles in the innovation process (Chiesa *et al.*, 1996; Adams *et al.*, 2006). They help firms manage complex innovation projects and adapt them to the changing environment (D'Alvano and Hidalgo, 2012). Specifically, tools facilitate development activities in a variety of ways such as identifying customer needs (Alam, 2002), trouble-shooting causes of potential problems (Dorsch *et al.*, 1997), reducing uncertainty (Ahn and Skudlark, 2002), prototyping services before implementation (Shostack, 1984), and service positioning and planning (Smith *et al.*, 2007). In this day and age when customer needs are changing rapidly and service offerings are getting more complex, the utilization of tools forms an indispensable part of NSD efforts in many companies. The Software Engineering Institute (SEI) concluded that tools/equipment, together with people and procedures/methods, are three critical dimensions that service firms typically focus on when developing quality services (Paulk *et al.*, 1995; SEI, 2010). However, in spite of their practical importance, NSD tools have received few attentions from academics and existent NSD tool studies are rather scattered. For example, this thesis comprises a comprehensive literature

review on NSD (refer to Study 1), and the results show that people and procedure related topics (e.g., *NSD Process* and *Employee Management*) have emerged to be key research themes while NSD tool has yet to become a prominent topic in NSD. The lack of knowledge of NSD tools may hinder their diffusion in service firms, leading to ineffective applications. Therefore, the primary goal of this thesis is to study tool related issues so as to foster a better understanding of NSD tools.

Existent NSD tool studies generally adopt two approaches: assimilation and demarcation. The assimilation approach stresses that the concepts developed in the product context can be readily applied to services (Coombs and Miles, 2000). Due to the proven link between the use of new product development (NPD) tools and increased NPD performance (Nijssen and Lieshout, 1995; Barczak *et al.*, 2009), NSD scholars have applied classic NPD tools in the service context, such as benchmarking (Koller and Salzberger, 2009), scenario planning (Moyer, 1996), focus group (Alam, 2002), brainstorming (Zeithaml *et al.*, 2003), concept testing (Page and Rosenbaum, 1992), quality function deployment (Tan and Pawitra, 2001), and structured analysis and design technique (Congram and Epelman, 1995). The demarcation approach, on the other hand, emphasizes that NSD has its distinctive features, so the development process should be specially designed rather than being directly adapted from NPD (Coombs and Miles, 2000). Service characteristics such as intangibility and intense interaction with customers render some classic NPD tools unable to meet the unique requirements of NSD (Bitran and Pedrosa, 1998; Fähnrich and Meiren, 2007). As a result, an increasing number of service-specific tools have been proposed in recent years. Some examples include service blueprinting (Shostack, 1984; Bitner *et al.*, 2008) and SERVQUAL (Parasuraman *et al.*, 1988).

1.2. Objectives of the Thesis

The main focus of this thesis is on NSD tools. The thesis has three objectives. The first objective is to investigate the usage pattern and the effectiveness of NSD tools (refer to Study 2). These two aspects are among the most important issues of concern about facilitating tools (e.g., Mahajan and Wind, 1992; Nijssen and Lieshout, 1995). First, as for the usage pattern, we are interested in what the commonly used NSD tools are and how they are implemented in service firms. Despite the proliferation of NSD tools, few studies have taken a holistic view of NSD tools and provided empirical evidence on their applications in firms. Our study responds to the repeated calls urging for more research to be conducted to foster a solid understanding of NSD tools (e.g., Johnston, 1999; Menor *et al.*, 2002). Second, the purpose of examining effectiveness is to reconcile some of the discrepancies related to the influence of NSD tools. The efficacy of NSD tools is mainly demonstrated by case study research (e.g., Wind *et al.*, 1989; Thomke, 2003; Bitner *et al.*, 2008), and this limits the representativeness and generalizability of the results. Although some efforts have been made to evaluate the impact of NSD tools through large scale survey, the investigations are confined to information and communication techniques and the results show a weak effect (e.g., Hull, 2004b). Overall, our study provides valuable insights into the usefulness of NSD tools and the associated practices. This could enhance the understanding of NSD tools and help service firms choose the appropriate ones for certain activities.

The second objective is to identify key factors that affect the adoption of NSD tools (refer to Study 3). Study 2 reveals that the adoption rate of NSD tools is not high, especially for design-focused tools. This result is consistent with findings of other studies showing that service firms utilize a limited number of tools (e.g., Damanpour and Gopalakrishnan, 2001; Barczak *et al.*, 2009). No matter how good they have

claimed to be, NSD tools will be of no use if they are not ultimately adopted. Thus, there is a need to investigate the antecedents of NSD tool adoption. Although some studies have inspected the issue of tool adoption (e.g., Nijssen and Frambach, 2000; Chai and Xin, 2006), their findings are not applicable to NSD tools because the units of analysis are mainly NPD tools. Besides, these studies are not built on sound theories, and this might leave out some important factors. Based on the Theory of Planned Behavior (TPB) and organizational adoption of innovation literature, our study takes a systematic approach to addressing this research void. It further enhances our understanding of NSD tools in that it points out key factors that need to be considered for successful design and implementation of NSD tools.

The third objective is to design a new NSD tool—NSD Maturity Model (NSDMM)—that helps analyze and improve the NSD process (refer to Study 4). The NSD process is an indispensable part of a NSD project and the quality of its execution casts a significant influence on NSD success (de Brentani, 1995; Edgett, 1996; Froehle *et al.*, 2000). It is thus important for firms to utilize process assessment tools as they provide firms with a systematic measurement system and support process improvement plans (Crawford, 2002; Panizzolo *et al.*, 2010). However, based on the review of NSD tools from the early studies of this thesis, we notice that there is a shortage of process assessment tools which are designed for NSD. Although research on process assessment tools is on the rise, most tools are not applicable to NSD because they have deep roots in NPD and have not incorporated service-specific characteristics (e.g., Paulk *et al.*, 1995; Kettinger *et al.*, 1997). Our study tackles this research gap by integrating the concept of maturity model and findings from NSD success factor studies. The proposed model can be used not only as a diagnostic tool to

assess current NSD process but also as a guideline for continuous process improvement.

1.3. Developments and Outline of the Thesis

This thesis consists of 6 chapters, and the outline is depicted in Figure 1.1. Chapter 1 provides an overview of the background and motivation. The lack of research on NSD tools prompts us to focus on tool-related topics. The research gaps and objectives are also highlighted for the main studies of this thesis.

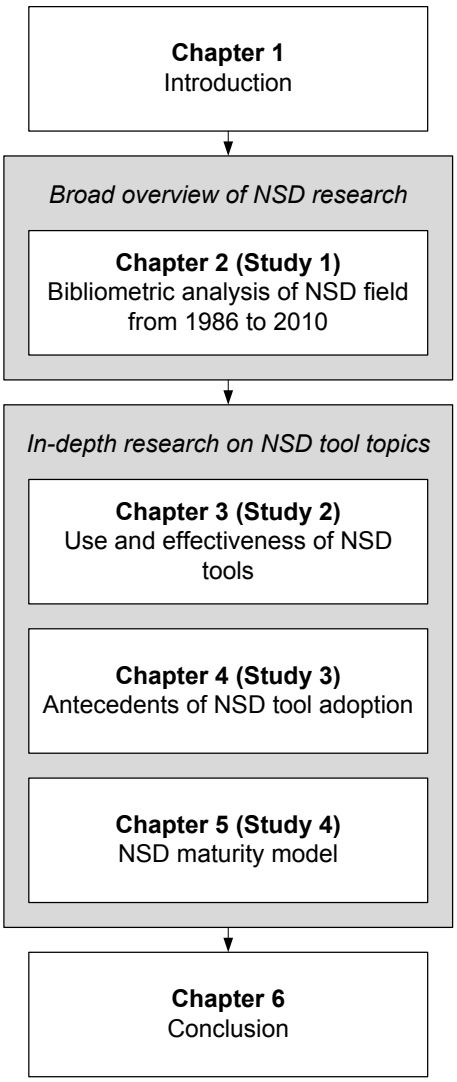


Figure 1.1 Outline of the Thesis

Chapter 2 presents Study 1. It provides a quantitative review of the field of NSD. Bibliometric analysis techniques are used to analyze 187 NSD articles published between 1986 and 2010: (1) citation analysis shows that the number of citations to NSD works and the variety of citing journals have both increased dramatically over the years, indicating the growing influence of NSD research on a wider range of audiences; (2) bibliographic coupling analysis identifies several key NSD research themes. The gaps between separated themes in a two-dimensional map suggest future research opportunities; and (3) co-citation analysis unveils the intellectual structure of NSD research. Its evolution pattern indicates that NSD has reached the mature stage and is on its way to evolving into a distinct discipline in its own right. This study complements the existent qualitative NSD reviews in that it provides an objective and unbiased overview of the discipline. Those who are interested in NSD will gain a deeper understanding of the current status of NSD research and its future research opportunities. Also, the study plays an important role in the development of this thesis because the general knowledge of NSD field helps identify research gaps and supplement key inputs for subsequent in-depth research on NSD tools.

Chapter 3 presents Study 2. It investigates the usage pattern of NSD tools and their influences on NSD performance. A model is proposed to illustrate the relationships between tool usage and NSD performance. By adopting an integrative marketing and operations perspective, we suggest that NSD tools can be categorized into market tools and development tools, and NSD performance should be measured by distinguishing product performance from operational performance. To test the conceptual model, the survey method is used to collect empirical data from financial institutions in Singapore and Taiwan. The findings indicate that market tools are widely used and their usage improves operational performance, which in turn has a

significant impact on product performance. However, development tools are underutilized and their influence on NSD performance has not been observed. The study provides first-hand information about how service firms use NSD tools. This would strengthen our understanding of NSD tools and help firms decide when to use which tools.

Chapter 4 presents Study 3. Our previous study shows that the adoption rate of NSD tools is not high, so this study aims to identify the key factors that influence the adoption of NSD tools. By integrating TPB and the literature on organizational adoption of innovation, a framework is developed and then tested by the empirical data collected from financial institutions in Singapore and Taiwan. The results show that attitude, subjective norm, and perceived behavior control are significantly related to tool adoption intention. Perceived usefulness and perceived ease of use are antecedents of attitude. Competitive pressure influences subjective norm. Perceived behavior control is determined by compatibility and resource commitment. Our study has identified factors worth noticing when researchers and practitioners develop and implement NSD tools. The results demonstrate the appropriateness of the extension of TPB to predict organizational adoption behavior.

Chapter 5 presents Study 4. From the early studies of this thesis, we notice that there is a lack of tools which are specifically designed for NSD. Therefore, this study devises a tool to facilitate the managerial processes and organizational mechanisms through which NSD is performed. NSDMM is theoretically developed by integrating the maturity model concept and findings from NSD success factor studies. The study concludes that most NSD success factors can be categorized into four process areas: strategy management, process formalization, knowledge management, and customer involvement. Maturity dimensions and levels are further devised for each of the

process areas. It is hypothesized that a higher capability to handle these process areas positively associates with higher NSD performance. The proposed tool can be used as a diagnostic model to assess current development process. Also, service firms can apply it as a guideline for continuous process improvement.

Chapter 6 integrates the four studies and highlights the main theoretical contributions, practical implications, and limitations of this thesis. The chapter ends with suggestions for future research.

Chapter 2

New Service Development: Research Themes, Intellectual Structure, and Future Research Opportunities [1]

2.1. Introduction

Due to the ever increasing competition brought by technology advancement and deregulation in the service industry, new service development (NSD) has become imperative to the success of service firms (Edvardsson *et al.*, 2000). NSD offers companies a number of important benefits which include attracting new customers, enhancing the profitability of existing products, and opening a market of opportunity (Storey and Easingwood, 1999; Fitzsimmons and Fitzsimmons, 2008). However, the development of new services is not an easy task because it involves complex adaptive combinations of various key elements such as people, technology, and processes (Ostrom *et al.*, 2010). Furthermore, the distinctive nature of services stresses the necessity to re-examine the applicability of well-established practices which have proven to be suitable to tangible products (Hollenstein, 2003; Drejer, 2004; Nijssen *et al.*, 2006). These challenges have raised many research questions that require careful investigation. As a result, NSD is regarded as one of the research priorities for the science of service (Ostrom *et al.*, 2010).

Since the 1980s, NSD has attracted increasing attentions from academia and a number of relevant studies have been published (Miles, 2005). With the growing body of NSD research, efforts have been made to conduct reviews of the developments in the field (e.g., Johne and Storey, 1998; Menor *et al.*, 2002; de Jong and Vermeulen, 2003; Droege *et al.*, 2009; Papastathopoulou and Hultink, 2012). These studies offered

[1] Chapter 2 is adapted from Jin, D. and Chai, K.H. (2012), "New Service Development: Research Themes, Intellectual Structure, and Future Research Opportunities". Manuscript submitted for publication consideration in *Journal of Service Research*.

valuable insights into the key NSD research topics and provided helpful suggestions for future research. However, since these qualitative reviews are largely based on authors' personal views, they are prone to biases caused by subjective judgments and individual interests (Podsakoff *et al.*, 2005; Kunz and Hogreve, 2011). These biases might jeopardize the validity and representativeness of the review results. Therefore, bibliometric analysis is recommended for an objective assessment of the discipline (Ramos-Rodríguez and Ruíz-Navarro, 2004; Samiee and Chabowski, 2012). Bibliometric analysis refers to the analysis of patterns found in publications via statistical techniques, such as citation and co-citation analysis. The rationale is that, although intellectual leaders might set the agenda for a discipline, it is the collective action of contributors from the discipline that ultimately determines its identity and direction (Banville and Landry, 1989). Since bibliometric analysis is based on large volumes of publication data, it has the advantages of quantifiability and objectivity (Nerur *et al.*, 2008). It can also unveil research topics currently undetected by expert evaluations (Kunz and Hogreve, 2011). As a result, bibliometric examination complements previous qualitative NSD reviews, enabling investigators to illustrate the happenings in the research field, as it were, "in the rear-view mirror" (White and McCain, 1998). In addition, bibliometric methods are effective for examining the exchange of knowledge and scientific communication that cannot be handled by qualitative review studies (Culnan, 1986; McCain, 1990). In particular, forward citation count traces the knowledge flow from the focal research field to other disciplines, and it provides an objective indicator of the impact of the research efforts (Fernandez-Alles and Ramos-Rodríguez, 2009). Backward citation of references tracks the knowledge flow from other disciplines to the focal field, and it is an appropriate tool to investigate the intellectual structure underlying the field's evolution (Nerur *et*

al., 2008). This citation data could provide a dynamic overview of the development within the NSD field, a topic which has not been fully examined by the existent literature reviews.

The objective of this study is to provide a quantitative review of the NSD research and to suggest future research opportunities based on bibliometric analysis techniques. The investigation relies on citation data from NSD papers published in top-tier academic journals during the timeframe from 1986 to 2010. The research objective consists of three parts: (1) to examine the impact of NSD research based on citation analysis; (2) to reveal key NSD subfields and possible research opportunities based on bibliographic coupling analysis; and (3) to unveil the intellectual foundation of NSD research and its evolution based on co-citation analysis.

This research makes four contributions to the NSD literature. First, we demonstrated the usefulness of bibliometric analysis as an objective and quantifiable review tool. As a complement to the existent qualitative reviews, our study provided an objective account of the NSD research which reflects the joint efforts of its contributors. Second, citation analysis quantified the impact of NSD research on other disciplines. From a knowledge-flow perspective, we identified the disciplinary journals that cited NSD works most frequently. This provided clues about the growing status and contribution of NSD research. Third, using bibliographic coupling results, we identified key NSD subfields and provided a detailed review of each topic. Researchers and practitioners who are interested in NSD can use this study as a reference to locate relevant works and gain a deeper understanding of the field. Furthermore, the gaps between the separated subfields in the two-dimensional map highlighted research opportunities that could be further explored by NSD scholars. Fourth, co-citation analysis revealed the intellectual foundation of NSD research. It provided a dynamic

view of the evolution of the NSD field which was barely unveiled by qualitative reviews. The change of knowledge groups over time evidences the recognition of NSD as a distinct discipline.

The rest of the paper is organized as follows. In the next section, we conduct an overview of NSD review articles and present an introduction to bibliometric analysis techniques. After clarifying the methodologies, we report the key results and important findings. Based on the results, future research opportunities are highlighted. The paper concludes with a discussion of contributions and implications.

2.2. Literature Review

2.2.1. NSD Review Studies

A few periodic reviews of NSD research have been conducted in an attempt to examine the developments in the field and suggest future research opportunities. A study by Johne and Storey (1998) was the first and most comprehensive NSD review. From a theoretical perspective, the authors discussed the definition and types of NSD, its purposes, and its challenges. The review concluded that future research should cover more sectors than just financial services and address the international aspects of NSD. From a practical perspective, the authors investigated the development process, key tasks and activities, and success measurements. On the basis of the review results, areas requiring further research were identified, such as the objective measurement of NSD success, implementation of cross-functional teams, and application of system control. Noticing the inadequate understanding of NSD, Menor *et al.* (2002) provided a structured review of the extant research and identified areas deserving of further exploitation and exploration. Unlike Johne and Storey's review which looked at all aspects of NSD, Menor *et al.*'s study focused mainly on operational issues. They

asserted that the emphasis on operations management supplemented early NSD research, which was largely service marketing-driven, and added credence to the growing recognition of NSD as an interdisciplinary field. Building on the extensive literature review, the study pointed out a number of future research opportunities, which included NSD for e-services, the design of service experiences, and service supply chain management. de Jong and Vermeulen (2003) contributed another literature review of NSD. They provided an overview of the highly fragmented literature on organizing NSD and summarized the results in a two-stage model. The first stage concentrated on organizational characteristics associated with the management of key NSD activities, while the second stage covered characteristics that create a climate for continuous innovation. The authors discussed the impact of these characteristics in great detail and called for more research to help companies foster an innovative culture. A more recent NSD review was conducted by Droege *et al.* (2009). They first reviewed representative studies that adopted each of the four schools of thought operating in NSD research, namely technologist, assimilation, demarcation, and synthesis. Next, five important NSD subfields were outlined: (1) taxonomies of service firms; (2) innovation classification frameworks; (3) success factors for innovation in different service dimensions; (4) success factors for innovation projects with different degrees of newness; and (5) success factors for service and product innovation. Based on a thorough review of these subfields, further research opportunities were suggested accordingly. To date, the most recent NSD literature review is from Papastathopoulou and Hultink (2012) and they examined NSD research spanning 27 years from 1982 to 2009. Adopting the content analysis method, the authors investigated the articles' publication characteristics, research focus, and research methodology. They found that more recent NSD works studied a broader

range of research topics with the use of more advanced analytical techniques, indicating the emergence of NSD as a sophisticated and mature discipline. 25 research topics were identified and sorted into six categories: organizing for NSD, NSD process, performance measurement, customer involvement, new service strategy, and new service design. Suggestions were made for future research and some of the opportunities included the examination of international NSD, service design, and longitudinal NSD studies.

As one discipline becomes more mature and sophisticated, it is necessary to take the discipline itself as the object of study (Ramos-Rodríguez and Ruíz-Navarro, 2004). The above-mentioned qualitative literature reviews addressed this concern in the NSD field. Irrespective of their approaches and focuses, they provided valuable insights into the state of NSD research and offered recommendations for advancing the discipline. However, a few limitations of the qualitative literature reviews need to be highlighted (Kunz and Hogreve, 2011). The reviews are subject to their authors' focuses and perspectives, and this limits the representativeness of the results. As acknowledged by Menor *et al.* (2002), literature reviews only represent the views of the authors, and so other researchers are advised to add their assessments. Similarly, the experts' ratings might be biased toward their own interests and expertise. It is likely that certain research directions will be promoted due to the participation of scholars who are specialized in related areas (Baumgartner and Pieters, 2003; Podsakoff *et al.*, 2005). These mechanisms may introduce biases into the assessments, especially in relation to the potential research directions. This threatens the face validity of the qualitative review studies. Therefore, quantitative literature reviews are recommended to correct any errors of perception and provide objective evaluations (Fernandez-Alles and Ramos-Rodríguez, 2009).

2.2.2. Bibliometric Techniques

The term "bibliometric" was first proposed by Groos and Pritchard (1969) in an effort to replace the clumsy and confusing term "statistical bibliography". It refers to the application of mathematical and statistical techniques to analyze the patterns that appear in publications and documents. Our research adopts three common bibliometric techniques: citation analysis, bibliometric coupling, and co-citation analysis. Citation analysis is a procedure to examine the exchange of knowledge (Garfield, 1979). It is based on the premise that authors cite papers which they consider to be important to the development of their research. Citation analysis provides objective data on scientific communication and activity indicators in relation to the impact of research efforts (Fernandez-Alles and Ramos-Rodríguez, 2009). As such, it is particularly amenable for providing insights into the influences of research that prevails within its own field and across other academic disciplines (Hoffman and Holbrook, 1993). Cote *et al.* (1991) used citation data to investigate the contributions of consumer research. They concluded that citation analysis offers a more quantitative and objective means of evaluating the research influences. Jeung *et al.* (2011) examined citation data in the field of human resource development. Their results confirmed the usefulness of citation analysis as a reliable way to reveal the value-added contributions of the research across disciplines. Such application has been adopted by studies in other fields such as innovation management (Biemans *et al.*, 2007; Biemans *et al.*, 2010), marketing (Baumgartner and Pieters, 2003), and management (Podsakoff *et al.*, 2005).

Bibliometric coupling is a technique to cluster source articles that refer to similar references (Kessler, 1963). It is of particular use for mapping the full coverage of the literature in one research field and providing a valid representation of the underlying structure (Persson, 1994). The rationale is that studies from the same

research stream are more likely to cite similar references than studies with different origins. Peters *et al.* (1995) provided empirical evidence that the word profile similarity of groups sharing common highly cited publications was significantly higher than that of groups without such a relationship. They concluded that bibliographically coupled articles form a set of cognitively related documents, thus representing works of the same research theme. In a recent study, Jarneving (2007) applied bibliographic coupling in combination with the complete link cluster method to test its applicability as a mapping method on the field level. The results demonstrated that bibliographic coupling generated statistically coherent groups which mirrored relevant research topics. Unlike direct citation which only considers reference links among source articles, bibliometric coupling includes external references, and this significantly increases the number of papers that can be used for pairing. Therefore, bibliometric coupling generates the most accurate subfield clusters of all the bibliometric methods (Boyack and Klavans, 2010). Furthermore, bibliographic coupling is able to detect early stages of subtopic evolution. This is because a critical mass of papers on the new topic is not necessary in order to produce highly cited publications, unlike what has generally been required by co-citation analysis (Glänzel and Czerwon, 1996). Despite these favorable features, only a few researchers have applied bibliographic coupling as an intelligence tool for science mapping (Jarneving, 2007). However, there has been a recent surge in its use (Boyack and Klavans, 2010).

Co-citation analysis measures the number of times that two references have been cited together, and it provides a natural and quantitative way to reveal the knowledge structure in a field (Small, 1973). It is based on the assumption that references represent concept surrogates and a group of closely cited references comprises the consensual structure of concepts in a field (Small, 1980). Calado *et al.*

(2006) compared several similarity measures in the classification of web documents, and the results showed that clusters generated by co-citation links achieved higher degree of precision than other approaches. Unlike bibliographic coupling which is used to understand research topics, co-citation analysis focuses on the knowledge base of the specialty (Small, 1977). Intellectual structure can be used to trace the evolution of a research field because scholars sharing the same topic tend to cite the most recent relevant literature; therefore, paradigm shifts are manifested in changes of the core references. Based on a co-citation analysis of literature on atomic and molecular physics over a 10-year period, Braam *et al.* (1991b) demonstrated that cited references manifested a more dynamic evolutionary pattern than those associated with source articles. Although the specialty's general topics did not change much, co-citation analysis was able to reveal a series of interesting new contributions that changed the course of further research (Braam *et al.*, 1991b). This is in line with White and McCain's (1998) conclusion that co-citation analysis is able to objectively reflect change in a field, despite scholars' subjective views of a semi-permanent disciplinary structure. A number of studies have adopted co-citation analysis to explore the intellectual structure of various research disciplines including strategic management (Ramos-Rodríguez and Ruíz-Navarro, 2004), operations management (Pilkington and Meredith, 2009), and human resource management (Fernandez-Alles and Ramos-Rodríguez, 2009).

2.3. Research Methodology

2.3.1. Step 1: Journal Selection

The primary objective of this study is to provide a quantitative review of the NSD field, so the most suitable publications should be academically rather than managerially

oriented. Of all the academic publications, we chose articles published in research journals because they represent "certified knowledge" that has undergone strict peer review processes (Ramos-Rodríguez and Ruíz-Navarro, 2004). Influential journals not only provide a good platform to understand research evolution, but future development of the field can be inferred from the current debates as well (Furrer *et al.*, 2008). Since the topics in service research are cross-disciplinary in nature (Bitner and Brown, 2006; Tronvoll *et al.*, 2011), we selected the top ten journals from each of the relevant disciplines, namely service (see ranking by Fisk *et al.*, 1993; Svensson *et al.*, 2008), innovation management (see ranking by Linton and Thongpapanl, 2004), marketing (see ranking by Baumgartner and Pieters, 2003), operations (see ranking by Barman *et al.*, 2001), and management (see ranking by Podsakoff *et al.*, 2005). Due to practical constraints, the journal set was not intended to be comprehensive, only representative of the main publishing outlets of NSD research.

2.3.2. Step 2: Sample Preparation

Our next step was to retrieve NSD studies that appeared in the selected journals from 1981 to 2010. We focused on this timeframe because the pre-1980 period was the "scurrying about" stage when the number of published service studies and publishing outlets were rather limited (Fisk *et al.*, 1993). Furthermore, the earliest service research oriented publication, *Service Industries Journal*, was only established in 1981. This 30-year time-span allows for a comprehensive investigation of the evolution of NSD research. Due to the limited coverage confined to one database, our search was conducted using the Web of Science (WoS), Scopus, and journal homepages. We mainly searched for articles whose title, abstract, or keywords field contained at least one of these phrases or their variations: service innovation, service development, and

service design. These keywords are common terms used in the literature to address ideas about how service firms design new service offerings (Goldstein *et al.*, 2002). We also included a broader spectrum of NSD articles associated with new product development (NPD) terms because scholars used to apply NPD and NSD terms interchangeably. This was done by finding articles with the exact word "service" and at least one of the following phrases or their variations: product innovation, product development, and product design. This procedure identified a total of 472 articles.

2.3.3. Step 3: Sample Refinement

As all of the articles were retrieved automatically by the search engine, further refinement was necessary to exclude the ones that did not address NSD issues. The authors and another two NSD scholars conducted independent judgments. An article was classified as NSD research if it was clear from the title and abstract that it had direct implications on NSD management or research. This means that peripheral NSD topics (e.g., adoption of service innovation, NPD studies using service industry data) and specific document types (e.g., book reviews, editorials) were not included. In case of disagreement, the full article was consulted and a consensus was achieved through discussions with all judges. After refinement, 187 articles representing the work of 312 authors were retained.

2.3.4. Step 4: Coding and Purification

Information for the bibliometric analysis was extracted from the WoS social science citation index where available. The content extracted for each article included the author names, title, abstract, keywords, year of publication, journal name, and a list of cited references. As WoS did not cover all volumes of the selected journals, we

manually processed the missing content for 30 articles. We observed that around 10-15% of the total 10,105 cited references were not in the standardized form with errors such as misspelled author names and variations in journal names. These errors could lead to incorrect frequency counts and article pairing, resulting in serious problems for subsequent bibliographic coupling and co-citation analysis. Therefore, we paid close attentions to the purification of the cited references. Bibexcel was used to export the details for all of the cited references to a Microsoft Word document, which were then sorted in descending order of first author's last name. Next, find-and-replace routines were applied to correct misspelled author names and missing publication years. For journal-style references, additional corrections were made to wrong or missing volume and page numbers and inconsistent journal name abbreviations. For book-style references, multiple editions and inconsistent titles were standardized. Full cited reference strings were used for subsequent frequency counts so as to mitigate any problems caused by multiple publications from one author in the same year or authors with same the name.

2.3.5. Step 5: Analysis of Source Articles

Having cleansed the database, we conducted the bibliometric analysis which was separated into two stages. Stage one involved the citation analysis and bibliographic coupling analysis of source articles. For the citation analysis, we calculated descriptive statistics about NSD articles. In addition, the WoS data of forward citations to these works was analyzed to reveal the types of journals that frequently cited NSD research. To examine changes over time, we divided the whole sample period into three sub-periods: period 1 (1986-1994), period 2 (1995-2002), and period 3 (2003-2010). The pre-1986 period was ignored because no NSD publications were found in our sample.

Bibliometric coupling analysis was conducted by counting the number of shared references cited by any two of the 187 source articles. These coupling links were then used to construct a raw matrix of proximity values. The off-diagonal cells were filled with counts of shared references of row and column articles, and the diagonal cells were left undefined. The raw matrix was converted into a correlation matrix using normalized similarity measures. Normalized similarity measures are insensitive to different scales of coupling strengths and they generate more accurate maps than those based on raw citation counts (Boyack *et al.*, 2005). Instead of Pearson transformation, we used cosine as a similarity measure because it does not erroneously treat zero as an indication of similarity (Ahlgren *et al.*, 2003).

To analyze the bibliometric coupling data, we performed a multidimensional scaling (MDS) routine in SPSS. MDS offers a visual representation of the distance between two documents according to their bibliographic coupling strengths. The proximity of two documents in the map indicates that they cited more common references, and discernible subfields are represented by a group of documents within a close distance. MDS has advantages for capturing as much of the original data as possible in lower level dimensions and identifying salient underlying dimensions (McCain, 1990). We chose a two-dimensional solution for the bibliographic coupling links because it renders results that are easy to interpret and, at the same time, captures a high proportion of the variance (Nerur *et al.*, 2008). Kruskal's stress was used to assess the goodness-of-fit, and we deemed a stress value of 0.2 as acceptable (McCain, 1990).

One issue worth mentioning is setting the threshold for the bibliographic coupling strength. It is necessary to impose a cut-off threshold on the coupling strength to filter out random associations. In this way, the remaining significant links show a

clearer structure of subfields. However, there is no existing criterion for this threshold and previous studies usually set threshold values according to empirical experience. In this study, we selected a series of coupling strength values ranging from 5 to 15 (i.e., 10% to 30% of the average number of references in one article). We determined the threshold by taking the following factors into consideration: (1) the MDS map offers easy-to-understand subtopic structures; (2) Kruskal's stress is within the acceptable range; (3) the number of mapped documents is under 100 due to the capacity of SPSS. The final threshold was set at 10 because this led to the most satisfactory results given all of the above conditions. 72 articles were mapped and the MDS procedure obtained a stress value of 0.153.

2.3.6. Step 6: Analysis of Cited References

In stage two, we conducted co-citation analysis based on a frequency count that two references were cited together in the same article. These counts were used to construct raw co-citation matrices with off-diagonal cells representing co-occurrence counts of row and column references and diagonal cells undefined. In order to trace the evolution of the intellectual structure, the whole time period was divided into three sub-periods. We imposed a threshold value of 7% of the average number of references per publication in the same period. In other words, references retained for analysis in period 1 had to be cited by at least 2 articles in that period (4 citations for period 2, and 5 citations for period 3). The threshold was defined through an iterative process during which we tried to ensure interpretable results in the subsequent factor analysis while taking into account large variances in the reference numbers across the three sub-periods. This resulted in the formation of a 54×54 matrix for period 1, a 123×123 matrix for period 2, and a 202×202 matrix for period 3.

These co-citation matrices were used as inputs for factor analysis in SPSS. Factor analysis attempts to identify the dominant factors that account for the majority of the interrelationships observed in the co-citation matrices. The factor loading is an indication of the degree to which a reference belongs to a certain factor, and the frequently co-cited references tend to load on the same factor which can be deemed a knowledge group. Factors were extracted by principal component analysis with varimax rotation, and the interpretation of each factor was based on an assessment of the research topics represented collectively by references with loadings above the conventional threshold of ±0.3 (Culnan, 1986; White and McCain, 1998). Braam *et al.* (1991a) pointed out that it is possible for co-citation analysis to yield fragmented yet cognitively related clusters because scholars tend to cite the most recent earlier literature in relation to the same topic. Therefore, we combined some of the factors that we deemed to represent the same knowledge base, and only factors that explained more than 3% of the variance were ultimately reported.

2.4. Results and Discussion

2.4.1. Citation Analysis

Based on the results of the citation analysis, descriptive statistics are provided in relation to 187 source articles. Figure 2.1 shows the number of published NSD papers per year and the cumulative percentages of articles in different journal categories. The first NSD paper did not appear until 1986 when Barras published his seminal work that applied reverse product cycles to service innovation. This was perceived by many as marking the beginning of NSD research (Droege *et al.*, 2009). NSD research gained its momentum in the 1990s when the average number of yearly published papers amounted to 3.9. A notable increase in article quantities was observed after 1996. This

may have been facilitated by Edvardsson and Olsson's (1996) heavily cited article which explained the key concepts for NSD. In the 2000s, NSD research was on a fast growth track and the average number of yearly published papers increased to 13. Several special issues on NSD were launched by journals such as *The Service Industries Journal*, *Journal of Operations Management*, and *Managing Service Quality*. Due to steady growth, 2009 and 2010 were the first two years with more than 20 papers published annually. All these are clear signs that NSD related topics are gaining popularity among academics, especially service research scholars.

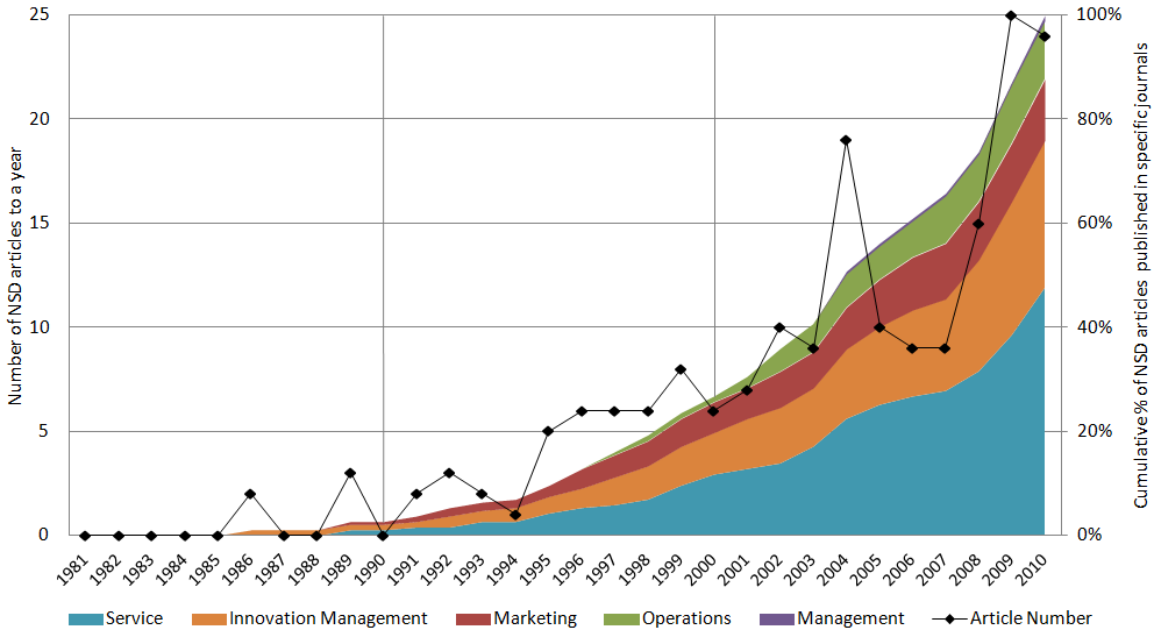


Figure 2.1 NSD Article Frequency and Publishing Outlet Categories

In terms of publishing outlets, Figure 2.1 illustrates that marketing and innovation management journals formed the main powerhouse that produced NSD articles in the late 1980s and early 1990s. The representative journals included *Journal of Product Innovation Management*, *Research Policy*, and *European Journal of Marketing*. However, their dominance was later reduced due to the emergence of a number of

dedicated service journals in the 1990s. Four of the five most recognized service journals from Svensson *et al.*'s (2008) survey were established around this time. Their rapid development resulted in NSD articles being frequently published in journals such as *Journal of Service Management*, *The Service Industries Journal*, and *Managing Service Quality*. By the end of 1999, 40% of NSD papers being published appeared in service journals. The new millennium saw the diffusion of NSD research into new disciplines. The number of papers published in operations management journals surged to 19 during the 2000s, compared to merely two works published over the previous two decades. *Journal of Operations Management* and *International Journal of Operations and Production Management* emerged as the main outlets in this field. On the other hand, service journals accounted for over 50% of all NSD papers published during this decade, further consolidating their key role in the dissemination of NSD knowledge. Table 2.1 depicts the breakdown of article counts from the most productive publishing outlets for NSD research. It shows that altogether the top ten

Table 2.1 Journals Most Frequently Publishing NSD Research

Journal Name	Overall Counts	Across sub-periods		
		Period 1	Period 2	Period 3
1. The Service Industries Journal (SVC) [a]	30	1	7	22
2. Journal of Service Management (SVC)	22	2	8	12
3. Journal of Product Innovation Management (IM)	15	3	5	7
4. Journal of Service Research (SVC)	14	N/A [b]	3	11
5. Managing Service Quality (SVC)	13	0	2	11
6. Research Policy (IM)	13	1	4	8
7. Journal of Services Marketing (SVC)	10	2	1	7
8. European Journal of Marketing (MKT)	8	2	3	3
9. International Journal of Technology Management (IM)	8	0	3	5
10. Journal of Operations Management (OPS)	8	0	5	3
11. Technovation (IM)	6	0	1	5
12. Decision Sciences (OPS)	5	0	1	4
13. Industrial Marketing Management (MKT)	5	1	2	2
14. Journal of Business Research (MKT)	5	0	3	2
15. Production and Operations Management (OPS)	4	0	0	4
16. International Journal of Production Economics (OPS)	3	0	1	2
17. Journal of the Academy of Marketing Science (MKT)	3	0	1	2
18. Technology Analysis & Strategic Management (IM)	3	0	1	2
19. International Journal of Operations & Production Management (OPS)	2	0	0	2
20. Technological Forecasting and Social Change (IM)	2	1	1	0
Subtotal	179	13	52	114

Note: [a] Journal category is indicated in the parenthesis: SVC=Service, IM=Innovation Management, OPS=Operations & Production, MKT=Marketing.

[b] N/A represents that the journal was not established by then.

journals published over 75% of all NSD works. Although the number of NSD articles grew dramatically over time, the dominant position of these journals persisted across all three sub-periods. This indicates that NSD scholars tend to concentrate their publications in a few selected journals.

In addition to the descriptive statistics about NSD articles, forward citation analysis was conducted to evaluate the influence of NSD research on other disciplines. We defined the forward citation count as the number of academic journal papers that cited NSD articles in our sample. Due to the coverage constraints of WoS, we retrieved data for citations to 157 of the total 187 NSD articles. Considering that these papers account for 84% of all source articles, we believe forward citation analysis based on this data will enable us to derive an acceptable approximation of the results. For the period from 1986 to 2010, WoS registered a total of 2,405 citations contained in 836 articles published in 223 journals. This translated to an average of 15.3 citations to each NSD article. Figure 2.2 illustrates the forward citation counts by journals across

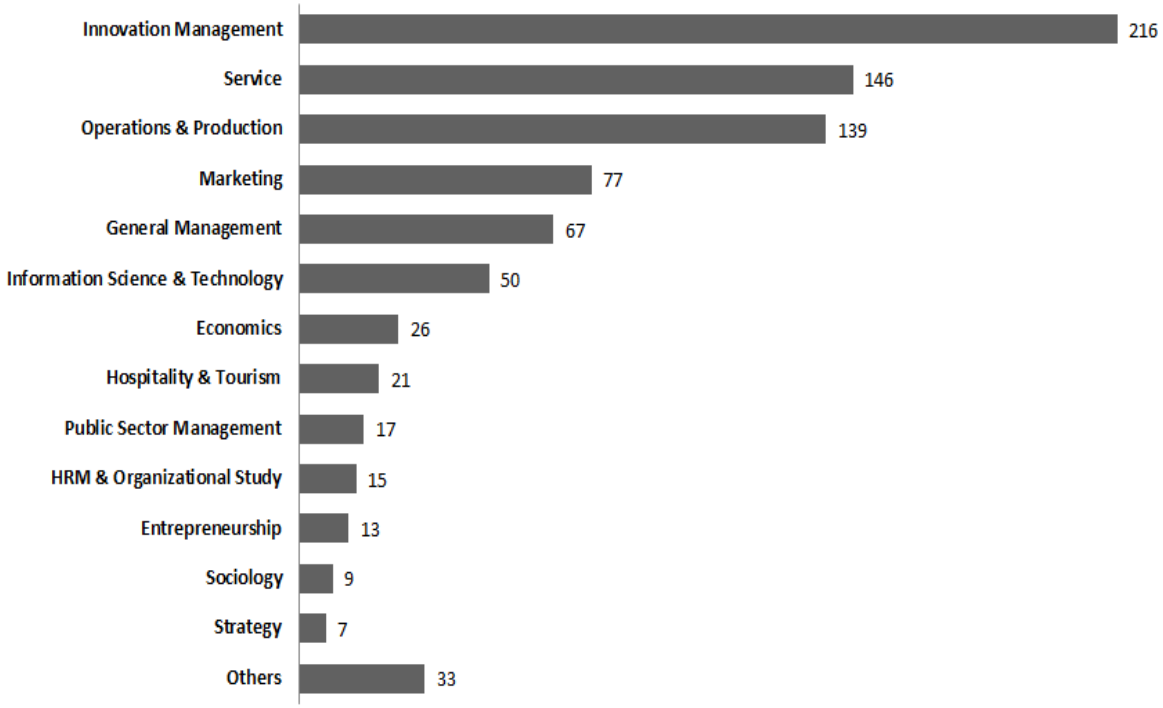


Figure 2.2 Forward Citations to NSD Research across Discipline

different disciplines. The classification scheme was based on the Academic Journal Quality Guide (ABS, 2010). The results show that innovation management, service, operations and production, marketing, and management journals produced the most citations to NSD articles, and they altogether accounted for 77% of the total citations.

Table 2.2 further depicts the breakdown of the forward citation counts in each journal. It demonstrates that the top 20 journals that most frequently cited NSD research all come from the top five fields as shown in Figure 2.2. One explanation is that NSD scholars tend to publish their works in journals from these disciplines, and this significantly increases the likelihood that such articles are cited. Over the three sub-periods, the citation counts as well as the variety of citing journals have dramatically increased. In the first two periods, the list was dominated by a few innovation management and marketing journals. When entering the third period, more journals from various disciplines had begun to take the leading positions. This indicates the growing influence of NSD research on a wider range of audiences.

Table 2.2 Journals Most Frequently Citing NSD Research

Journal Name	Overall Counts	Across sub-periods		
		Period 1	Period 2	Period 3
1. Journal of Product Innovation Management (IM) [a]	58	4	11	43
2. The Service Industries Journal (SVC)	58	0	8	50
3. Journal of Service Management (SVC)	49	0	8	41
4. Research Policy (IM)	39	1	6	32
5. Technovation (IM)	30	0	2	28
6. Industrial Marketing Management (MKT)	29	1	7	21
7. Journal of Business Research (MKT)	23	0	7	16
8. Journal of Operations Management (OPS)	22	0	3	19
9. International Journal of Operations & Production Management (OPS)	20	0	1	19
10. Journal of Service Research (SVC)	20	N/A [b]	0	20
11. R&D Management (IM)	16	0	2	14
12. International Journal of Technology Management (IM)	15	0	0	15
13. Production and Operations Management (OPS)	15	0	0	15
14. Decision Sciences (OPS)	14	0	2	12
15. Total Quality Management & Business Excellence (MGT)	11	0	1	10
16. Journal of the Academy of Marketing Science (MKT)	10	0	3	7
17. International Journal of Production Economics (OPS)	9	0	1	8
18. Technological Forecasting and Social Change (IM)	9	0	5	4
19. Technology Analysis & Strategic Management (IM)	9	0	4	5
20. European Journal of Marketing (MKT)	8	0	0	8
Subtotal	464	6	71	387

Note: [a] Journal category is indicated in the parenthesis: SVC=Service, IM=Innovation Management, OPS=Operations & Production, MKT=Marketing, MGT=General Management.
[b] N/A represents that the journal was not established by then.

2.4.2. Bibliographic Coupling Analysis

The subfields of NSD research are depicted in a two-dimensional MDS map based on the bibliographic coupling links (refer to Figure 2.3). The nodes represent source articles. Articles having more paired references are placed closer to each other, while articles sharing fewer references are placed farther apart. The nodes situated near the origin of the map are papers that have high co-citations with others. We closely examined the theme of each article and manually allocated it to the most appropriate cluster(s). In total, eight clusters were revealed which represent the major subfields of NSD research from 1986 to 2010. These clusters are oriented along a horizontal "temporal continuum" and a vertical "functional emphasis" dimension. The horizontal axis seems to showcase the subfields in such a way that the subfields mainly comprised of older studies are aligned at the left side, while the subfields comprised of more recent research are situated at the right side. The vertical axis appears to allocate papers according to their functional focus with the upper ones associated mainly with marketing functions and the lower ones with an operations perspective. In order to be more comprehensive, we classified the papers not presented in the MDS map into subfields if they were frequently cited by articles from a certain subfield (a complete list of papers can be found in Appendix A). It should be noted that these subfields do not cover all NSD research topics; rather, they represent the most commonly "talked about" issues among scholars. A detailed review of the subfields and their main findings is presented below.

NSD Success Factor. Adapted mainly from the NPD and services marketing literature, the subfield of *NSD Success Factor* aims to identify various drivers for the successful development of new services. It is regarded by many as one of the most advanced fields of research on NSD (Droege *et al.*, 2009). A number of studies have

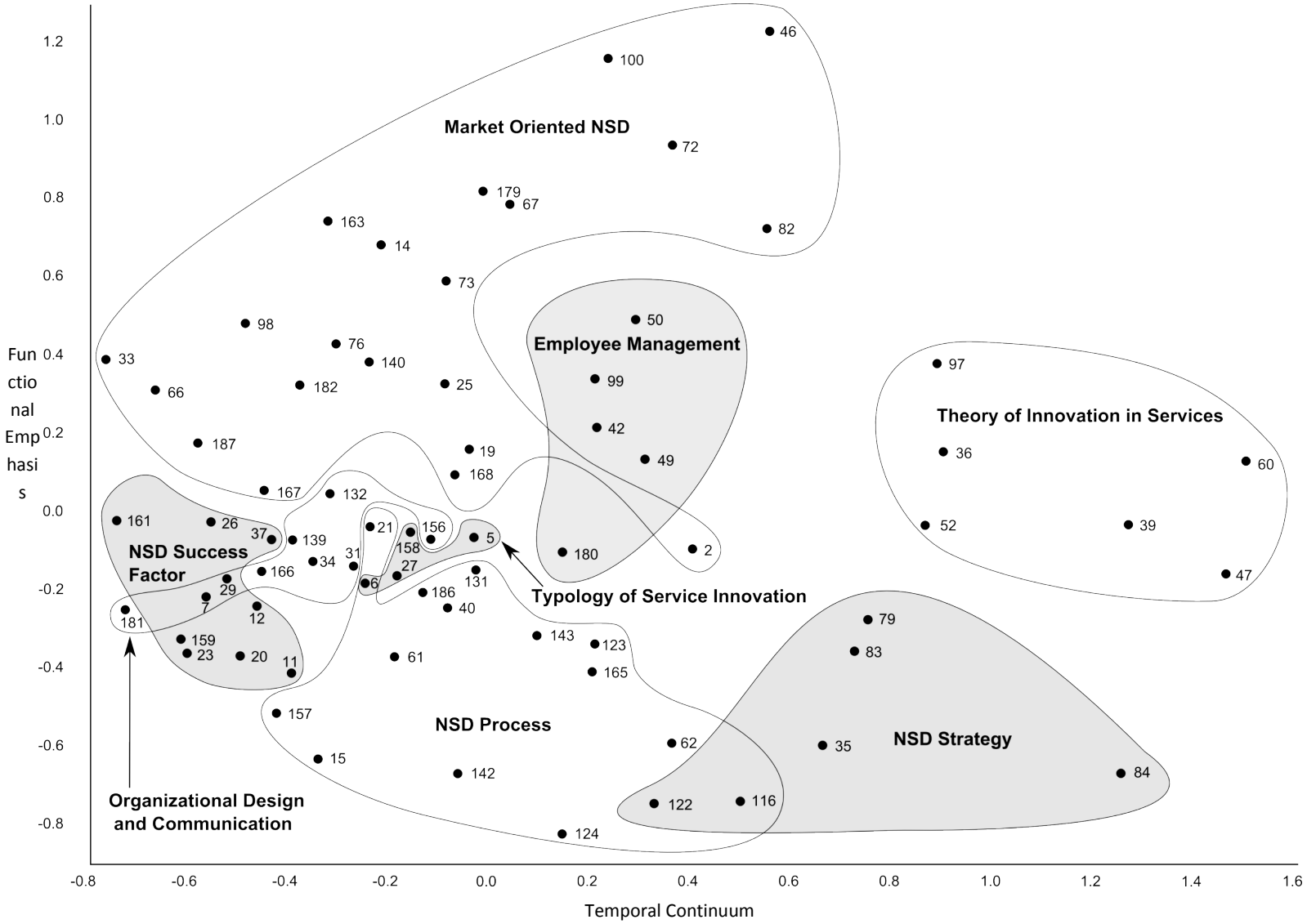


Figure 2.3 Subfields of NSD Research

set out to uncover the differentiating factors for the success or failure of new services (e.g., de Brentani, 1991; Martin and Horne, 1995; de Brentani and Ragot, 1996). The results unanimously confirmed the critical roles of customer input and product advantage. On a macro level, some studies focused on the contributing factors to a firm's overall NSD performance (e.g., Thwaites, 1992; Martin and Horne, 1993; Edgett, 1996). The results highlighted the importance of a rigorous development process which facilitates internal and external communication flows. Another group of studies investigated how successful NSD differs from NPD. de Brentani and Cooper (1992) maintained that NSD shares key success factors that are similar to NPD, but Atuahene-Gima (1996a) pointed out that the relative importance of the various factors depends on the nature of the firm. Mostly published in the early 1990s, the success factor studies facilitated the understanding of critical development activities. Although their findings were more descriptive than instructional, they brought various schools of thought into the NSD research and gave rise to the rapid disciplinary development that started in the late 1990s.

Organizational Design and Communication. Studies from this subfield examine the roles of communication and cross-functional integration during the NSD process. Based on findings from the service management literature, exploratory research (e.g., Lievens *et al.*, 1999b; Lievens and Moenaert, 2000a) investigated the influence of internal and external communication on NSD performance. The results indicated that communication has an indirect impact on project success, mediated by the level of uncertainty reduction. The relationship between communication and organizational learning was also explored (e.g., Lievens *et al.*, 1999a; Blazevic and Lievens, 2004), and empirical results confirmed its significance. By treating service development as information processing procedures, the effectiveness of cross-

functional teams was studied (e.g., Vermeulen and Dankbaar, 2002; Perks and Riihela, 2004). Service firms were advised to ensure appropriate and timely functional inputs so as to alleviate communication barriers that were commonly seen in these teams. The *Organizational Design and Communication* subfield contributes to the NSD research by consolidating the understanding of organizational mechanisms in a way that involves both internal and external stakeholders.

Typology of Service Innovation. The subfield *Typology of Service Innovation* focuses on categorizing various types of new services and unveiling their associated management practices. The literature review by Johne and Storey (1998) conceptually proposed a classification scheme for service innovation. Avlonitis *et al.* (2001) carried out an empirical new service typology study and the findings suggested the existence of six distinct new service types. Later studies (e.g., de Brentani, 2001; Oke, 2007) investigated the management practices required for the success of NSD with different degrees of innovativeness. Although the results demonstrated that different innovation types call for different sets of practices, a well-planned formal development process was found to be necessary to manage all types of service innovation. Furthermore, these studies concluded that the distinction between NPD and NSD makes it inappropriate to directly apply the concept of product innovativeness to the service context. The subfield *Typology of Service Innovation* has advanced NSD research by clarifying the various service innovation types and highlighting the importance of studying them separately.

NSD Strategy. The *NSD Strategy* subfield researches operations strategies that assist service firms to build core competencies during NSD projects. Menor and Roth (2007; 2008) maintained that the strategic alignment of NSD within the overall business strategy facilitates the management to plan for the appropriate resources and

routines necessary to develop new services. Their empirical results confirmed that NSD strategy is an indispensable component of NSD competence. At a more detailed level, strategies specific to knowledge management and concurrent planning were studied (e.g., Hull, 2004b; Storey and Hull, 2010). It was found that the effectiveness of development practices is contingent on strategies deployed by the companies. By expanding the operations and strategy literature, this subfield reveals the importance of aligning NSD strategy with corporate strategy and calls for more attentions to be paid to the strategic planning of NSD.

NSD Process. The subfield *NSD Process* deals with issues in direct relation to the process of service development. A number of studies have attempted to identify the critical development activities and elements and then integrate them into a systematic model (e.g., Tax and Stuart, 1997; Stuart and Tax, 2004; Stevens and Dimitriadis, 2005). From a service system perspective, these studies provide an in-depth presentation of the NSD process and the mechanism through which design elements interact with each other. Having identified a wide range of major obstacles in the development process (Edvardsson *et al.*, 1995), further research was carried out with the aim to study the antecedents of an effective NSD process, such as culture and politics (Stuart, 1998) and organizational learning (Stevens and Dimitriadis, 2004). The results showed that a good command of these factors may lead to improvement in the efficiency and effectiveness of NSD projects. The relationship between the formalized process and NSD success was studied by another group of scholars (e.g., Froehle *et al.*, 2000; Menor and Roth, 2007; Menor and Roth, 2008). Their empirical findings pointed out that the process focus exerted a positive impact on NSD competence. Despite its roots in the operations and NPD literature, the subfield *NSD Process* pays close attentions to the distinctive nature of services and thus offers a

good understanding of the service development process and its key managerial practices.

Market Oriented NSD. The subfield *Market Oriented NSD* addresses how service firms can utilize market information and involve external stakeholders, especially customers. Due to the importance of market orientation revealed by the marketing and NPD literature, one stream of research probed the role of market orientation in NSD (e.g., Syson and Perks, 2004; Chen *et al.*, 2009; Ordanini and Maglio, 2009; Jaw *et al.*, 2010). These studies adopted the multiple stakeholder perspective (e.g., customers, competitors, and suppliers), and their results suggested that a firm's capability to generate and respond to market information from its stakeholders casts a significant influence on NSD performance. In particular, these NSD scholars devoted close attentions to the involvement of customers (e.g., Magnusson *et al.*, 2003). While the previous studies provided insights into the critical role of customers, they did not explicitly state how customers can be incorporated into the NSD process. This became the objective of a series of exploratory studies that investigated practices of customer involvement (e.g., Gustafsson *et al.*, 1999; Alam, 2002; Alam and Perry, 2002). Key elements of customer involvement were identified, such as purposes, roles of customers, and activities in each development stage. These studies reached the conclusion that the effectiveness of customer involvement depends on how it is managed. Therefore, more recent research has concentrated on strategies for successful customer involvement (e.g., Matthing *et al.*, 2006; Kristensson *et al.*, 2008; Magnusson, 2009). It was found that different types of customers possess different kinds of product knowledge, so the involvement of a heterogeneous group of users is necessary to ensure a diversity of ideas. The subfield *Market Oriented NSD* has extended the NSD research by stressing that service development is not just an

internal effort and that the involvement of external stakeholders substantially increases the chance of success.

Employee Management. The *Employee Management* subfield addresses issues in relation to human resource management in NSD. Based on the service management literature, scholars examined the extent to which NSD success depends on human issues, such as the training of employees, empowerment, and evaluation (e.g., Ottenbacher *et al.*, 2006; Gebauer *et al.*, 2008; Ottenbacher and Harrington, 2010). The results revealed a significant relationship between these factors and new service performance, but the level of contribution was contingent on the service type and innovativeness. From a decision-making perspective, the studies revealed that the decision architecture and management support influenced employees' learning and motivation (Blazevic *et al.*, 2003). Therefore, the antecedents of effective decision-making were also studied (e.g., van Riel and Lievens, 2004). The subfield *Employee Management* takes a human resource management approach and highlights the necessity of seamlessly integrating employees into the complex development process.

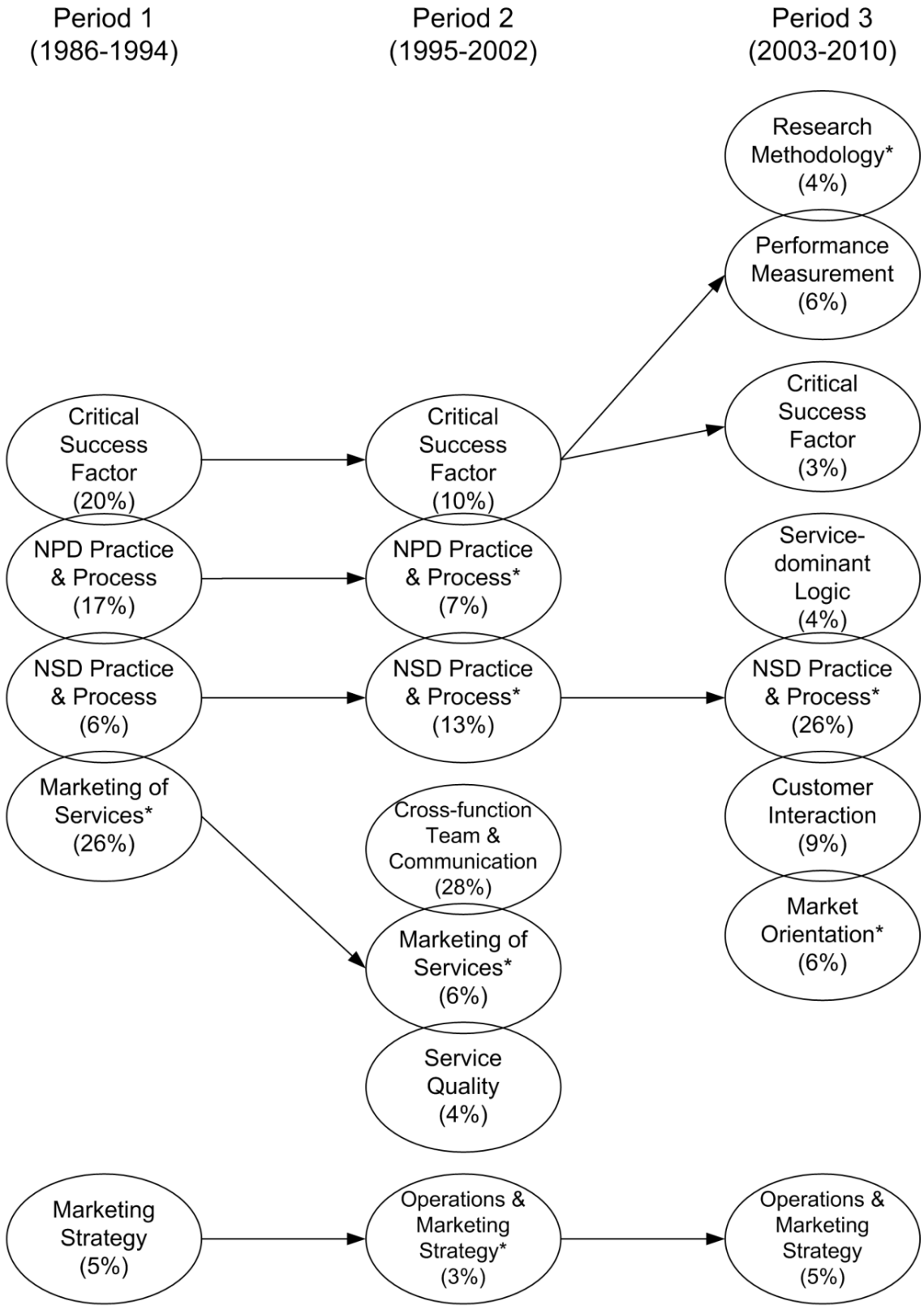
Theory of Innovation in Services. Studies from the *Theory of Innovation in Services* subfield respond to the most basic question "what is service innovation?", and usually come up with a theoretical representation of the key dimensions and modes of service innovation. Three different approaches have been adopted: assimilation, demarcation, and synthesis (Coombs and Miles, 2000). Early studies usually took the assimilation approach (e.g., Barras, 1986), believing that the concepts developed in the product context could be readily applied to the service context. Later studies (e.g., Gadrey *et al.*, 1995; Sundbo, 1997) adopted the demarcation approach, which argues that service innovation is distinctively different from innovation in manufacturing. More recent studies (e.g., Gallouj and Weinstein, 1997; Drejer, 2004; de Vries, 2006)

have utilized the synthesis approach and advocate the integration of relevant concepts from both the service and product contexts. By adopting this approach, research has been conducted to investigate how manufacturers can adapt the concept of NSD (e.g., Kindström and Kowalkowski, 2009; Gremyr *et al.*, 2010). Based mostly on the innovation management literature, the subfield *Theory of Innovation in Services* forms the theoretical groundwork for the development of various phenomena in relation to NSD.

2.4.3. Co-citation Analysis

Based on the co-citation pattern of the cited references, factor analysis was conducted for each sub-period to show the intellectual structure and its evolution (refer to Figure 2.4). The factor represents the major structural knowledge group that contributes to the conceptual foundation of NSD research, and the amount of variance explained by the factor measures its influence. In each sub-period, the overlap between knowledge groups A and B suggests that at least two references cognitively belonging to group A (or B) actually loaded highly on group B (or A). This is a sign of a close relationship between the two knowledge groups. Across different sub-periods, the arrow linking two knowledge groups means that at least two references belonging to the earlier group also appeared in the later group. This demonstrates the stability and continuity of the specific knowledge group. By observing the relationships across time, together with the emergence and disappearance of certain groups, we are able to provide a longitudinal perspective of the intellectual structure of NSD research.

In the first period, factor analysis revealed five knowledge groups which accounted for 74% of the total variance. The primary intellectual structure concerned the *Marketing of Services*. This knowledge group contained works by pioneering



Note: Number in parentheses indicates the variance explained by the knowledge group.
* At least two factors representing the same knowledge group have been combined.

Figure 2.4 The Intellectual Structure of NSD Research

services marketing scholars, such as Lovelock and Shostack, who highlighted the unique characteristics of services and the importance of differentiating services marketing from product marketing. These works were heavily cited by NSD scholars to stress the need to deviate from NPD studies and start a new research stream of NSD. The *Critical Success Factor* was the second largest knowledge group. It consisted mainly of articles identifying key factors for the successful development of tangible products. These articles were frequently cited by early NSD success factor studies. The knowledge group *NPD Practice & Process* captured a variety of classic NPD books and journal papers depicting product development activities and processes. Due to limited NSD specific references in the early years, these NPD works served as the theoretical groundwork whose concepts and frameworks were repeatedly modified and adapted by NSD scholars. The only NSD related knowledge group in the first period was the *NSD Practice & Process*, and it accounted for only a small portion of the variance. The associated works did not propose specifically designed NSD practices and processes per se; they mainly adapted traditional NPD practices to the service context. Despite this, these works were among the first studies devoted to NSD topics and they provided the knowledge base for subsequent research on the management of NSD practices and processes. The representative works included Levitt's production-line approach to service and Bowers' suggested product development model for banks. Yet another knowledge group with a relatively low impact was the *Marketing Strategy*. Its works were largely cited by studies examining the role of marketing strategy on the development of new services.

When it came to the second period, all previously identified knowledge groups were present with another two new groups emerging. Altogether, they explained 71% of the total variance. The most prominent knowledge group was the new *Cross-*

function Team & Communication. Organizational issues in relation to communication and functional integration were the key themes of the references in this group. Its emergence reflected scholars' increasing interest in internal cooperation and communication in NSD projects during period 2. A large portion of the references in this knowledge group contributed to the establishment of the NSD subfield *Organizational Design and Communication*. Another new knowledge group was the *Service Quality*. Included here were works from authors such as Parasuraman and Crosby. They laid the foundation for the development of service quality research and were heavily cited by NSD scholars who advocated designing quality into new services. As for the factors inherited from the previous period, there have been some noticeable changes. The *NSD Practice & Process* doubled its explained variance to 13%. This was caused by an increasing number of NSD specific references and growing interest in NSD related topics, suggesting that the NSD research stream had evolved from its inception stage to a rapid growth stage. This trend was also demonstrated by the knowledge group *Critical Success Factor* as studies pertinent to NSD success factors now accounted for the majority of works in that group. On the other hand, the *NPD Practice & Process* dramatically lost influence in period 2, evidencing a more concentrated interest in NSD dedicated references. Although the *Operations & Marketing Strategy* was derived from the knowledge group *Marketing Strategy*, it became slightly different from its ancestor in that its references covered a wider span of strategic focuses, including both operations and marketing strategy.

Moving to the third period, the intellectual structure exhibited more diversity. It was represented by eight knowledge groups, five of which were newly formed. In total, 63% of the variance was explained by these major factors. The *Customer Interaction* included works that stressed the value of the voice of the customer and promoted

turning customer input into innovation. The *Market Orientation* was constituted of works whose topics surrounded market orientation. These two knowledge groups gave fresh perspectives to the NSD field, advocating that more attentions be paid to customers. The associated references facilitated the formation of the subfield *Market Oriented NSD*. The knowledge group *Service-dominant Logic* included seminal works by Lusch and Vargo together with other articles that adopted service-dominant logic. These references suggested that the traditional dichotomy of product versus service was no longer suitable and more attentions had to be diverted to "value-in-use". The new dominant logic overshadowed the traditional marketing view that differentiated between services and products. This explains why the knowledge group *Marketing of Services* disappeared during this period. Another newly formed knowledge group is the *Performance Measurement*. It contributed to NSD research by proposing various fine-grained NSD performance measures. A closely related knowledge group is the *Research Methodology*. It included classic literature on both quantitative and qualitative research methodologies. The emergence of these two groups indicated that the NSD field had moved toward a more mature stage where rigorous and empirical research set the norm. The *NSD Practice & Process* further increased in influence, becoming the dominant factor in period 3. Newer references began to replace older works as standard references. In particular, references discussing the theoretical background of service innovation assisted the formation of the NSD subfield *Theory of Innovation in Services*. On the other hand, works from the *Critical Success Factor* subfield were now unanimously NSD success studies, and the *NPD Practice & Process* disappeared from the intellectual space. These changes implied the maturation of the NSD field as a large number of cited references in NSD studies had been grouped in the common intellectual repository, suggesting high quality and increased

relevance. The knowledge group *Operations & Marketing Strategy* did not deviate much from the previous period, showing only a slight supplement of more recent works. The disappearance of the *Cross-function Team & Communication* and *Service Quality* showed the decreasing influence of these knowledge groups on NSD research.

By examining the continuities and changes in the knowledge groups over different sub-periods, we were able to evaluate the extent of focus and diversity in the development of the field (Taylor *et al.*, 2010). As shown in Figure 2.4, three core knowledge groups—*Critical Success Factor*, *NSD Practice & Process*, and *Operations & Marketing Strategy*—are clearly distinguishable through all sub-periods. This demonstrates the continuity and temporal stability in the NSD field. The influence of the knowledge group *NSD Practice & Process* has dramatically increased over time, suggesting that a growing number of knowledge inputs to NSD studies now come from the common intellectual repositories within the NSD field. This evidences the increasing consistency in the intellectual structure and is a sign of the maturation of a certain field (Durisin *et al.*, 2010). The intellectual structure also shows a pattern of diversity with some knowledge groups emerging and fading over time. The variety of identifiable knowledge groups has continuously increased, confirming the increasing sophistication of the field. This is another indication of the maturation of an academic field (Durisin *et al.*, 2010). The changes within certain knowledge groups also signify the growing diversity in the intellectual structure. Older works related to the core knowledge groups have been gradually replaced by more recent references. Such substitution implies the increasing depth and rigor of the knowledge base, which again suggests the field's maturation (Durisin *et al.*, 2010). Taking into consideration the fact that the intellectual structure of the NSD field is characterized by both focus and diversity and it shows increasing consistency, sophistication, depth, and rigor, we can

draw the conclusion that NSD research has reached the maturity stage and is on its way to evolving into a distinct academic field in its own right.

2.5. Looking into the Future

In this section we elaborate on future research opportunities based on previous bibliometric analyses. Bibliometric examinations are data-driven and objective, so the rationale follows that advancements in the research field are, to a large extent, dependent on previous studies (Hoffman and Holbrook, 1993; Kuhn, 1996). In the search for potential research topics, we take into consideration the spatial characteristics of research themes in the MDS map. The size of the subfield can be treated as a proxy for the amount of attentions that has been paid to a certain research topic. A subfield containing a small number of recent works can be deemed a research front worth further exploration. The distance between two subfields reflects the strength of the bibliographic coupling links. A large gap suggests a lack of common references, highlighting the need to conduct research that is able to fill the blank. In total, we have identified three potential avenues for exploration which are detailed as follows.

First, research on *NSD Strategy* needs to be further strengthened. The MDS map identified only a limited number of relevant studies on NSD strategy, signifying that NSD scholars have yet to address this issue in detail. In their literature review, Menor *et al.* (2002) pointed out that one research opportunity is to exploit strategic and tactical issues related to NSD. However, this topic has not been thoroughly investigated during the past decade. Considering that it is widely accepted that a clear NSD strategy is the most consistently held prescription for development success (Sundbo, 1997; Johnson *et al.*, 2000; Cooper and Edgett, 2010), the NSD community

should divert more efforts to clarifying the practices that help service firms devise these strategies. In particular, the connection between the subfields *Market Oriented NSD* and *NSD Strategy* is worthy of research consideration as they have the largest separation in the MDS map. The market orientation advocates quick responses to a changing environment, while NSD strategy favors the alignment of a development strategy with an organization's overall business strategy. Conflict arising from adaptation and standardization needs to be further addressed in future studies. Also, as *NSD Strategy* is located far from the subfield *Typology of Service Innovation*, it would be worthwhile to investigate strategies for services with different degrees of innovativeness.

Second, *Employee Management* is another subfield that requires more attentions according to the MDS map. Johne and Storey (1998) stressed that the development and customer-contact staff are the individuals that have to be effectively managed in NSD projects. However, most of the existent studies were descriptive in nature and usually correlated a few human resource management practices with NSD success in an aim to identify the most important activities. Many management related questions regarding how to effectively manage these activities were left unanswered. The benefits of involving employees have long been recognized by NSD scholars (e.g., Schneider and Bowen, 1984; Edvardsson and Olsson, 1996). Therefore, the subfield *Employee Management* could be expanded by investigating various human resource management practices at a more detailed level. In particular, the clear distinction between *Employee Management* and *Market Oriented NSD* indicates potential research opportunities. The missing link between employees' perception of human resource practices and customer satisfaction is regarded as one of the research priorities for service scholars (Ostrom *et al.*, 2010).

Third, the subfield *Theory of Innovation in Services* offers considerable opportunities for further development. This subfield is situated far away from other NSD subfields in the MDS map, indicating a small number of shared references with other research topics. Since *Theory of Innovation in Services* mainly focuses on developing abstract theories, more studies relevant to management are needed to understand how companies can cope with different modes of service innovation in a real business environment. Our bibliometric analysis shows that a growing number of recent studies have adopted the synthesis approach and investigated how manufacturers can adapt the concept of NSD. With more manufacturing companies moving from product offerings to value-added services (Mathieu, 2001; Matthyssens and Vandenbempt, 2008), one research opportunity is to examine the ways through which goods-based companies can successfully provide service offerings and even evolve into service-oriented enterprises. The subfield *Theory of Innovation in Services* has laid a sound groundwork of theories, but more empirical studies are needed in relation to this topic.

2.6. Conclusions

The objective of this paper is to provide a review on NSD research themes and intellectual structure and to suggest future research opportunities. Unlike previous qualitative NSD review articles which mainly depended on authors' subjective reflections, we attempted to accomplish our objective by conducting bibliometric analysis, which is based on objective data and a quantitatively rigorous methodology (Nerur *et al.*, 2008; Kunz and Hogreve, 2011). This study contributes to the NSD research in that it not only offers special insights into the current state of the NSD field

and future directions, but also demonstrates the usefulness of bibliometric techniques as an objective and quantifiable review tool.

Several noteworthy results have been obtained. First, the citation analysis showed that both the number of NSD studies and the variety of publishing outlets have increased dramatically over the past three decades, indicating the growing popularity of NSD topics among academics. The forward citations to NSD articles displayed a similar fast growth pattern, with papers from innovation management, service, and operations production journals being the biggest consumers of NSD knowledge. This suggests that NSD research is becoming an important source of ideas and thinking in areas beyond the service field.

Second, the bibliographic coupling analysis identified eight major NSD subfields in a two-dimensional MSD map oriented along a horizontal "temporal continuum" and a vertical "functional emphasis" dimension. Although previous NSD reviews also uncovered research topics (e.g., Droege *et al.*, 2009; Papastathopoulou and Hultink, 2012), our results were data-driven and the MDS map was able to reveal the relationships among the subfields. The spatial characteristics of the map offer an objective account of the further research opportunities. Specifically, we advise that more studies should be conducted to address the research voids in relation to the subfields *NSD Strategy*, *Employee Management*, and *Theory of Innovation in Services*.

Third, the co-citation analysis provided a longitudinal perspective of the intellectual structure of the NSD field. Combined with factor analysis, it identified a number of key knowledge groups that contributed to the development of NSD research. On the one hand, the variety of identifiable knowledge groups has continuously increased over time, highlighting the diversity of the NSD field. On the other hand, three core knowledge groups—*Critical Success Factor*, *NSD Practice & Process*, and

Operations & Marketing Strategy—are clearly distinguishable through all sub-periods, evidencing the focus of the field. In particular, the knowledge group *NSD Practice & Process* has dramatically increased in influence, implying that NSD research is now more solidly rooted in its own knowledge repositories. This provides evidence that NSD research has reached the maturity stage and is on its way to evolving into a distinct academic field in its own right.

From a stakeholder perspective, this bibliometric study offers valuable implications for the stakeholders of academic journal articles, i.e., readers, authors, and editors. For readers, this research serves as a thorough account of the disciplinary development of the NSD field. The major research themes have been identified, and those who are interested in a certain subfield could get acquainted with the key references in relation to that topic. We also identified the journals that most frequently publish NSD studies, and this will help readers locate NSD articles more easily. For authors, an objective and data-driven analysis of the current state of NSD research can help them avoid reinventing the wheel. The evolution of the intellectual structure underlines the emerging knowledge groups that authors should pay attention to. In addition, we identified the topics that are under-researched and provided authors with suggestions for future research opportunities. For editors, our results indicate that NSD research has attracted a wide range of audiences from various disciplines. Therefore, editors from non-service journals should also be open to publishing NSD studies to meet the growing demand for the relevant knowledge. It was found that special issues played an important role in disseminating NSD knowledge. Articles published in special issues usually draw great attentions from NSD scholars, which in turn brings a large number of citations to the journal. Thus, special issues in relation to NSD problems should be promoted by editors.

All methodologies have their limitations and bibliometric analysis is no exception. Therefore, the results need to be interpreted with caution. First, articles may be cited for various reasons and citation may not reflect a transfer of knowledge or acknowledgement of intellectual indebtedness (Baumgartner and Pieters, 2003). However, this study used techniques (i.e., bibliographic coupling and co-citation analysis) that are able to establish the citation relationships based on groups of references that were frequently cited together. This alleviated the above bias because the repeated citation of a certain group of references is a reliable indication of intentional knowledge reuse. Second, we selected NSD papers from a limited number of top journals, and it is possible that a few NSD papers from other journals were left unexamined. However, we decided to opt for paper quality instead of quantity because our sample size was big enough for us to derive valid statistics. In fact, Papastathopoulou and Hultink's (2012) study identified a similar number of NSD articles, assuring us of the representativeness of our sample. Third, White and McCain (1998) expressed concerns that bibliometric analysis cannot be a substitute for extensive reading and elaborate content analysis. To compensate for this, we have supplemented the discussion with a detailed qualitative analysis.

Chapter 3

New Service Development Tools and Techniques: Use and Effectiveness [2]

3.1. Introduction

In the face of competitive and turbulent economies, new service development (NSD) is indispensable to the survival of service firms. On top of the apparent financial benefits, NSD can enhance the competitiveness of an organization, create value for existing customers and attract new customers (Edvardsson *et al.*, 2000; Fitzsimmons and Fitzsimmons, 2006). However, NSD success rates are far less than satisfactory. 35% to 40% new services are estimated to have disappeared from the market after a very short period of time (Edvardsson *et al.*, 2000).

To turn things around, various NSD tools and techniques have been proposed to support NSD projects, and they offer opportunities for developing new and improved services (Smith *et al.*, 2007). Despite the proliferation of NSD tools, few studies focused on the tools employed for successful NSD exist (Menor *et al.*, 2002; Adams *et al.*, 2006). Most NSD tool studies mainly explain the application of certain tools to a particular situation while the general impact of the NSD tools on NSD performance remains unclear. Thus, researchers call for a more systematic approach to evaluating the impact of tools (Brady *et al.*, 1997). When measuring NSD performance, extant studies typically use market-oriented indicators. Although they reflect the most important concerns of NSD managers, project performance—such as time and expenditure—is also indispensable to project rating. By adopting the operations and marketing perspectives of product innovation proposed by Tatikonda and Montoya-

[2] An earlier version of the paper was presented at 2012 IEEE International Conference on Management of Innovation and Technology (ICMIT 2012), Bali, Indonesia.

Weiss (2001), our study specifically looks into NSD tools' impact on both operational and product performance.

In summary, the present study aims to determine the role of NSD tools in supporting and improving NSD projects. To be specific, three research questions are raised,

- What are the common NSD tools?
- How are NSD tools used in contemporary service firms?
- Does the use of NSD tools improve NSD operational and product performance?

3.2. Definition of NSD Tools and Common NSD Tools

By referring to Brady *et al.*'s (1997) definition of management tool, we define a NSD tool as a precisely described framework, procedure, system, or method for supporting and improving NSD processes. Amid the ongoing debate about whether NSD processes are distinctively different from those of NPD, there emerged three approaches to studying the development of new services: the assimilation approach, demarcation approach, and synthesis approach (Coombs and Miles, 2000). Since these approaches represent different views on the concepts and methodologies which can be used for NSD, we conducted a review of NSD tool related studies by classifying them according to these schools of thought.

The assimilation approach stresses that the concepts developed in the product context can be readily applied to the service context, and it is supported by the observation that successful service and manufacturing companies share similar development practices (Nijssen *et al.*, 2006). Due to the proven link between the use of NPD tools and the increased NPD performance (Nijssen and Lieshout, 1995; Nijssen and Frambach, 1998; Barczak *et al.*, 2009), a number of studies have applied classic

NPD tools to NSD projects. Benchmarking is an useful strategic planning tool that has been widely adopted in the service industry (Koller and Salzberger, 2009). By comparing NSD practices against those of best-in-class companies, a service firm can improve its own development processes to achieve the desired performance levels. Benchmarking acts as a powerful technique that facilitates organizational learning and continuous improvement (Gable *et al.*, 1993). The major problem of service benchmarking is the difficulties in selecting appropriate benchmarking partners because of the idiosyncrasies associated with particular service (Narayan *et al.*, 2008). Another frequently mentioned tool for strategic decision-making in the service industry is scenario planning (e.g., Moyer, 1996; Ahn and Skudlark, 2002). It provides service firms with a set of scenarios and a wide range of possibilities so that they can capture changes in the turbulent market which otherwise are easily ignored. It is a good way to establish the first-mover advantage by identifying future needs and generating new product concepts before competition; however, the lack of future market knowledge might make it difficult to evaluate product concepts (Ozer, 1999). To generate marketable new service ideas, it is suggested that companies utilize traditional NPD tools, like focus group and brainstorming (Alam, 2002). Focus group is a planned discussion among a group of customers and/or experts. It is designed to obtain qualitative data regarding customers' perceptions, feelings and manner of thinking about services (Krueger and Mary, 2009). It is usually conducted quickly and at a low cost, while its limitation is that the group may not be representative and the discussion might be dominated by talkative person (Ozer, 1999). When innovative ideas are needed, brainstorming serves as a direct trigger (de Jong and Vermeulen, 2003). It is a systematic creative group session in which barriers to creative thinking are removed to stimulate the production of new ideas (Zeithaml *et al.*, 2003). Brainstorming has

advantages in encouraging open sharing of ideas and stimulating participation among group members (Furnham, 2000). However, it may sometimes result in creative but rather meaningless ideas (Goldenberg *et al.*, 1999). Prior to actual development, concept testing is an important tool to assess the marketability of service ideas (Page and Rosenbaum, 1992). It has been used in service firms to evaluate whether a customer: i) understands the idea of the new service offerings, ii) is favorable for it, and iii) feels it provides benefits that can satisfy unmet needs (Murphy and Robinson, 1981). It requires only survey data, so it is relatively easy to implement; however, there is no specific best decision rule to help select the most promising service ideas (Ozer, 2002). In the development stage, one of the most widely-applied NPD tools is the quality function deployment (QFD). It is a technique to translate customer requirements into product designs through the house of quality. By synthesizing external customer needs and internal development efforts, QFD provides actions-oriented guidelines to design quality into a process and to facilitate coordination (Jeong and Oh, 1998). And as a result, QFD has been gradually introduced into the service industry (Chan and Wu, 2002). Concerns about QFD mainly associate with its cumbersome procedures which require extensive cross-functional involvement (Jeong and Oh, 1998; Smith *et al.*, 2007). Another commonly used development tool is the structured analysis and design technique (SADT). It is a graphical representation of activities at different abstract levels. SADT focuses on the modeling of processes so that roles and responsibilities of activities are clearly defined. This makes it tailor-made for the development of service processes (Congram and Epelman, 1995). SADT has advantages in allowing rigorous expression of high-level ideas and problems that are too nebulous to treat technically, but it is not a tool that directly solves problems (Ross, 1985).

The demarcation approach, on the other hand, emphasizes that NSD possesses its distinctive features so that processes should be specially designed rather than being directly adapted from NPD. Bitran and Pedrosa (1998) pointed out the inability of some NPD tools to support NSD processes because the intangibility of services makes it more difficult to understand customer's latent needs. Also, service's intense interaction between customers and employees needs to be well addressed, and the direct application of classic NPD tools might offer little value to NSD projects (Fähnrich and Meiren, 2007). Therefore, there is a need to design NSD tools that enable the translation of distinctive service features into specifications. In recent years, we have witnessed an increasing number of service-specific tools. One example is the service blueprinting (Shostack, 1984; Bitner *et al.*, 2008). It is a technique to systematically map service delivery processes by specifying the linkages between key activities, physical evidences, waiting times, and points of failure. It is useful for designing support processes in an efficient manner with focuses on efficiency and time reduction (Smith *et al.*, 2007). However, it is of limited use to tackle the multichannel nature of services because it emphasizes on micro level person-to-person processes (Patricio *et al.*, 2008).

The synthesis approach advocates the integration of relevant concepts from both service and product contexts, because many of the claimed peculiarities of NSD also apply to NPD and vice versa (Drejer, 2004). Most existent NSD tool studies treat one particular tool as the unit of analysis, but no single tool can handle all critical issues that firms may encounter in NSD projects. Therefore, there is a need to take a holistic view by taking into account both NPD tools and service-specific development tools. Here, we propose a summary of common NSD tools and their strengths and weaknesses (refer to Table 3.1). This is to provide scholars and practitioners with the

common language to talk about NSD tools, because it is often the case that managers apply procedures derived from certain tool without knowing they are using it.

Table 3.1 Purpose, Advantage, and Disadvantage of Common NSD Tools

NSD tool	Purpose	Advantage	Disadvantage
Benchmarking	To benchmark against best practices of NSD	Powerful to facilitate organizational learning	Difficult to select appropriate benchmarking partners
Scenario Planning	To predict risks and needs in the future	Help establish first-mover advantage	Difficult to assess future needs
Focus Groups	To understand customers' opinions about new service ideas	Low cost and quick implementation	Group might not be representative
Brainstorming	To generate innovative new service ideas	Facilitate group participation to share ideas	May result in creative yet meaningless ideas
Concept Testing	To identify promising new service ideas for further consideration	Easy to implement	No single best decision rule to predict market acceptance
Quality Function Deployment (QFD)	To translate customer requirements into new service specifications	Provide actions-oriented guidelines to design quality into a process	Complex to use and require extensive cross-functional involvement
Structured Analysis and Design Technique (SADT)	To map service processes with clearly defined responsibilities	Allow rigorous expression of high-level ideas and problems	Provide few instructions to solve the identified problems
Service Blueprinting	To clarify service concepts and systematize service delivery processes	Powerful to design processes emphasizing on efficiency and time reduction	Too much focus on standardization and individual encounter

3.3. Classification of NSD Tools

The various tools have their own strengthens and are intended to tackle particular issues. So it is necessary to devise a classification scheme to make clear their usage patterns and effectiveness under different situations. Following the contention that innovation success arises from a combination of technical feasibility and market demand recognition (Gupta *et al.*, 1986), service research scholars argue that services result from cross-functional production efforts of operations and marketing management (Zeithaml *et al.*, 2009). Each department is responsible for coping with different sets of objectives—operations management concerns the development and

delivery of the services, while marketing management embodies identifying, understanding, and satisfying customer needs (Roth and Van Der Velde, 1991). Thus, operations and marketing constitute two indispensable drivers of successful new services. We posit that two groups of NSD tools can facilitate the development processes—NSD development tools and NSD market tools (refer to Figure 3.1). NSD development tools are composed of techniques which intend to support development efforts from an operations perspective, especially for the NSD stages of service design and service testing. Some of the examples are concept testing and service blueprinting. Their usage fosters internal communication among NSD team members, facilitating organizational learning and lowers the risks and uncertainties prior to product launch. NSD market tools are tools which are employed to engage customers for a better understanding of user needs and commercial potential, and thus facilitating development effort from a marketing perspective. They are mainly used in the NSD stages of idea generation and screen, business and market analysis, and service launching. Market research and communication tools, such as focus groups and brainstorming, are helpful to service providers to get first-hand information before and after the technical development of a new service.

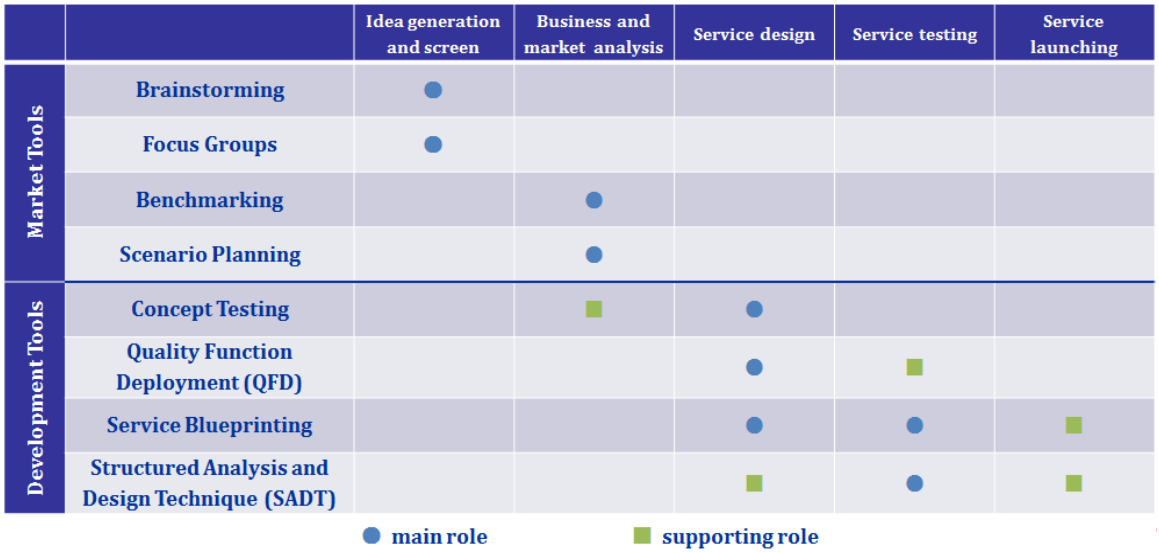


Figure 3.1 NSD Tool Classification Scheme

3.4. Theoretical Framework and Hypotheses

3.4.1. NSD Performance Measurement

Following Tatikonda and Montoya-Weiss's (2001) integrative operations and marketing perspective, we measure NSD performance by dividing it into operational and product performance. Operational performance describes how the NSD project is executed and operationalized within the service firm, while product performance assesses the commercial outcome of the new service that is launched in a market (Blindenbach-Driessen *et al.*, 2010). They reflect both internal and external perspectives of the product development processes. The lack of either measurement leads to an incomplete view of the development outcome (Tatikonda and Montoya-Weiss, 2001). The use of NSD tools may lead to high customer satisfaction, although it is also likely to inflate expenditure due to extra man power and extended time. One the other hand, tool usage is possible to speed project at the cost of a deep understanding of customer needs. Therefore, it is important to separate both criteria so as to make clear the role of NSD tools in projects. Operational performance is assessed through time-to-market, cost, service quality and knowledge gained, covering both efficiency and effectiveness concepts (Henderson and Lee, 1992). According to the project management literature, both effectiveness and efficiency are reliable predictors of project success (Verworn *et al.*, 2008). Product performance gauges both financial and non-financial performance of the new service after it is launched into a marketplace (Avlonitis *et al.*, 2001). Gained profit, revenue and market share are used to measure financial product performance, while non-financial measurements include the achievement of competitive advantage, customer satisfaction, and opening of a new market. The influences on the use of NSD tools on NSD performance are depicted in Figure 3.2.

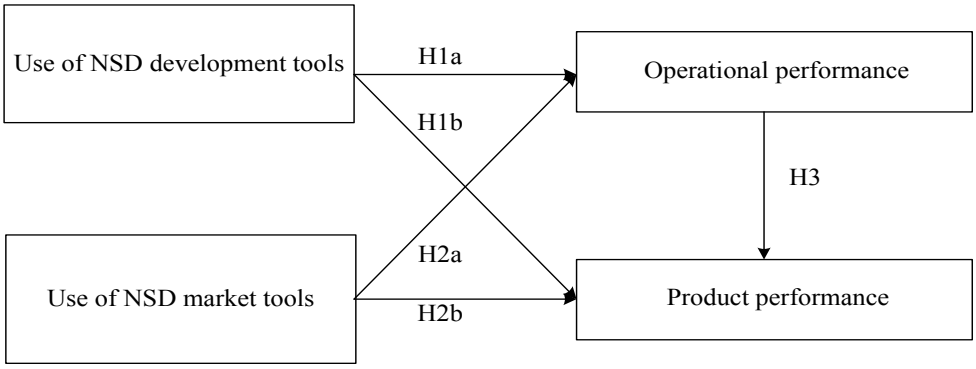


Figure 3.2 Framework of the Use and Effectiveness of NSD Tools

3.4.2. The Effect of NSD Tool Usage on NSD Performance

Organizational information processing theory indicates that product development processes can be constructed as a complex information-processing network (Yassine *et al.*, 2008). The implementation of practices facilitating internal communication helps firm access, integrate and transform widely dispersed information, leading to effective team learning (Lynn *et al.*, 1999; Kleinschmidt *et al.*, 2010). It was found that innovation management techniques play an important role in building the network and aligning network members to shared goals, thus improving the quality of development projects (Igartua *et al.*, 2010). Also, computer aided design techniques were found to significantly accelerate the development processes because they provide team members easy access to prior product design experience and current project information, regardless of location and time (Zirger and Hartley, 1994). In addition, the frequent sharing and feedback of information brought by NSD tools helps a firm go through rigorous review and analysis on key decisions and problems. Coordination mechanisms, like quality function deployment (QFD) and concept testing, foster a cooperative climate in marketing and development functions to accurately translate customer needs into company-specific development features (Jeong and Oh, 1998).

This helps various functions avoid incompatible decisions which will later cause conflicts, so the subsequent time and expenses spent on modifying decisions and designs are reduced (Olson *et al.*, 2001). The empirical study confirmed that the use of product design, virtual prototyping and concept testing tools, has a positive impact on product quality because they allow teams to share and revise designs effectively (Durmusoglu and Barczak, 2011). Therefore, we argue that the use of development tools will positively affect operational performance.

Hypothesis 1a*: The use of development tools has a positive influence on operational performance.*

Due to the functional separation between the back and front offices, uncertainties in the service innovation processes are inevitable. A company's capability of uncertainty reduction is closely linked to NSD performance (Lievens and Moenaert, 2000b). Testing tools, such as failure modes and effects analysis (FMEA) and service blueprint, can be used to identify possible service-related mishaps or problems (Chuang, 2007; Bitner *et al.*, 2008). This scrutinizes all of the underlying opportunities for productivity improvement, helping firms lower the risk of service failure and enhance customer satisfaction (Geum *et al.*, 2011). Besides, service firms can visualize intangible service products through prototyping tools and have it tested with customers prior to official launch. In this way, the disparity between product features and real customer needs are discovered and bridged, so the finalized service is more likely to conform to customer requirements (Adamopoulos *et al.*, 1998). In the case study of Bank of America, feedback about service concepts were frequently elicited from real-life "laboratories" before the service is rolled out nationally, and this resulted in high customer satisfaction and low NSD failure rates (Thomke, 2003). The empirical study showed

that the use of product development techniques is positively related to a multidimensional success index which includes market share, success rate, launching frequency, sales, and customer satisfaction (González and Palacios, 2002). Also, firms with higher sales and profit usually employ more testing and engineering tools than the rest (Barczak *et al.*, 2009). Hence, we argue that the use of development tools will have a positive impact on product performance.

Hypothesis 1b*: The use of development tools has a positive influence on product performance.*

Market information can improve the ways in which managers think about problems, thus increasing decision effectiveness and enhancing project implementation (Moorman, 1995). Some well-established market research techniques, such as focus groups and lead users, are widely used to narrow down the product concept and seek customer input (Hoyer *et al.*, 2010). This decreases the need for input and effort from service firms, therefore reducing time-to-market and development cost (Cooper and Kleinschmidt, 1994; Fang, 2008). Besides, according to the customer-as-a-resource view, customers can provide access to development capabilities and resources that a company may lack in-house (Athaide *et al.*, 1996). Market tools can be used to elicit technological know-how and processed information residing in customers. This information reduces development risks and difficulties, so higher quality for both execution processes and final product can be achieved (Campbell and Cooper, 1999; Dong *et al.*, 2008). Firms which used simulated test market tools acquired adequate information and, in the meantime, successfully saved developing time and cost (Cordero, 1991). In a survey on innovation management techniques, managers reported that the application of market intelligence techniques strengthens competitive

advantages in ways such as increasing project flexibility and efficiency, improving productivity and time-to-market, and managing knowledge effectively (Hidalgo and Albors, 2008). So, we argue that the use of market tools will enhance operational performance.

Hypothesis 2a*: The use of market tools has a positive influence on operational performance.*

From a service-dominant logic perspective, customers are co-creator of value-in-use (Vargo and Lusch, 2004). Market tools facilitate companies to focus on the context of use and features that customers value most. Market information is critical for identifying customer needs and communicating with them effectively. Its acquisition and use positively correlated with a firm's performance (Parry and Song, 2010). In a case study of 3M, Lilien, Morrison, Searls, Sonnack, and von Hippel (2002) found that projects that utilized the lead users technique gained higher forecasted market share and sales. The market information can also enable service firms to identify and open a new market where fewer competitors exists, and therefore, help them develop more profitable services (Witell *et al.*, 2011). Besides, market tools can be used to engage customers in the trial and to generate user awareness of a new service. This can reduce risks perceived by customers and increase positive attitudes towards the service, thus fostering higher purchase intentions and improving the likelihood of product success (Franke *et al.*, 2009; Hoyer *et al.*, 2010). The impact of market tools on product performance was confirmed in several empirical studies. The PDMA survey revealed that best performing firms, in terms of sales and profits, employ significantly more market research tools than the rest of the firms (Barczak *et al.*, 2009). Also, structured market information processing tools were shown to have significant positive impact on

the amount of information shared, which contributes to a company's financial success (Ottum and Moore, 1997). In line with this reasoning, we argue that the use of market tools will positively influence product performance.

Hypothesis 2b*: The use of market tools has a positive influence on product performance.*

3.4.3. The Effect of Operational Performance on Product Performance

Tatikonda and Montoya-Weiss (2001) argue that the ability to achieve operational goals represents an organization's product development capabilities. Therefore, the achievement of operational outcomes aids the achievement of market outcomes. A fast time-to-market leads to an increase in product profitability and market share because the firm can satisfy early adopters who are willing to pay a premium (Brown and Eisenhardt, 1995). Also, a firm with the capability of short innovation speed is able to quickly respond to market demand, thus improving customer satisfaction (Chen *et al.*, 2010). When it comes to project cost, it is closely associated with a product's profitability and competitiveness (Monden and Talbot, 1995). High development cost eventually transmits to customers in the form of high product price, reducing their purchase intention (Tatikonda and Montoya-Weiss, 2001). Conversely, when a company is very effective in reducing cost, cheap products and good market performance can be expected (Spence, 1984). Service quality contributes to product performance in the way that customer satisfaction, loyalty and purchase intentions are key consequences of service quality (Cronin and Taylor, 1992; Parasuraman *et al.*, 1994). The superior service quality increases favorable behavioral intentions of customers, in terms of favorable word-of-mouth, willingness to pay a premium and high customer loyalty. All these bring positive financial results (Zeithaml *et al.*, 1996).

Empirical studies have confirmed a positive relationship between operational and product performance (Tatikonda and Montoya-Weiss, 2001; Blindenbach-Driessen *et al.*, 2010). In a break-down manner, time-to-market (Ali *et al.*, 1995; Carbonell and Escudero, 2010), project cost (Kato, 1993; Tatikonda and Montoya-Weiss, 2001), and service quality (Rust *et al.*, 1995; Chang and Chen, 1998) are found to be associated with market performance. Consequently, we argue that NSD operational performance will positively influence NSD product performance.

Hypothesis 3*: NSD operational performance has a positive influence on NSD product performance.*

3.5. Methodology

3.5.1. Sample and Data Collection

Given the nascent nature of the research topic, this study adopted the survey method in order to unveil NSD tool usage patterns and effectiveness. To mitigate potential contextual influences associated with an inter-industry sample (McGahan and Porter, 1997), we focused on financial service firms. They are ideal for study because they are active innovators of a range of products and services (Menor and Roth, 2008), and these offerings are somehow standardized and available off-the-shelf which provides opportunities for the use of NSD tools (Easingwood, 1986).

Two rounds of survey were conducted in Singapore and Taiwan. We chose these two countries because they are widely recognized among the Four Asian Tigers who boast highly developed financial services and there exist only subtle differences as for NSD practices (Song *et al.*, 2000). The questionnaire went through two pretests regarding its wording, design, relevance of items, and estimated completion time by 3 knowledgeable academics in the field of NSD and 4 practitioners from financial

institutions. Both pretests yielded only minor suggestions for improvement. The first round of survey was conduct in Singapore and a list of 420 financial institutions was drawn from the financial institutions directory compiled by the Monetary Authority of Singapore. The tailored design method was adopted for survey administration (Dillman *et al.*, 2009). Various techniques for improving response rates were incorporated (Frohlich, 2002). One week prior to mailing the survey package, invitation letters (refer to Appendix B) were sent out to the chief executive officer or principal officer in each company. This served three purposes: (1) to identify potential nonrespondents by asking them to inform us either if they want to opt out or they do not have NSD; (2) to ask recipients to pass the questionnaires to more qualified persons if they do not feel equipped to provide the accurate information requested; and (3) to enhance response rate by establishing a relationship of trust with the participants. 23 firms informed us to withdraw from the survey. A questionnaire (refer to Appendix E) accompanied by a two-page explanation of NSD tools, a personalized cover letter (refer to Appendix C), and a prepaid envelope was mailed to each of the remaining 397 financial institutions. Reminder letters (refer to Appendix D) were sent to nonrespondents two weeks later. Telephone calls were made to further solicit responses two weeks after the reminder. A total of 99 questionnaires were returned. Of these, 63 indicated no NSD and 2 were incomplete. This resulted in 34 usable responses with an actual response rate of 8.6% (34/397). An executive summary report (refer to Appendix F) containing the analysis results were mailed to all the respondents six months later. The second round of survey was conducted in Taiwan and the forth author utilized her personal network to distribute questionnaires to NSD managers in 60 financial institutions. A double-translation method was used to translate the questionnaire into a Chinese version for Taiwan distribution (Parry and Song, 1994). 45 questionnaires were returned and 4

were incomplete. This led to 41 usable responses with an actual response rate of 68% (45/60). In total, 75 responses were eligible for data analysis. Table 3.2 shows the characteristics of the respondents.

Table 3.2 Sample Characteristics

Characteristics	Frequency (Percentage)	Characteristics	Frequency (Percentage)
Industry		*Local NSD employee*	
Bank	44 (59%)	<10	30 (40%)
Insurance	12 (16%)	10-49	10 (13%)
Fund Management	10 (13%)	50-99	8 (11%)
Others	9 (12%)	>100	27 (36%)
Local full-time employee		*Business type*	
<100	19 (25%)	B-2-B	16 (21%)
100-499	16 (21%)	B-2-C	19 (26%)
500-999	2 (3%)	Mix	40 (53%)
>1000	38 (51%)		
Annual sales revenue (USD)		*Company ownership*	
<$24M	19 (26%)	Local	50 (67%)
$25-99M	9 (12%)	Foreign	23 (31%)
$100-499M	9 (12%)	Joint-venture	2 (3%)
>$500M	38 (50%)		

The unit of analysis was the NSD project. Respondents were asked to recall a largely internally developed NSD project that was conducted over the past 3 years. This new service has to be on the market for more than 6 months to ensure sufficient data for NSD performance evaluation. 69 (92%) respondents have over 1 year NSD experience with current company, indicating a high knowledge level on NSD activities. To test nonresponse bias, all measurement items of interest were compared between early and late respondents (Armstrong and Overton, 1977). No significant differences were found (p<0.01). Since responses were drawn from two different countries, the Mann-Whitney U Test was used to determine whether there were systematic differences between the two samples (Siegel and Castellan, 1988). Only one of the 23

measurement items used in the data analysis shows significant difference (p<0.01), indicating that it is safe to combine the two populations.

3.5.2. Measurement

An extensive literature review was conducted to help identify previously operationalized measurement items for NSD performance. All constructs, except tool usage, were developed using multiple items and 7-point Likert scales. An inventory of measurement items, together with loadings and *t*-values, are provided in Appendix G. Operational performance reflects how the NSD project is executed. Its measurements were adapted from Blindenbach-Driessen *et al.* (2010) by assessing time to market, project cost and quality. Product performance evaluates the commercial outcome of the NSD project. It was measured through six items borrowed from Voss, Johnston, Silvestro, Fitzgerald, and Brignall (1992) and Griffin and Page (1996).

NSD project was divided into five stages—idea generation and screen, business and market analysis, service development, service testing, and service launching (Song *et al.*, 2009). To limit the length of the questionnaire, four market tools (i.e., benchmarking, scenario planning, brainstorming, and focus group) and four development tools (i.e., concept testing, quality function deployment, service blueprint, and structured analysis and design) that appear frequently in the literature were listed in the questionnaire. Respondents were asked to indicate all tools that were used for each NSD stage. The number of tools used in all five stages is totaled for market and development tool respectively, and it serves as usage level for each tool category. Prior to the data analysis, all measurement items were standardized to avoid computational errors by lowing the correlation between the product indicators and their individual components.

3.6. Analysis and Results

3.6.1. Descriptive Results

Figure 3.3 describes the overall tool use. Market tools are more frequently employed than development tools among all surveyed companies. Brainstorming, benchmarking, and scenario planning stand out to be the top 3 market tools used by financial institutions, with more than 50% usage. Brainstorming tops the tools for needs identification owing to its inexpensiveness and easy-to-use. The high usage of benchmarking shows firms' eagerness to get input from competitors, indicating that one of the most used strategies for service firms is to imitate lucrative products from others. Scenario planning is useful to strategically position a company and its services in the marketplace. Struggling with economic stagnation, service firms become more prudential, thus putting more weight on strategic planning. Although scholars advocate the use of focus group, the high investment required as for capital and time may serve as obstacles to their adoption.

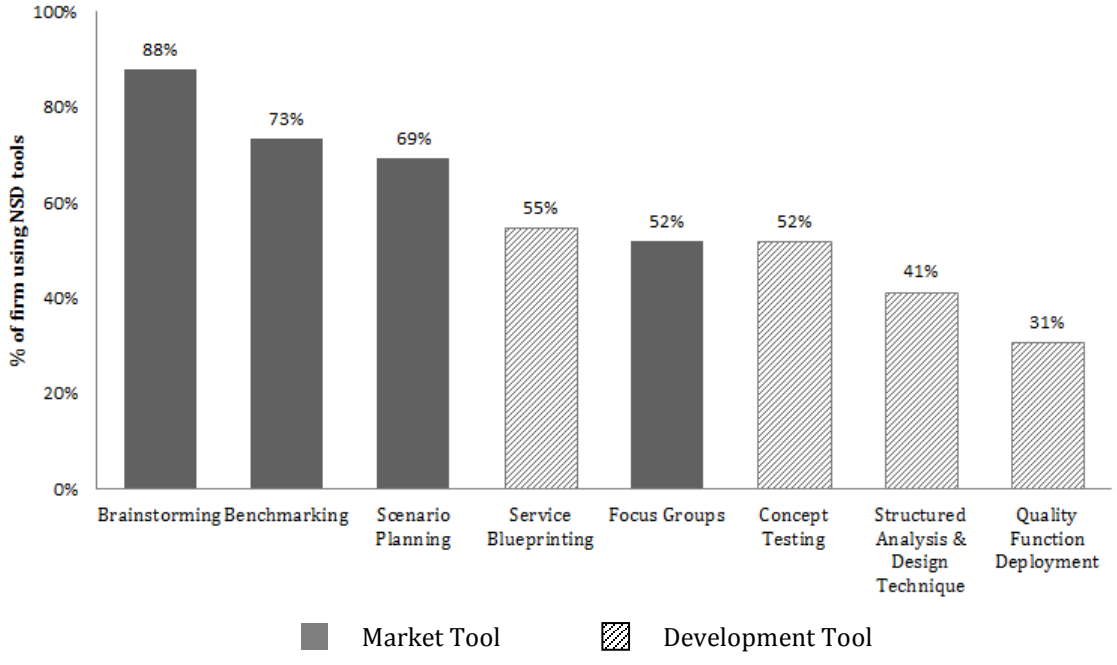


Figure 3.3 The Overall Usage of NSD Tools

Development tools are relatively less utilized, compared to their market tool counterparts. Top 3 most frequently used tools are concept testing, structured analysis and design, and service blueprinting. Concept testing helps firm filter service ideas so that limited resources can be allocated to those most promising service concepts. Structured analysis and design technique and service blueprinting facilitate formal service design procedures, but it seems that not so many firms are making advantage of them. Surprisingly, tools for trouble-shooting draw very few attentions. Consequently, the disappointing NSD success rate partially attributes to firms' unwillingness to detect potential failure and problems.

Figure 3.4 maps tools usage across several financial service sectors. Fund management firms utilize more market tools than banks and insurance companies, and banks use more development tools than other industries. All financial institutions rely heavily on benchmarking and brainstorming for market and competitor information. These tools help generate innovative ideas that meet customers' changing needs and industrial standards. More banks harness focus group. This is most useful when they want to thoroughly understand customer needs of a specific target group.

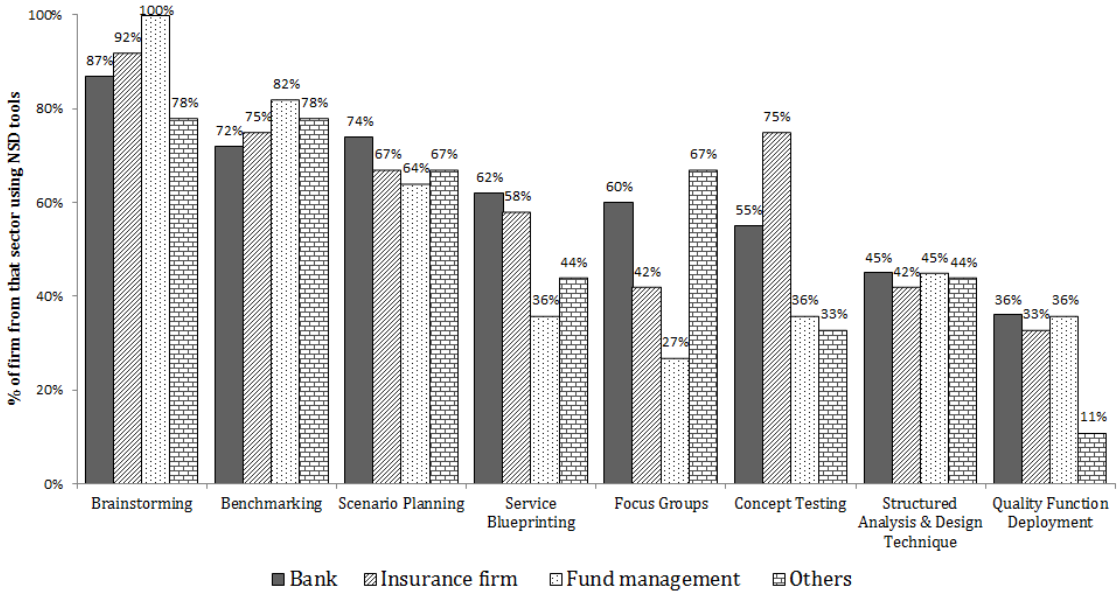


Figure 3.4 Use of NSD Tools in Different Financial Service Sectors

With regard to development tools, banks make the most use of structured analysis and design and service blueprinting, and this means that they attach more emphases on service design than other industries. Insurance companies utilize significantly more concept testing tools, reflecting their discretion in judging new service ideas. Fund management companies rank below average as for development tool usage. One explanation is that their business decisions relate largely to investment, which requires fewer efforts in service design and testing.

Confining to firms engaging certain tool, we calculated the percentage of these firms who apply such tool in each NSD stage (refer to Figure 3.5). The results show that NSD tools are not used in a focused manner; however, it is observed that firms tend to apply market tools in initial stages of idea generation/screen and business/market analysis while development tools are most frequently used in the development stage like service design and testing. This confirms our proposed tool classification scheme that NSD tools are intended to mainly facilitate either operations or market management.

		Idea generation and screen	Business and market analysis	Service design	Service testing	Service launching
Market Tools	Brainstorming	**71%**	47%	68%	12%	20%
	Focus Groups	39%	**53%**	45%	39%	29%
	Benchmarking	45%	**75%**	49%	25%	16%
	Scenario Planning	53%	**57%**	45%	28%	17%
Development Tools	Concept Testing	39%	24%	**42%**	39%	21%
	Quality Function Deployment (QFD)	17%	17%	**58%**	29%	13%
	Service Blueprinting	15%	22%	**54%**	37%	34%
	Structured Analysis and Design Technique (SADT)	41%	38%	**69%**	31%	21%

Figure 3.5 Use of NSD Tools in Different NSD Stages

3.6.2. Model Estimation

Structural equation modeling (SEM) is employed to test the proposed hypotheses. Covariance- and component-based SEM are two widely used types of SEM, and Partial Least Squares (PLS)—a component-based SEM—is selected in this study. The reasons are two folds. First, the survey is the first large-scale test of the exploratory hypotheses regarding NSD tool effectiveness. PLS is ideal for studies whose focus is on prediction since it maximizes the explained variance of dependent variables to account for observed dependent variables as they stand (Wold, 1985). Second, we have a relatively small sample size. PLS can well handle the resulting biases as it is constructed basing on ordinary least square, which is remarkably stable even at low sample size (Chin *et al.*, 2003). The acceptable smallest sample size used in PLS should be ten times greater than either (1) the block with the largest number of formative measures or (2) the dependent latent variable with the largest number of independent latent variables impacting it, whichever is the greater (Chin and Newsted, 1999). By applying this rule of thumb, it indicates that a sample size of 30 would be sufficient enough. The PLS results are interpreted in two stages: by assessment of the relationship between measures and underlying construct (measurement model) and by assessment of the relationships among hypothetical constructs (structural model) (Fornell and Larcker, 1981).

3.6.3. Measurement Model

Construct reliability and validity were evaluated in the measurement model. Reliability assesses the internal consistency and measurement error among the individual indicators within a construct. Two types of reliability tests were used in this study: internal consistency reliability and construct reliability (Nunnally, 1978). Internal

consistency reliability test was carried out by calculating Cronbach's alpha. As shown in Table 3.3, Cronbach's alphas of all constructs exceed the conventional threshold of 0.7. Construct reliability was tested using composite reliability that assesses the extent to which measurement items in the construct measures the construct. Composite reliabilities of this study range between 0.8 and 0.9, well exceeding the cut-off value of 0.7 (Nunnally, 1978).

Table 3.3 Means, Standard Deviations (SD), Cronbach's alpha (α), Composite Reliability (CR), Average Variance Extracted (AVE) and correlations

	Mean	SD	α	CR	AVE	1	2	3	4
1.Operational performance	4.14	1.11	0.73	0.84	0.64	**0.80**			
2.Product performance	4.41	1.47	0.87	0.90	0.60	0.54	**0.78**		
3.Development tool usage [a]	2.91	2.96	1.00	1.00	1.00	0.16	0.12	**1.00**	
4.Market tool usage [a]	5.92	3.94	1.00	1.00	1.00	0.30	0.12	0.46	**1.00**

Note: Numbers in boldface show the square root of the AVE, and numbers below the diagonal represent construct correlations. [a] Single indicator construct

Construct validity determines whether the indicators actually measure the concept that is intended to be measured (Straub, 1989). Convergent validity refers to the extent to which multiple measures of a construct agree with one another. Values of average variance extracted (AVE) are greater than 0.5, indicating that more variance was explained than unexplained in the variables associated with a given construct (Fornell and Larcker, 1981). The fact that item loadings for all constructs are greater than 0.5 and significant (p<0.05) further evidences good convergent validity (Hulland, 1999). Discriminant validity refers to the extent to which measures of different constructs are distinct. According to Table 3.3, no correlation is greater than the corresponding square root of AVE, confirming discriminant validity between constructs (Fornell and Larcker, 1981).

3.6.4. Structural Model

With an adequate measurement model, we further tested proposed hypotheses by examining the size and significance of structural paths via bootstrapping by using SmartPLS 2.0.M3. Table 3.4 presents the results regarding the main effects between NSD tool usage and NSD performance.

Table 3.4 Determination Coefficient (R^2), Standardized Path Coefficients (β), *t*-Values, and Effective Size (f^2)

Dependent Variable	Predictor	*β (t-Values)*	f^2	Conclusion
Operational Performance (R^2=0.10)	Development tool usage	0.02 (0.29)	0.00	n.s.
	Market tool usage	0.29 (2.53)**	0.08	H2a supported
Product Performance (R^2=0.30)	Development tool usage	0.08 (0.91)	0.01	n.s.
	Market tool usage	-0.08 (1.09)	0.00	n.s.
	Operational Performance	0.55 (5.09)***	0.39	H3 supported

Notes: *t*-values for path coefficient are reported in brackets, **p<0.05, ***p<0.01

Tool Usage and Performance. Both development and market tools are hypothesized to positively influence NSD performance in terms of operational and product performance. The results reveal that market tool usage has a strong positive relationship with operational performance (β=0.29, p<0.05, H6a). None of the other three relationships show a significant direct effect, disconfirming H5a, H5b, and H6b.

Operational and Product Performance. Operational performance is found to be significantly related to product performance (β=0.55, p<0.01, H7). The relatively high R^2 and path coefficient indicate that the achievement of operational outcomes facilitates the achievement of market outcomes.

3.6.5. Quality of the Structural Model

Since the primary objective of this study is prediction, the endogenous variables' determination coefficient (R^2) is examined (refer to Table 3.4). It reflects the level of

the latent construct's explained variance and a value of 0.1 is suggested for minimal explanation (Falk and Miller, 1992). By taking the nascent nature and complexity of this study into consideration, we deem that our dependent variables' R^2 are acceptable and the structural model shows explanation power.

The effect size f^2, which is decided by the change in R^2, shows whether an independent variable has a substantial influence on its dependent variable. Values of 0.02, 0.13 and 0.26 stand for small, medium, and large effect size respectively (Cohen, 1988). Operational performance has a large effect on product performance (f^2=0.39), indicating that operational performance is a good predictor of product performance (refer to Table 3.4). All other independent variables in significant paths show small to medium effective size, ranging from 0.07 to 0.08. This further confirms the relationship between independent and dependent variables as shown in the paths.

PLS does not optimize any global scalar function so that it cannot provide any index for global model validation. As an operational solution for this gap, goodness-of-fit (GoF) was suggested as a validation index (Tenenhaus *et al.*, 2005). It is the geometric mean of the weighted average communality and the average R^2. Because communality equals AVE in PLS path modeling approach, the average communality is calculated as a weighted average of AVE for all constructs with the weights being the number of measures per construct. The constructs of development tool and market tool use were excluded from average communality calculation because each of them contains only one indicator (Tenenhaus *et al.*, 2005). The GoF value for our model is 0.31. According to the criteria suitable for PLS from Wetzels *et al.* (2009) — GoF_{small}=0.10, GoF_{medium}=0.25, and GoF_{large}=0.36, it indicates a good fit of the model to the data.

3.7. Discussion and Conclusion

In this paper we have investigated the usage pattern of NSD tools and their impact on NSD performance. Contrary to the findings from NPD tool studies that tools are underutilized, this study's results show that financial institutions are more likely than traditional manufacturing companies to adopt facilitating tools, especially those for gathering market information. This reflects that financial service providers are recognizing the need to develop new services that are responsive to customers' changing yet heightened needs. The low usage of the development tools may be the result that firms still are not familiar with the concepts and benefits associated with these tools, and this was also observed in the NPD field (Barczak *et al.*, 2009). This requires that more research be directed to impart their advantages and applications to managers.

In accordance with previous research, our study shows that NSD tools are not used in a focused manner. However, an interesting finding is that market tools are used more intensively in the stages of idea generation and business analysis while companies tend to apply development tools in the development stages such as service design and testing. Our market/development tool classification scheme is thus confirmed, and this echoes service research scholars' contention that services result from cross-functional development efforts of both operations and marketing management (Zeithaml *et al.*, 2009). Researchers are advised to adopt a broader (market or development oriented) perspective when they devise new NSD tools, because a tool capable of tackling a group of related problems seems to be more welcomed by service firms.

As for NSD tool effectiveness, the use of market tool demonstrates a positive relationship with operational performance. This strengthens our belief that the

information gathered by market tools helps lower the development risks and difficulties, bringing about higher quality, shorter cycle time, and reduced cost. The usage level of development tools shows no impact on operational performance. Since these tools are much less frequently used by financial institutions, it is possible that they are not implemented in a correct way so as to exploit their full potentials (González and Palacios, 2002). We did not find direct relationships between NSD tool usage and product performance. However, this does not mean that NSD tools have no value in improving product performance. Our study shows that market tools have an indirect effect on product performance through influencing operational performance. This is consistent with Nijssen and Frambach's (1998) finding that market research tools have an indirect effect on product development performance because they provide market information which is necessitate to success.

The link between operational and product performance is strong yet positive, confirming previous findings in the NPD literature (Tatikonda and Montoya-Weiss, 2001; Blindenbach-Driessen *et al.*, 2010). Our contention is that NSD performance should be operationalized by gauging operational and product performance separately.

3.8. Implications, Limitations, and Future Research

3.8.1. Managerial Implications

Our research is among one of the first studies that benchmark the use of NSD tools and empirically test their effectiveness. It offers several managerial implications for NSD best practices. First, innovation in the service industry does not necessarily mean using the cutting-edge technology. NSD tools strengthen the firms' development capacity and their adaptability to market challenges. The classification scheme provides support that there is no one-to-one correlation between one tool and a specific problem.

Problems relating to each perspective (i.e., development or market) have similar causes and it is both economical and efficient to use a combination of tools to tackle a group of related issues. There is no one cure for all problems, so service firms should be open to the various tools available and develop a suitable tool box and corresponding implementation skills.

Second, the use of market tools improves NSD performance in that they facilitate the identification of customer needs and market environment. They are well received by most financial institutions with an overall penetration level of 70%. However, internal resource synergy affects their usage in that market tools are expensive to use and the implementation is time consuming. Therefore, service firms are advised to utilize more suitable market tools by taking their capabilities and needs into consideration.

Third, despite the plethora research that advocates the use of development tools, a relatively low development tool usage is observed. Especially, QFD is used only by 32% of the firms, remaining at a usage level as low as even two decades ago (Griffin, 1992). Research in innovation reveals that reluctance to change is common in the organization, so firm should foster a culture which favors the introduction of these tools. Training and workshop are important to develop necessary in-house skills, which is crucial to fully exploit the benefits. Also, firm can resort to consulting and market research firms for advices regarding the advantages and correct implementation of development tools.

3.8.2. Limitations and Future Research

This results of this study need to be interpreted with some constraints in mind. First, the size and nature of the sample do not allow us to make robust inferences as for NSD

tool usage and effectiveness. We focused on the financial service industry while other service providers may require a different set of NSD tools which might affect their performance in other ways. Second, only eight tools are listed in this study, and they do not represent the whole set of tools used by financial institutions. However, these tools are the most frequently researched tools in the literature, and this is the best we can do without a clearly defined reference framework of NSD tools. Third, the increasing competitive pressures and uncertainties drive financial service firms to outsource NSD activities (David, 1996). Our research does not count in the portion of tools used by professional service or market research firms to facilitate financial institutions' NSD projects. Forth, the study resorts to single key informants for the survey data. Although tests show that CMV does not pose potential threats, it is more suitable to use the Multi-Trait Multi-Method to gather objective assessment from both manager and customer.

The current study sheds lights on some directions for future research. A more comprehensive literature review on NSD tools would be beneficial to advance research in relation to NSD tools. What's more, it is worthwhile to figure out either the limitations or contradictory effects that NSD tools have on each other.

Chapter 4

Organizational Adoption of New Service Development Tools [3]

4.1. Introduction

In the search for critical factors for the development of quality services, the Software Engineering Institute (SEI) summarized that organizations typically focus on three dimensions: people, procedures and methods, and tools and equipment (1995; SEI, 2010). Literature reviews on new service development (NSD) revealed that the first two dimensions have been covered by a sizable body of literature (Johne and Storey, 1998; de Jong and Vermeulen, 2003), but the dimension of tools has received few attentions. The lack of research on NSD tools could lead to the unawareness and misuse of various useful tools, preventing firms from using them to their full potential. Since tools are regarded as an important input to the innovation process and play an enabling role in the development of services (Menor *et al.*, 2002), there is a need to narrow the theoretical and practical gaps by focusing on NSD tools.

Existent NSD tool studies generally treat one particular tool as the unit of analysis, such as the extension of a certain new product development (NPD) tool to service context (e.g., Moyer, 1996; Tan and Pawitra, 2001) or the design of a specific NSD tool (e.g., Moyer, 1996; Tan and Pawitra, 2001). A recent survey suggested that the development tool usage level was not high in the service industry (Barczak *et al.*, 2009). In the investigation of organizational adoption of product and process innovations, Damanpour and Gopalakrishnan (2001) also found that service firms were less likely to introduce new elements (e.g., tools and systems) into processes of service

[3] Chapter 4 is adapted from Jin, D., Chai, K.H., and Tan, K.C. (2012), "Organizational Adoption of New Service Development Tools", *Managing Service Quality*, Vol. 22 No.3, pp. 233-259. An earlier version of the paper was presented at 2010 Portland International Center for Management of Engineering and Technology (PICMET 10), Phuket, Thailand.

productions and operations. This raises an interesting research question regarding the reasons why NSD tools are underutilized despite the many benefits acclaimed by the academy. We thus argue that there is a pressing need to investigate the antecedents of NSD tool adoption so as to facilitate their diffusion in service firms.

The purpose of this study is to conceptualize and empirically test a theory-driven model that attempts to explain what affects the adoption of NSD tools. The research objective consists of two parts: (1) to understand the frequently used NSD tools in the service industry; and (2) to investigate the driving factors of NSD tool adoption. Data was collected from financial institutions located in Singapore and Taiwan. Financial service firms are ideal for this study because they are active innovators who are more likely to employ tools (Easingwood, 1986). Due to the small sample size and the use of formative measures, Partial Least Squares (PLS) is used for data analysis (Chin, 1998b).

This study makes four contributions to the NSD literature. First, we identified NSD tools that can facilitate the development efforts in service firms. This responds to Menor *et al.*'s (2002) call urging more research to be conducted on NSD tools. It aims to raise awareness of the available NSD tools among academics and practitioners. Second, based on the Theory of Planned Behavior (TPB) (Ajzen, 1985) and literature on organizational adoption of innovation (e.g., Tornatzky and Klein, 1982; Rogers, 1995), we tested the links between the antecedents and the intention to adopt NSD tools. This is to remind researchers of the critical factors that need consideration when new tools are to be designed. It is also of practical value because service firms can follow the suggestions to enable tool adoption. Third, this study demonstrated the applicability of TPB to explain organizational behavior by treating manager's intention as a proxy. Future research on organizational adoption of innovation can thus consider

the use of TPB. Fourth, we highlighted the need to construct some measures in a formative way because measure misspecification will lead to inaccurate conclusions (Diamantopoulos *et al.*, 2006). A series of rigorous validation and analysis procedures pertaining to formative measures have been illustrated in the methodology section. The rest of the paper is organized as follows. In the next section, we put forth a review of NSD tools, present an introduction to TPB, and justify how it can be applied to the organizational context. Then, after laying out our conceptual framework, we report the empirical findings regarding tool usage and adoption antecedents. The paper concludes with discussions of theoretical and managerial implications and directions for future research.

4.2. Literature Review

4.2.1. New Service Development Tools

By referring to Brady *et al.*'s (1997) definition of management tool, we define a NSD tool as a precisely described framework, procedure, system, or method for supporting and improving NSD processes. Amid the ongoing debate about whether NSD processes are distinctively different from those of NPD, there emerged three approaches to studying the development of new services: the assimilation approach, demarcation approach, and synthesis approach (Coombs and Miles, 2000). Since these approaches represent different views on the concepts and methodologies which can be used for NSD, we conducted a review of NSD tool related studies by classifying them according to these schools of thought.

The assimilation approach stresses that the concepts developed in the product context can be readily applied to the service context, and it is supported by the observation that successful service and manufacturing companies share similar

development practices (Nijssen et al., 2006). Due to the proven link between the use of NPD tools and increased NPD performance (Nijssen and Lieshout, 1995; Nijssen and Frambach, 1998; Barczak et al., 2009), a number of studies have applied classic NPD tools in the service context, such as benchmarking (Koller and Salzberger, 2009), scenario planning (Moyer, 1996), focus groups (Alam, 2002), brainstorming (Zeithaml et al., 2003), concept testing (Page and Rosenbaum, 1992), quality function deployment (Tan and Pawitra, 2001), and structured analysis and design technique (Congram and Epelman, 1995).

The demarcation approach, on the other hand, emphasizes that NSD possesses distinctive features so processes should be specially designed rather than directly adapted from NPD. Bitran and Pedrosa (1998) pointed out the inability of some NPD tools to support NSD processes because the intangibility of services makes it more difficult to understand customers' latent needs. Also, service's intense interaction between customers and employees needs to be carefully addressed, and the direct application of classic NPD tools might offer little value to NSD projects (Fähnrich and Meiren, 2007). In recent years, we have witnessed an increasing number of service-specific tools, such as service blueprinting (Shostack, 1984; Bitner et al., 2008) and SERVQUAL (Parasuraman et al., 1988). These tools help translate distinctive service features into design specifications.

The synthesis approach advocates the integration of relevant concepts from both service and product contexts, and is based on the fact that many of the claimed peculiarities of NSD also apply to NPD and vice versa (Drejer, 2004). Most existent NSD tool studies treat one particular tool as the unit of analysis, but no single tool can handle all the critical issues that firms may encounter in NSD projects. Therefore, there

is a need to take a holistic view by taking into account both NPD tools and service-specific development tools.

4.2.2. Theory of Planned Behavior

TPB is one of the most popular social psychological models for the prediction of behavior. It asserts that behavioral intention is influenced by three antecedents: a favorable or unfavorable evaluation of the behavior (attitude towards the behavior), perceived social pressure to perform or not perform the behavior (subjective norm), and perceived capability to perform the behavior (perceived behavioral control) (Ajzen, 1985). The more favorable the attitude and subjective norm and the greater the perceived behavioral control, the stronger the intention to perform the behavior will be. Meta-analyses of the literature covering diverse domains have substantiated the predictive validity of TPB (e.g., Sheeran and Taylor, 1999; Albarracin *et al.*, 2001). The mean correlations between attitude and intention range from 0.45 to 0.60; the mean correlations between subjective norm and intention vary from 0.34 to 0.42; and the mean correlations between perceived behavior control and intention go from 0.35 to 0.46 (Ajzen, 2011).

Due to its high predictive power, TPB is frequently utilized to study organizational adoption of process innovations, which are defined as tools, devices, and knowledge in throughput technology that mediate between inputs and outputs and are new to an organization (Gopalakrishnan and Damanpour, 1997). Riemenschneider *et al.* (2002) found that attitude and subjective norm were positively associated with software developers' intention to use new methodology. Green *et al.* (2004) showed that perceived behavior control over the use of IT process innovations positively influenced their diffusion in software development projects. Eikebrokk *et al.* (2011)

used TPB to investigate the factors that influence organizational adoption of business process modeling. While acknowledging that there could be many determinants, they demonstrated that constructs from TPB were comprehensive and relevant to understanding process innovation adoption. We argue that NSD tools can be regarded as process innovations that are used by service firms. The predictive power demonstrated by the aforementioned studies justifies our use of TPB to explain the adoption of NSD tools.

In the use of TPB, this study treats the manager's intention as a proxy for that of the organization. When deciding whether to use a certain NSD tool, the NSD manager is usually the key decision maker. Therefore, TPB can be directly used to predict firm-level adoption behavior. In other situations where the adoption decision is made through group decision-making processes, the collective intention is formed by combining various views from individual members. Thus, TPB is still applicable to indirectly predict organizational behavior. An organization can be deemed to be as goal directed as an individual (Montalvo, 2006), so it is reasonable to take a behavioral approach (e.g., TPB) to examine an organization's innovation behavior. Cordano and Frieze (2000) used environmental managers as proxies to predict manufacturing organizations' pollution reduction preferences. They concluded that constructs from TPB had significant influences on firm-level preferences. Riemenschneider *et al.* (2003) examined the adoption of IT in small businesses by focusing on adoption decisions made by individual executives. They found strong support for TPB to predict firm-level adoption behavior.

4.3. Research Framework and Hypotheses

The framework is adapted from TPB (see Figure 4.1). Our dependent variable is behavioral intention, which stands for the strength or potency of the decision to adopt

NSD tools. At its most basic level of explanation, TPB postulates that behavioral intention is a function of attitude, subjective norm, and perceived behavioral control.

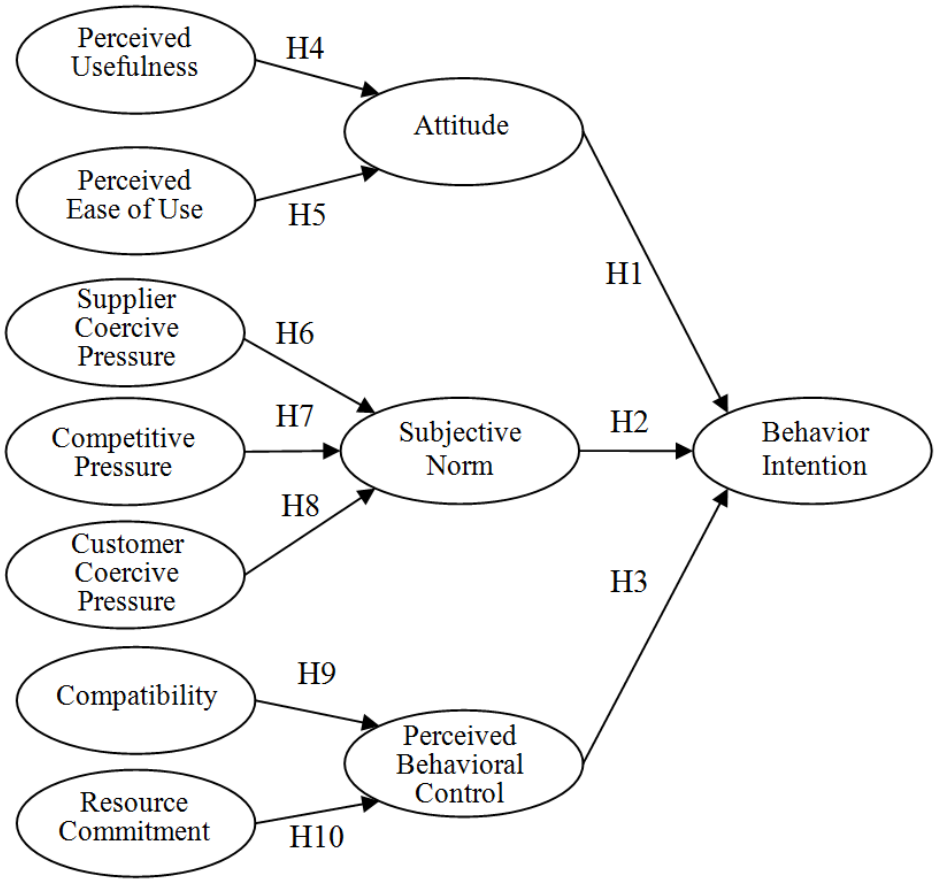


Figure 4.1 Framework of the Organizational Adoption of NSD Tools

4.3.1. Attitude

In accordance with Montalvo (2006), we define attitude as an index of the degree to which an organization likes or dislikes any aspect arising from the adoption of NSD tools. While NSD tools offer a wide range of benefits, they also suffer from various shortcomings (Jin *et al.*, 2010a). How a service firm views the potential value of these tools has a large influence on the final adoption decision. Thia *et al.* (2005) proposed that whether a tool is regarded as useful or easy to use has a positive impact on adoption. The literature on organizational adoption of innovation suggests that the

willingness of a firm to engage innovation can be explained by its attitude towards adoption (Riemenschneider *et al.*, 2003; Montalvo, 2006).

Hypothesis 1*: Attitude towards adopting NSD tools has a positive and direct effect on the intention to adopt these tools.*

4.3.2. Subjective Norm

Subjective norm indicates the social pressure or social norm caused by the environment surrounding the company (Montalvo, 2006). Service firms are likely to involve various parties during the development of new services, such as professional service firms (Dankbaar, 2003), competitors (Semadeni and Anderson, 2010), and customers (Edvardsson *et al.*, 2010). These external parties might cast normative pressures on service firms as to NSD tool adoption. Organizational adoption intention will increase as environmental pressures associated with adoption increase. It was found that the integration of external stakeholders (e.g. consultants or auditors) in business process management activities led to more modeling tools being used (Becker *et al.*, 2010). Also, Cordano and Frieze (2000) confirmed that subjective norm positively influenced organizational preferences of management practices.

Hypothesis 2*: Subjective norm towards adopting NSD tools has a positive and direct effect on the intention to adopt these tools.*

4.3.3. Perceived Behavioral Control

Perceived behavioral control represents an index of the presence or absence of requisite resources and opportunities to carry out innovative activities (Montalvo, 2006). The application of tools to service processes necessitates the optimal resource allocation (Dörner *et al.*, 2011). However, fierce competition in the service industry

forces companies to develop new services with a shorter time-to-market while charging their customers less (Johne and Storey, 1998). The perception of such internal and external constraints is thus likely to diminish the intention to adopt NSD tools. For example, strategic planning tools were found to be less adopted in smaller companies because they possess insufficient financial resources and implementation capabilities (Aldehayyat and Anchor, 2008). Harrison *et al.* (1997) demonstrated that perceived behavioral control had a significant positive impact on organizational adoption of innovation.

Hypothesis 3*: Perceived behavioral control towards adopting NSD tools has a positive and direct effect on the intention to adopt these tools.*

4.3.4. Decomposed TPB

Ajzen (1991) postulated that salient beliefs are true determinants of behavioral intention and they should be considered to explain behavior rather than merely to predict it. Behavioral beliefs, normative beliefs, and control beliefs are the salient beliefs which influence attitude, subjective norm, and perceived behavioral control, respectively. Taylor and Todd (1995a) decomposed these beliefs into multi-dimensional belief constructs. By doing so, the antecedents of intention become readily understood and the decomposed model is more managerially relevant (Taylor and Todd, 1995b). In line with this reasoning, we decompose the salient beliefs by referring to the literature on organizational adoption of innovation.

4.3.4.1.Decomposing Behavioral Beliefs

According to the Technology Acceptance Model (TAM), behavioral beliefs are determined by perceived usefulness and perceived ease of use (Davis, 1989).

According to the innovation literature, relative advantage, which is analogous to perceived usefulness, and complexity, which is analogous to perceived ease of use in an opposite direction, are factors consistently found to influence innovation adoption (Tornatzky and Klein, 1982). Therefore, we decompose behavioral beliefs into perceived usefulness and perceived ease of use.

Perceived usefulness is the degree of benefit that firms can reap from the use of NSD tools. If a certain tool offers specific benefit, a positive attitude will be formed and this will further influence its adoption in the organization (Beatty *et al.*, 2001). According to prior research, the main reason that companies adopt development tools is because they facilitate development processes, such as identifying problems and improving success rate (Mahajan and Wind, 1992; Nijssen and Lieshout, 1995). Also, research has shown that a high level of market newness gives rise to a high adoption rate of market research tools (Callahan and Lasry, 2004). The major reason for companies to use such tools is because they are useful for identifying customers' latent needs in the face of high market uncertainty.

Hypothesis 4*: Perceived usefulness has a positive and direct effect on organizational attitude towards NSD tool adoption.*

Perceived ease of use means the degree of difficulties perceived by service firms regarding learning and implementing NSD tools. Due to the resource and time constraints on NSD projects, companies tend to utilize tools that require fewer efforts to understand and implement. In the inspection of technology management tools, Brady *et al.* (1997) argued that the degree of complexity of use was a major determinant of tool adoption. Similarly, a survey of the quality management tools

revealed that the majority of companies adopted tools that were easy to understand and implement while complex techniques were barely used (Fotopoulos and Psomas, 2009).

Hypothesis 5*: Perceived ease of use has a positive and direct effect on organizational attitudes towards NSD tool adoption.*

4.3.4.2.Decomposing Normative Beliefs

Normative beliefs are decomposed according to reference group, which represents a collectivity which the focal organization takes into account in the course of selecting a behavior (Taylor and Todd, 1995b). To be specific, a service firm has suppliers, competitors, and customers as its reference group.

Service firms are likely to run into situations where specific knowledge must be obtained from external channels, such as professional service firms (de Brentani and Ragot, 1996). Professional service firms provide advisory services and their suggestions usually involve the change of work patterns (Edvardsson, 1997). They are often the producers and carriers of new technology and influence the adoption of innovation in other firms (Premkumar and Roberts, 1999; Dankbaar, 2003). The pressure exerted by other organizations upon which they are dependent is coercive pressure (DiMaggio and Powell, 1983).The supplier coercive pressure is thus defined as the extent to which a service firm is influenced by professional service firms for NSD tool adoption. Chances are that an organization will form its normative beliefs towards the adoption of a certain NSD tool because the tool is recommended by professional service firms.

Hypothesis 6*: Supplier coercive pressure has a positive and direct effect on organizational subjective norm towards NSD tool adoption.*

According to institutional theory, normative institutional pressure from competitors will prompt mimetic actions (DiMaggio and Powell, 1983). Such pressure manifests itself in two ways: the prevalence of a practice in the focal organization's industry and the perceived success of organizations which adopt the practice (Haveman, 1993). Therefore, we define competitive pressure as the extent to which other service firms have adopted NSD tools and the extent to which they have benefited from these tools. Firms may be reluctant to adopt a certain tool because of concerns about its potential value. As more firms adopt it, the uncertainty surrounding its value diminishes and nonadopters benefit from the experience of adopters. The more pressure perceived, the more likely the innovation will be adopted (Tolbert and Zucker, 1983). Competitor adoption pressure has been examined by various studies on organizational adoption of innovation, and it has proven to be a significant discriminator of adopters and nonadopters (e.g., Flanagin, 2000; Scott, 2001).

***Hypothesis** 7: Competitive pressure has a positive and direct effect on organizational subjective norm towards NSD tool adoption.*

Customer involvement in NSD is regarded as one of the key determinants of NSD success (Matthing *et al.*, 2004). In situations where customers have more decision power, they can specify how the new services should be developed (Swan *et al.*, 2002). We thus define customer coercive pressure as the extent to which adopting certain NSD tools is articulated by customers. Organizations will have a strong feeling of normative pressure if customers explicitly require the use of NSD tools. As a result of this pressure, NSD tools are more likely to be adopted. Teo *et al.'s* (2003) study on electronic data interchange demonstrated that adoption pressure arose when companies relied heavily on customers who accounted for a large percentage of their sales and

had alternative suppliers. In addition, Liang *et al.* (2007) showed that the coercive pressure stemming from dominant customers positively affected the usage of enterprise resource planning systems.

Hypothesis 8*: Customer coercive pressure has a positive and direct effect on organizational subjective norm towards NSD tool adoption.*

4.3.4.3.Decomposing Control Beliefs

Perceived behavioral control is determined by the internal and external constraints that may affect organizational behavior. For internal constraints, Bandura (1986) argued that past experience of a behavior is the most important source of information about behavioral control. Studies have suggested that it is a significant determinant of innovation adoption (Tornatzky and Klein, 1982). According to Rogers's (1995) definition, we define compatibility as the degree to which NSD tools are perceived as being consistent with existing values, past experiences, and preferred work practices. When a tool possesses high compatibility, it will cast fewer constraints on the organization, thus leading to high level of behavioral control. A study on the adoption of development tools indicated that companies with previous experience were more likely to adopt tools (Nijssen and Frambach, 1998). In addition, Blazevic *et al.* (2003) found that service firms were more likely to adopt information processing platforms when the tools corresponded to project preferences.

Hypothesis 9*: Compatibility has a positive and direct effect on organizational perceived behavioral control towards NSD tool adoption.*

Taylor and Todd (1995a) argued that external resource constraints on the engaging of a behavior influence the perceived behavioral control. According to the resource-based

view, resources can be classified as tangible or intangible (Wernerfelt, 1984). In our context, tangible resources are the financial funds at a firm's disposal. A lack of funds will give rise to constrained feelings, thus impeding tool adoption. It has been observed that complex scenario development tools were adopted only by large companies because they require substantial financial resources (Fusfeld and Spital, 1980). On the other hand, we postulate that a firm's skills and competencies about NSD tool implementation are intangible resources. It is more likely that the organization will feel less constrained if employees have a high level of experience with NSD tools. Jespersen and Buck (2010) showed in a case study that high information analytical competencies led to the adoption of customer communication tools.

Hypothesis 10*: Resource commitment has a positive and direct effect on organizational perceived behavioral control towards NSD tool adoption.*

4.4. Methodology

4.4.1. Sample and Data Collection

To test the proposed hypotheses, we conducted a survey among financial service firms in Singapore and Taiwan. Financial institutions are ideal for this study because they are active innovators and are more likely to engage in NSD activities (Menor and Roth, 2008). Their offerings are standardized and available off-the-shelf, and this provides opportunities to use NSD tools (Easingwood, 1986). We chose Singapore and Taiwan because both countries boast highly developed financial services and only subtle differences in NSD practices were observed (Song *et al.*, 2000). The unit of analysis was the NSD projects conducted in the last three years. Respondents were asked to recall their experiences of NSD tool implementation. The original questionnaire was

developed in English and went through two pretests by three NSD academics and four practitioners from the financial service industry.

In the first round of the survey in Singapore, 420 financial institutions were drawn from the directory of the Monetary Authority of Singapore. The tailored design method was adopted for survey administration (Dillman *et al.*, 2009). Various techniques for improving response rate were incorporated (Frohlich, 2002). First, invitation letters (refer to Appendix B) were sent to chief executive officers. They were asked to inform the researchers if they wanted to withdraw from the following survey. Twenty-three firms responded within one week. A survey package, which comprised of a questionnaire (refer to Appendix E), a personalized cover letter (refer to Appendix C), a prepaid envelope, and a two-page explanation of NSD tools, was sent to each of the remaining 397 companies. Reminders (refer to Appendix D) and telephone calls were used to further solicit responses two weeks later. We received 97 completed responses and 63 of them indicated that they did not have NSD activities. This resulted in 34 usable responses with a response rate of 8.6%. The second round of the survey was conducted in Taiwan. A double-translation method was employed to translate the questionnaire into a Chinese version (Parry and Song, 1994). In total, 60 questionnaires were sent to financial institutions. Forty-five completed questionnaires were returned, giving a response rate of 75%. In total, 79 responses were eligible for data analysis. Table 4.1 shows the characteristics of the respondents.

All measurement items from early and late respondents were compared to test for nonresponse bias (Armstrong and Overton, 1977). No significant differences were found ($p<0.01$). The Mann-Whitney U test was performed to check for possible systematic differences between the responses from Singapore and Taiwan (Siegel and Castellan, 1988). The results indicate it is reasonable to combine the two samples

because only 4 out of 39 measurement items used in the data analysis show significant differences (p<0.01).

Table 4.1 Sample Characteristics

Characteristics	Frequency (Percentage)
Sector	
Bank	47 (59%)
Insurance	11 (14%)
Fund Management	12 (15%)
Others	9 (11%)
Business type	
B-2-B	16 (20%)
B-2-C	21 (27%)
Mix	42 (53%)
Annual sales revenue (USD)	
<$24M	19 (24%)
$25-499M	18 (23%)
>$500M	42 (53%)

4.4.2. Measurement

The measurement items were developed through a comprehensive literature review on organizational adoption of innovation. Modifications were made to existing instruments so that they were compatible with the NSD tool context. An inventory of measurement items, together with loadings and *t*-values, are provided in the Appendix H. The definitions of constructs are provided in Table 4.2.

A distinction between reflective and formative measures was made. Reflective measures have direct effects on latent variables, while formative measures are indicators that latent variables have direct effects on them (Bollen, 1989). Measure misspecification will lead to inaccurate conclusions, and the evaluation procedures for formative indicators are quite different from those for reflective ones (Diamantopoulos *et al.*, 2006). Following Jarvis *et al.*'s (2003) validation rules, competitive pressure,

Table 4.2 Construct Definitions

Construct	Definitions
Behavior intention	The strength or potency of the decision to adopt NPD tools for NSD projects.
Attitude	The positive or negative feelings of NSD teams towards adopting NSD tools.
Subjective norm	The normative pressures on NSD team as for the adoption of NSD tools.
Perceived behavior control	NSD team's perception of internal and external constraints on adoption of NSD tools.
Perceived usefulness	The degree of benefits to which the new service development team believes can be drawn from employing NSD tools.
Perceived ease of use	The degree of difficulty perceived by new service development team regarding learning and implementing NSD tools.
Supplier coercive pressures	The extent to which NSD team is persuaded by professional service firms to adopt NSD tools when such service suppliers are involved in the NSD project.
Competitive pressures	The extent to which other interrelated service firms in the market place have adopted NSD tools and the extent to which competitors benefit from NSD tools.
Customer coercive pressures	The degree to which the design knowledge exchange among platform-based product development teams.
Compatibility	The degree to which NSD tools is perceived as being consistent with the existing values, past experiences, and preferred work practices of the new service development team.
Resource commitment	The extent to which both financial resources and competent personnel are available to NSD team in order to adopt NSD tools.

compatibility, and resource commitment were operationalized as formative constructs while other constructs were reflective.

Behavioral intention was operationalized with multi-item scales adapted from Venkatesh *et al.* (2003). Attitude, subjective norm and perceived behavioral control were measured by referring to the seminal studies of Davis *et al.* (1989) and Taylor and Todd (1995b). Perceived usefulness and perceived ease of use items were developed based on Davis *et al.* (1989) and Moore and Benbasat (1991). Supplier coercive pressure instruments were adapted from Premkumar and Roberts (1999). We formed competitor adoption pressure as a formative construct by capturing its two

facets (i.e., the prevalence of NSD tools in industry and perceived advantages offered by such tools). Items were adapted from Iacovou *et al.* (1995) and Chwelos *et al.* (2001). Diamantopoulos and Winklhofer (2001) suggested the inclusion of global indicators for model specification purpose, so two global indicators of competitor adoption pressure were incorporated into the questionnaire. Customer coercive pressure items were constructed by following Wu *et al.* (2003). The majority of prior research measured compatibility as a unidimensional construct, confounding it with preferred work style or existing situation (Karahanna *et al.*, 2006). Thus, we measured compatibility with formative indicators that cover its three aspects (i.e., consistency with existing values, past experiences, and the needs of potential adopters). Items were adapted from Moore and Benbasat (1991) and Karahanna *et al.* (2006). Two global items of compatibility were supplemented. Resource commitment was operationalized as another formative construct to reflect the two aspects in the definition (i.e., financial funds and competent personnel). It was measured by two items from Iacovou *et al.* (1995), together with two global indicators.

4.5. Results

4.5.1. The Use of NSD Tools

The survey included eight NSD tools that appear frequently in the literature, and respondents were asked to indicate which they had used in previous NSD projects. The use of NSD tools is depicted in Table 4.3. In general, the penetration level of NSD tools is low. The top three tools adopted by financial institutions are brainstorming, benchmarking, and scenario planning. A close look at the tools used in surveyed companies reveals that most of them are market research techniques, which are used to gather market information and understand customer needs. As for cross-sector

differences, the fluctuations of tool usage levels are small, yet distinguishable. Banks are more likely than others to employ NSD tools, especially scenario planning and service blueprinting. Fund management firms are heavy users of brainstorming and benchmarking. Insurance firms adopt a moderate number of NSD tools, and their usage of concept testing is the highest.

Table 4.3 NSD Tool Usages in Financial Service Industry

	Overall tool use	Financial service sector			
		Bank (47) [b]	Insurance firm (11)	Fund management (12)	Others (9)
Brainstorming (70) [a]	89%	87%	92%	**100%**	78%
Benchmarking (59)	75%	72%	75%	**82%**	78%
Scenario planning (56)	71%	**74%**	67%	64%	67%
Service blueprinting (44)	56%	**62%**	58%	36%	44%
Focus groups (42)	53%	60%	42%	27%	**67%**
Concept testing (42)	53%	55%	**75%**	36%	33%
Structured analysis and design (35)	44%	**45%**	42%	**45%**	44%
Quality function deployment (26)	33%	**36%**	33%	**36%**	11%

Note: Numbers in boldface show the highest tool usage across financial service sector.
[a] Parentheses indicates the number of firms that use certain tool.
[b] Parentheses indicates the number of firms in certain sector.

4.5.2. Model Estimation and Identification

PLS was used for data analysis. We chose PLS because the partial nature of its estimation procedure allows for accurate model estimation with a small sample size (Chin and Newsted, 1999). Additionally, PLS uses components-based algorithms so it is able to estimate formative constructs in our model (Chin, 1998a). Also, this study further extends TPB by applying it at the firm level and by incorporating literature of organizational adoption of innovation, and PLS is suitable when the focus is on theory development (Chwelos *et al.*, 2001).

Due to indeterminacy associated with the construct-level error term, each construct with formative indicators should incorporate two reflective indicators so as to resolve the identification problem (Jarvis *et al.*, 2003). For each formatively

operationalized construct, we added two global items tapping the overall level of the focal construct. In this way, the residual variances associated with formative measurements were determined and the model was identified. The PLS results are interpreted in two stages: by assessment of the relationship between measures and underlying constructs (measurement model) and by assessment of the relationships among hypothetical constructs (structural model) (Fornell and Larcker, 1981).

4.5.3. Measurement Model

Reliability and validity were evaluated in the measurement model. For the reflectively measured constructs, we inspected internal consistency reliability, construct reliability, convergent validity, and discriminant validity. Cronbach's alpha was used to assess internal consistency reliability. In our model, all Cronbach alphas exceed the conventional threshold of 0.7 (refer to Table 4.4). A construct reliability test was carried out by calculating composite reliability. Table 4.4 shows that the values of composite reliability are all larger than the acceptable level of 0.7 (Nunnally, 1978). All reflective constructs show convergent validity because the values of average variance extracted (AVE) are greater than 0.5 (Fornell and Larcker, 1981). The fact that item loadings for all constructs are greater than 0.5 and significant (p<0.05) is further evidence of convergent validity (Hulland, 1999). The discriminant validity was evaluated by comparing the square root of AVE against the correlations (Fornell and Larcker, 1981). Table 4.4 shows that all diagonal elements are greater than the off-diagonal elements in the corresponding rows and columns. This suggests discriminant validity.

As formative indicators do not necessarily correlate with each other, convergent and discriminant validity by no means represent reasonable criteria for

evaluation (Fornell and Larcker, 1981). Thus, we examined content validity, indicator reliability, and construct reliability for formative constructs. Our formative constructs show content validity because an intense literature review was conducted to confirm that they cover all facets of the focal construct (Petter *et al.*, 2007). Indicator reliability was tested by assessing the variance inflation factor (VIF). A VIF value over 10 is problematic because it indicates the possibility of multicollinearity (Diamantopoulos and Winklhofer, 2001). In our model, all formative indicators have VIFs smaller than the cut-off value, evidencing indicator reliability. The multiple indicators and multiple causes (MIMIC) model was used to assess construct reliability (Diamantopoulos and Winklhofer, 2001). For each formative construct, the indicators act as direct causes of the latent variable, which is indicated by its two global reflective items. The results show an acceptable overall model fit for the formative construct of compatibility (χ^2 = 2.34, d.f. = 2, p = 0.31, RMSEA = 0.046, GFI = 0.99, CFI = 0.99), resource commitment (χ^2 = 0.70, d.f. = 1, p = 0.40, RMSEA = 0.00, GFI = 0.99, CFI = 1.00), and competitive pressure (χ^2 = 1.41, d.f. = 1, p = 0.24, RMSEA = 0.07, GFI = 0.99, CFI = 0.99). This means that the formative constructs possess construct reliability.

Table 4.4 Means, Standard Deviations (SD), Cronbach's alpha (α), Composite Reliability (CR), Average Variance Extracted (AVE) and Correlations of Reflective Constructs

	Mean	SD	α	CR	AVE	1	2	3	4	5	6	7	8
1.Behavioral intention	4.56	1.29	0.94	0.96	0.90	**0.95**							
2.Attitude	5.14	1.08	0.90	0.93	0.77	0.57	**0.88**						
3.Subjective norm	5.27	0.98	0.94	0.96	0.89	0.53	0.49	**0.94**					
4.Perceived behavioral control	4.54	1.27	0.86	0.91	0.78	0.61	0.59	0.53	**0.88**				
5.Perceived usefulness	4.70	1.22	0.92	0.94	0.81	0.63	0.70	0.40	0.45	**0.90**			
6.Perceived ease of use	4.15	1.21	0.93	0.95	0.87	0.62	0.56	0.49	0.63	0.52	**0.93**		
7.Supplier coercive pressure	3.08	1.55	0.92	0.95	0.87	0.28	0.06	0.20	0.15	0.01	-0.02	**0.93**	
8.Customer coercive pressure	3.42	1.72	0.95	0.97	0.91	0.29	0.27	0.43	0.27	0.24	0.18	0.39	**0.95**

Note: Numbers in boldface show the square root of the AVE, and numbers below the diagonal represent construct correlations.

4.5.4. Structural Model

We tested the proposed hypotheses via a bootstrapping procedure consisting of 500 runs (Chin, 1998b). In general, the size and significance of the structural paths provide

strong empirical support for the model (refer to Table 4.5). As for the antecedents of behavioral intention, attitude (β=0.26, p<0.05, H1) and perceived behavioral control (β=0.34, p<0.01, H3) show significant influence on a firm's intention to adopt NSD tools. However, subjective norm has only a marginal impact (β=0.22, p<0.1, H2). As predicted by TAM, perceived usefulness (β=0.56, p<0.01, H4) and perceived ease of use (β=0.27, p<0.01, H5) regarding NSD tools have strong positive relationships with a firm's attitude towards the adoption. When it comes to subjective norm, only competitive pressure casts a positive influence (β=0.43, p<0.01, H7). Neither supplier (β=-0.01, n.s., H6) nor customer coercive pressure (β=0.18, n.s., H8) are found to be significantly related to the subjective norm. In terms of influence on perceived behavioral control, both compatibility (β=0.45, p<0.01, H9) and resource commitment (β=0.40, p<0.01, H10) show a strong positive impact.

Table 4.5 Determination Coefficient (R^2), Cv-redundancy (F^2), Standardized Path Coefficients (β), and t-Values

Dependent Variable	Predictor	β	t-Value	Conclusion
Behavioral intention	Attitude	0.26	2.30**	H1 supported
(R^2 = 0.47, F^2 = 0.41)	Subjective norm	0.22	1.86*	H2 supported
	Perceived behavioral control	0.34	3.08***	H3 supported
Attitude	Perceived usefulness	0.56	7.14***	H4 supported
(R^2 = 0.54, F^2 = 0.40)	Perceived ease of use	0.27	3.27***	H5 supported
Subjective norm	Supplier coercive pressure	-0.01	0.19	H6 not supported
(R^2 = 0.30, F^2 = 0.27)	Competitive pressure	0.43	3.34***	H7 supported
	Customer coercive pressure	0.18	1.43	H8 not supported
Perceived behavioral control	Compatibility	0.45	5.27***	H9 supported
(R^2 = 0.50, F^2 = 0.39)	Resource commitment	0.40	3.69***	H10 supported

Note: *p<0.10, **p<0.05, ***p<0.01

The determination coefficient (R^2) reflects the level of the variance explained for a certain dependent construct. The smallest R^2 in our model is 0.30. This shows that all dependent variables are well predicted by their corresponding antecedents. The model's predictive relevance is also evaluated through the Stone-Geisser test (Geisser,

1975). This is a cross validation procedure that removes some original data and reconstructs "missing data" by using estimated parameters. Cv-redundancy (F^2) assesses the quality of the structural model. A value above zero is indicative of predictive validity (Fornell and Cha, 1994). Table 4.5 shows that the F^2 for all dependent variables are larger than the minimum requirement, confirming the predictive power of the proposed model. In addition, a goodness-of-fit (GoF) was calculated to evaluate the overall model fit (Tenenhaus *et al.*, 2005). The criteria suitable for PLS are GoF_{small}=0.10, GoF_{medium}=0.25, and GoF_{large}=0.36 (Wetzels *et al.*, 2009). We obtained a GoF value of 0.62. Thus, our model possesses a satisfactory overall model fit.

4.6. Discussion and Implications

With services playing an increasingly prominent role in the economy, NSD and its associated tools have attracted attentions from both researchers and practitioners. In this paper, we conducted a survey on NSD tool usage among financial institutions and investigated the adoption antecedents. The primary findings suggest that: (1) NSD tools are underutilized in financial service firms; (2) TPB's constructs (i.e., attitude, subjective norm, and perceived behavioral control) are reliable predictors of organizational intention to adopt NSD tools; (3) perceived usefulness and perceived ease of use positively influence attitude towards NSD tool adoption; (4) competitive pressure has a significant positive impact on subjective norm; and (5) both compatibility and resource commitment are positively related to perceived behavioral control.

NSD tool usage. Our study shows that the diffusion of NSD tools remains at a relatively low level among financial institutions. Brainstorming, benchmarking, and

scenario planning were adopted by more than two thirds of the surveyed companies, but all other tools received few attentions. This is similar to the findings of surveys on NPD tools (e.g., Mahajan and Wind, 1992; Nijssen and Lieshout, 1995; Barczak *et al.*, 2009). The reason may be that most NSD tools are derived from NPD tools. The low acceptance rate stresses the pressing need to study the adoption antecedents in order to facilitate the diffusion of NSD tools in the service industry. Highlighting the distinctiveness of NSD, researchers have advocated that more service-specific tools should be developed (e.g., Bitran and Pedrosa, 1998; Fähnrich and Meiren, 2007). In fact, the results show that service blueprinting, the only service-specific tool in our survey, outranks half of the NPD derived tools in terms of adoption rate. This is an encouraging sign, showing that service firms are more willing to embrace NSD tools that take the distinctive nature of service into account.

Antecedents of adoption intention. As predicted by TPB, attitude, subjective norm, and perceived behavioral control positively influence the intention to use NSD tools. When combined, these antecedents explained 47% of the total variance in firms' intentions to adopt NSD tools. This reconciles with previous studies that demonstrated the high predictive power of TPB in the context of process innovation adoption (e.g., Riemenschneider *et al.*, 2002; Eikebrokk *et al.*, 2011). It proves that it is reasonable to apply TPB at the firm level by treating a manager's intention as a proxy for a firm's intention. Attitude significantly influences the adoption intention because managers tend to prefer behaviors believed to have desirable consequences (Montalvo, 2006). Perceived behavior control has a significant impact on tool adoption intention because firms are less likely to adopt process innovations if they anticipate having inadequate resources to overcome obstacles or barriers during implementation (Harrison *et al.*, 1997). One interesting finding is the marginal influence of the subjective norm. It

reveals that the adoption of NSD tools is less likely to be influenced by other parties (i.e., suppliers, customers, and competitors). One possible explanation is that the adoption of process innovation is mainly driven by internal efforts. The distinctive nature of NSD underlines the need for a specially designed framework to explain NSD related phenomenon, and this is exactly the point of departure of our study.

Behavioral beliefs and attitude. According to TAM, behavioral beliefs were decomposed into perceived usefulness and perceived ease of use, and both significantly influence attitude. Studies have consistently found that perceived usefulness is a strong determinant of tool adoption (Riemenschneider *et al.*, 2002). The rationale follows that the specific benefits offered by tools would create positive attitudes, which further influences the adoption intention. Ease of use has also been proven in various studies as a significant antecedent of tool adoption (Riemenschneider *et al.*, 2002). The perception of the ease to understand and implement a certain tool would lead to a positive attitude, which has a strong impact on the adoption of that tool. We thus conclude that NSD tools possessing a high degree of usefulness and ease of use are much more likely to be employed by companies.

Normative beliefs and subjective norm. Normative beliefs were decomposed into supplier coercive pressure, competitive pressure, and customer coercive pressure according to the general reference group of a company. Among these factors, only competitive pressure significantly influences a firm's subjective norm. This shows that financial service firms pay most of their attentions to competitors when it comes to NSD tool adoption. The findings are contrary to previous studies claiming that suppliers and customers are also determinants of organizational adoption of innovation (e.g., Premkumar and Roberts, 1999; Dankbaar, 2003; Liang *et al.*, 2007). One explanation for this incongruity is that NSD is mainly driven by internal efforts.

Another explanation is that NSD usually follows ad hoc processes (Sigala and Chalkiti, 2007), and it is common for service firms to imitate all or a portion of the first move innovation (Semadeni and Anderson, 2010). This results in more weight being put on competitors as a source of innovation practices, and competitive pressure thus emerges as a significant driving factor for tool diffusion. However, with the development of service-dominant logic advocating value co-creation (Vargo and Lusch, 2004), we assert that financial service firms should attach equal importance to the opinions of suppliers and customers because they could supplement organizations with development capabilities that are lacking in-house but essential to the effective utilization of tools.

Control beliefs and perceived behavior control. Control beliefs were decomposed into compatibility and resource commitment by referring to internal and external constraints. Our results reveal that perceived behavior control is positively affected by compatibility and resource commitment. Although compatibility has not typically been found to be significant in tool adoption studies (Riemenschneider *et al.*, 2002), it is significant in the present study. NSD tools represent the specification of procedures and steps to be used for NSD projects, so their use might be associated with substantial efforts and uncertainties (Hoffer *et al.*, 2011). Considering NSD is usually conducted in an ad hoc way, NSD tools compatible with current practices are more likely to lead to a high degree of perceived behavior control, which positively influences adoption intention. Similarly, a lack of either tangible or intangible resources for NSD tool implementation would cast a constrained feeling on the firm, thereby reducing adoption intention. The influential role of resource commitment on the adoption of tools has been confirmed by a number of studies (e.g., Fusfeld and Spital, 1980; Jespersen and Buck, 2010). Therefore, we maintain that tool's high

compatibility with current NSD practices and adequate firm resources are significant facilitators of NSD tool adoption.

4.6.1. Theoretical Implications

This study offers three significant implications for research. First, we have uncovered the critical factors that influence organizational adoption of NSD tools. Our empirical results show that the use of NSD tools is rather limited in financial service firms, stressing the need to investigate the driving factors for their adoption. To fill the research gap, this study reveals that firms are more likely to adopt tools that offer perceivable benefits, require less effort to understand and implement, and match existing organizational NSD practices. This provides valuable insights for scholars who engage in the development of NSD tools. They are well advised to balance the trade-offs among these tool related characteristics, and that no priority should be given to certain characteristics at the cost of others. For example, QFD is traditionally regarded as complex to use (Jeong and Oh, 1998). Despite its usefulness, the lack of ease of use probably inhibits diffusion and explains why it is the least adopted tool in our survey.

Second, this study illustrates the applicability of TPB to predict organizational adoption of NSD tools. TPB has demonstrated itself as a powerful theory to predict individual behavioral intention across various domains (Ajzen, 2011). However, few studies have applied it at the firm level. By treating a manager's intention as a proxy for that of the organization, we have successfully extended it to explain organizational behavior intention. This supplements the innovation adoption literature from the behavior perspective (e.g., Montalvo, 2006). After all, organizational adoption of a certain innovation is a decision made by a manager or a group of relevant people. The

attitude, subjective norm, and perceived behavior control of key personnel would have a direct impact on adoption. We thus argue that researchers might extend TPB to explain organizational adoption of other types of innovations. Important premises for such extension include sound theoretical justifications and appropriate contextual modifications.

Third, it is more appropriate for competitive pressure, compatibility, and resource commitment to be operationalized as formative constructs. These constructs are traditionally measured reflectively. However, a close examination of existing measures of each of these constructs reveals that they can be viewed as defining characteristics of the focal construct and they are not necessarily interchangeable. Jarvis *et al.*'s (2003) decision rules indicate that it is more appropriate to measure them in a formative way. Measurement misspecification will lead to inaccurate conclusions, so researchers should be wary of the distinction between reflective and formative constructs (Diamantopoulos *et al.*, 2006). For example, inconsistent factor loadings for compatibility were reported when it was measured reflectively (e.g., Beatty *et al.*, 2001; Ungan, 2004). Additionally, this study demonstrates the evaluation and analysis procedures that are suitable for formative constructs. Although the concept of formative measures has been accepted by more and more service researchers, attentions have yet to be paid to the appropriate analysis procedures. The common routine of calculating VIF is not sufficient to evaluate the quality of formative measures. More sophisticated procedures, such as the MIMIC model, should be used (Jarvis *et al.*, 2003). The model identification requires that the formative construct be linked to at least two global reflective indicators or two independent reflective constructs (Bagozzi, 2011). These evaluation and analysis procedures necessitate the incorporation of proper measures during the questionnaire design stage.

4.6.2. Managerial Implications

This study also offers several managerial implications. First, financial service firms should be more open to various NSD tools. This study suggests that the penetration level of NSD tools is low in financial institutions and only a small group of market research tools are frequently used. It is possible that companies are not familiar with some tools and their associated value. The academy and industry should cooperate to facilitate the diffusion of various effective tools. This can be achieved through regular workshops and seminars organized by research institutions and industry associations. Also, scholars are advised to publish more instructional papers on NSD tools in industry oriented outlets. Companies, on the other hand, can contribute by participating in benchmarking surveys about NSD tools and providing scholars with easy access to key personnel.

Second, the allocation of adequate resources is necessary for NSD tool adoption. Our results show a significant influence of resource commitment on tool adoption. As for tangible resources, needless to say, managers should assign adequate financial funds. On the other hand, it is of equal importance to develop essential skills and capabilities to facilitate the implementation of NSD tools. One way is to provide sufficient training to NSD personnel regarding tool related topics.

Third, financial service firms should be cautious about competitors' influence on tool adoption. With regard to external pressures, the significant path from competitive pressure to adoption intention indicates that firms are more likely to be affected by competitors. This may mean that, even if managers regard a certain tool as less helpful and incompatible with current NSD practices, they may still adopt it simply because their competitors are using it. To avoid such follower's movements, it is important for companies to establish formal NSD processes where the procedures of

tool selection and evaluation are clearly defined. Managers should also encourage organizational learning about NSD tools to ensure that only the most suitable and essential tools are employed.

Fourth, financial service firms should emphasize the long-term benefits rather than the short-term costs of NSD tools. Our results show that managers pay more attentions to costs incurred during NSD tool adoption (i.e., ease of use, compatibility, and resource commitment). While the long-term benefits may include the improvement of overall NSD success rate, enhancement of process efficiencies, and consolidation of good firm reputation. As noted by Leonard-Barton (1987), the benefits of innovation adoption are long-term while the costs are immediate. When managers focus on short-term benefits in one or two projects, they might be lured to pay too many attentions on the costs while overlooking those benefits which will come in the long run. Therefore, it is necessary for firms to institutionalize the adoption of NSD tools for the whole NSD program instead of just a few NSD projects. By doing so, the long-term benefits can then be evaluated on a continuous basis. Since a good command of certain tools requires complex learning processes, managers are advised to design a migration path where NSD tools are gradually incorporated into existing practices. In this way, only controllable costs will be incurred in each NSD project.

4.6.3. Limitations and Future Research

Although this study offers valuable insights into the use and adoption of NSD tools, the results need to be interpreted with caution. First, the size and nature of the sample do not allow us to make robust inferences; our findings are confined to financial institutions. It is possible that other service industries adopt different sets of tools and have different driving factors for adoption. We thus maintain that our results should be

treated with caution. Second, this study uses the key informant approach, so data is likely to be susceptible to common method variance. To test the potential response bias, we conducted a Harman's single-factor test (Podsakoff *et al.*, 2003). The first factor accounts for only 30.38% of the total variance explained, indicating that common method variance is not a major problem in this study. Nevertheless, it is important for future studies to use multiple data sources. Third, the tools listed in the questionnaire do not represent the whole set of NSD tools used in the service industry. It was not our intent to survey all NSD tools, and we believe that the tools included in this study are representative of the most frequently used tools. As one of the first studies to investigate NSD tools, this paper encourages future researchers to examine NSD tools on a broader scale.

There are several possible directions for future research. First, although previous NSD tool related studies have identified a couple benefits, few studies addressed the direct relationship between the use of NSD tools and NSD performance. Thus, it is necessary to take a holistic view and examine the influence of NSD tools on NSD performance. Second, because different development processes are adopted for projects with different novelties, it is argued that the use of NPD tools is contingent on product innovativeness (Tidd and Bodley, 2002). More research needs to be conducted on the impact of NSD innovativeness on the use of NSD tools. Third, this study surveyed managers shortly after tool adoption, thus representing post-adoption behavior. It is possible that different variables might influence pre-adoption behavior. Therefore, there is a need to investigate the time sensitivity of the framework.

Chapter 5

New Service Development Maturity Model [4]

5.1. Introduction

Developing a successful new service offering is not easy. Data showed that the success rate is only 58% (Griffin, 1997). One reason is that new service development (NSD) tends to be ad hoc (Martin and Horne, 1993; Sundbo, 1997). Different from most new product development (NPD) projects which follow stage-gate process, NSD projects are treated by service firms as if they just happen naturally. Due to the intangibility of services, new features of a service offering are difficult to be recognized (de Jong *et al.*, 2003). Also, NSD projects require less investment in raw materials so that new services are much easier to be imitated by competitors (Shostack, 1984). As a result, service firms prefer simple and quick processes and are reluctant to engage in sophisticated and time-consuming formal development efforts.

With the aim to guide service firms to engage in formalized and standardized NSD process, a number of NSD process models have been put forth (e.g., Scheuing and Johnson, 1989b; Cooper, 1994; Edvardsson and Olsson, 1996; Kindström and Kowalkowski, 2009; Song *et al.*, 2009). They are able to identify activities at different development stages and link them in a sequential manner, from idea generation to service launch. The existence of such stage-gate process is deemed as a key differentiating factor between the successful and unsuccessful NSD projects (de Brentani, 1991; Edgett, 1994; de Brentani and Ragot, 1996; Griffin, 1997). Service firms utilizing formalized NSD process usually enjoy benefits such as the reduction in

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miscommunications, the elimination of non-value-added activities, and the improvement of project flows (Froehle *et al.*, 2000).

Although the process models facilitate the implementation of NSD projects, their existence alone does not help define what must be produced during each stage (Stevens and Dimitriadis, 2005). The importance of execution quality of the NSD process has been highlighted by researchers (e.g., Shostack, 1984; Cooper, 1993; Menor *et al.*, 2002). Empirical studies have confirmed that service firms that executed NSD process in a consistent and standardized way were more successful than those firms that did not have a high execution quality (e.g., de Brentani and Cooper, 1992; de Brentani, 1995; Edgett, 1996). Despite the appealing results, determining project execution capability is something less than a science but more of an art (Crawford, 2002). There is a shortage of assessment tools which can help evaluate and benchmark NSD processes. Such tool will be effective in providing companies with a systematic means to enable the practices of high quality (Panizzolo *et al.*, 2010).

The objective of this paper is to develop an assessment tool: NSD Maturity Model (NSDMM). It aims to facilitate the evaluation of NSD capabilities and to show the direction for continuous process improvement. This paper offers three contributions to the NSD literature and practices. First, based on previous studies on NSD success factors, the study showed that most success factors take root in four managerial processes: strategy management, process formalization, knowledge management, and customer involvement. Instead of looking at individual success factors, NSD scholars and practitioners should take a holistic view on NSD projects and well manage these processes in order to enhance success rate. Second, as a variety of domains have reaped the benefits from using maturity models, this research took the initiative to apply the maturity model concept to the NSD field. We demonstrated

rigorous procedures in the development of NSDMM and elaborated on its possible implementation. Third, since NSDMM incorporates various NSD best practices, it can be used not only as an assessment tool, but also as a guideline for continuous improvement. By comparing current practices with descriptions from higher maturity levels, managers would be able to have a thorough understanding of current state of NSD capability and the associated deficiencies. Process improvement plan can thus be executed to enhance the execution quality of NSD processes.

5.2. Literature Review

5.2.1. Maturity and Maturity Models

Maturity is defined as the extent to which a specific process is explicitly defined, managed, measured, controlled, and effective (Paulk *et al.*, 1995). Paulk *et al.* argued that higher maturity led to more consistent and repeatable processes and reduced the differences between targeted and actual results, thus, giving rise to improved performance. Firms can use maturity as an indication of the measurement of organizational capability, and it can be applied to projects with different purposes (Andersen and Jessen, 2003). Due to the importance of maturity, a number of maturity models have been proposed. Generally, there are two kinds of maturity models: maturity grids and capability maturity models (Moultrie *et al.*, 2007). The maturity grids are rooted in Crosby's quality management maturity grid (Crosby, 1979). They usually contain several process areas which are representative of the focal subjects. Several maturity levels, generally 3 to 6, form an evolutionary path of capabilities. For a given factor at a specific maturity level, detailed descriptions are provided to serve as the base for maturity measurement. Process areas are independent of each other, and they may achieve different maturity levels at the same time (refer to Figure 5.1). By

inspecting the maturity level for each key factor, companies get to know the weaknesses and consequently embark on improving relevant activities. The maturity grids have been adopted in many fields such as product development (Fraser *et al.*, 2002; Fraser *et al.*, 2003; Moultrie *et al.*, 2007), project management (Ibbs and Kwak, 2000; Kwak and Ibbs, 2002), and knowledge management (Paulzen *et al.*, 2002; Pee *et al.*, 2006).

	Process Area 1	Process Area 2	Process Area 3
Maturity Level 1	*Achieved*	*Achieved*	*Achieved*
Maturity Level 2	*Achieved*		*Achieved*
Maturity Level 3			*Achieved*
Conclusion:	***Level 2***	***Level 1***	***Level 3***

Figure 5.1 Maturity Grid

The capability maturity models can be traced back to the early 1990s when the Software Engineering Institute (SEI) proposed the software capability maturity model in an aim to improve the quality of software development (Paulk *et al.*, 1995). The capability maturity models are characterized by their comprehensive yet complex architectures (Fraser *et al.*, 2002). Different from the maturity grids, each maturity level in a capability maturity model has its own process areas. A specific maturity level is achieved only if the practices and goals for all process areas in this level and its preceding level(s) are satisfied (refer to Figure 5.2). The software capability maturity model has spawned a large number of maturity models in other fields such as product design (Caffyn, 1997), knowledge management (Kulkarni and Freeze, 2004), and product and service development (SEI, 2010).

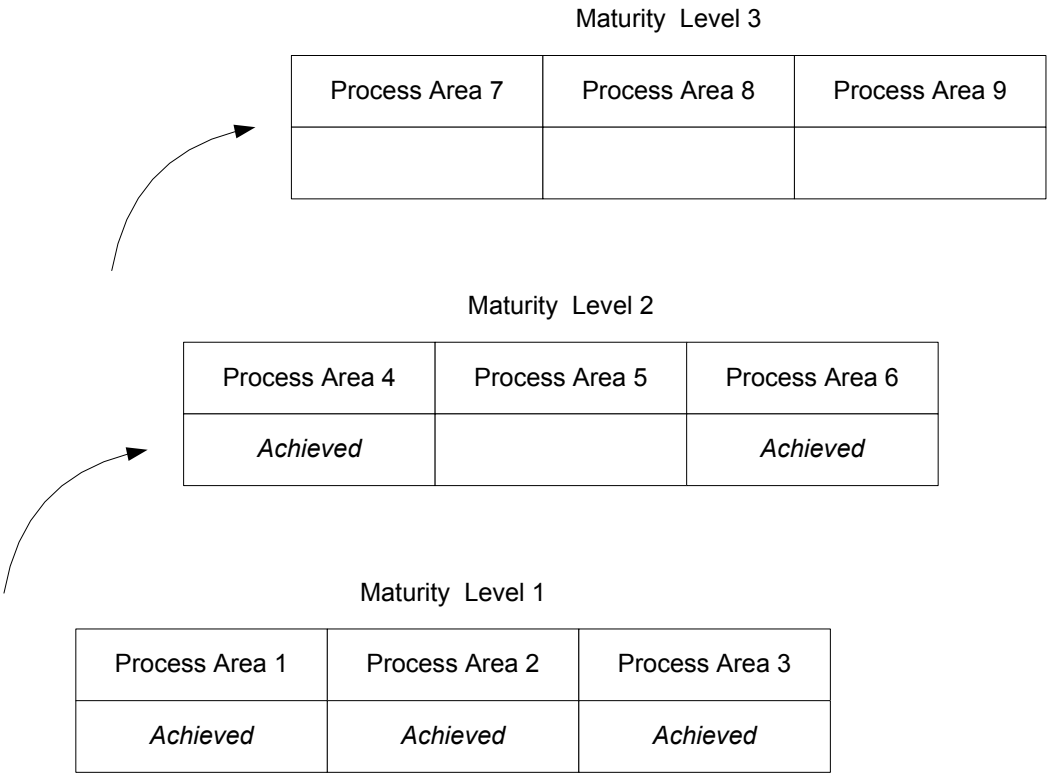

Figure 5.2 Capability Maturity Model

Regardless of the fields in which the maturity models are applied, they all function around the same purposes. They serve as reference models to assess the current situation, and they provide guidelines for improvement (Niessink *et al.*, 2005). By comparing one's own practices with the descriptions in the maturity models, an organization is able to decide the maturity levels which reflect objective measurement of organizational capabilities. Discrepancies between existing practices and best practices can be identified, and the progressing paths from current maturity levels to desired levels form a clear roadmap to narrow the gaps. There is ample evidence that implementing the maturity models leads to satisfactory results. According to SEI report (Gibson *et al.*, 2006), companies that implemented the capability maturity models witnessed improvements in terms of cost, schedule, productivity, quality,

customer satisfaction, and return on investment. Through the studying of 54 Fortune 500 firms across five different industries, Ibbs *et al.* (2004) found that there was a correlation between improved project management maturity and improved project performance. Their work showed that companies with higher maturity levels delivered projects with more predictable costs and better schedule performance.

Despite the successful application of maturity models to a variety of domains, limited research efforts have been invested in NSD related maturity models. CMMI (Capability Maturity Model Integrated) for Development (SEI, 2010) is among the few identifiable frameworks which have addressed development maturities in relation to services. However, it is not attractive to be used in service firms because it is a rather complex model. As a substantial amount of time has to be spent to attain the required levels of understanding (Whittaker and Voas, 2002; Moultrie *et al.*, 2007), its implementation usually requires the involvement of external auditors. Maturity models designed for other domains cannot be directly transferred to the NSD field. This is because key components of a maturity model (i.e., process areas and maturity levels) have to be context specific so as to provide theoretical rigour. The construction of these components requires thorough reviews on literature in the focal domain (van Steenbergen *et al.*, 2010). Besides, many of the existent maturity models have not followed rigorous development procedures (Maier *et al.*, 2012). Since these models subject to authors' own views in terms of what consists of the best practices, they may give rise to inaccurate and biased assessments. Thus, there is a need to devise a maturity model for NSD, which is easy to use, fitting for NSD context, and based on rigorous development procedures.

5.2.2. NSD Success Factors

Over the past two decades, there emerged ample studies which were dedicated to identify the determining factors for NSD success. These studies shared the following two common characteristics: (1) there existed a dependent variable measuring NSD performance; and (2) a broad range of possible factors for NSD success were included as independent variables, and these factors were empirically tested in search of key success drivers. Different perspectives have been taken, and it is worthwhile to review them.

A large number of NSD success studies (e.g., Cooper and de Brentani, 1991; de Brentani and Cooper, 1992; Martin and Horne, 1993; Edgett, 1994; de Brentani and Ragot, 1996; Oldenboom and Abratt, 2000) divided NSD projects as being either successes or failures. Referring to Cooper's success/failure methodology (Cooper, 1980; Cooper and Kleinschmidt, 1993), these studies asked respondents to rate two NSD projects—one success and another failure—according to a set of collective performance measures. A large number of potential success factors were compared so that key determinants of NSD performance can be identified. The resulting factors were grouped under each descriptive category through factor analysis. These studies offered a general view of the factors that service firms should keep an eye on in order to achieve NSD success. Arguing that the determinants of success and failure and the measures of NSD performance were closely linked, de Brentani (1989; 1991) looked into the success factors which related to different facets of NSD performance. Their results showed that NSD success with different objectives called for different subsets of success factors. Managers should keep in mind the purpose of NSD projects so as to concentrate on those relevant key factors.

Prioritizing among the promising NSD projects was also regarded as critical to service firms because management should focus limited resources on the very best projects in order to achieve maximum success (Cooper *et al.*, 1994). Cooper *et al.* (1994) set out to compare major success with modest success, and the authors concluded that the determinants uncovered were somewhat different from those of the success/failure studies. First, the product advantage was not a discriminator between major and modest success, while it was a clear factor in success/failure studies. Second, a market-driven, customer-focused NSD process gave rise to very successful NSD projects. The third yet outstanding factor was that an excellent launch was a key discriminator between mere successes and true winners. Ottenbacher *et al.* (2006) drew distinction between huge and less successful NSD projects in the German hospitality industry. However, their point of departure was more operational than theoretical. The average score on 12 performance scales was calculated for all cases and those with a score above 3.5 were considered successful, while those below 3.5 were less successful. Seven factors were identified as key determinants among a total of 23 factors.

Except for the above perspectives, de Brentani (1995) used 17 descriptive factors to cluster NSD projects into five service product groups—three were successful scenarios (i.e., customized expert service, planned pioneering venture, and improved service experience) while two were unsuccessful (i.e., peripheral low-market service and poorly planned clone). The key success factors for each group were then identified. Based on the belief that situation-orientation was important to improving the understanding of complex managerial decisions, de Brentani claimed that the identified success factors provided detailed yet unique descriptions for different scenarios that managers in service firms typically experience.

Emerging only in recent years, various studies on the influence of success factors on specific degrees of service innovativeness were conducted (Droege *et al.*, 2009). de Brentani (2001) investigated the antecedents which were necessary to excel at developing either discontinuous or incremental new services. Among the total of 12 identified factors, three global factors—front line expertise, client/need fit, and formal testing and launch—played their roles in both type of service innovations, while six other factors were found to have differential impacts, depending on which end of the innovativeness continuum the new service offerings were located. Through the hierarchical cluster analysis of four groups of innovativeness items, Avlonitis *et al.* (2001) constructed a new service classification continuum, anchored from "new to the market services" to "service line extensions". Their study tested three success factors, namely process activities, NSD process formality, and cross-functional involvement. An interesting finding was revealed that radically new and incremental service innovations did not necessarily call for totally different antecedents. More specifically, both "new to the market services" and "service line extensions" shared similar success factors. In a similar manner, Oke (2007) categorized new services into "incremental services", "radical services", and "me-too services". He assessed their relationship using the five success factors of innovation strategy, human resource management, creativity and ideas management, selection and portfolio management, and implementation. The results showed that three of these factors affected radical services, while none had significant impact on either incremental or me-too services. In a response to remarks by Menor *et al.* (2002) that it was problematic to treat new services in aggregate given their different degrees of newness, these studies suggested that companies should emphasize on different factors, depending on the type of new service, so as to achieve success in each type of venture.

The vast majority of NSD success studies were more descriptive than instructional. Although they successfully identified key success factors, little was known about how to handle them in service firms. Also, we noticed that most of these studies utilized the factor analysis to group the success factors. However, this methodology is vulnerable to the interpretational confounding which arises from the discrepancy between the theoretical meaning and the empirical meaning of a construct (Burt, 1976). Menor and Roth (2008) argued that NSD studies should be more theory-driven. Therefore, there is a need to systematically investigate the contributing factors of NSD success. In this way, the underlying mechanisms can be revealed, and they are useful to advance both theoretical and practical knowledge of NSD implementation.

5.3. New Service Development Maturity Model

In the development of NSDMM, we consulted guidelines for developing maturity models (e.g., de Bruin *et al.*, 2005; Becker *et al.*, 2009; van Steenbergen *et al.*, 2010; Maier *et al.*, 2012). These guidelines have identified and synthesized phases and decision points which have to be handled, allowing us to implement rigorous development procedures.

5.3.1. Define Aim and Specify Audience

The scope of NSDMM is confined to NSD, which refers to the processes of developing new service offerings that spans stages from idea generation to launch (Edvardsson *et al.*, 2000; Johnson *et al.*, 2000). NSDMM has two aims: (1) it is to raise awareness of strengths and weaknesses associated with current NSD practices through process assessment; and (2) it is to diagnose opportunities for continuous improvement through gap analysis. The audience is defined as the organizational unit which is responsible

for NSD. Depending on different organizational structures, such unit can be a traditional business unit (e.g., marketing and sales department) or a cross-functional NSD team.

5.3.2. Select Process Areas

Process areas reflect organizational capabilities which have to be developed to achieve the maturity goal (van Steenbergen *et al.*, 2010). The widespread practice is to solicit process areas by synthesizing critical success factors in relevant domains (de Bruin *et al.*, 2005; Becker *et al.*, 2009). Based on NSD success factor studies, we extracted NSDMM process areas by clustering key factors into recurring management processes. We believed that the approach is appropriate because innovation success relies on good practices in important development processes (Chiesa *et al.*, 1996). The empirical findings of NSD success factor studies reflected an extensively validated set of useful NSD practices, and these practices can be used as key inputs to the development of an assessment tool (Moultrie *et al.*, 2007).

To retrieve NSD success factor studies, we searched in Google Scholar for journal articles whose title, abstract, or keywords field contained "new service development" and "success". Study had to meet three criteria so as to be included: (1) it had a dependent variable measuring NSD success; (2) it had at least three independent variables; and (3) survey method was used to test the relationships. A total of 15 studies had been identified. We sorted significant success factors and regrouped them into coherent categories. After several rounds of discussion, we established a four-group classification scheme and labeled each group based on its underlying process: strategy management, process formalization, knowledge management, and customer involvement (refer to Table 5.1). It is well acknowledge that the four

management processes cast significant influences on NSD performance (Jin *et al.*, 2010b). Therefore, they formed the four process areas of NSDMM.

As process areas situated at a high abstractness level, we decided to further decompose each of them into maturity dimensions. Maturity dimensions capture the critical aspects of the process area (van Steenbergen *et al.*, 2010). They help an organization gain a deeper understanding of their strengths and weaknesses and target at improvement strategies in a more efficient manner (de Bruin *et al.*, 2005). The construction of maturity dimensions was based on thorough reviews of relevant literature and existent maturity models. Descriptions of each process area and its maturity dimensions were given as follows.

5.3.2.1.Strategy Management

The strategy management process area refers to the capability of strategic planning of NSD. A high strategic planning capability enables service firms to well align NSD strategy within the overall business strategy, to make appropriate use of resources, and to find the right balance between market needs and service offerings (Menor and Roth, 2007; Menor and Roth, 2008). The implementation of a clearly articulated and well-communicated NSD strategy is regarded as the most consistently held prescription for NSD success (Sundbo, 1997; Johnson *et al.*, 2000; Cooper and Edgett, 2010). Thus, strategy management was defined as one of the process areas of NSDMM.

Based on previous studies on product development strategy (e.g., Crawford, 1980; Cooper, 1984a; Crawford, 1984; Cooper and Edgett, 2010), we posited that the strategy management process area is manifested by how service firms define NSD goals and objectives, identify areas of focus, and allocate necessary resources. First, innovation strategy begins with clearly defining goals and objectives and

Table 5.1 NSD Success Factors and Process Areas

Reference	Strategy Management	Process Formalization	Knowledge Management	Customer Involvement
de Brentani (1989)	Corporate synergy Market synergy Innovativeness Service modifications Service quality	NSD process	Expert service	Market need Market orientation
Cooper and de Brentani (1991)	Market size & growth Product market fit Product uniqueness & superiority Synergy with regard to expertise and resources Tangible evidence	Quality of execution of launch activities Quality of execution of marketing activities Quality of execution of pre-development activities Quality of execution of technical activities Quality of service delivery	Service expertise Synergy with regard to expertise and resources	
de Brentani (1991)	Market attractiveness Overall corporate synergy Service newness to firm	Detailed/formal NSD process	Expert-/people-based service Utilization of expertise in the firm	
de Brentani and Cooper (1992)	Product advantage Product/company fit Product/market fit	Quality of execution of launch activities Quality of execution of marking activities	Service expertise	
Cooper *et al.* (1994)	Product advantage Customer service Managerial and financial synergy Market-driven NSD process Marketing expertise and resource		Innovative technology Marketing expertise and resource Training for launch	Effective marketing communications Product responsiveness
Edgett (1994)	Business/financial analysis Market potential Market research Market synergy Resource allocation	Formalization Preliminary assessment Project update Thorough testing Well planned launch	Organizational (e.g., high qualified members and inter-functional cooperation)	
de Brentani (1995)	Synergistic with firm's established reputation and resource	Involve some type of 'NSD Proficiency' through a formal process		Respond to market needs
de Brentani and Ragot (1996)	Client and marketing fit Market size/potential Service newness to firm Service superiority/innovativeness	Formal NSD process Effective NSD culture	Service expertise	Customer participation Client and marketing fit
Oldenboom and Abratt (2000)	Adequate skills and resources Degree of service newness Detailed prediction studies Product advantage	Precision Formalized plans	Adequate skills and resources Cross-functional integration	Consumer insights
Avlonitis *et al.* (2001)		NSD process formality	Cross-functional involvement	
de Brentani (2001)	Market potential Service complexity/cost Service quality evidence Strategy and resource fit	Formal evaluation and design Formal testing and launching	Front line expertise Innovation culture and management	Client/need fit
Ottenbacher *et al.* (2006)	Market attractiveness Market synergy Strategic human resource management	Empowerment Employee commitment (responsibility)	Strategic human resource management Training of employees	Market responsiveness
Oke (2007)	Innovation strategy		Creativity and idea management Human resource management	
Menor and Roth (2008)	Market acuity NSD strategy	NSD process focus	IT experience	
Jaw *et al.* (2010)	Innovation resources		Innovation reward	Market orientation
Note: Only significant NSD success factors are listed.				

communicating them to all employees (Cooper and Edgett, 2010). They should fit into the overall business plan so that service firms can utilize existing development capabilities (Cooper, 1984b). Second, identifying the areas of focus relates to the specification of strategic arenas, such as markets and industry sectors (Cooper and Edgett, 2010). Successful service firms tended to conduct thorough market research to identify promising markets with low uncertainties (Edgett, 1994). Third, the resource allocation refers to the strategic alignment of innovation development with business goals (Cooper and Edgett, 2010). How service firms managed their available resources was consistently found to be tied to NSD success (e.g., Cooper *et al.*, 1994; de Brentani, 1995; Oldenboom and Abratt, 2000). In line with the above reasoning, maturity dimensions of the strategy management process area were defined as:

- *Goals and objectives*: the competency of defining, communicating, and aligning NSD strategy.
- *Arenas of focus*: the competency of selecting targeted markets.
- *Resource allocation*: the competency of allocating resources.

5.3.2.2.Process Formalization

The process area of process formalization refers to the capability of executing formal NSD processes. Formal development processes enhance the predictability of projects, so firms can take timely responses and corrective actions in case of breakdown (Dooley *et al.*, 2001). They also reduce the risks in relation to scheduling and budgeting (Persse, 2007). The execution of formal NSD processes is widely acknowledged as a key success factor (Zomerdijk and Voss, 2011). Therefore, we defined process formalization as the second process area of NSDMM.

Avlonitis *et al.* (2001) proposed that NSD process formalization should be manifested in three facets: systematic behavior, documentation, and assignment of responsibilities. Systematic behavior refers to the degree to which regular systematic procedures and rules govern the development processes. Documentation examines the extent and intensity of formal paperwork pertaining to NSD. Assignment of responsibilities looks at the presence and/or degree of defined and specialized roles and assigned responsibilities regarding NSD decision making. In addition, process formalization was defined as the degree to which rules, policies and procedures govern role behaviors and activities in organizations (van de Ven and Ferry, 1980). It was often expressed through instructions, guidelines, and communications (Oldham and Hackman, 1981). Based on these works, we defined maturity dimensions of process formalization as follows:

- *Systematic behavior*: the competency of using standardized and formal rules to govern NSD processes.
- *Documentation*: the competency of conducting formal paperwork.
- *Assignment of responsibilities*: the competency of defining roles and assigning responsibilities.

5.3.2.3.Knowledge Management

The knowledge management process area refers to the capability of managing skills and know-how pertaining to NSD. NSD team can be regarded as an information processing system, so knowledge management activities, such as communication and exchange of information among NSD team, are critical to NSD success (Lievens and Moenaert, 2000b; Froehle and Roth, 2007). Effective knowledge management also improves the decision-making process in NSD projects because a well-managed

knowledge process reduces uncertainties and risks (van Riel *et al.*, 2004). As a result, knowledge management constituted another process area of NSDMM.

To better manage knowledge, it was advised that attentions should be paid to people, culture, organizational structure, and information technology, because knowledge is rooted in human experiences and social contexts (Havens and Knapp, 1999; Chait, 2000; Gold *et al.*, 2001). Besides, a thorough review of knowledge management maturity models revealed three key aspects of knowledge management: people/organization, process, and technology (Pee *et al.*, 2006). The people dimension includes issues relates to organizational culture. It has components such as explicitly stated corporate vision and value statements that can prompt the growth of knowledge (Gold *et al.*, 2001). The process dimension refers to the aspect concerning knowledge management processes, i.e., knowledge creation, storage, transfer, and application (Alavi and Leidner, 2001). The technology dimension examines the technology and infrastructure designed for knowledge management, such as knowledge mapping and security (Gold *et al.*, 2001). Along the lines of these findings, we defined knowledge management maturity dimensions as follows:

- *Culture*: the competency of supporting and encouraging knowledge management.
- *Process*: the competency of creating, storing, transferring and applying knowledge.
- *Technology*: the competency of utilizing information technologies and infrastructures to facilitate knowledge management.

5.3.2.4.Customer Involvement

The customer involvement process area relates to the capability of engaging customers in NSD. From the customer-as-a-resource view, customers are deemed as important sources of new service ideas and inputs (Nambisan, 2002; Lundkvist and Yakhlef,

2004). The involvement of customers in NSD can facilitate the generation of ideas with great user value (Magnusson, 2003), better and differentiated features (Alam, 2002), and high innovativeness (Matthing *et al.*, 2004). It can also provide access to the development capabilities and resources that a company lacks in-house (Campbell and Cooper, 1999). Therefore, customer involvement was treated as another process area of NSDMM.

In devising maturity dimensions of the customer involvement process area, we looked into key elements of customer involvement. We first identified the customer role of involvement as one important dimension. This is because a key concern of customer involvement is the determination of the roles played by customers during the development process (Martin and Horne, 1995). When the intensity of involvement rises from a lower degree to a higher degree, the customer's role will evolve from passive user to proactive participant. The stage of involvement is another element which relates to customer involvement. It describes the prevalence of customer interaction in the various NSD stages. Kaulio (1998) interpreted the points of interaction between customers and the design process as a key dimension that characterized customer involvement. Last but not least, the method of involvement also links to customer involvement, and it refers to the methods and techniques used to interact with customers. Depending on the degree of customer interaction, the choice of the development tools also differs (Kaulio, 1998; Lagrosen, 2005). Reactive development methods (e.g., survey and observation) usually associate with less intensive customer involvement while proactive development methods often necessitate close interaction with customers (Slater and Narver, 1998). Thus, we defined customer involvement maturity dimensions as follows:

- *Customer role of involvement*: the competency of involving customers as different roles.
- *Stage of involvement*: the competency of engaging customers in different NSD stages.
- *Method of involvement*: the competency of using NSD tools and techniques to solicit customer inputs.

5.3.3. Select Maturity Levels

The main task in this step is to design a number of logically progressive maturity levels where higher levels build on the requirements of lower levels (de Bruin *et al.*, 2005; Maier *et al.*, 2012). The construction of maturity levels needs to consult literature review so as to obtain theoretical rigour (van Steenbergen *et al.*, 2010). Considering that NSDMM process areas represented different organizational capabilities, we defined maturity levels of each process area based on a specific theory. Such theory was chosen according to two criteria: (1) the theory modeled the evolutionary path of practices or characteristics pertaining to the process area; and (2) there existed four or five sequential phases which underlies the rationale of how the process area can be incrementally developed. A brief account of maturity levels of each process area was given as follows.

5.3.3.1.Maturity Levels of Strategy Management

Maturity levels of strategy management were mainly derived from Gluck *et al.*'s (1982) four-phase strategic management model, which offers valuable insights into representative practices and processes associated with different levels of strategic planning capability. Based on a McKinsey study involving a number of the world's

most advanced firms, Gluck *et al.* found that the strategic management could be segmented into four phases: financial planning, forecast-based planning, externally oriented planning, and strategic management. Thus, maturity levels of the strategy management process area comprised these four key phases, with an additional initial phase added.

1) *Initial*: strategy management receives few attentions from the company and there exist few strategic planning activities.
2) *Financial planning*: implicit strategy is informally worked out by top management. The strategic planning does not evolve beyond annual budgeting. Planning is viewed as a financial problem and involves procedures which are developed to forecast revenue, cost, and capital needs.
3) *Forecast-based planning*: formal strategy is formed by using simple forecasting tools. However, such analyses are static, focusing on current capabilities, rather than paying attentions to the availability of alternatives. A resource allocation scheme is established to ensure a circulatory flow of capital and other resources.
4) *Externally oriented planning*: strategic business unit is established. In-depth analyses are conducted to better understand the key factors driving future business success. The resource allocation is dynamic rather than static either through creating new capabilities or through redefining the market.
5) *Strategic management*: strategic planning framework is shaped around tomorrow's concept of a business. It links the strategic planning to the operational management and facilitates the participation and commitment of all levels in the organization. A resource allocation scheme has to be in tune with the overall business strategy.

5.3.3.2.Maturity Levels of Process Formalization

The process formalization maturity levels were inspired by the levels of software capability maturity model (Paulk *et al.*, 1995), because it has been widely accepted as a de facto standard for process modeling and assessing (Crawford, 2002). Taking the process management premise, software capability maturity model claimed that the quality of a product is highly influenced by development processes (SEI, 2010). Five levels were defined to indicate an evolutionary path from ad hoc and immature processes to disciplined and mature processes.

1) *Initial*: processes are ad hoc and chaotic. An organization lacks a stable environment to support development processes. Even though the firm can still produce functional products, the success depends largely on individuals.
2) *Managed*: the projects of the organization have ensured that processes are planned and executed according to the policy. Documented plans are established so that existing practices are retained for future projects.
3) *Defined*: processes are described more rigorously than that in the previous level, and it is institutionalized across the organization. All projects use an approved, tailored version of organization's standard processes.
4) *Quantitatively managed*: statistical and other techniques are used. Quantitative measurements for quality and process performance are established. Special causes of process variation are identified and removed.
5) *Optimizing*: organization is concerned with addressing common causes of the process variation. The process performance is improved through the incremental and innovative processes and technological improvements.

5.3.3.3.Maturity Levels of Knowledge Management

Knowledge and learning are interrelated since learning produces new knowledge and knowledge reinforces future learning (Vera and Crossan, 2003). The integrating skills and knowledge and an emphasis on information communication within a NSD team can create innovative results (Stevens and Dimitriadis, 2004). Therefore, we referred to the 4I model of organizational learning (Crossan *et al.*, 1999) to devise maturity levels of knowledge management. The 4I model claims that the learning process in an organization is based on four phases (i.e., intuiting, interpreting, integrating and institutionalizing) which occur at three levels (i.e., individual, group and organization). An additional initial phase was added to the existing four phases.

1) *Initial*: employees have few intentions to conduct knowledge management activities.
2) *Intuiting*: employees do not think consciously about an action. Judgments are based on past experiences and observations. They recall the same or similar situations, recognize the patterns and then know what to do, spontaneously. Although the intuition guides action, it is difficult to share with others. The intuiting learning process occurs at the individual level.
3) *Interpreting*: employees are able to express insights or ideas to others in the group. A sense of shared understanding is developed among group members. Conscious elements are picked up and shared at the group level. This does not lead to a collective or coherent group action, but it changes the employees' understandings and actions.
4) *Integrating*: occurring at a group level, an integrating process aims to change the collective understandings of the group. Conversations are held among group

members to promote the collective mind, through which mutual adjustments and negotiated actions are achieved.

5) *Institutionalizing*: learning occurs at an organizational level. Structures, systems, and procedures are established to capture the way in which group members interact and communicate. Successful learning experiences become embedded in the organization in the form of routines.

5.3.3.4.Maturity Levels of Customer Involvement

Several customer involvement continuums have been proposed to describe the intensity of the customer interaction in the product and service development projects (e.g., Ives and Olson, 1984; Alam, 2002; Nagele, 2006). As they depict different levels of interaction between the firm and customers, ranging from no involvement at all to long-term partnership, they can be used as a starting point to construct maturity levels of customer involvement. Based on the customer involvement continuums, we proposed that customer involvement is manifested by five maturity levels.

1) *No involvement*: there is no customer involvement, and customers are regarded as pure buyers. Company assumes that development team knows exactly what their customers want.
2) *Involvement by observation*: customers are treated as objects of study, and only symbolic customer involvement occurs. There is no direct contact between the development team and customers. The gathering of ideas is realized through internal channels, such as complaints and sales reports.
3) *Involvement by advice*: company asks directly customers with respect to their needs and requirements. Customers shed their passive role and behave as experts and sources of information.

4) *Involvement by doing*: as co-designers, customers become part of the development team and have influences on development processes. Proactive market research techniques are employed to interact with customers.
5) *Involvement by strong control*: customers become partners. The customer-company relationship does not dissolve once the project is completed, and the same customer participates through the whole program. The firm interacts with its valued customers by ways such as customer groups and clubs.

5.3.4. Formulate Maturity Grid

This step determines behavioral characteristics associated with different maturity levels of each process area (Maier *et al.*, 2012). These characteristics represent the capabilities which company needs to acquire so as to achieve a status of maturity. Based on the process areas and maturity levels selected for NSDMM, we formulated the capability maturity grid. For each cell locating at the intersection of a specific maturity dimension and maturity level, precise and concise descriptions were derived to capture the behavioral characteristics pertaining to that maturity dimension and maturity level (refer to Table 5.2 for summarized descriptions of capability characteristics and Appendix I for detailed descriptions). The maturity grid forms the basis for the assessment of NSD processes. The comparison of existing practices against the descriptions in the grid helps firm identify current maturity levels of each process area. By referring to behavioral characteristics associated with higher maturity levels, firms could devise the process improvement plans which aim to achieve higher capabilities.

Table 5.2 Summarized Descriptions of Capability Characteristics

Level	Strategy Management			Process Formalization		
	(1) Goals and Objectives	(2) Arenas of Focus	(3) Resource Allocation	(1) System Behavior	(2) Documentation	(3) Assignment of Responsibilities
1	No clear NSD goals or objectives. Employees have no idea of NSD strategy.	Lacks market research. No focus of markets. Quite high market uncertainties.	No established practices.	No rule or procedure.	No documentation.	Informal NSD team with no clear roles or responsibilities.
2	"Don't screw up." Not well understood by employees. Relatively low synergy between NSD and overall strategy.	Informal market research. Similar markets as competitors. Relatively high market uncertainties.	Informally documented practices for allocating resources about financial planning. Practices for single NSD project.	Project-centered rules and procedures are established. Basic metrics are used to evaluate current NSD processes.	Informal documentations about basic procedures are created and are circulated in current NSD project. Information is a mix between intermediate and summary-level data.	Formal NSD team with basic responsibility definition for key team members.
3	"Don't let competitors gain too much of an advantage of us." Partially understood by employees. Medium synergy between NSD and overall strategy.	Formal market research. Niche markets. Medium market uncertainties.	Formally documented practices for allocating all resources. Practices for almost all NSD projects.	Formal rules and procedures are institutionalized among almost all NSD projects. Informal metrics are conducted to evaluate current NSD processes.	Formal documentations about institutionalized rules and procedures are created and are circulated in almost all NSD projects. Information is a mix between summary and detail-level data.	Formal NSD team with formal responsibility definition for all team members.
4	"Do better than competitors." Well understood by employees. Relatively high synergy between NSD and overall strategy.	In-depth market research. Markets with high corporate-market synergy. Relatively low market uncertainties.	Formally documented practices are institutionalized in the whole organization. Dynamic to deal with unforeseen problems.	Formal metrics are incorporated into the institutionalized rules and procedures. Formal metrics are conducted to improve current NSD processes.	Formal documentations about the utilization of metrics are created and are circulated in all NSD projects. Data collected enters a detail level.	Formal NSD team with formal responsibility definition for all team members and with adequate training.
5	"Do things that competitors cannot do." Employees take active part in strategy planning. High synergy between NSD and overall strategy.	Advanced market research. New markets by creating needs and establishing expectations. Low market uncertainties.	Formally documented practices are integrated into corporate processes and systems. Creative to improve effectiveness and efficiency. Business strategy in tune with available resources.	Formal improvement procedures exist to achieve continuous innovation, improvement, and refinement. Formal metrics are collected to better future NSD processes.	Formal documentations about the improvement procedures are created and are circulated in all NSD projects, even in organization. Data collected is at a detail level.	Formal NSD team is not only held responsible for current project but also for the improvement for future projects.

Table 5.2 Summarized Descriptions of Capability Characteristics (Continued)

Level	Knowledge Management			Customer Involvement		
	(1) Culture	(2) Processes	(3) Technology	(1) Customer Role	(2) Stage	(3) Method
1	Management is not aware of the need for knowledge management.	No knowledge management processes exist.	No knowledge management technology is in place.	Pure buyer.	None.	None.
2	Management becomes aware of the need for knowledge management. Value of knowledge sharing is recognized by none of the team members.	Knowledge creation is based on tacit personal experience. Knowledge is not documented. No knowledge sharing. Knowledge is assessed and used purely by individual.	Technologies are called for maintaining personal implicit NSD knowledge repositories.	Object of study.	Only in early stage.	Indirect need analysis techniques.
3	Management recognizes the importance of knowledge management. Value of knowledge sharing is recognized by only some team members. Basic incentive system is in place.	Knowledge creation is based on explicit personal experience. Knowledge is documented as individual protocols. Knowledge is shared in an informal way. Knowledge is assessed and used through limited communication with others in the personal network.	Basic knowledge management technologies are used to maintain personal group NSD knowledge repositories.	Source of information.	In early and late stages.	Direct and structured need analysis techniques.
4	Management makes commitments to knowledge management. Value of knowledge sharing is recognized by all team members. Basic training is in place.	Knowledge creation is based on collective understanding of team members. Knowledge is documented as NSD team protocols. Knowledge is shared in a formal way in NSD team. Knowledge is assessed and used through team approval and justification according to consensus in the NSD team.	Advanced knowledge management technologies are used to maintain team NSD knowledge repositories.	Co-designer.	Through all NSD stages.	Direct and unstructured need analysis techniques and co-development methods.
5	Knowledge management is institutionalized and incorporated into organizational strategy. Team members find it easy to share and utilize knowledge. Advanced training and incentive system are in place.	Knowledge creation is based on organizational rules and procedures. Knowledge is documented as organization protocols. Knowledge is shared in a formal way in the service firms. Knowledge is assessed and used through team approval and justification according to institutionalized organizational procedures.	Enterprise-wide knowledge management systems and advanced technologies are used to maintain organizational NSD knowledge repositories.	Partner.	Maintain long-term relationship with customers.	Long-term relationship maintenance methods.

5.4. The Implementation of NSDMM

In line with its two aims, we next proposed procedures to implement NSDMM. They are grounded in a number of case studies which have showcased practices of maturity model implementation (e.g., Chiesa *et al.*, 1996; Cormican and O'Sullivan, 2004; Moultrie *et al.*, 2007; van Steenbergen *et al.*, 2010). As the application of NSDMM will be situation specific, we intended to present the procedures as suggestions rather than as prescriptions. Service firms are advised to use them as references so as to devise courses of action which are suitable to them.

NSDMM basically serves as a self-assessment tool through which a company measures its current status of development capabilities and points out future directions for process improvement. The implementation comprises three main steps. The first step is to conduct evaluation of current NSD capabilities. NSDMM describes behavioral characteristics associated with different maturity levels, and they provide the basis for capability evaluation. For a specific maturity dimension, existing practices are compared against relevant capability characteristics, and then the maturity level is determined if all characteristics in this level and in its preceding levels are achieved while few characteristics in its succeeding levels are satisfied. In deciding the maturity level, the company can conduct group discussions among all relevant members so as to obtain an unbiased judgment. Alternatively, the company can develop assessment instruments based on NSDMM capability characteristics and use them to conduct a more quantitative evaluation. The same procedures are repeated for all 12 maturity dimensions, and final results represent current NSD capabilities which can be depicted in a radar chart (refer to Figure 5.3). In the second step, the company decides the maturity level that it hopes to achieve for each maturity dimension. The gaps between current and targeted practices are revealed by visualizing the maturity goals in the

same radar chart. This provides the company with an overview of its strengths and weaknesses, highlighting the areas that it should examine in more depth. In the third step, the company sets out to identify the reasons for maturity gaps and defines the action plan intended to close these gaps. Capability characteristics associated with targeted maturity levels can be used as references in developing the improvement plan. Depending on available resources, different strategies can be adopted. The company may engage in iterative incremental improvements, or it may want to achieve the ultimate goal through a one-off radical progress.

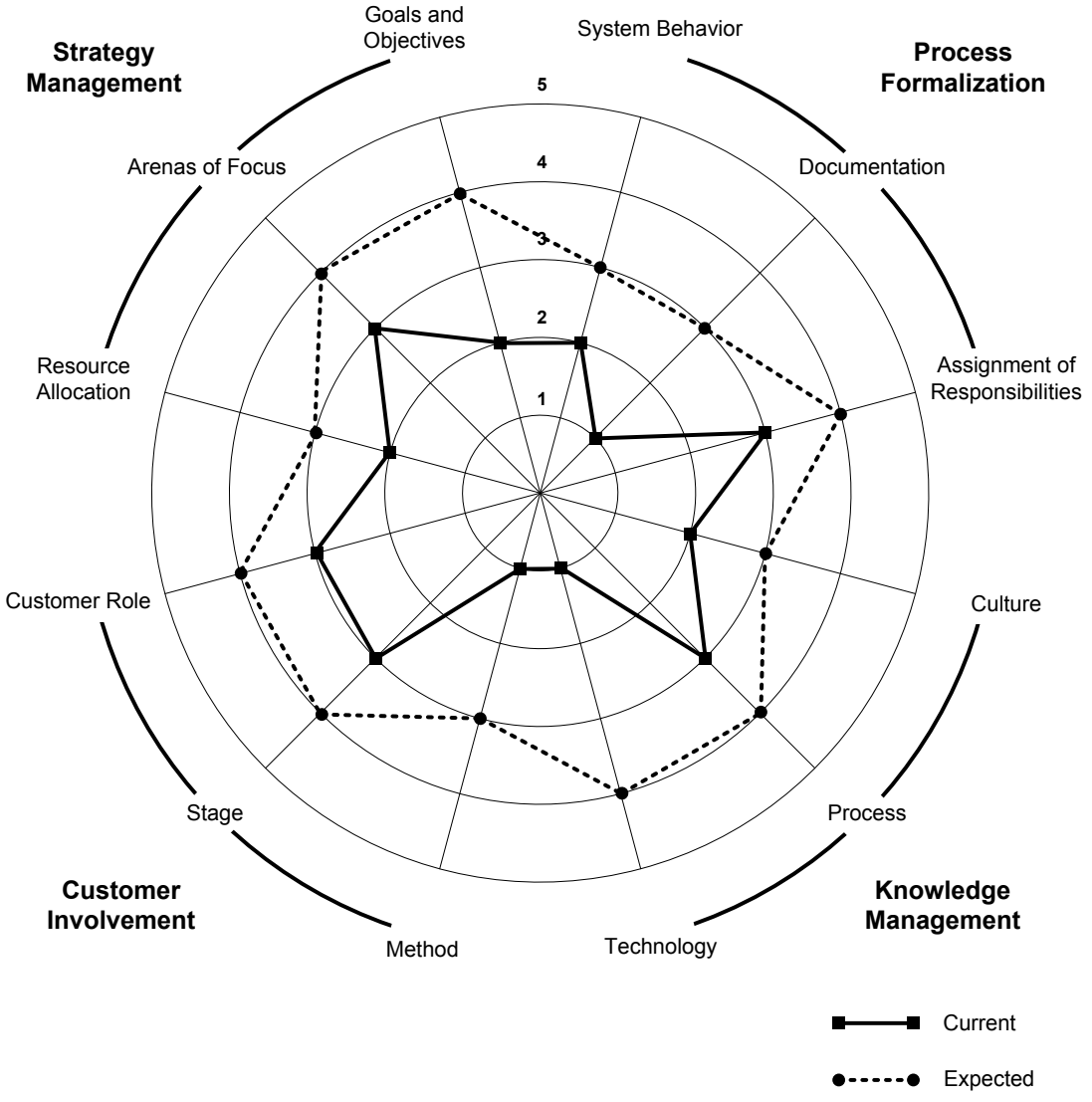

Figure 5.3 New Service Development Maturity Model

5.5. Conclusion

This study proposed a conceptual framework, NSDMM, to facilitate the development of new services. Through the review of NSD success factor studies, we put forward that four process areas—strategy management, process formalization, knowledge management, and customer involvement—are critical to NSD performance. By adopting the concept of maturity model, we further identified maturity dimensions and maturity levels for each process area. High NSD maturity ensures consistent and repeatable development process, and this decreases the difference and variability between targeted and actual results. Continuous improvement and higher performance can thus be obtained. Service firms can use NSDMM not only as a reference model to assess current state of NSD capabilities, but also as a guideline for the improvement of development processes.

5.5.1. Theoretical Implications

The NSD success studies are more descriptive than instructional, and little is known regarding how to manage NSD projects from a managerial perspective. Based on a comprehensive review of past NSD success studies, we concluded that the key success factors actually take root in four managerial processes, and they were postulated to be positively related to NSD success. As a result, researchers should take a holistic view of NSD success and study the key success drivers in relation to these areas. The studies on strategy management (e.g., Manion and Cherion, 2009; Jaw *et al.*, 2010), process formality (e.g., Alam, 2011; Tuunanen and Cassab, 2011), knowledge management (e.g., Storey and Hull, 2010; Love *et al.*, 2011), and customer involvement (e.g., Carbonell *et al.*, 2009; Melton and Hartline, 2010) in NSD are taking a rising trend.

Research focusing on these areas would enable a deeper understanding of NSD project execution and offer insights which are management relevant.

The concept of maturity models has been applied to a wide range of fields. However, to the best of our knowledge, there exist few maturity models which are specially designed for NSD. Existent maturity models from other fields are not transferrable because they are neither specified for a service context nor do they start with the specification of NSD processes. NSDMM addresses this research gap by synthesizing research findings from the NSD field. Following the rigorous development guidelines (de Bruin *et al.*, 2005; Becker *et al.*, 2009; van Steenbergen *et al.*, 2010; Maier *et al.*, 2012), we defined the audience of NSDMM as organizational unit responsible for NSD. Process areas were solicited by clustering critical NSD success factors into recurring management processes. Maturity dimensions were further identified to reflect key aspect of NSD processes. Based on the established theories and NSD practices, we then proposed maturity levels for each process area. All these efforts have ensured that NSDMM has achieved the theoretical rigour which is deeply grounded in NSD literature. Therefore, NSDMM is unique to the NSD field and it can be readily applied to measure NSD capabilities.

This study resonates with the increasing interest in analyzing the dynamic capabilities of service innovation (e.g., Agarwal and Selen, 2009; den Hertog *et al.*, 2010; Killen and Hunt, 2010). New services concepts can be easily copied by competitors due to intangibility, so the dynamic capabilities embedded in the processes and routines are keys to competitive advantage in that they cannot be imitated by others. Besides, the dynamic capabilities allow firms to adapt to the changing environment arising from the deregulation and technology advancement in the service industry. The concept of maturity resembles dynamic capability in the way that they

both tackle with processes and emphasize on continuous improvement. It can be assumed that a higher maturity level associates with a higher grade of dynamic capability. NSD scholars can develop theories and models that combine both fields so as to advance research in services.

5.5.2. Managerial Implications

Since the four management processes situate at high abstract levels, we further identified their sub-dimensions. These dimensions form the manageable areas that service firms could pay attention to. By comparing current practices with descriptions of each maturity level, managers would be able to assess organizational capabilities in an objective way. In other words, NSDMM can be used as a reference model to assess the current state of the development efforts. However, this should not be the end because higher maturity levels associate with higher chances of NSD success. Managers are advised to aim at higher maturity levels, and the descriptions in these levels offer guidelines for improvement. Instead of trial and error, service firms can utilize NSDMM as a gap analysis tool, and it serves as the roadmap to achieve higher NSD competency.

Just like the widespread acceptance of CMMI for Development as a standard for process modeling and assessment cross various industries, NSDMM can be promoted to service industry to improve NSD performance. It will establish a common language for talking about NSD projects across the service sector, and as a result, benchmarking can be conducted through NSDMM. Rather than depending on managers' subjective judgments and intuitions, service firms could then rely on such a unified assessment tool to compare their practices to those of other firms in the same service sector. Due to resource constraints and time limitations, it would be costly for

an organization to aim for the highest possible capabilities. It is wise to investigate the common approaches that are adopted by other firms and then decide on the appropriate practices.

As a general assessment tool, NSDMM is developed with the purpose to facilitate common NSD projects, and it does not address issues that are particular to certain firms. Therefore, firms should not blindly adopt NSDMM without considering their specific needs and abilities. NSDMM is a flexible model in that it is possible to devise different maturity dimensions according to the service types and project characteristics. Managers can treat the dimensions as modules of NSDMM and they are free to delete, add, or modify them. It is also suitable to manufacturing firms who are to design value-added services. One thing companies should keep in mind is that they should ensure consistency among the different maturity dimensions under the same management process. The modification of NSDMM should be guided by the overall description of maturity levels, or it would cause conflict and confusion.

5.5.3. Limitations and Future Research

Although the conception of NSDMM is based on rigorous theories and previous empirical results, NSDMM has yet to be tested in the service industry. Thus, there is a need to validate NSDMM in the organizational setting through empirical studies. By referring to Chiesa *et al.*'s (1996) proposed requirements for translating academic work into a managerial tool, we propose that future research can focus on three key aspects: functionality, usability, and usefulness. Functionality refers to the degree to which NSDMM could be used by a wide range of service firms. Usability describes the degree to which firms can independently and properly use NSDMM. Usefulness stands for the degree to which firms perceive NSDMM as effective to assess and improve

NSD processes. A variety of methods can be used for this purpose, such as verbal feedback from participants, independent researcher observation, and structured feedback from questionnaire (Moultrie *et al.*, 2007).

This research has hypothesized that higher maturity levels in four process areas would lead to higher NSD performance; however, such proposition has not been empirically tested. Therefore, it is of great importance to demonstrate the relationship between the degrees of maturity levels and NSD performance. The value of NSDMM clearly rests on the establishment of this vital link. This may require the development of assessment measures for capability characteristics at different maturity levels (de Bruin *et al.*, 2005; van Steenbergen *et al.*, 2010). These measures can then be combined in a questionnaire, which is administrated through surveys and interviews. This would enable consistent statistical analysis and improves comparability of results.

Another limitation associated with this study is that it did not look into the interrelationship among dimensions. It is possible that the achievement of high maturity in one dimension will be at the cost of other dimensions. Research has to be done to unravel the interactions and provide possible guidelines to help managers handle the tradeoffs. NSDMM is designed in a way that facilitates general NSD projects. But this overlooks specific needs arising from different service sectors. By referring to the generic NSDMM, future research can extend its application to suit particular service sector.

Chapter 6

Conclusion

NSD has emerged to be the key focus and origin of innovation with the rapid growth of the service economy (Droege *et al.*, 2009; Miles, 2012). In order to develop high quality services, firms typically focus on three critical dimensions: people, procedures and methods, and tools and equipment (Paulk *et al.*, 1995; SEI, 2010). Our literature review of NSD research (Study 1) shows that the first two dimensions have already received a lot of attentions from academics, while the tool dimension is still under-researched. This thesis aims to further our understanding of NSD tool related issues. We present an overview of the thesis in Table 6.1, illustrating how the objectives have been addressed in the previous chapters and what the main findings are. Next, we conclude our work by presenting the theoretical contributions, practical implications, limitations of this thesis, and suggestions for future research.

6.1. Theoretical Contributions

6.1.1. Contributions to the NSD Tool Literature

A key contribution of our work to the NSD tool literature is in demonstrating for the first time the use of a holistic view in studying NSD tools. Existent NSD tool studies generally treat one particular tool as the unit of analysis. There is a lack of studies which provide an overview of NSD tools. This is why, despite a plethora of NSD tool studies, researchers are still wondering what tools are beneficial to NSD (Johnston, 1999; Menor *et al.*, 2002; Adams *et al.*, 2006). Our study addresses this concern by identifying the most common NSD tools and highlighting their purposes, advantages, and disadvantages (Study 2 & 3). This advances our understanding of the various NSD

Table 6.1 An Overview of Objectives and Findings of the Thesis

Objectives	Studies	Main Findings
1. To investigate the usage pattern and the effectiveness of NSD tools	Chapter 3 (Study 2)	• NSD tools can be categorized into two groups: market tools and development tools. Market tools are mainly used for market research purposes and development tools are mainly used for service design and testing. • The use of market tools improves operational performance, which has a significant impact on product performance. However, the use of development tools has no significant influence on NSD performance.
2. To identify key factors that influence the adoption of NSD tools	Chapter 4 (Study 3)	• Attitude, subjective norm, and perceived behavior control are significantly related to tool adoption intention. Perceived usefulness and perceived ease of use are antecedents of attitude. Competitive pressure influences subjective norm. Perceived behavior control is determined by compatibility and resource commitment. • It is appropriate to apply TPB in the organizational context and it has high predictive power to explain organizational adoption behavior.
3. To design a process assessment tool which helps analyze and improve NSD process	Chapter 5 (Study 4)	• Most NSD success factors can be categorized into four process areas: strategy management, process formalization, knowledge management, and customer involvement. • By integrating the maturity model concept and findings from previous NSD success factor studies, we develop the NSD Maturity Model. It can be used not only as a diagnostic tool to assess development process capabilities but also as a guideline for continuous process improvement.

tools available. In addition, our study is the first to provide empirical evidence on the usage pattern of NSD tools (Study 2 & 3). The results show that firms usually utilize a combination of NSD tools in one project. This stresses the need to conduct research which treats a group of NSD tools as a whole. It is not sufficient to just focus on one particular tool, because its application is likely to be influenced by the use of other tools. Therefore, it is important to take a holistic view to examine the overall effect of NSD tools and their possible interrelationships.

The second contribution is in investigating the effectiveness of NSD tools in a systematic way. Thus far, the efficacy of NSD tools is mainly demonstrated by case study research (e.g., Wind *et al.*, 1989; Thomke, 2003; Bitner *et al.*, 2008), and this limits the representativeness and generalizability of the results. Our study proposes a well-devised framework that explains the relationship between NSD tools and NSD performance, and the framework is tested by a large scale survey (Study 2). It responds to the call for using more systematic approaches to evaluating the impact of tools (Brady *et al.*, 1997). The results show that the use of market tools improves operational performance. This demonstrates that the information gathered by market tools is effective in mitigating development risks, enhancing service quality, shortening cycle time, and reducing costs. The use of development tools is found to have no significant impact on NSD performance. It is possible that they are not implemented in a correct way so as to exploit their full potentials (González and Palacios, 2002). Thus, more research needs to be conducted to facilitate the utilization of such development tools.

The third contribution is in uncovering the critical factors that influence the adoption of NSD tools. Despite the various benefits claimed by researchers, our study has found that the use of NSD tools is rather limited in service firms. We thus set out to investigate the driving factors for the adoption of NSD tools (Study 3). The results

show that firms are more likely to adopt tools that offer perceivable benefits, require less effort to understand and implement, and match existing organizational NSD practices. This offers valuable insights for scholars who engage in the development of NSD tools. NSD tools will be of no value if they are not adopted by firms, so scholars need to pay close attentions to these key factors so as to facilitate the diffusion and adoption of tools. They are also advised to balance the trade-offs among characteristics related to these tools, and no priority should be given to any particular characteristics over others.

6.1.2. Contributions to the General NSD Literature

The first contribution to the general NSD literature is that our study provides a quantitative review of the field of NSD. Existent NSD literature reviews are mainly qualitative reviews, and these studies are prone to biases arising from authors' subjective judgments (Baumgartner and Pieters, 2003; Kunz and Hogreve, 2011). As a complementary, our study provides an objective account of the NSD field which reflects the joint efforts of its contributors (Study 1). The results demonstrate that NSD research has reached a mature stage and is on its way to evolving into a distinct discipline in its own right. This provides researchers with empirical evidence regarding the status of the field of NSD. Also, the review study has identified key research themes and revealed the intellectual foundation of NSD research. This provides a detailed description of the development of NSD research since its inception and offers valuable insights into what has been researched in the discipline. Researchers who are interested in NSD could thus get a deep understanding of NSD research and refer to our results to locate key references. Furthermore, the study integrates both quantitative results and qualitative analysis to point out future research opportunities. Researchers

could follow the suggestions to explore various topics which are currently under-researched.

The second contribution is in identifying four process areas which are crucial to NSD success. Although there exist a number of studies that examine key success factors for NSD (e.g., Cooper *et al.*, 1994; Edgett, 1994; de Brentani, 1995), they are more descriptive than prescriptive. Little is known regarding how to manage NSD projects from a managerial perspective. Based on a comprehensive review of NSD success factor studies, our research concludes that key success factors actually take their roots in four process areas (Study 4). They include strategy management, process formalization, knowledge management, and customer involvement. For each of these process areas, sub-dimensions that comprise critical aspects of the process are also identified. They represent the areas that are worth careful investigations and deep discussions. Furthermore, when comparing the findings with the key research themes revealed by Study 1, we notice that the process areas of strategy management and knowledge management are currently receiving fewer attentions from NSD scholars. As they play crucial roles in contributing to NSD success, more research is needed to strengthen our understanding in relation to these two processes.

6.1.3. Contributions to the Organizational Adoption of Innovation Literature

This thesis also contributes to the organizational adoption of innovation literature by illustrating the applicability of the Theory of Planned Behavior (TPB) to predict organizational adoption of NSD tools. TPB has demonstrated itself as a powerful theory to predict individual behavioral intentions across various domains (Ajzen, 2011). However, few studies have applied it at the firm level. By treating a manager's intention as a proxy for that of the organization, we have successfully extended it to

explain the organizational behavior intention (Study 3). This supplements the organizational adoption of innovation literature from the behavior perspective. The rationale follows that: it is the managers or relevant people who make the decisions for the adoption of certain innovations, and the constructs of TPB (i.e., attitude, subjective norm, and perceived behavior control) would have a direct impact on these key personnel's behavior intention. Therefore, TPB provides an alternative perspective to investigate the organizational adoption of innovation. In fact, considering that innovation adoption studies usually collect the empirical data by surveying managers, we deem that the results predicted by TPB would be more accurate because the survey scales from TPB directly measure the subject's opinions regarding the adoption intention.

6.1.4. Contributions to the Research Methodology Literature

The contribution to the research methodology literature is in providing support for the use of formative measurement and demonstrating the appropriate analysis procedures. Researchers are, until recently, still wary of the use of formative measurement, emphasizing their potential deficiencies and problems (e.g., Wilcox *et al.*, 2008; Kim *et al.*, 2010). Our study offers empirical evidence on the usefulness of formative measurement (Study 3). The results show that competitive pressure, compatibility, and resource commitment should be operationalized as formative constructs because their measurement scales define the key aspects of the focal construct and they are not necessarily interchangeable. Since measurement misspecification will lead to inaccurate conclusion (Diamantopoulos *et al.*, 2006), researchers are advised to make the distinction between reflective and formative constructs in their studies. Besides, our study illustrates the use of analysis procedures that are suitable for formative

measurement (Study 3). Based on the MIMIC model proposed by Diamantopoulos and Winklhofer (2001), we have demonstrated how to achieve model identification by linking one formative construct with two global reflective indicators. This procedure provides useful information about the construct reliability; and more importantly, it resolves the error term in the model and thus enabling a more accurate estimation.

6.2. Practical Implications

This thesis has originated from the need to foster a better understanding of tools which facilitate NSD projects. Therefore, our results are readily applicable to managers. A contribution to practice is in identifying the various useful NSD tools from the literature. Most of the existent NSD tool studies focus on one specific tool and few of them have provided an overview of NSD tools. This would lead to firms' unfamiliarity with the various NSD tools that are available to them. Our study addresses this gap by identifying those NSD tools which are most frequently investigated by researches and are believed to have great application potentials (Study 2 & 3). Specifically, we have mapped the various tools according to the different NSD stages and proposed a market/development tool classification scheme. Service firms could refer to our results to locate appropriate tools which can be used for certain purposes. In addition, we have also highlighted the advantages and disadvantages of NSD tools. Companies could thus use this information to evaluate the trade-offs associated with the tools that they intend to use. This will increase the efficiency and effectiveness of the tool usage.

The second contribution to practice is in revealing the usage pattern of NSD tools through large scale survey. Although a number of NSD tools have been proposed by academics, there is limited knowledge about how these tools are used in corporate settings. Our study offers valuable insights into NSD tool usage (Study 2). First, the

research benchmarks the use of tools in various NSD stages across different service sectors. Firms can thus find out what tools are commonly used in their specific sector and how are they utilized in NSD projects. Second, our results suggest that the penetration level of NSD tools is still low, with only a small group of market research tools being frequently used. Service firms are advised to be more open to the various NSD tools that are available to them. To facilitate the diffusion, companies should foster a culture which favors the introduction of process innovations. For example, trainings and workshops can be set up to develop the necessary in-house skills in relation to NSD tools.

The third contribution to practice is in examining the influence of NSD tools on NSD performance. While case study research has demonstrated the efficacy of certain NSD tools, the overall impact of the use of NSD tools on NSD performance is still unclear. As we have found that service firms usually utilize a combination of several tools and each tool has its pros and cons, it is necessary to investigate the overall influence of a group of tools on NSD performance. By adopting an integrative marketing and operations perspective (Tatikonda and Montoya-Weiss, 2001), our study provides empirical evidence on the general impact of NSD tools on the two dimensions of NSD performance (Study 2). The results show that the use of market tools enhances operational performance, which has a direct impact on product performance. This indicates that, although market tools do not directly enhance financial results (i.e. product performance), their usage will lead to financial benefits through the improvement of project execution quality. Service firms should not abandon these tools just because they do not bring about direct financial benefits. The use of such tools is effective in facilitating project execution, and this will eventually lead to financial gain.

The fourth contribution to practice is in identifying the key factors that affect the adoption of NSD tools. We have found that the usage level of NSD tools is relatively low in service firms, therefore our study set out to examine the driving factors for tool adoption (Study 3). First, our results show a significant influence of resource commitment on the adoption of NSD tools. Since resource commitment is operationalized as a formative construct which is reflected by its two aspects (i.e. financial funds and competent personnel), we suggest that service firms should pay close attentions to these issues so as to implement NSD tools well. On one hand, adequate financial funds should be assigned at project team's disposal. On the other hand, essential skills and capabilities associated with tool implementation need to be developed. Second, our findings indicate that competitors' behavior casts great influence on the adoption of NSD tools. It is likely that, even if a company regards a certain tool as less helpful and incompatible with current NSD practices, it will still adopt the tool because its competitors are using it. It is thus important for companies to establish formal NSD processes where the procedures of tool selection and evaluation are clearly defined. Companies should also encourage the learning of NSD tools so as to ensure that only the most suitable and essential tools are employed. Third, our results show that service firms pay more attentions to costs incurred during tool adoption (i.e. ease of use, compatibility, and resource commitment). Leonard-Barton (1987) argued that the benefits of innovation adoption are long-term but the costs are immediate. Therefore, it is necessary for service firms to evaluate the benefits of NSD tools on a continuous basis. Since a good command of certain tools requires complex learning processes, companies are advised to design a migration path where NSD tools are gradually incorporated into existing practices. In this way, only controllable costs will be incurred in each project.

The fifth contribution to practice is in devising a maturity model that helps analyze and improve the NSD process. Although maturity models have been applied to a wide range of fields, there exist few maturity models which are designed especially for developing services. By integrating the maturity model concept and findings from NSD success factor studies, our study proposes the NSD Maturity Model (NSDMM) which facilitates the managerial processes and organizational mechanisms through which NSD is performed (Study 4). NSDMM points out that strategy management, process formalization, knowledge management, and customer involvement are four process areas which are crucial to NSD success. For each of these processes, NSDMM elaborates on the respective sub-dimensions and maturity levels. Detailed descriptions of the practices are given for a certain maturity dimension at a certain maturity level. Therefore, by comparing current practices with these descriptions, NSDMM can be used as a reference model to assess the current state of the development processes. Instead of depending on managers' subjective judgments and intuitions, companies could rely on NSDMM to obtain a more objective and accurate measurement of their NSD capabilities. Furthermore, NSDMM provides service firms with a gap analysis tool to be used in planning for process improvement. Since the descriptions in NSDMM represent the practices at different maturity levels, they highlight what service firms have to achieve when they plan to move from lower maturity levels to higher ones. A clear understanding of the differences between current practices and targeted practices will guide companies in drawing effective process improvement plans. NSDMM establishes the common language for talking about NSD projects within and across organizations, and as a result, the benchmarking of NSD capabilities can be conducted. This will facilitate the process improvement plan by comparing development processes at different points of time.

6.3. Limitations and Future Research

Prior to suggesting some future research directions, it is important to consider the research outcomes in the context of its limitations. One limitation is that the size and nature of the sample do not allow us to make robust inferences (Study 2 & 3). We have a small number of usable survey responses, and this might lead to biased estimates of the proposed models. To alleviate the problem, we have used Partial Least Squares (PLS) for data analysis because the partial nature of its estimation procedure allows an accurate model estimation with even a small sample size (Chin and Newsted, 1999). In fact, all constructs in our models have passed stringent reliability and validity tests, evidencing that the small sample size does not pose a serious problem to the results of our research. Except for the issue of sample size, our sample consists of data collected from financial firms in Singapore and Taiwan, and some may argue that the merging of survey data from two different countries is problematic. However, we chose Singapore and Taiwan because both countries boast highly developed financial services and they are shown to have subtle differences in NSD practices (Song *et al.*, 2000). The Mann-Whitney U test shows that there is no significant difference between the two samples.

The second limitation is that our study uses the key informant approach to collect the data, so the results are susceptible to common method variances (CMV) (Study 2 & 3). We have implemented several practices to control CMV prior to data collection, such as counterbalanced question order and different scale endpoints. However, it is still not possible to entirely eliminate CMV. We thus conducted several post-hoc analyses to evaluate the influence of CMV. Marker variable approach in Study 2 demonstrates that correlations among major constructs have not changed their significance after controlling for CMV. Harman's single-factor test in Study 3 shows

that the first factor accounts for only 30.38 percent of the total variance explained. All these indicate that CMV has not introduced significant biases into our results.

The third limitation is that NSDMM has yet to be tested in the service firms (Study 4). Although the conception of NSDMM is based on rigorous theories and previous empirical results, it is still necessary to investigate the effectiveness of NSDMM in corporate settings. However, due to limited resources, we are unable to do so. It is of great importance to demonstrate the relationship between the degrees of maturity levels and NSD performance so as to facilitate the implementation of NSDMM. The value of NSDMM clearly rests on the establishment of this vital link.

Our research has provided a number of opportunities for future investigations. First, our broad overview of the NSD field has identified several research themes which need to be further strengthened (Study 1). The results show that researchers can focus more on the *NSD Strategy* subfield. It is well accepted that a clear NSD strategy is the most consistently held prescription for NSD success (Sundbo, 1997; Johnson *et al.*, 2000; Cooper and Edgett, 2010); however, only a few studies have touched on this topic, and Menor *et al.* (2002) have also pointed out that it is worthwhile to exploit strategic and tactical issues about NSD strategy. The NSD community should thus divert more efforts to clarify the practices that help service firms devise the appropriate NSD strategy. Another research opportunity is related to the *Employee Management* subfield. Most of the existent studies in this subfield are descriptive in nature because they generally correlate a few human resource management practices with NSD success so as to identify the most important activities. More management-relevant questions regarding how to effectively manage these activities need to be addressed by future studies. What's more, the subfield of *Theory of Innovation in Services* offers considerable opportunity for further development. Existent research in this subfield

mainly focuses on developing abstract theories, so more management-oriented studies are required to shed light on how service firms can cope with different modes of service innovation.

Second, it is beneficial to advance research by conducting more comprehensive reviews on NSD tools. Although our study takes the initiative to provide an overview of NSD tools (Study 2 & 3), we have only included a small number of tools in our study. This results from the fact that our review is mainly based on academic studies whose subjects are confined to a few classical tools, such as QFD and scenario planning. Due to the rapidly changing environment and the increasing complexity of service offerings, it is possible that the use of these classical tools is not sufficient to meet companies' requirements. Thus, there is a need to identify other tools which have not been covered by researchers but are frequently used by service firms. This would better our understanding of NSD tools from a managerial perspective. To fulfill this purpose, researchers can consider using field studies, such as in-depth interviews and non-structured surveys. Besides, nowadays there are growing interests in value co-creation with customers through the paradigm of service-dominant-logic (Vargo and Lusch, 2004). Customer involvement is critical to NSD success. Thus, it is of utmost importance to investigate those NSD tools which would facilitate NSD success through the co-creation of value with customers. The market NSD tools, as we discussed before, are this types of tools. Both academics and managers should pay more attentions to these tools and research on related topics so as to make full use of them to achieve high level of customer integration and interaction.

Another opportunity for future research is related to NSDMM (Study 4). First, while our study has proposed a rigorously-developed process assessment and improvement tool, it has yet to be tested in the service industry. Researchers could

conduct case studies to examine the effectiveness of NSDMM. One possible research question is: will the use of NSDMM improve organizational capabilities of managing key development processes? Second, our study has not examined the interrelationships among various maturity dimensions in NSDMM. It is possible that the achievement of a higher maturity level in one dimension will be at the cost of maturity levels in other dimensions. Thus, researchers could provide empirical evidence on such interactions, and their findings would serve as useful guidelines to help managers evaluate the trade-offs and devise the optimal process improvement plans. Third, NSDMM is designed to facilitate general NSD projects, but it overlooks specific needs arising from different types of services. Researchers who specialize in certain service sectors could further extend the NSDMM by modifying the model. NSDMM is a flexible model in that it is possible to design different maturity dimensions according to the service types and project characteristics.

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Appendices

Appendix A List of Papers from Each Subfield of NSD Research

Node	Article
NSD Success Factor	
11	Atuahene-Gima, 1996a
7	Cooper *et al.*, 1994
159	de Brentani, 1991
23	de Brentani and Cooper, 1992
12	de Brentani, 1995
20	de Brentani and Ragot, 1996
37	Edgett, 1996
161	Martin and Horne, 1993
26	Martin and Horne, 1995
29	Thwaites, 1992
Organizational Design and Communication	
34	Blazevic and Lievens, 2004
181	Lievens *et al.*, 1999a
31	Lievens *et al.*, 1999b
156	Lievens and Moenaert, 2000a
166	Lievens and Moenaert, 2000b
132	Perks and Riihela, 2004
139	Vermeulen and Dankbaar, 2002
Typology of Service Innovation	
6	Avlonitis *et al.*, 2001
5	de Brentani, 2001
158	Johne and Storey, 1998
27	Oke, 2007
NSD Strategy	
35	Blindenbach-Driessen and Van Den Ende, 2006
83	Hull, 2004b
146	*Storey and Kelly, 2001* [a]
79	Storey and Hull, 2010
84	Storey and Kahn, 2010
NSD Process	
170	*Bowers, 1989*
17	*Bullinger et al., 2003*
15	Edvardsson *et al.*, 1995
155	*Edvardsson and Olsson, 1996*
22	*Edvardsson, 1997*
165	Froehle *et al.*, 2000
123	Froehle and Roth, 2007
142	Goldstein *et al.*, 2002
145	*Hill et al., 2002*
143	Menor *et al.*, 2002
122	Menor and Roth, 2007
116	Menor and Roth, 2008
16	*Meyera and DeToreb, 2001*
157	Pennings *et al.*, 1999
169	*Scheuing and Johnson, 1989b*
62	Shulver, 2005
40	Stevens and Dimitriadis, 2004
186	Stevens and Dimitriadis, 2005
61	Stuart, 1998
131	Stuart and Tax, 2004
21	Tax and Stuart, 1997
24	*Verma et al., 2001*
124	Yang, 2007
Market Oriented NSD	
136	*Abramovici and Bancel-Charensol, 2004*
140	Alam, 2002
168	Alam and Perry, 2002
19	Alam, 2006
2	Atuahene-Gima, 1996b
100	Chen *et al.*, 2009
98	Gottfridsson, 2010
38	*Gustafsson et al., 1999*
76	Jaw *et al.*, 2010
18	*Kelly and Storey, 2000*
46	Kristensson *et al.*, 2008
163	Magnusson *et al.*, 2003
67	Magnusson, 2009
14	Matthing *et al.*, 2004
179	Matthing *et al.*, 2006
82	Olsen and Sallis, 2006
72	Ordanini and Maglio, 2009
73	Paswan *et al.*, 2009
187	Smith and Fischbacher, 2005
33	Song *et al.*, 2000
66	Song *et al.*, 2009
167	Syson and Perks, 2004
25	van Riel *et al.*, 2004
182	Zolfagharian and Paswan, 2008
Employee Management	
49	Blazevic *et al.*, 2003
180	Gebauer *et al.*, 2008
42	Ottenbacher *et al.*, 2006
99	Ottenbacher and Harrington, 2010
50	van Riel and Lievens, 2004
Theory of Innovation in Services	
3	*Barras, 1986*
39	de Vries, 2006
4	*Drejer, 2004*
52	Droege *et al.*, 2009
10	*Gadrey et al., 1995*
1	*Gallouj and Weinstein, 1997*
97	Gremyr *et al.*, 2010
9	*Hipp and Grupp, 2005*
60	Hull, 2004a
36	Kindström and Kowalkowski, 2009
127	*Neu and Brown, 2005*
8	*Sirilli and Evangelista, 1998*
153	*Sundbo, 1997*
47	Tether and Tajar, 2008

Note: Cross-loaded papers were only reported once.

[a] Italic items are database papers which did not appear in the MDS map but were frequently cited by papers from that subfield in the map.

Appendix B Invitation Letter

Invitation for the participation in the research of *Use and Adoption of New Product Development Tools and Techniques in Financial Service Firm*

Dear <Input salutation> <Input name>

What are the tools and techniques that successful financial service firms use in their new product development? How do these firms measure their new product development? These are some of the important questions which Engineering Management Research Group at National University of Singapore (EMRG-NUS) aims to shed light on.

As part of the research, a questionnaire will be mailed to you in the next few days. We would be very grateful if you can spend around 20 minutes to help us. Your responses are voluntary and will be kept strictly confidential. The survey is anonymous, and all data will be aggregated and statistically analyzed exclusively for research purpose.

As an appreciation, we will present respondents a valuable benchmarking report regarding how successful financial service firms conduct their new product development projects. It will cast lights on best practices (especially on the tools and techniques) adopted by successful financial service companies.

If (1) you decide not to respond to this survey; or (2) there is no new product development activity in your company, please contact EMRG-NUS (Attn: Mr. Jin Dayu, at phone 65-8337 8113 or email at dayu_jin@nus.edu.sg) so that we can remove your company from our database.

We look forward to your favorable reply.

Best wishes,

<Signature>	<Signature>	<Signature>
TAN Kay Chuan, PhD	**CHAI Kah Hin, PhD**	**JIN Dayu, PhD candidate**
Associate Professor Department of ISE, NUS Tel: (65) 6516 3128 Fax: (65) 6777 1434 E-mail : isetankc@nus.edu.sg	Assistant Professor Department of ISE, NUS Tel: (65) 6516 2250 Fax: (65) 6777 1434 E-mail : iseckh@nus.edu.sg	Research Assistant Department of ISE, NUS Tel: (65) 8337 8113 Fax: (65) 6777 1434 E-mail : dayu_jin@nus.edu.sg

Appendix C Cover Letter

Survey on New Product Development Tools and Techniques in Financial Service Firms

Dear <Input salutation> <Input name>

We are writing to invite you to participate in an important research conducted by Engineering Management Research Group at National University of Singapore (EMRG-NUS). The study aims to find out:

- What are the new product development (NPD) tools that successful financial service firms use?
- How can NPD tools improve NPD project efficiency and success rate?
- What are the prevalent NPD performance measures adopted in the industry?

<Input company name> is **among a small group** that being selected for this study. We would be grateful if you or your senior manager who is in charge of NPD (e.g., Business Development Director) could help complete the enclosed questionnaire. Please kindly submit it either by fax or by mail, preferably **before Dec. 15, 2010**.

The questions should take about 20 minutes. Your responses are voluntary and will be kept **strictly confidential**. Respondent identity is **anonymous**. Survey data will be aggregated and statistically analyzed exclusively for research purpose. Please do not hesitate to contact EMRG-NUS should you have any enquiry (Attn: Mr. Jin Dayu, at phone 65-8337 8113 or email at dayu_jin@nus.edu.sg). This survey has been **approved by National University of Singapore Institutional Review Board**. For an independent opinion regarding the research and the rights of research participants, you may contact NUS IRB (Attn: Mr. Chan Tuck Wai, at telephone 65- 6516 1234 or email at irb@nus.edu.sg).

As an appreciation, we will present respondents a **valuable benchmarking report** regarding how successful financial service firms conduct their NPD projects. We believe it will cast lights on best practices (especially on the tools and techniques) adopted in the contemporary financial industry.

We wish you all the best on your new product development and we look forward to receiving your response.

Many thanks,

<Signature>

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Appendix D Reminder Letter

Dear <Input salutation> <Input name>

Last week, a questionnaire about new service development (NSD) tools was mailed to you by National University of Singapore. We have already received overwhelming responses from many service firms, who showed their interest in improving NSD success rate.

If you have completed and returned the questionnaire to us, please accept our sincere thanks. If not, please submit the completed questionnaire before **November 15.** A valuable benchmarking report will only be offered to respondents who completed the questionnaire. The report includes managerial relevant topics such as: What are the NSD tools that successful service firms use? How can they increase NSD efficiency and success rate? What are the prevalent NSD performance measures adopted in the industry?

If you did not receive a questionnaire, please contact survey administrator Mr. Jin Dayu by phone at 8337-8113 or by email at dayu_jin@nus.edu.sg. We will get another one in the mail for you today.

Please do not hesitate to contact us if you need any further information. Your dedicated time and effort in contributing your expertise to this research are greatly appreciated.

Sincerely,

<Signature>	<Signature>	<Signature>
TAN Kay Chuan, PhD	**CHAI Kah Hin, PhD**	**JIN Dayu, PhD candidate**
Associate Professor Department of ISE, NUS Tel: (65) 6516 3128 Fax: (65) 6777 1434 E-mail : isetankc@nus.edu.sg	Assistant Professor Department of ISE, NUS Tel: (65) 6516 2250 Fax: (65) 6777 1434 E-mail : iseckh@nus.edu.sg	Research Assistant Department of ISE, NUS Tel: (65) 8337 8113 Fax: (65) 6777 1434 E-mail : dayu_jin@nus.edu.sg

Appendix E Survey Questionnaire

New Product Development Tools and Techniques Survey

Engineering Management Research Group
Department of Industrial and Systems Engineering
National University of Singapore

Section A New Product Development Project

How many **New Product Development (NPD) projects*** has your company done in the past 3 years, approximately?
***NPD project**: the complete process of bringing a new <u>product</u> or <u>service</u> (e.g., credit card, loan, internet banking, insurance plan, investment plan) to the market.

- ☐ None → Please go to Section F-Demographic Information (page 6).
- ☐ 1-2
- ☐ 3-5
- ☐ 6-10
- ☐ >10

Please recall <u>ONE</u> New Product Development (NPD) project conducted within 3 years.

Section B Project Performance

Note: Please indicate **Project Performance*** and **Objective Importance^**.

***Project Performance:** the performance rating against a specific objective.
^Objective Importance: the importance of a specific objective being considered by your firm.

Sample response:

	Project Performance							Objective Importance						
	Much worse than targeted			Exactly on target			Much better than targeted	<u>NOT</u> Important at all			Neutral			Very Important
Overall, the project succeeded?	1	2	3	4	5	6	7	1	2	3	4	5	6	7

	Project Performance							Objective Importance						
	Much worse than targeted			Exactly on target			Much better than targeted	<u>NOT</u> Important at all			Neutral			Very Important
1. Overall, the project succeeded?	1	2	3	4	5	6	7	1	2	3	4	5	6	7
2. Time-to-market objective met?	1	2	3	4	5	6	7	1	2	3	4	5	6	7
3. Project cost objective met?	1	2	3	4	5	6	7	1	2	3	4	5	6	7
4. Profit objective met?	1	2	3	4	5	6	7	1	2	3	4	5	6	7
5. Revenue objective met?	1	2	3	4	5	6	7	1	2	3	4	5	6	7
6. Market share objective met?	1	2	3	4	5	6	7	1	2	3	4	5	6	7
	Strongly <u>Dis</u>agree			Neutral			Strongly Agree	<u>NOT</u> Important at all			Neutral			Very Important
7. The product was of excellent quality.	1	2	3	4	5	6	7	1	2	3	4	5	6	7
8. The product provided firm a competitive advantage.	1	2	3	4	5	6	7	1	2	3	4	5	6	7
9. The product satisfied customers' needs.	1	2	3	4	5	6	7	1	2	3	4	5	6	7
10. The product opened up a new market for our firm.	1	2	3	4	5	6	7	1	2	3	4	5	6	7

Section C Project Innovativeness

To what extent.....	To a very small extent						To a very large extent
1. ..... was the technology involved in this product new to customers?	1	2	3	4	5	6	7
2. ..... was the technology involved in this product new to the firm?	1	2	3	4	5	6	7
3. ..... was the product concept difficult for customers to evaluate or understand?	1	2	3	4	5	6	7
4. ..... did the product require a change in the customer's way of using it?	1	2	3	4	5	6	7
5. ..... did the product require a major learning effort by customers?	1	2	3	4	5	6	7
6. ..... did the product require considerable advance planning by customers before use?	1	2	3	4	5	6	7
7. ..... was the market for this product new to the firm?	1	2	3	4	5	6	7
8. ..... did the product cater to customer needs that are new to the firm?	1	2	3	4	5	6	7
9. ..... were firm's existing R&D resources, people, and skills adequate?	1	2	3	4	5	6	7
10. ..... were firm's existing Marketing resources, people, and skills adequate?	1	2	3	4	5	6	7
11. ..... did firm's current strategy fit with this product?	1	2	3	4	5	6	7
12. ..... was the product consistent with existing customer experience and values?	1	2	3	4	5	6	7

Section D Use of New Product Development (NPD) Tools

Note: Please indicate whether each **NPD tool*** was used in this project, and at which **NPD stages^**.
For tools used in this project, check relevant NPD stages in which they were used (Please check all that apply).
For tools unused in this project, check "We didn't use" and leave the following columns blank.

Definition for each **NPD tool*/NPD stage^** can be found in **Appendix**.

Sample response:

	We didn't use	We used this tool at				
		Idea generation and screen	Business and market analysis	Product development	Product testing	Product launching
Benchmarking	☐	☑	☑	☐	☐	☑
Scenario planning	☑	☐	☐	☐	☐	☐

	We didn't use	We used this tool at				
		Idea generation and screen	Business and market analysis	Product development	Product testing	Product launching
1. Benchmarking	☐	☐	☐	☐	☐	☐
2. Scenario planning	☐	☐	☐	☐	☐	☐
3. Brainstorming	☐	☐	☐	☐	☐	☐
4. Focus group	☐	☐	☐	☐	☐	☐
5. Concept testing	☐	☐	☐	☐	☐	☐
6. Quality function deployment	☐	☐	☐	☐	☐	☐
7. Service blueprint	☐	☐	☐	☐	☐	☐
8. Structured analysis and design	☐	☐	☐	☐	☐	☐
9. Others:_____	☐	☐	☐	☐	☐	☐

Section E Adoption of New Product Development (NPD) Tools

Note: Please answer each question based on your experiences with those **NPD tools used in this project**.

Sample response:

	Strongly Disagree			Neutral			Strongly Agree
Using NPD tools makes it easier to conduct NPD project.	1	2	3	4	5	6	7
Using NPD tools would be a ..... idea.	☐ extremely bad	☐ quite bad	☐ slightly bad	☐ neither	☑ slightly good	☐ quite good	☐ extremely good

B1. Usefulness

	Strongly Disagree			Neutral			Strongly Agree
1. Using NPD tools makes it easier to conduct NPD project.	1	2	3	4	5	6	7
2. Using NPD tools enhances effectiveness on NPD project.	1	2	3	4	5	6	7
3. Using NPD tools enables us to accomplish NPD project more quickly.	1	2	3	4	5	6	7
4. Using NPD tools is useful in NPD project.	1	2	3	4	5	6	7

B2. Ease of use

	Strongly Disagree			Neutral			Strongly Agree
1. We believe that it is easy to get NPD tools to do what we want to do.	1	2	3	4	5	6	7
2. Learning to use NPD tools is easy for us.	1	2	3	4	5	6	7
3. Overall, NPD tools are easy to use.	1	2	3	4	5	6	7

B3. Compatibility

	Strongly Disagree			Neutral			Strongly Agree
1. Using NPD tools is consistent with our company's existing value and beliefs.	1	2	3	4	5	6	7
2. Using NPD tools is compatible with our past experience of conducting NPD project.	1	2	3	4	5	6	7
3. Using NPD tools fits well with the way we conduct NPD project.	1	2	3	4	5	6	7
4. Overall, using NPD tools is compatible with our company.	1	2	3	4	5	6	7
5. Overall, NPD tools fit well in our company.	1	2	3	4	5	6	7

B4. Resource commitment

	Strongly Disagree			Neutral			Strongly Agree
1. We have the financial resources to use NPD tools.	1	2	3	4	5	6	7
2. We have the human resources to use NPD tools.	1	2	3	4	5	6	7
3. Our company devotes enough resources (money/people) to the use of NPD tools.	1	2	3	4	5	6	7
4. Overall, using NPD tools is easy for us because we have enough resources (money / people).	1	2	3	4	5	6	7

B5. Supplier* coercive pressure (*firm being involved in providing support for NPD projects, e.g., consulting firms.)

	Strongly Disagree			Neutral			Strongly Agree
1. To work with our suppliers, they require us to use NPD tools.	1	2	3	4	5	6	7
2. We are recommended by our suppliers to use NPD tools.	1	2	3	4	5	6	7
3. We have pressures from our suppliers to use NPD tools.	1	2	3	4	5	6	7

B6. Competitive pressure

	Strongly Disagree			Neutral			Strongly Agree
1. The use of NPD tools is helpful in allowing a company to remain competitive.	1	2	3	4	5	6	7
2. We are feeling great pressures to use NPD tools due to our competitors.	1	2	3	4	5	6	7

3. Please indicate the extent of NPD tool adoption by your competitors.	☐ extremely low	☐ quite low	☐ slightly low	☐ neither	☐ slightly high	☐ quite high	☐ extremely high
4. Please rate the pressures placed on your company of adopting NPD tools given by your competitors.	☐ extremely low	☐ quite low	☐ slightly low	☐ neither	☐ slightly high	☐ quite high	☐ extremely high

B7. Customer coercive pressure

	Strongly Disagree			Neutral			Strongly Agree
1. Our customers require us to use NPD tools.	1	2	3	4	5	6	7
2. Our customers may consider us as backward if we do not use NPD tools.	1	2	3	4	5	6	7

3. To what extent do your customers influence your decision to use NPD tools?	☐ extremely small	☐ quite small	☐ slightly small	☐ neither	☐ slightly large	☐ quite large	☐ extremely large

B8. Attitude

1. Using NPD tools would be a ..... idea.	☐ extremely bad	☐ quite bad	☐ slightly bad	☐ neither	☐ slightly good	☐ quite good	☐ extremely good
2. Using NPD tools would be a ..... idea.	☐ extremely foolish	☐ quite foolish	☐ slightly foolish	☐ neither	☐ slightly wise	☐ quite wise	☐ extremely wise
3. Using NPD tools would be	☐ extremely unpleasant	☐ quite unpleasant	☐ slightly unpleasant	☐ neither	☐ slightly pleasant	☐ quite pleasant	☐ extremely pleasant
4. We would ..... the idea of using NPD tools.	☐ extremely dislike	☐ quite dislike	☐ slightly dislike	☐ neither	☐ slightly like	☐ quite like	☐ extremely like

B9. Subjective norm

	☐ extremely oppose	☐ quite oppose	☐ slightly oppose	☐ neither	☐ slightly support	☐ quite support	☐ extremely support
1. Those parties who influence our behavior would ..... our use of NPD tools.							
2. Those parties who are important to us would ..... our use of NPD tools.							
3. Those parties whose opinions we value would ..... our use of NPD tools.							

B10. Perceived behavior control

	☐ extremely out of	☐ quite out of	☐ slightly out of	☐ neither	☐ slightly under	☐ quite under	☐ extremely under
1. Using NPD tools would be ..... our control.							
2. Our company would have ..... resources, knowledge and ability to use NPD tools.	☐ extremely few	☐ quite few	☐ slightly few	☐ neither	☐ slightly much	☐ quite much	☐ extremely much
3. Given the resources, knowledge and ability it takes to use NPD tools, it would be..... for us to use NPD tools.	☐ extremely difficult	☐ quite difficult	☐ slightly difficult	☐ neither	☐ slightly easy	☐ quite easy	☐ extremely easy

B11. Adoption intention

	Strongly Disagree			Neutral			Strongly Agree
1. We are planning to use NPD tools in future NPD projects.	1	2	3	4	5	6	7
2. We intend to use NPD tools in future NPD projects.	1	2	3	4	5	6	7
3. We intend to use NPD tools frequently in future NPD projects.	1	2	3	4	5	6	7

Section F Demographic Information

1. Company's main industry:

- ☐ Banks
- ☐ Fund management companies
- ☐ Insurance companies
- ☐ Real estate
- ☐ Trust companies
- ☐ Other services, please specify_____

2. Number of full-time employees in Singapore:

- ☐ <49
- ☐ 50-99
- ☐ 100-249
- ☐ 250-499
- ☐ 500-749
- ☐ 750-999
- ☐ >1000

3. Number of full-time employees engaged in New Product Development projects in Singapore:

- ☐ None
- ☐ 1-9
- ☐ 10-24
- ☐ 25-49
- ☐ 50-99
- ☐ 100-199
- ☐ >200

4. Company's dominant service business type:

- ☐ Business-to-Business (B-2-B)
- ☐ Business-to-Customer (B-2-C)
- ☐ Mix of B-2-B and B-2-C

5. Company's ownership:

- ☐ Local
- ☐ Foreign
- ☐ Joint-Venture

6. Approximate sales revenue (in US $) over the last calendar year:

- ☐ <$10M
- ☐ $10-24M
- ☐ $25-99M
- ☐ $100-499M
- ☐ $500-999M
- ☐ >$1,000M

7. Your job designation:

- ☐ General Manager/Director
- ☐ Marketing Manager
- ☐ NPD Project Manager
- ☐ R&D Manager
- ☐ Others, please specify_____

8. How long have you been with this company?

- ☐ <1 year
- ☐ 1-5 years
- ☐ 6-9 years
- ☐ >9 years

8. How many years of experience do you have in product development in the financial industry?

- ☐ <1 year
- ☐ 1-5 years
- ☐ 6-9 years
- ☐ >9 years

If you would like to have a benchmarking report, please indicate your contact details:

Email: _____

Please go to back cover

Appendix

NPD Tool Definition

NPD tool	Definition
1. Benchmarking	Compare NPD performance measures to the industry standards.
2. Scenario planning	Use different scenario to make NPD strategy respond to future opportunities and challenges.
3. Brainstorming	A creative group session to stimulate new ideas.
4. Focus group	A planned, focused discussion involving similar people.
5. Concept testing	Evaluate whether customers i) understand NPD idea, and ii) are favorable for it.
6. Quality function deployment	Translate customer expectations into appropriate design requirements.
7. Service blueprint	A map of flowchart of all transactions constituting the product/service delivery processes.
8. Structured analysis and design	Use a diagrammatic notation to divide product/service delivery processes into smaller partitions.

NPD Stage Definition

NPD stage	Definition
Idea generation and screen	Identify opportunities and initial generation of possible ideas. Sort and rank ideas and eliminate unsuitable ones.
Business and market analysis	Evaluate the concept financially, and prepare protocol/development contract.
Product development	Convert concept into a new product/service.
Product testing	Product/service use testing and field testing with customers.
Product launching	Launch the new product/service into sales.

Thank you for taking the time to complete this questionnaire!

If you have any other thoughts, please share with us.

Should you have any inquiry, please contact EMRG-NUS.
(Attn: Mr. Jin Dayu, at phone 65-8337 8113 or email at dayu_jin@nus.edu.sg)

Please return your questionnaire by fax or by the business reply envelope enclosed to:
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Engineering Management Research Group
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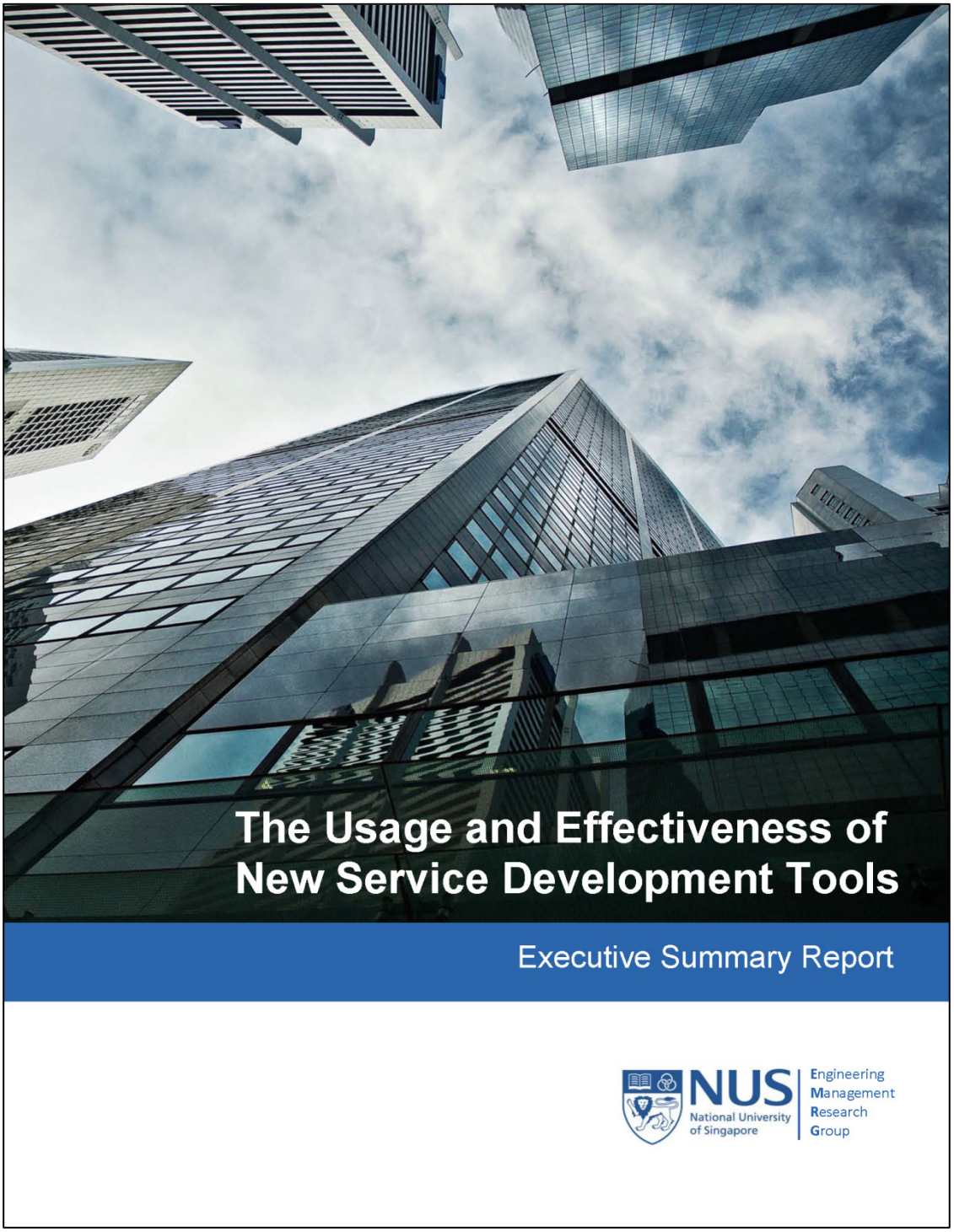
1 Engineering Drive 2
National University of Singapore
Singapore 117576

Appendix F Executive Summary Report



The Usage and Effectiveness of New Service Development Tools

May 2011

Jin Dayu[1], Chai Kah Hin[2], Tan Kay Chuan

The research team would like to thank all participants, contact persons, and secretaries who had taken the extra mile to help make this study possible.

If you have any enquires and comments, please feel free to contact Mr. Jin Dayu at dayu_jin@nus.edu.sg or visit service research blog at http://servicesresearch.blogspot.com.

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EXECUTIVE SUMMARY

Grappling with fierce competitions and economic instability, financial service institutions invest a lot in new service development (NSD) in an attempt to attract new customers and gain competitive advantage. However, to their dismay, NSD success rate is on average 58%[3]. To turn things around, a number of NSD tools have been proposed to facilitate development efforts.

The purpose of this study is to estimate the usage and effectiveness of NSD tools adopted by Singapore financial service institutions. Specific objectives include: (1) analyze NSD tools usage pattern; (2) assess NSD performance and its measurement; (3) estimate the impact of NSD tools on NSD performance; (4) estimate the influence of NSD innovativeness on the choice of NSD tools.

This report is based on information collected from 34 NSD projects in a mailed survey of 420 Singapore financial institutions. The results for each objective are presented in the following sections.

NSD Tools Usage Pattern

NSD tools are classified into *market tools* (to encourage customers' input) and *development tools* (to facilitate technical development and testing). Their usage is inspected by looking into different development stages and industries.

- Market tools are used more frequently than development tools. Top 3 market tools are brainstorming, benchmarking, and scenario planning. Top 3 development tools are concept testing, structured analysis and design, and service blueprinting;
- Most market tools are used in NSD stages with intensive customer interaction while most development tools are employed in the design and testing stages;
- Fund management firms utilize more market tools than other industries, and banks more development tools.

[3] Griffin, A. (1997). "PDMA research on new product development practices: updating trends and benchmarking best practices." Journal of Product Innovation Management 14(6): 429-458.

NSD Performance and Its Measurement

NSD performance is assessed by differentiating *market performance* (commercial outcomes) from *operational performance* (project execution outcomes). Performance rating and importance attached to specific measurement are evaluated across various industries.

- Financial service institutions obtain better market performance than operational performance. Specifically, real estate firms and banks report above-average operational and market results, and insurance firms achieve above-average market results;
- Firms emphasize more on market outcomes than operational outcomes. Prevalent NSD performance measurements include obtaining high product quality, achieving competitive advantages, and satisfying customer needs;
- The more the importance is attached to certain performance measurement, the better the performance is reported.

NSD Tools Effectiveness

Each NSD project is labeled as either success or failure according to its market performance and operational performance. The tools usage in successful projects is compared to that in failed projects.

- Market tools have a positive impact on operational performance, but not on market performance;
- Development tools have a positive influence on market performance, but not on operational performance.

NSD Innovativeness

NSD innovativeness is mapped along four independent dimensions—*firm familiarity*, *firm fit*, *customer familiarity*, and *customer behavior change*. Tools usage is compared between projects with higher and lower rating on each dimension.

- Most financial products are modifications and extensions of existing products.
- Firms are inclined to develop services that are compatible with existing resources and are familiar to customers.
- NSD tools are used more frequently when (1) service concepts are new to firm; (2) service concepts are new to customers; (3) firm has sufficient capital and human resources; and (4) behavior change is required for customer consumption.

INTRODUCTION TO NSD TOOLS

NSD tools are defined as precisely described methods or procedures for supporting and improving NSD processes. By referring to the contention that innovation success arises from a combination of technical feasibility and market demand recognition[4], we classified NSD tools to market and development tools. *Market tools* are used to engage customers for a better understanding of their needs and commercial potentials, and *development tools* support development efforts of technical design and testing.

Each tool has its own strengths and is intended to tackle with particular issues. Figure 1 lists the 8 NSD tools inspected in this study, along with their main and supporting roles. All of them meet the following criteria: (1) appear most frequently in NSD literature; (2) have been applied to real service context; and (3) implementation does not require huge amount of investments.

Figure 1: List of tools in this study and their roles in projects

		Strategic planning	Needs identification	Requirement specification	Service design	Trouble-shooting
Market tools	Benchmarking	●				
	Scenario planning	●				
	Brainstorming		●	○		
	Focus group		●	○		
Development tools	Concept testing		○	●		
	Quality function deployment			●	○	
	Service blueprinting			○	●	○
	Structured analysis and design			○	●	○

● main role ○ supporting role

[4] Tatikonda, M. V. and M. M. Montoya-Weiss (2001). "Integrating Operations and Marketing Perspectives of Product Innovation: The Influence of Organizational Process Factors and Capabilities on Development Performance." Management Science 47(1): 151-172.

SURVEY RESULTS AND MAIN FINDINGS

The following sections elaborate on main findings, based on Facts, Analysis, and Tip. *Facts* list results in the form of tables and figures. *Analysis* is a detailed explanation of the phenomenon behind Facts. *Tip* offers managerial recommendations.

NSD Tools Usage Pattern

The first part discusses overall NSD tools usage, together with usage differences across NSD stages and industries.

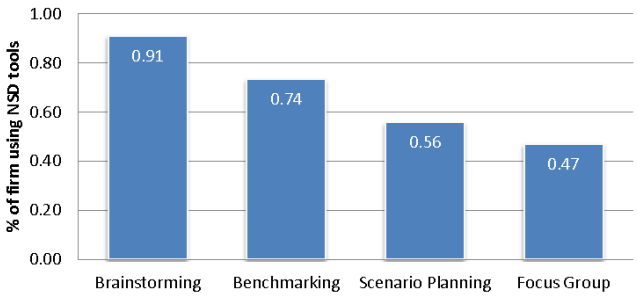
Tools Usage among Contemporary Financial Institutions

This section reports overall market and development tools usage.

FACTS

Figure 2 describes the percentage of firm using market tools. Brainstorming, benchmarking, and scenario planning stand out to be the top 3 market tools used by financial institutions, with more than 50% usage.

Figure 2: Percentage of financial institutions using market tools



ANALYSIS

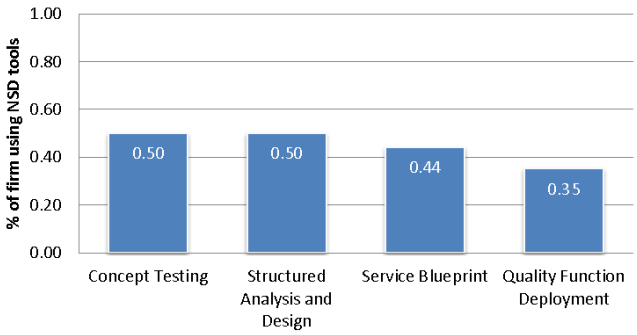
Brainstorming tops the tools for needs identification owing to its inexpensiveness and easy-to-use. The high usage of benchmarking shows firms' eagerness to get input from competitors, indicating that one of the most used strategies for service firms is to imitate lucrative products from

others[5]. Scenario planning is useful to strategically position a company and its services in the marketplace. Struggling with economic stagnation, service firms become more prudential, thus putting more weight on strategic planning. Although scholars advocate the use of focus group, the high investment required as for capital and time may serve as obstacles to their adoption.

FACTS

Figure 3 shows the percentage of firm using development tools. Development tools are relatively less utilized, compared to their market tool counterparts. Top 3 most frequently used tools are concept testing, structured analysis and design, and service blueprinting.

Figure 3: Percentage of financial institutions using development tools



ANALYSIS

Concept testing helps firm filter service ideas so that limited resources can be allocated to those most promising service concepts. Structured analysis and design technique and service blueprinting facilitate formal service design procedures, but it seems that not so many firms are making advantage of them. Surprisingly, tools for trouble-shooting draw very few attentions. Consequently, the disappointing NSD success rate partially attributes to firms' unwillingness to detect potential failure and problems.

[5] Semadeni, M. and B. S. Anderson (2010). "The Follower's Dilemma: Innovation and Imitation in the Professional Services Industry." Academy of Management Journal 53(5): 1175-1193.

Tools Usage across 5 NSD Stages

This section reports tools usage difference across 5 NSD stages—idea generation and screen, business and market analysis, service design, testing, and launching[6].

FACTS

Table 1 describes the percentage of firms who apply certain tool in specific NSD stage. We can see that tools are not used only in stages that match their main and supporting roles; rather, a more dispersed manner is observed.

Table 1: Percentage of firms that apply NSD tools in each stage

		Idea generation and screen	Business and market analysis	Service design	Service testing	Service launching
Market tools	Benchmarking (25)	44%	**76%**	60%	**28%**	**24%**
	Scenario planning (19)	42%	**74%**	53%	32%	**16%**
	Brainstorming (31)	**77%**	58%	**74%**	**13%**	35%
	Focus group (16)	50%	56%	63%	50%	50%
Development tools	Concept testing (17)	47%	**24%**	41%	47%	29%
	Quality function deployment (12)	17%	25%	**83%**	25%	**8%**
	Service blueprinting (15)	**20%**	27%	**80%**	60%	33%
	Structured analysis and design (17)	**29%**	47%	**82%**	41%	**24%**

■ Significantly higher than usage in other NSD stages ($p<.05$)

■ Significantly lower than usage in other NSD stages ($p<.05$)

Note: Parentheses indicates the number of firms using that tool.

ANALYSIS

Generally, most market tools are used in stages with intensive customer interaction while most development tools are employed in the design and testing stages. This indirectly confirms that financial service firms may not have rigorous development procedures. Another finding is that the tools usage in service launching stage is significantly lower than the usage in other stages, this can be contributed to firms paying fewer attentions to service launching in NSD projects.

[6] Song, L., M. Song, et al. (2009). "A Staged Service Innovation Model." Decision Sciences 40(3): 571-599.

TIP

Service firms should follow a formal NSD process— idea generation and screen, business and market analysis, service design, testing, and launching. In this way, roles and responsibilities of each functional department become clear and suitable NSD tools can be applied to each stage.

Tools Usage across Financial Service Industries

This section looks into tools usage difference across financial service industries.

FACTS

Table 2 maps tools usage across several financial service industries. Fund management firms utilize more market tools than banks and insurance companies, and banks use more development tools than other industries. We should be cautious about real estate sample in that it comprises only two firms.

Table 2: Percentage of firms from each service industry that apply NSD tools

		Bank (8)	Fund mgmt (11)	Insurance (8)	Real estate (2)	Other (5)
Market tools	Benchmarking	75%	82%	62.5%	**100%**	60%
	Scenario planning	50%	55%	62.5%	50%	**100%**
	Brainstorming	87.5%	91%	**100%**	**100%**	80%
	Focus group	62.5%	36%	**25%**	**100%**	60%
Development tools	Concept testing	50%	36%	**75%**	**0%**	60%
	Quality function deployment	37.5%	36%	50%	**0%**	20%
	Service blueprinting	50%	36%	50%	**0%**	60%
	Structured analysis and design	62.5%	36%	50%	**100%**	40%

■ Significantly higher than usage in other industries ($p<.05$)

■ Significantly lower than usage in other industries ($p<.05$)

Note: Parentheses indicates the number of firms from that industry.

ANALYSIS

All financial institutions rely heavily on benchmarking and brainstorming for market and competitor information. These tools help generate innovative ideas that meet customers' changing needs and industrial standards. More banks harness focus group. This is most useful when they want to thoroughly understand customer needs of a specific target group.

With regard to development tools, banks make the most use of structured analysis and design and service blueprinting, and this means that they attach more emphases on service design than other industries. Insurance companies utilize significantly more concept testing tools, reflecting their discretion in judging new service ideas. Fund management companies rank below average as for development tool usage. One explanation is that their business decisions relate largely to investment, which requires less efforts in service design and testing.

TIP

Banks and insurance firms can consider using more market tools to solicit customer preferences and needs. While service imitation is the rule of game, developing services outperforming competitors is a more effective way to achieve competitive advantage.

Service failure could drive the reputation down and make customers shift to other service providers. Financial institutions, especially insurance companies and fund management firms, should utilize more development tools so that potential problems can be detected before services are launched to market.

NSD Performance and Its Measurement

The second part discusses NSD performance rating and importance attached to each measurement. Two independent performance categories are referred to—*market performance* assesses the commercial outcome after service is launched to the market and *operational performance* describes how NSD project is executed and operationalized[7].

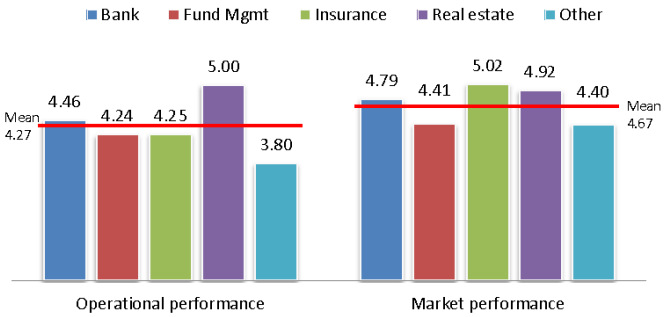
NSD Performance Rating

This section reports NSD performance rating of each industry.

FACTS

Figure 4 describes operational and market performance across industries on a 1-7 scale (1=much worse than targeted, 4=exactly on target, 7=much better than targeted). On the whole, firms achieve better market performance than operational performance. Specifically, real estate firms and banks report both above-average operational and market performance, and insurance firms achieve above-average market performance.

Figure 4: Overall NSD performance across industries



ANALYSIS

It is possible for a new service to achieve market success in terms of market share, but it may incur substantial development costs and time, so it is important to distinguish both. This explains why operational and market performance differ.

[7] Blindenbach-Driessen, F., J. Van Dalen, et al. (2010). "Subjective Performance Assessment of Innovation Projects." Journal of Product Innovation Management 27(4): 572-592.

FACTS

Table 3 further details on NSD performance rating. Fund management firms rank the highest regarding cost objective, but the lowest as for time-to-market objective. Real estate companies rank the highest with respect to quality and market-opening objective.

Table 3: Break-down of NSD performance across industries

		Bank	Fund mgmt	Insu-rance	Real estate	Other
Operational	Time-to-market objective met?	4.00	**3.18**	3.63	4.50	3.60
	Project cost objective met?	4.50	**4.64**	3.75	4.50	3.40
	The product was of excellent quality.	4.88	4.91	5.38	**6.00**	**4.40**
Market	Profit objective met?	4.00	3.82	4.75	4.00	3.60
	Revenue objective met?	4.25	3.73	4.63	4.00	3.60
	Market share objective met?	3.88	3.45	4.38	4.00	3.40
	The product provided firm a competitive advantage.	5.38	5.09	5.88	5.50	5.40
	The product satisfied customers' needs.	5.63	5.18	5.50	5.50	4.80
	The product opened up a new market for our firm.	5.63	5.18	5.00	**6.50**	5.60

■ Significantly better than performance of other industries ($p<.05$)

■ Significantly worse than performance of other industries ($p<.05$)

ANALYSIS

Interestingly, all firms report higher scores for the last three market performance measurements, which are more subjective. This reminds us that managers tend to exaggerate subjective ratings, so companies should keep an eye on such measurement's limitation.

TIP

Accurate assessment is crucial to allocate key resources and to abandon unfavorable projects. When evaluating NSD projects, companies are advised to devise a rigorous measurement system. NSD project should be evaluated by covering both operational and market performance. Also, subjective measurements should be used with cautions because managers are tended to exaggerate such ratings.

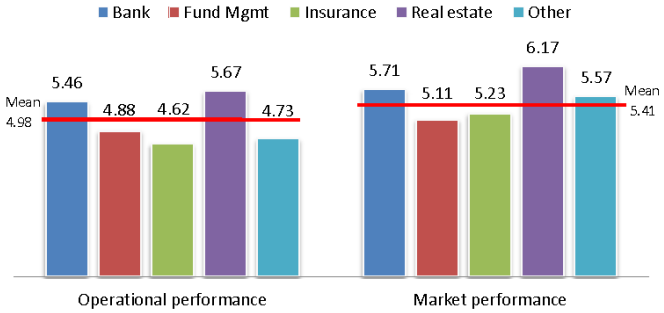
NSD Performance Measurement

This section reports the importance attached to each NSD performance measurment.

FACTS

Figure 5 demonstrates the importance attached to performance measurement on a 1-7 scale (1=not important at all, 4=neutral, 7=very important). In general, firms emphasize more on market than operational outcomes. Banks and real estate firms attach above-average importance to both operational and market performance.

Figure 5: Importance attached to NSD performance across industries



ANALYSIS

Recalling the data presented in **Figure 4**, we discover that—the more the importance is attached to certain performance measurement, the better the performance are reported. The reason for this is that companies will commit more resources to tackle areas that they want to address, and this will result in the better performance in these areas.

FACTS

Table 4 illustrates the weights assigned to individual measurement. As for operational performance, all industries underline the importance of product quality. Achieving competitive advantage and satisfying customer needs are the top market related priorities among all industries. For respective industry, banks emphasize the most on time-to-market objective, while real estate firm stress the most on profit and revenue targets.

Table 4: Importance attached to individual measurement across industries

		Bank	Fund mgmt	Insu-rance	Real estate	Other
Operational	Time-to-market objective met?	**5.50**	4.45	**3.88**	5.00	4.60
	Project cost objective met?	5.13	4.82	4.25	5.50	4.20
	The product was of excellent quality.	5.75	4.36	5.75	6.50	5.40
Market	Profit objective met?	5.63	5.00	5.25	**6.50**	5.20
	Revenue objective met?	5.63	4.91	4.63	**6.50**	5.40
	Market share objective met?	4.75	4.00	4.13	5.50	4.40
	The product provided firm a competitive advantage.	6.13	**5.64**	6.13	6.50	6.00
	The product satisfied customers' needs.	6.38	5.73	5.88	6.50	6.00
	The product opened up a new market for our firm.	5.75	5.36	5.38	5.50	6.40

■ Significantly more weight than other industries ($p<.05$)

■ Significantly less weight than other industries ($p<.05$)

TIP

Firms are recommended attaching importance not only to market outcomes but also to operational results. Cost efficiency, market responsiveness, and quality orientation are especially important at a time when economic turmoil continues and business development is largely constrained by limited resources.

NSD Tools Effectiveness

The third part discusses whether NSD tools usage associates with improved NSD performance.

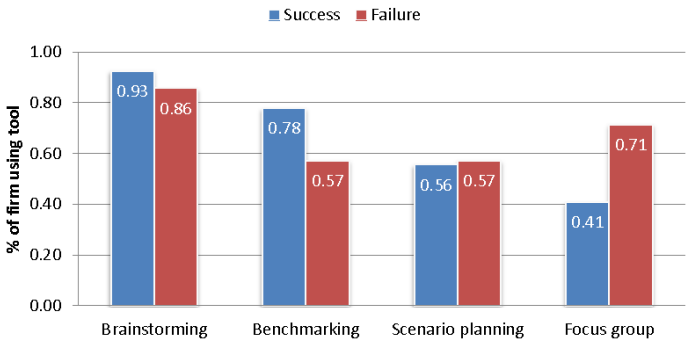
Impact of NSD Tools on Market Performance

This section reports the relationship between NSD tools usage and market performance. The sample is split into two groups based on market performance. Projects labeled as success are those with mean higher than 4.00. This results in 19 successful projects with mean of 5.38 and 15 failed projects with mean of 3.78. The differences noted in two samples are statistically significant ($p<.05$).

FACTS

Figure 6 describes the percentage of firms using market tools from both success and failure groups. Generally speaking, market tools usage does not significantly differentiate market success from failure. Benchmarking is the only tool that associates with 10% more usage in successful projects. All other tools do not manifest themselves in a significant way, with less than 10% usage difference.

Figure 6: Impact of market tools on market performance



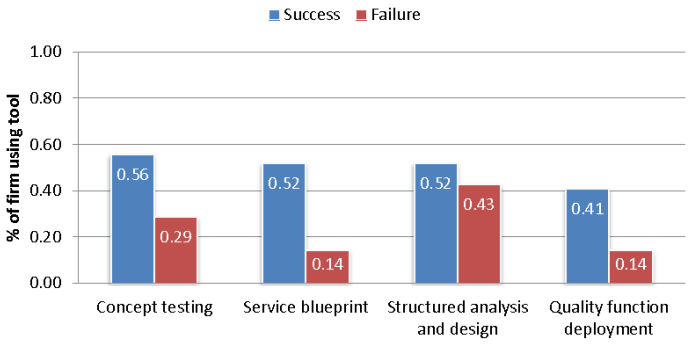
ANALYSIS

The higher utilization of benchmarking in successful projects points out that imitating competitor services is one of the effective NSD strategies. Notice that focus group has a large popularity among failed projects. This does not necessarily mean that it impose negative impact on performance. One possibility is that firms are not making full advantage of its benefits.

FACTS

Figure 7 illustrates the percentage of firms using development tools from each group. It is safe to draw the conclusion that development tools influence NSD performance in a positive way. The most effective tools are concept testing, service blueprinting, and quality function deployment.

Figure 7: Impact of development tools on market performance



ANALYSIS

Both concept testing and quality function deployment assist companies in filtering service ideas and translating them into development specifications. And as a result, resources can be committed to the most promising projects. Service blueprinting helps to map out service delivery processes so that potential problems can be identified and solved before final roll-out. In spite of their effectiveness, development tools are utilized by less than 50% firms (refer to **Figure 3**). We suggest service firms recognizing their value and trying to apply them to NSD projects.

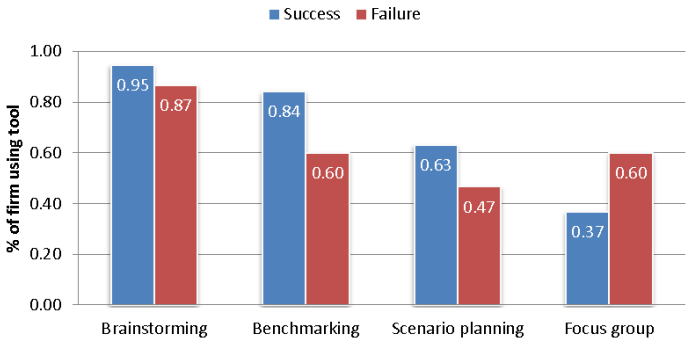
Impact of NSD Tools on Operational Performance

This section reports the relationship between NSD tools usage and operational performance. We divide samples into successful and failed projects according to operational performance. Those projects with mean higher than 4.00 are rated as successful. This leads to 19 successful projects with mean of 4.81 and 15 failed projects with mean of 3.60. The differences noted in two samples are statistically significant ($p<.05$).

FACTS

Figure 8 presents the percentage of firms using market tools from two groups. One the whole, successful NSD projects use market tools more frequently. The most effective tools are benchmarking, and scenario planning.

Figure 8: Impact of market tools on operational performance



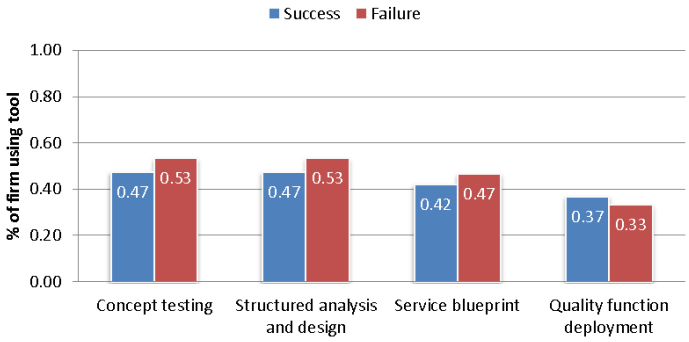
ANALYSIS

Compared to the result shown in **Figure 6**, scenario planning seems to play an important role in enhancing operational performance. The reason is that it helps firm forecast situational factors surrounding a new service, lowing development risks. On the other hand, focus group contributes negatively. One explanation is that the use of focus group necessitates quite a lot of implementation time, and this prolongs the development time and leads to lower operational performance. Therefore, it's crucial to carefully pick tools that meet real NSD needs.

FACTS

Figure 9 describes the percentage of firms using development tools from two samples. To our surprise, development tools, which are intended to facilitate operations efforts, do not show their values in improving operational performance.

Figure 9: Impact of development tools on operational performance



ANALYSIS

This can be the result of limited number of tools that are used. **Figure 3** indicates that less than 50% of the firms use development tools, so it is difficult to detect differences basing on such a small sample. Also, it is possible that tools usage requires allocation of additional resources and efforts, such as time and costs.

TIP

Brainstorming and benchmarking are market tools which prove to be effective in enhancing both market and operational performance. Firms that have not employed them yet are thus recommended using them in future projects.

All development tools listed in this study have positive impacts on market performance. Besides, quality function deployment is also effective in strengthening operations capability. Considering its low usage, we propose that managers should consider adopting it in future projects.

NSD Innovativeness

The forth part reports NSD innovativeness across different industries and discusses the influence of NSD innovativeness on the choice of NSD tools.

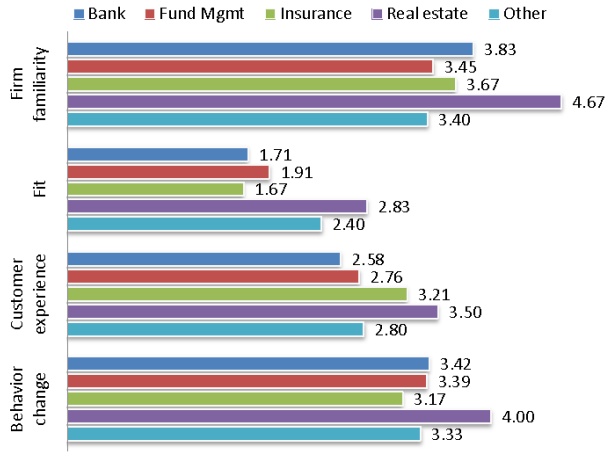
NSD Innovativeness across Industries

This section reports NSD innovativeness along its four dimensions[8]. *Firm familiarity* stands for the extent to which firms are familiar with market needs and technology involved. *Fit* indicates the synergy between firms' internal resources and the requirements for the NSD project. *Customer experience* refers to the experience that customers will have in getting and using the services. *Behavior change* reflects the extent to which changes of consumption patterns are needed for customers.

FACTS

Figure 10 depicts service innovativeness on a 1-7 scale (1=least innovative, 4=neutral, 7= most innovative). On the whole, financial service products are not innovative. The most innovative products are from real estate firms. Services from other industries have innovativeness less than 4.00 (neutral).

Figure 10: Service innovativeness across industries



[8] Danneels, E. and E. J. Kleinschmidt (2001). "Product Innovativeness from the firm's perspective: its dimensions and their relation with project selection and performance." Journal of Product Innovation Management 18(6): 357-373.
Calantone, R. J., K. Chan, et al. (2006). "Decomposing Product Innovativeness and Its Effects on New Product Success." Journal of Product Innovation Management 23(5): 408-421.

ANALYSIS

The results show that most new services are just modification of existing services. Given innovativeness dimensions, most firms are inclined to develop services that are compatible with current capital and human resources and they are reluctant to launch services that are unfamiliar to customers. Comparatively, companies are more flexible as for firm familiarity and customer behavior change.

TIP

Financial institutions should step out of the box and provide more innovative products. While services are easily copied, first mover in financial service industry enjoys benefits such as lower costs and better reputation[9].

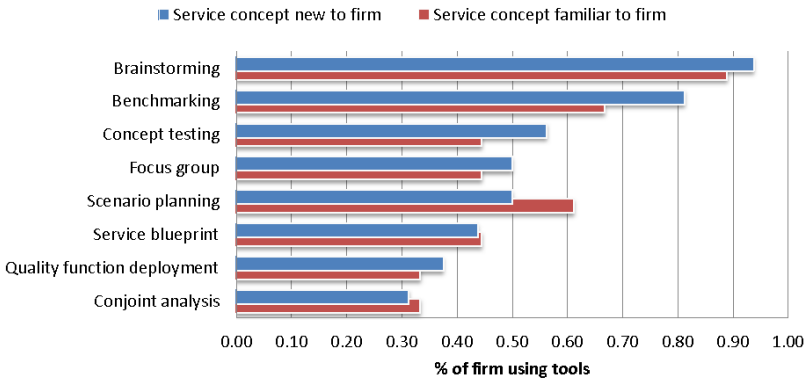
Impact of Firm Familiarity on Tools Usage

This section discusses the impact of firm's familarity on NSD tools usage. Each project is classified into one of the two groups basing on whether its familarity rating is higher or lower than overall familarity mean (3.66).

FACTS

Figure 11 describes the percentage of firms using tools when the service concept is either new or familiar to them. Generally, more firms tend to use NSD tools for projects with service concept that are new to them.

Figure 11: Tools usage in projects with different degree of firm familiarity



[9] Tufano, P. (1989). "Financial innovation and first-mover advantages." Journal of Financial Economics 25(2): 213-240.

ANALYSIS

Market tools, such as brainstorming, benchmarking, and focus group, are more frequently utilized in innovative projects. They provide firm a better understanding of customer needs. As for development tools, structured analysis and design, concept testing, and quality function deployment are more frequently used. On the contrary, scenario planning is less used in more innovative projects. One explanation is that firms are unable to conduct rigorous service testing and accurate forecasts when they are unfamiliar to service concepts.

TIP

When the service concept is new to firm, market tools should be used more frequently to get a better understanding of customer needs.

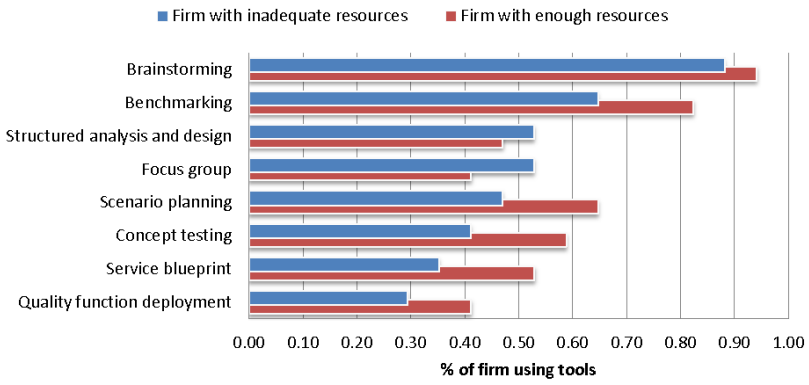
Impact of Firm Fit on Tools Usage

This section discusses the impact of firm's fit on NSD tools usage. Each project is classified into one of the two groups basing on whether its fit rating is higher or lower than overall firm fit mean (1.93).

FACTS

Figure 12 describes the percentage of firms using tools when they possess enough or inadequate resources. The result shows that when companies are equipped with enough resources, they are more likely to employ NSD tools.

Figure 12: Tools usage in projects with different degree of firm fit



ANALYSIS

This reminds managers that resource commitment is one of the key factors that affect tools usage. If companies want to reap the benefits of NSD tools, it is important to enhance empowerment of NSD team by committing enough capital and human resources. As for market tools, firms with adequate resources tend to use more brainstorming, benchmarking, and scenario planning. Concept testing, service blueprinting, and quality function deployment are frequently used when project shows a better company-project fit.

TIP

The lack of resource commitment imposes a constraint feeling to development teams. In order to fully harness NSD tools, management should devote enough capital and human resources.

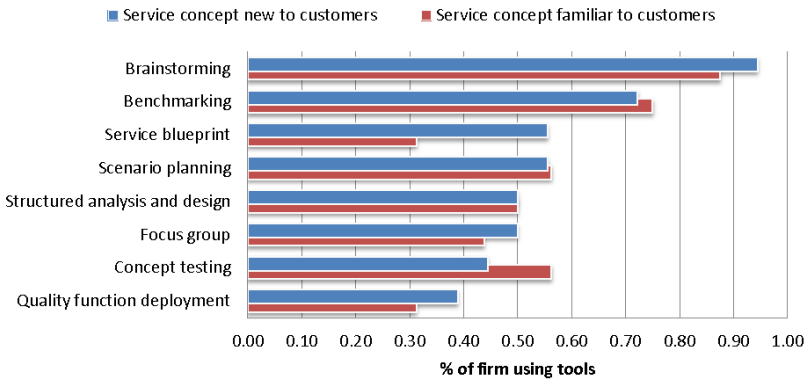
Impact of Customer Experience on Tools Usage

This section discusses the impact of customer experience on NSD tools usage. Each project is classified into one of the two groups basing on whether its customer experience rating is higher or lower than overall customer experience mean (2.87).

FACTS

Figure 13 depicts the percentage of firms using tools when service concept is new or familiar to customers. The result manifests that projects whose service concepts are new to customers are associated with higher tools usage, especially service blueprinting.

Figure 13: Tools usage in projects with different degree of customer experience



ANALYSIS

Service blueprinting is used more frequently in innovative projects because firms want to make sure that potential service failure is lowered to minimum so as not to add up to existing risks associated with customer unfamiliarity.

TIP

Service firms should take more responsibilities in visualizing customer needs and testing prototypes when customers are unfamiliar to the service concept. Tools like service blueprinting are the most frequently used tools in such situation.

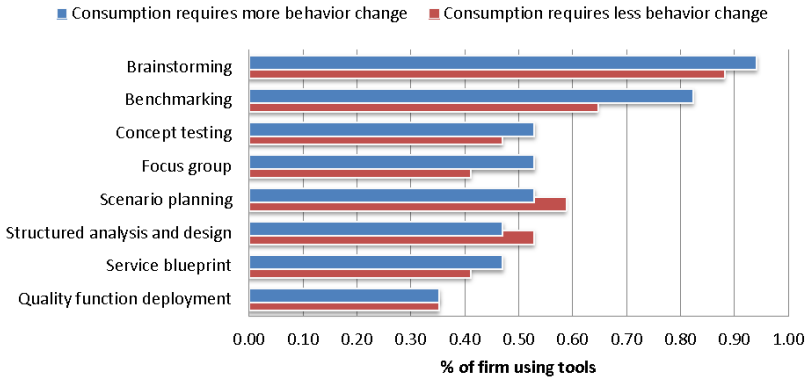
Impact of Behavior Change on Tools Usage

This section discusses the impact of customer behavior change on NSD tools usage. Each project is classified into one of the two groups basing on whether customer behavior change rating is higher or lower than overall bahavior change mean (3.37).

FACTS

Figure 14 illustrates the percentage of firms using tools when service consumption requires high or low degree of behavior change. The results show that when more behavior change is required, firms tend to use more tools, especially market tools like brainstorming, benchmarking, and focus group.

Figure 14: Tools usage in projects with different degree of behavior change



The result provides support to the fact that more firms will use NSD tools to develop services whose consumption requires more behavior change. Especially, financial service firms intend to use more market tools, such as brainstorming, benchmarking, and focus group. Most customers are reluctant to adopt services which will change their consumption patterns, so this propels firms to use more make tools to figure out the trade-offs.

Bigger role has to be taken by firms when the service consumption requires more behavior change. Tools, such as benchmarking and focus groups, are used more frequently by firms facing such scenario.

CONCLUSIONS

This study looks into the usage and effectiveness of NSD tools by surveying Singapore financial service institutions.

Our analyses confirm the relationship between NSD tools usage and improved NSD performance. Despite the high usage of market tools, less development tools are used. We suggest firms adopting more development tools because they are useful in reducing risks.

Financial service firms pay more attention to market performance though; equal importance should be attached to operational outcomes in the face of current economic stagnation.

Most of the new services are just modification of existing ones. To achieve sustainable competitive advantage and good reputation, firms should consider taking the lead in developing more innovative services. Firms are recommended using more tools when engaging in innovative projects.

APPENDIX - SURVEY APPROACH AND METHODS

Survey method was used in this study. A company list was constructed by combining financial institutions directory from Monetary Authority of Singapore[10] and the commercial database provided by OneSource[11]. Chief executive officer or principal officer from each company was requested for information about one NSD project conducted in the recent 3 years. Table 5 presents a summary of demographics.

During November 2010, 420 invitation letters were sent out, and 23 firms declined participation. One week later, survey packages with cover letter and questionnaire were mailed to the rest 397 companies. Reminder letters were sent out two weeks afterwards. During the end of December 2010, phone calls were made to those who did not respond. By the mid of February, 68 companies declined participation through emails or phone calls, and another 34 were undeliverable due to wrong addresses.

Table 5: Demographics of responses from postal mail

		With NSD (34)	Without NSD (29)
Industry	Banks	24% (8)	34% (10)
	Fund mgmt	32% (11)	17% (5)
	Insurance	24% (8)	21% (6)
	Real estate	6% (2)	3% (1)
	Trust	0% (0)	0%
	Other	15% (5)	24% (7)
# of employee in Singapore *	<100	56% (19)	83% (24)
	100-499	36% (12)	10% (3)
	500-999	3% (1)	7% (2)
	>1000	6% (2)	0%
Business type	B-2-B	41% (14)	59% (17)
	B-2-C	32% (11)	21% (6)
	Mix	26% (9)	21% (6)
Ownership	Local	38% (13)	17% (5)
	Foreign	59% (20)	83% (24)
	Joint-venture	3% (1)	0%
Revenue *	<$24M	47% (16)	69% (20)
	$25-99M	18% (6)	17% (5)
	$100-499M	12% (4)	10% (3)
	>$500M	24% (8)	3% (1)

Note: Parentheses indicates the number of respondents.
* indicates two samples are significantly different ($p<.05$).

[10] http://www.mas.gov.sg/fi_directory/index.html
[11] http://www.onesource.com/

In total, 99 responses—34 via phone call 65 via postal mail—were received. 63 responses indicating no NSD activities were exclude from further analysis, together with the two that provided incomplete NSD data. Therefore, following sections in this report are based on the 34 usable responses.

A Preliminary Analysis of Demographics

The sample with NSD is largely comprised of banks (24%), fund management firms (32%) and insurance firms (24%). Nearly half of them have less than 100 employees and generate less than $24 million revenue, implying that they are mainly SMEs (Small and Medium Enterprise). However, a close look on the ownership data shows that 59% of them have foreign ownership. This means that they are most likely to be branches of large MNCs (Multi-National Company), so our data do not bias towards SMEs.

We conducted T-test between the two samples with NSD and without NSD activities. Significant differences are reveals in terms of employee number and revenue. For firms with employee number less than 100, only 44% (19/43) of them had NSD. On the other hand, for firms having more than 100 employees, 75% (15/20) of them conducted NSD. This shows that large financial service firms are more likely to implement NSD projects. The reason is that they usually enjoy more capital and human resources than smaller firms.

Appendix G Construct Measurement of Study 2

Construct	*Loading*	*t-Value*
Operational Performance		
Time-to-market objective met? *(1=much worse than targeted, 7=much better than targeted)*	0.82	12.84
Project cost objective met? *(1=much worse than targeted, 7=much better than targeted)*	0.76	10.17
The product was of excellent quality. *(1=strongly disagree, 7=strongly agree)*	0.83	15.37
Product Performance		
Profit objective met? *(1=much worse than targeted, 7=much better than targeted)*	0.72	9.71
Revenue objective met? *(1=much worse than targeted, 7=much better than targeted)*	0.74	10.30
Market share objective met? *(1=much worse than targeted, 7=much better than targeted)*	0.76	12.14
The product provided firm a competitive advantage. *(1=strongly disagree, 7=strongly agree)*	0.85	20.40
The product satisfied customers' needs. *(1=strongly disagree, 7=strongly agree)*	0.80	13.50
The product opened up a new market for our firm. *(1=strongly disagree, 7=strongly agree)*	0.78	12.75

Appendix H Construct Measurement of Study 3

Scale items	*Loading* [a]	*t-Value*
Behavioral intention		
INT1: We are planning to use NSSD tools in future NSD projects.	0.93	53.68
INT2: We intend to use NSD tools in future NSD projects.	0.96	113.02
INT3: We intend to use NSD tools frequently in future NSD projects.	0.94	60.18
Attitude		
A1: Using NSD tools would be a …… idea. (1=extremely bad, 7=extremely good)	0.92	39.83
A2: Using NSD tools would be a …… idea. (1=extremely foolish, 7=extremely wise)	0.89	27.36
A3: Using NSD tools would be a …… (1=extremely unpleasant, 7=extremely pleasant)	0.80	14.65
A4: We would …… the idea of using NSD tools. (1=extremely dislike, 7=extremely like)	0.90	32.25
Subjective norm		
SN1: Those parties who influence our behavior would …… our use of NSD tools. (1=extremely oppose, 7=extremely support)	0.94	55.65
SN2: Those parties who are important to us would …… our use of NSD tools. (1=extremely oppose, 7=extremely support)	0.95	59.92
SN3: Those parties whose opinions we value would …… our use of NSD tools. (1=extremely oppose, 7=extremely support)	0.95	74.99
Perceived behavioral control		
PBC1: Using NSD tools would be …… our control. (1=extremely out of, 7=extremely under)	0.88	27.98
PBC2: Our company would have …… resources, knowledge and abilities to use NSD tools. (1=extremely few, 7=extremely much)	0.86	25.95
PBC3: Given the resources, knowledge and abilities it takes to use NSD tools, it would be …… for us to use NSD tools. (1=extremely difficult, 7=extremely easy)	0.90	39.55
Perceived usefulness		
PU1: Using NSD tools makes it easier to conduct NSD projects.	0.91	37.54
PU2: Using NSD tools enhances effectiveness on NSD projects.	0.94	66.77
PU3: Using NSD tools enables us to accomplish NSD projects more quickly.	0.83	16.93
PU4: Using NSD tools is useful in NSD projects.	0.91	41.37
Perceived ease of use		
PEU 1: We believe that it is easy to get NSD tools to do what we want to do.	0.91	33.37
PEU 2: Learning to use NSD tools is easy for us.	0.95	75.29
PEU 3: Overall, NSD tools are easy to use.	0.94	53.58

Appendix H Construct Measurement of Study 3 (Continued)

Scale items	*Loading* [a]	*t-Value*
Supplier* coercive pressure		
(*firm being involved in providing support for NSD projects, e.g., consulting firms)		
SPLP1: To work with our suppliers, they require us to use NSD tools.	0.93	6.95
SPLP2: We are recommended by our suppliers to use NSD tools.	0.94	7.22
SPLP3: We have pressure from our suppliers to use NSD tools.	0.92	8.28
Competitive pressure		
CPTP1: In your industry, the use of NSD tools is helpful in allowing a company to remain competitive.	0.46	2.22
CPTP2: Please indicate the extent of NSD tool adoption by your competitors. (1=extremely low, 7=extremely high)	0.63	2.99
CPTP3 (Global): We are feeling great pressure to use NSD tools due to our competitors.	N/A [b]	N/A
CPTP4 (Global): Please rate the pressure to adopt NSD tools placed on your firm by your competitors. (1=extremely low, 7=extremely high)	N/A	N/A
Customer coercive pressure		
CSTP1: Our customers require us to use NSD tools.	0.95	66.03
CSTP2: Our customers may consider us as backward if we do not use NSD tools.	0.97	115.90
CSTP3: To what extent do your customers influence your decision to use NSD tools? (1=extremely small, 7=extremely large)	0.94	55.96
Compatibility		
CPB1: Using NSD tools is consistent with our company's value and beliefs.	0.30	1.65
CPB2: Using NSD tools is compatible with our past experience of conducting NSD projects.	0.20	1.14
CPB3: Using NSD tools fits well with the way we conduct NSD projects.	0.59	4.00
CPB4 (Global): Overall, using NSD tools is compatible with our company.	N/A	N/A
CPB5 (Global): Overall, NSD tools fit well with our company.	N/A	N/A
Resource commitment		
RSC1: We have the financial resources to use NSD tools.	0.09	0.78
RSC2: We have competent people who can use NSD tools well.	0.94	8.05
RSC3 (Global): Our firm devotes enough resources (financial and personnel) to the use of NSD tools.	N/A	N/A
RSC4 (Global): Overall, using NSD tools is easy for us because we have enough resources (financial and personnel).	N/A	N/A

Note: unless otherwise mentioned, all measures were rated on seven-point Likert scales (1=strongly disagree, 7=strongly agree).

[a] Path coefficients are shown for formative constructs.

[b] Loadings are not applicable to global measures.

Appendix I Detailed Descriptions of Capability Characteristics

Strategy Management

1) *Initial*: (1) a service firm pays few attentions to how competitors develop and deliver new services. There exists no clear goal or objective, and it is assumed that if a NSD team can do what they are supposed to do, the NSD project will be a success. (2) Market research is nowhere to be found, so the targeting markets are usually associated with very high uncertainty. (3) The firm recognizes the importance of the resource allocation to NSD success. However, there is no established practice or rule that guides resource management.
2) *Financial planning*: (1) the firm begins to form rudimentary NSD strategy by drawing up annual budgeting for NSD projects. The NSD goals and objectives are neither well understood by employees nor aligned with overall business strategy. The guideline for a NSD project is: "Don't screw up." (2) The company begins to utilize informal market research to understand the market. To reduce risk, it usually follows its competitors into similar markets while not caring too much about whether the markets fit the firm or vice versa. As a result, the market uncertainties are still high. (3) There are informally documented resource allocation practices in place. They are most of the time for allocating those resources relating to the financial planning in a single NSD project.
3) *Forecast-based planning*: (1) a formal NSD strategy is formed by understanding how competitors develop new services. The guideline for a NSD project is: "Don't let competitors gain too much of an advantage over us." The NSD goals and objectives are clearly defined, though they are still just partially understood by employees. The synergy between the NSD strategy and the overall strategy is at a medium level. (2) The management makes use of formal market research to better understand what creates value in the current customers' eyes, and niche markets are targeted. At this level, the company is so enchanted by the market potential that it pays few attentions to its own strengths and limitations. The level of market uncertainty ranges from medium to high. (3) There are formally documented resource allocation practices to ensure a circulatory flow of capital

and other resources. These practices are considered organizational standards and are circulated among almost all NSD projects by management.

4) *Externally oriented planning*: (1) the firm evolves a strategic business unit for managing the NSD strategy. Management clarifies the strategic direction and develops a shared vision with a view to articulate the strategy more fully. The guideline is: "Do better than competitors." The NSD goals and objectives are institutionalized in the whole organization, and they show a relatively high synergy between the NSD strategy and the overall strategy. (2) In-depth market research is used to better understand the key factors that affect future business success. Service firm enters markets showing high synergy between organizational capabilities and market requirements. The market fits the company so well that the associating uncertainties are relatively low. (3) Formally documented resource allocation practices are in place and they are totally institutionalized in the whole organization. They are dynamic rather than deterministic so as to deal with unforeseen problems.

5) *Strategic management*: (1) a strategic management framework is shaped to link the strategy management to other management facets of NSD projects. The guideline is: "Do things that competitors cannot do." Employees take active part in making the NSD strategy work. The NSD goals and objectives are well articulated. Due to the involvement of front-line employees in strategy planning, the synergy between the NSD strategy and the overall strategy achieves the highest level possible. (2) Rather than simply investigating the customer needs and attempting to satisfy them, the company conducts thorough market research to create needs, establish expectations, and continually expand those expectations. Since the firm explores markets by aligning itself with its own strengths, the markets show very high corporate-market synergies and the associated uncertainties are low. (3) Formally documented resource allocation practices are integrated into other corporate processes and systems. The processes are created in order to improve the resource management effectiveness and efficiency. The business strategy is in tune with available resources.

Process Formalization

1) *Initial*: (1) the NSD process is ad hoc and occasionally chaotic. The mission at this level is simply to get the work done. Issues such as accountability and efficiency are not considered. Neither rule nor procedure is used to guide the development efforts. NSD activities are heavily dependent on individual talents. (2) There exists no documentation regarding the NSD process. (3) A NSD team is formed in an ad hoc way such that no formal role or responsibility is assigned for its members.
2) *Managed*: (1) specific rules and procedures for the NSD process are established, but they are project-centered and are not considered as the organizational standards. The mission is to ensure that the current project is effectively planned, managed, and controlled. (2) Informal documentation exists on these basic procedures and is circulated only among current NSD team members. Basic metrics are used to track cost, schedule, and performance. But available information is often a mix between intermediate-level data and summary-level data. (3) A formal NSD team is established only for an NSD project. Basic responsibility definition, such as narrative description and responsibility assignment matrix, is established so that the responsibilities for the key NSD team members are clear.
3) *Defined*: (1) institutionalized rules and procedures are established. They are tailorable standards and are used in almost all NSD projects with minimal exception. The mission is to get the successful NSD procedures repeated in all projects. (2) Formal documentation is created to record all institutionalized rules and procedures, and it is circulated among nearly all NSD projects. Informal analyses of the project cost, schedule, and performance are conducted to measure the performance of current project. The information provided is often a mix of summary-level and detailed-level data. (3) A formal NSD team is established according to the institutionalized standards. There exist formal descriptions of the responsibilities for all NSD team members.
4) *Quantitatively managed*: (1) on top of the institutionalized rules and procedures, formal empirical measurements, statistical techniques, and quantitative analyses of the project cost, schedule, and performance, are conducted to improve current process. At this level,

the NSD process shows high degrees of control, reliability, and predictability, and is integrated with other organizational processes. (2) The documentation regarding the utilization of formal metrics is also established and is circulated among all NSD projects. The data collection enters a detailed level. The management takes an organizational view of the NSD projects, so mandate is issued to comply with the organizational processes and procedures. (3) Formal NSD teams with clear definition of responsibilities are established according to such mandates. Training for the team members is scheduled when needed to assure that they are competent for their roles.

5) *Optimizing*: (1) the service firm shifts its focus from developing successful new service offerings to continuously improving and refining NSD process. There exist formal improvement procedures to learn from past experiences and lessons so as to improve and refine organizational rules and procedures relating to NSD. The development process is eminently controllable and reliable so that the performance, quality, and suitability of new services can all be statistically anticipated. Formal metrics are collected not only for measuring current project performance, but also for the process improvement in the future. (2) Formal documentation regarding the improvement procedures is created and circulated among all NSD projects, sometime even to the whole organization. The data collected is at a detailed level. Formal NSD team is created with the responsibilities clearly being defined for all team members. (3) The NSD team is held responsible not only for current NSD project, but also for continuous improvement in future projects. Training for team members is formally available, presenting experiences and lessons learnt from the past.

Knowledge Management

1) *Initial*: (1) there exists few intentions to engage in the knowledge management in NSD projects. The service firm is not aware of the need for the knowledge management. (2) There exist few knowledge management processes. (3) Knowledge management technology is not in place.

2) *Intuiting*: (1) the company becomes aware of the need for the knowledge management; however, it does not pay specific attention to the knowledge management activities. Therefore, NSD team members have sufficient NSD related experiences and knowledge, but they do not value knowledge sharing. (2) Knowledge is identified and captured by tacit personal experiences and observations. By comparing current and past situations, individual unconsciously knows what to do. Since such behavior is guided by intuition, the knowledge involved can neither be documented nor be transferred to other team members. (3) Knowledge management technologies only exist in some pilot projects. Their utilizations are limited to the maintenance of team member's personal implicit NSD knowledge repositories.
3) *Interpreting*: (1) the firm recognizes that the knowledge management can bring benefits to NSD projects, and a basic incentive system is established to encourage team members to transfer their explicit knowledge to others. Hence, some team members who understand the value of knowledge sharing form the willingness to share among their personal groups. (2) Knowledge is identified and captured by explicit personal experiences and observations, and it is documented as individual protocols. Individual is now able to express ideas to other team members, but the interaction is limited to personal group rather than the whole NSD team. Informal conversations in the personal networks are used to help exchange thoughts and ideas. Such communication and interaction lead to the changes of knowledge management activities so that individual is no longer the only one accountable for the knowledge application. (3) Basic knowledge management technologies are used to assist the constructing of personal group NSD knowledge repositories.
4) *Integrating*: (1) the organization makes commitment to the knowledge management in NSD projects, and NSD team leader actively encourages knowledge sharing among members. The value of knowledge sharing is recognized by all team members. Basic training is provided to facilitate the flow of knowledge. (2) Knowledge is identified and captured through collective understanding among NSD team members, and it is documented as team protocols which guides the knowledge management activities.

However, these protocols are not rooted in the organization, and they will disappear once the current project is finished. Formal conversations, meetings, and reports are used to prompt knowledge sharing in a NSD team. Team members have to conform to consensus regarding how the knowledge should be applied. (3) Advanced knowledge management technologies and systems exist to help maintain team NSD knowledge repositories.

5) *Institutionalizing*: (1) the knowledge management is institutionalized in the service firm for all NSD projects. It is also incorporated into the organizational strategy. Advanced training and incentive systems are in place so that NSD team members find it easy to utilize and share knowledge. (2) Formal organizational documents and reports are established to track NSD projects so that successful experiences and valuable knowledge can be shared inside the service firm to guide future projects. Making use of both individual and organizational knowledge resources, the NSD team is able to identify and capture necessary knowledge. NSD team members are required to follow institutionalized rules and procedures so that spontaneous and uncontrolled knowledge activities are reduced. (3) Enterprise-wide knowledge management systems and technologies are used to maintain organizational NSD knowledge repositories.

Customer Involvement

1) *No involvement*: (1) customers are pure buyers. A service firm thinks it has adequate knowledge and understandings about new service ideas and market needs. (2) Customers are not invited to participate in NSD projects at all. (3) Few techniques for customer involvement are used.
2) *Involvement by observation*: (1) customers are treated as objects of study. Since the information is based on current services and is rather limited, the service firm mainly focuses on present service problems and challenges so as to solve them by introducing better service offerings. (2) The interactions occur only in early NSD stages (e.g., strategy formulation). (3) The indirect interaction usually takes the form of indirect need analysis techniques, such as in-house demos and technological forecasting, customer complaints

and suggestions, market data collected by outside organizations and direct observations of customers.

3) *Involvement by advice*: (1) service firm integrates customers into NSD process and regards them as sources of information. (2) The involvement takes place in the early stages (e.g., strategy formulation, idea generation and analysis) and the late stages (e.g., introduction), but it seldom occurs during the service design and process development. (3) Direct and structured need analysis techniques are utilized to make the “voice of the customer" heard. They include face to face interview, questionnaire survey, focus group and brainstorming.
4) *Involvement by doing*: (1) customers are deemed as co-designers, and they no longer hold passive roles during NSD. (2) Being integrated into NSD team, customers now partake actively in NSD projects through all stages. (3) Direct and unstructured need analysis techniques and co-development methods are employed. They include open dialogue, lead user interview and customer site visit.
5) Involvement by strong control: (1) customers are becoming partners of the service firm. Not like the customer-firm relationships in the previous levels which are contingent on the projects, the relationship in this maturity level persists longer, lasting the whole NSD program. (2) The identified customers are mostly loyal and close customers to the service firm, and the company cooperates with them in almost all NSD projects. (3) User committees, business clubs, customer forums, and customer advisory panels are established to maintain long-term relationships with customers.