The Impact of Service Complexity on New Service Development – A Contingency Approach

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The Impact of Service Complexity on New Service Development – A Contingency Approach

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Abstract

The trend towards a global service economy has remained constant for several decades and services continue to gain in importance relative to the primary and secondary sectors. Yet, researchers repeatedly deplore that service innovation is poorly understood, especially in comparison to the development of physical products. The objective of this dissertation is to explore the limitations and impact on performance of applying formalised NPD processes and procedures in a service context. The thesis builds on a parsimonious structural framework of organisational factors, which have been identified to be linked to successful product innovation but have not been consistently supported in the service innovation literature. Furthermore, this thesis explores the interplay between organisational complexity and a number of identified antecedents of innovation performance.

Using a cross-sectional and multi-national sample of service development professionals and following a nomothetic quantitative research approach, the empirical model confirms the primary importance of *Development Culture* as success factor for service innovation and a positive impact of *Project Leadership* and *Timing Plans* on new service performance. *Process Formality*, which is generally accepted to be positively linked to product development performance, was not found to be a significant predictor variable of new service success. However, evidence for moderation through *Process Complexity* revealed that complex new services benefit from formal development processes to a stronger extent compared to less complex new services. A similar relationship was identified for *Project Leadership*.

Following a rigorous research approach, this dissertation delivers a number of findings with ramifications for both innovation researchers and service professionals. Evidence is presented for a moderating influence of service complexity on the relationship between factors relating to NSD process organisation and new service performance. The findings create a link between product and service innovation and demonstrate that whereas complex new services benefit from formalised development processes and structure, services with lower complexity do not.

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Statement of Originality

The author hereby confirms that this piece of work is the result of his own work. Material from work of others has been acknowledged, and quotations and paraphrases suitably indicated.

Statement of Copyright

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Dedication

To my mother, who was very supportive and proud of me committing to this research project and who, unfortunately, could not live to see its completion.

1. Introduction and Overview

Researchers in New Service Development (NSD) repeatedly bemoan the low volume of research in their field (Bretthauer, 2004; Easingwood, 1986; Tatikonda & Zeithaml, 2002), especially in comparison to New Product Development (NPD) research (Ettlie & Rosenthal, 2011; Meyer & DeTore, 2001). With regards to the operations management (OM) literature, Metters and Marucheck (2007) summarise the findings from various authors stating that the proportion of studies dealing with services only amounts to approx. 7.5% of all studies. Whereas this proportion might not be representative to other research disciplines, it emphasises the general difference in volume between NPD and NSD related work in academic literature. Research on service innovation has been described as 'nascent' (Ettlie & Rosenthal, 2011, p. 285) and the volume of literature explaining how now services are developed as 'embryonic' (Alam, 2002, p. 250). Other frequently expressed predications are that, in general, innovation in services is poorly understood (Chae, 2012; Gadrey, Gallouj, & Weinstein, 1995; Menor, Tatikonda, & Sampson, 2002) and that a generally accepted process model, explaining how new services come about has not been proposed to date (Nijssen et al., 2006) or might, in fact, be unfeasible to conceptualise (Johnson et al., 2000). With regards to NPD, as a highly subdued research area, dissensions as to whether research findings can be applied in a services context prevail.[1] Researchers further find that the diversity of services is inadequately explored (Storey & Hull, 2010) and more efforts should be undertaken to apprehend the differences amongst services (Lovelock & Gummensson, 2004).

Concepts from organisational ecology such as structural inertia (Hannan & Freeman, 1984) combined with general findings from transaction cost theory[2] (e.g. search and information cost related to change) result in a tendency for organisations to lean towards the status quo and try to hold on to proven concepts which have worked successfully in the past and thus refrain from the risks of innovation (Van Waarden, 2001). Nevertheless, Brown and Eisenhardt (1997, p. 3) postulate that modern organisations cannot statically sustain in fast changing, highly competitive environments, where "*…the ability to change continuously is a core capability of successful firms.*" Service innovation has been found to be a key factor for

[1] The two antithetic views, namely the assimilation and the demarcation approach are discussed in more detail in section 2.4.3.2.

[2] See Williams (1981) for a more elaborate discussion on transaction costs in an organisational context.

sustainability and competitive advantage (Kandampully, 2002). Concurrently, scholars note that "*…the world has become a service economy*" (Metters & Marucheck, 2007, p. 195). The importance of the service sector is increasing both globally and domestically. Between 2000 and 2011 the overall contribution of the service sector to the global GDP has risen from 67% to 70% (World Bank, 2012). This trend is reflected in both highly developed countries and most emerging economies (CIA, 2013; World Bank, 2012). An improved understanding of service innovation processes and contextual factors that lead to improved NSD performance is relevant from both a theoretical and practical perspective.[3] This dissertation strives to make a contribution to the on-going debate and propose a framework that addresses the critical dimension of service complexity and offers a perspective towards a service categorisation.

This thesis builds on the general assumption that the heterogeneity of services and the large bandwidth of activities that are subsumed under the term 'service' is the root cause for the underrepresentation of NSD within the organisation research literature. The motivation behind this thesis on service innovation processes and conditions originally grounded in academic interest in structured formal development processes in manufacturing. Whereas there is broad consensus amongst academics, who believe that products benefit from systematic processes (Martin & Horne, 1993), common findings in the service literature state that "*…new services happen*" (Rathmell, 1974, p. 14) rather than emerge from structured activities. Easingwood (1986) was amongst the first researchers to attest that new services are introduced in absence of a systematic approach. Yet, the following statement summarises a view that has remained prevalent until to the present day:

> *"Complex processes like new services cannot be planned altogether. Creativity and innovation cannot only rely on planning and control. There must be some elements of improvisation, anarchy, and internal competition in the development of new services."* (Edvardsson, Haglund, & Mattsson, 1995, p. 34)

Practical experience from NPD projects contrasted some of the research findings in service innovation. The widely shared notion that NSD consists of a series of ad hoc processes (Gallouj & Weinstein, 1997; Martin & Horne, 1993; Oke, 2007) let to initial

[3] Research on the determinants of innovation performance can generally be classified as applied research (Montoya-Weiss & Calantone, 1994).

disbelief and sparked the desire to further explore this vibrant and challenging area of research. Whereas it is conceivable that a simple new service (e.g. self-employed small-scale professions such as a landscapist, a tax consultant, or a craftsperson) is born through a service idea put into practice without formalised planning or structure, it seems counter-intuitive that a large service firm like airlines or international service firms such as franchise restaurant chains or retailers would be able to successfully introduce a new service following an ad-hoc approach. Oke (2007) suggests that as management focus their attention on radical innovations incremental service innovations are not developed in a formalised way. As the latter category is by far the most common form, Oke is to be included in the list of researchers who suggest that service development is an ad-hoc activity (Dolfsma, 2004).

The theoretical framework presented in this dissertation defines service complexity as a contingency upon the service innovation process. Researchers like Storey and Hull (2010, p. 156) have already concluded that different service types require separate and specialised approaches to NSD. The inherent level of complexity of a service is considered a possible approach to address service diversity and establish a service taxonomy that can be useful in a service innovation context. More specifically, the research hypotheses in this thesis assume that structural settings which support positive NSD outturns are contingent on the level of service complexity. Research findings indicating a that different approach to NSD should be applied compared to NPD (e.g. a lower level of process formality) are considered justified for services with low levels of complexity (e.g. one-person service provider, such as a massage therapist). These results notwithstanding, the theoretical framework anticipates a higher level of coherence between factors supporting successful NPD and factors promoting NSD performance amongst highly complex new services (e.g. service performed via interaction of a number of specialised professionals, following a structured sequence of process steps, such as a rehabilitation clinic). To test the basic assumptions, the research framework applies a number of established success factors which have been positively associated with superior NPD performance (e.g. process formality, project leadership, cross-functionality, management support)[4] and which have delivered mixed research findings within the NSD literature.

[4] See Barczak, Griffin, and Kahn (2009) for a recent summary of NPD success factors that have been determined as part of a Product Development & Management Association (PDMA) best practice project review.

The purpose of this study is twofold. First, both the limitations and the impact on performance of applying formalised and proven NPD processes and procedures to NSD should be assessed. Further investigation of the concept of new service development and the structural characteristics that improve development performance are intended to shed additional light on the emergence of services, representing the major component of economic activity in most countries. Despite recent growth in the body of NSD research, service innovation is still controversially discussed and generally poorly understood. A structural framework is proposed and used to analyse NPD processes and procedures in a NSD context to assess limitations and communalities between the two. Theory is developed and tested through empirical research using a survey questionnaire approach.
Second, this thesis examines how relative organisational complexity affects NSD processes and performance. Defining service complexity as a contingency upon NSD processes introduces a new perspective which has the potential to overcome the difficulty to identify a common solution of all service types and which puts forward an approach on how to address service diversity in service innovation research. The derived findings are far-reaching and have both theoretical and practical relevance. Findings and limitations are discussed and further research propositions presented.

This dissertation is structured as follows. Following a general introduction of the research topic and its contributions, the theoretical background of the study is systematically analysed and evaluated in the context of the research objectives. Section 3 introduces the conceptual model and research framework that is built on extant research issues and includes the main hypotheses of the thesis. The applied research methodology including the sample composition, data collection, and empirical observation is outlined in section 4. Sections 5 and 6 present the quantitative analysis of the data, testing of hypotheses through a moderated structural path model, and discussion of research results. Section 7 concludes the dissertation by summarising the main findings and contributions of this study and highlighting potential limitations. The section further includes implications and recommendations for future research.

1.1. Background

Service Innovation (SI) is a broad term in research, used to refer to processes that lead to services with an inherent degree of newness. As a planned activity, service firms conduct NSD, commonly organised as projects, to create, plan, and introduce

services which differ from what has been offered before. A hotel chain opening a new holiday resort or introducing a new loyalty programme requires individuals developing the concept, testing feasibility and impact on the existing service offering. This chain of activities is likely to be organised as a project, which would subject to some sort of formalised sequential structure Of particular interest are contextual organisational variables and structures that impact the development process and have an influence on the performance or successfulness of the new service. In contrast to common findings within the NPD literature, researchers have described SI to be marked by a lack of formalisation (Ettlie & Rosenthal, 2011). Whereas the development of new products has been studied in great depth over the past three decades and a number of conceptual models have been identified and accepted, research on NSD is still an emergent discipline, despite perceivable increases in academic interest in the topic.

Since the industrial revolution in the western world, the manufacturing sector has been of prime importance for all major economies. The increase in product introductions and improvements has sparked vast academic interest in the topic and led to a dispersion of various research streams connected to the field and the emergence of research with primary focus on the development of new products.
Despite the growing importance of the service sector, it was not until the 1980s that research on the development of services became more common [e.g. Lovelock (1984), Langeard et al. (1986), or Scheuing and Johnson (1989a, 1989b)]. Yet, it has often been deplored that NSD has been given less attention amongst academics and base findings that have shaped the direction NPD research such as Cooper's Stage Gate Process (Cooper, 1990) or Zirger and Maidique's model of NPD development (Zirger & Maidique, 1990) could not be replicated in a service context with a comparable level of consensus amongst researchers. NSD literature remains to a large degree fragmented and would benefit from additional efforts to achieve a coherent understanding of service specific processes and structures applied in NSD as well as the integration of NPD knowledge where appropriate (Drejer, 2004).

Today, more than twenty-five years after the first noteworthy research articles on the topic have been published, the body of NSD literature has become considerable in size. Yet, the call for an explanatory reference model hasn't fallen silent and rightfully so. The importance of the service sector in today's economy is predominant and still increasing. Metters and Marucheck (2007) speak of a rise of services in the global

economy. Let alone in Europe the service sector accounts for over 73% of the overall GDP[5] (CIA, 2013).

Table 1-1 visualises the growing importance of the service sector over a ten year time frame. With the exception of Argentina and Mexico, all listed countries reveal significant shifts towards the service sector, in detriment of the manufacturing and agricultural sectors.

Table 1-1: GDP Composition by Sector for Selected Countries

	GDP[a]		Acrigulture		Manufacturing		Other Industy		Services	
	2000	2011	2000	2011	2000	2011	2000	2011	2000	2011
	USD bn	USD bn	% of GDP							
Africa										
Nigeria[b]	46.00	244.00	49	31	3	4	28	39	21	26
South Africa	132.90	401.80	3	2	19	13	13	16	65	68
Australia	415.80	1,384.10	4	2	13	9	14	11	70	78
China	1,198.50	7,321.90	15	10	32	30	14	17	39	43
Europe										
France	1,326.30	2,779.70	3	2	16	11	7	8	74	79
Germany	1,886.40	3,600.80	1	1	23	21	7	7	68	71
Italy	1,104.00	2,192.40	3	2	21	17	7	8	69	73
Spain	580.30	1,476.90	4	3	19	13	10	13	66	71
United Kingdom	1,475.70	2,444.90	1	1	17	11	10	11	72	78
India	474.70	1,872.80	23	18	15	14	11	13	51	56
Japan	4,731.20	5,896.80	2	1	21	19	10	7	67	73
North America										
Canada[b]	724.90	1,777.80	2	2	19	16	14	12	65	70
Mexico	581.40	1,158.10	4	4	20	18	8	18	68	60
United States	9,889.80	14,991.30	1	1	16	13	7	7	75	79
Russian Federation	259.70	1,899.10	6	4	17	16	21	21	56	59
South America										
Argentina	284.20	446.00	5	11	18	21	10	10	67	59
Brazil	644.70	2,476.70	6	5	17	15	11	13	67	67
World	32,346.70	70,371.40	4	3	19	17	10	10	67	70

[a] Data source: World Bank (2012)

[b] Data for 2011 composition by service sector for Nigeria and Canada not available within original data source. Replacement through 2012 estimate data (CIA, 2013), manufacturing approximated based on 2010 industry/manufacturing split.

High competition in modern service economies is the most important driver of service innovation and leads to a constant stream of new service development activities. Other factors like the reduction of spare capacity, risk reduction or obsolescence (Cowell, 1988) are more and more thrust aside by an ubiquitous strive of service providers to understand and fulfil customer requirements and identify rapidly changing trends.

[5] Estimate data for 2012, obtained from public sources – the CIA World Fact Book (CIA, 2013).

Vast diversity and heterogeneity within the services sector (Hollenstein, 2003) can be seen as a driver of the difficulty to conceptualise NSD activities. A unified explanation of the general logic of service innovation and potential pitfalls that could be avoided by structurally organising the development processes is seemingly challenging. Researchers have therefore often restricted their scope through focussing on a particular service industry. Financial services, for example, are probably the most prevalent service industry within NSD research (De Brentani & Cooper, 1992; Menor & Roth, 2008; Scheuing & Johnson, 1989a; Storey & Easingwood, 1999). But calls for further research, answering questions as to how to systematically approach NSD across service industry sectors are still being made by interested scholars and the proposal of a comprehensive SI model would represent a further milestone in service research.

The activity of developing a new service can be broken down into several sub-activities. Edvardsson and Olsson (1996) propose a distinction between the development of *i) service concept*, *ii) service system*, and *iii*) *service process*. The *service concept* (*i)* represents the strategy and motivation behind the service proposition. The organisational infrastructure required for the delivery of the service is included in the *service system (ii)*. Besides physical and technological components, qualified human resources are of major importance. Atuahene-Gima (1996) found that for the development of new services, a conclusive human resource strategy is even more important than innovation advantage of the new service. The *service process (iii)* constitutes the blueprint of activities that need to be carried out during service delivery. Den Hertog (2000) further suggests the development of a client interface, referring to the platform that is used by a service firm to approach and interact with the customer.

In an early paper on service classifications, Rathmell (1966, p. 36) raises a fundamental question ‘What are services?’. He concludes that a comprehensive study of service activities needs to start by conceptually defining such activities. New service development might still be researched to a lesser extent than the development of new products. Yet, since the 1980s the research stream has constantly evolved and a number of key questions and issues have been addressed. Given the importance of services in today’s global economy, researchers have looked into the processes used to create new services, examined contextual factors that make one new service more successful than another and tried to connect these factors in form of a model, which increase the likelihood of a new service being a success be increased during and throughout the development process (De Brentani,

1989). Calls for additional research focussing on the structure of new service development activities are still being made by researchers (Ganz et al., 2011) and despite a few good efforts, a ubiquitously accepted model is still missing (Johnson et al., 2000). New product development research, being a closely related discipline, is therefore frequently quoted as the more deeply researched area (Tatikonda & Zeithaml, 2002).

Given a number of distinctive differences between products and services, amongst which intangibility, simultaneity of production and consumption, heterogeneity, and perishability are the most commonly cites ones (Easingwood, 1986; Johne & Storey, 1998; Lovelock, 1983), the question if NPD knowledge is applicable in a service context has been raised but not conclusively answered. Some researchers found that services 'just happen' (Gottfridsson, 2008; Hoffman et al., 1998; Rathmell, 1974), whereas others have suggested structured development models, which follow the generic logic of NPD models (De Brentani, 1991; Edgett, 1996). This research anticipates that the key to a better assessment of the nature of NSD lies in attaining an adequate understanding of the inherent complexity a service. The definition of service complexity adopted in this research takes a wide perspective of services and encompasses besides process complexity (e.g consulting services provided to individuals are generally related to shorter and less complex processes compared to the same type of service performed to large organisations) and service variety (i.e. the number of services offered such as business, financial, strategy consulting or advisory services) wider aspects related to the delivery of a service such as size and organisational structures of the service organisation (e.g. a service offered nationally vs. a service offered internationally), levels of specialist knowledge and competencies, customer requirements and involvement, service infrastructure (e.g. an amusement park vs. a magician, hired for a birthday party) and legal requirements. It is assumed that once the complexity of a service is understood and defined, the development approach that leads to a better service outcome becomes contingent thereof. Furthermore, this research tries to bridge the dichotomy between products and services and work towards a more integrated approach, by assuming that services with a higher degree of inherent complexity follow similar patterns than new products, whereas services with a lower ranking on the complexity scale diverge.

1.2. Research Approach

The outline of the research approach pursued in this dissertation is subdivided into an epistemological, a theoretical, and a methodological perspective. Whereas epistemology takes a philosophical stance and looks at the manifold ways in which individuals acquire knowledge as well as its nature and remit[6], a theoretical perspective in social sciences addresses the underlying logic and empirical evidence that knowledge is built on, often approached by and validated through a number of systematic observations, concepts and methods, that can be subsumed under the term methodology.

A post-positivist perspective of social research accepts that knowledge is conjectural and subject to a number of exogenous and endogenous biases that relate to the background and knowledge of the researcher as well extant theories that the researcher is exposed to. It further takes a fragmented view of reality and challenges modernist notions of truth and the search of ideal solutions for concrete problems or real life (Hatch, 1997). This dissertation is leaning towards a post-positivist view of organisational reality and rests upon an objectivist perspective towards knowledge and knowledge generation. This means that whereas the empirical study organisations and surrounding complexities is subject to a number of potential biases that need to be acknowledged and addressed, there are still ways of finding logical connexions and relationships in the reality of organisations, reducing complexity, and mapping simplified fractions of reality through model structures (Maguire et al., 2006).

Development of theories building on practical observations, knowledge from relevant literature, experience, and commons sense can be seen as a central activity within social sciences and organisational research (Eisenhardt, 1989). The theoretical approach of this dissertation builds on triangulation of service innovation. The research problem is addressed from different perspectives, involving knowledge from the body of organisational innovation, contingency theory and complexity sciences. This approach allows detaching this thesis from traditional research disciplines and facilitates theory building based on several theoretical perspectives.

[6] See Cook and Brown (1999) for a comprehensive discussion of epistemology in the context of organisational studies.

The applied methodology follows a robust and validated approach. Based on a synopsis of empirical research findings and the hypotheses of this study, a self-administered online survey questionnaire was constructed. Data collection was based on a cross-sectional and multi-national sample of service development professionals following a multi-stage cluster sampling approach (Bryman & Bell, 2011). The issue of declining survey response rates in industry questionnaires (Ettlie & Rosenthal, 2011) was mitigated though an adequately high sample size. The online format of the survey yielded advantages in terms of affinity to new technologies and reduced survey costs (Dillman, 2007).

The theoretical framework developed in this dissertation includes a number of factors that have been identified as antecedents of NPD performance within the innovation literature. Theoretical constructs were validated through a combination of multiple regression analysis techniques and resulted in a structural path model. Structural Equation Modelling (SEM) was used to test the anticipated causal relationships that are part of the model. Commonly applied model fit indicators were hereby used to verify that the model adequately represented the observed data in order to derive confidence in the empirical research findings of the model.

1.3. Research Problem and Objectives

Researchers from multiple disciplines have adopted several ontological and epistemological perspectives to explore organisational innovation (Wolfe, 1994). Within the heart of this research lies the question of how firms can organise innovation activities in a superior or effective way to meet their anticipated objectives and create the basis for future business success. Innovation processes themselves have often been characterised as complex (Brown & Eisenhardt, 1997) and researchers have investigated how to approach this type of complexity in service innovation (e.g. through formalised and structured processes or certain settings of organisational factors that facilitate innovation performance). A major issue in this process is the vast diversity and heterogeneity amongst services (Hollenstein, 2003). Taking air transportation as an example, airlines as service providers vary significantly in organisational size, service types offered (destinations travelled to), service quality (capturing both travel classes and overall service experience by customers). At the same time, the service experience will rarely be the same over time, even if the same airline, destination and travel class was chosen. Whereas some researchers suggest that NSD mirrors NPD (Johnson et al., 2000) and formalised, detailed and structured development processes enhance the changes of

NSD success (De Brentani, 1991), others warn about counterproductive effects of formalisation on creativity and innovation (De Jong & Vermeulen, 2003) and suggest that service innovation processes need to consider the individual characteristics of services (Dolfsma, 2004).

Differences in research findings and recommendations regarding the organisation of service innovation processes entailing a number of latent contradictions represent unresolved research problems to the present day. On a generic level, this thesis strives to add to the extant body of knowledge on the development of new services and deliver a better understanding of how new services emerge. The theoretical framework of this dissertation, however, is more encompassing and overarching. It tries to explain why some services show higher correlations in terms of factors contributing to innovation performance than others. It does so by proposing that service complexity works as a contingency factor within the aforementioned relationship. Reverting to the previous example from within the airline industry, the framework predicts significant differences in the development of a more complex new service (e.g. an intercontinental flight in first class with a major airline) versus a less complex new service, such as a short distance flight with a small private charter organisation. Implications of the theoretical framework are twofold. First, by trying to show that complex new services follow different behavioural patterns related to innovation processes compared to ‘simple services’, this study tries to deliver further insights into the relevance and applicability of product development findings in a service context. Second, by finding means to measure inherent organisational complexity, this dissertation takes an inaugural step towards the establishment of a service classification scheme, which can be used to address the extreme diversity amongst service firms. Both objectives are relevant to the academic debate on organisational innovation but also deliver implications to service development professionals, who constantly strive to find new ways to enhance their applied innovation knowledge and capabilities.

1.4. Relevance and Contribution

Industrial change during the past century has increased the importance of the service industry in the western world. An early paper by Fuchs (1965) already pointed towards the continuous growth of services in the United States since the start of the post-war period and its implications for major economies. Services are still emerging and cannibalise traditional sectors such as industry and manufacturing. As competitive pressures and changing customer expectations constantly urge

companies to modify their existing offering both in terms of physical products or services provided, firms engage in development activities which can be highly successful but can also result in failure. Research proposed in this paper adds to extant empirical work on NPD and NSD and strives to provide a dual contribution to academic theory and management practise. Krishnan and Ulrich (2001, p. 15) state that:

> *"…research in product development must be tightly motivated by the needs of industrial practise. This is because product development is essentially a commercial function and therefore most knowledge about product development does not have much meaning outside the commercial realm."*

The combination of a practically oriented research approach with strong links to the on-going theoretical debate as well as an innovative structural research framework of service innovation that is evaluated following a rigorous methodological approach is considered appropriate to deliver research results with both practical and academic relevance. Menor et al. (2002, p. 136) state that NSD "*…remains among the least studied and understood topics in the service management literature despite the plethora of rigorous research and models on product development, especially in recent years.*" Efforts made to improve the understanding of an area of paramount economic importance can enrich organisational knowledge in general and service innovation know-how in particular.

As NPD is frequently considered the more advanced and heterogeneous research field, further comparative analysis between the two areas bears the potential create important new findings. Whereas a well-formed body of literature on NPD encompasses numerous models and insights around formal process organisation (Barczak et al., 2009), many unexplored research avenues exist in NSD along these lines. The first objective of this dissertation, understanding applicability and limitations of applying formalised NPD processes and procedures in a services context, strives to narrow to a number of research gaps. Starting by critically examining the differences in extant literature between the two research areas, factors which have been found to support new product performance are evaluated in a NSD context. The second research objective, analysing how inherent complexity affects NSD performance, introduces a new theoretical framework, which empirically tests if services with consistent complexity levels reveal similar response patterns to organisational parameters structuring the NSD process. The findings deliver a unique contribution to service innovation research and contribute to a better understanding

of services, by showing that the formalised development approaches used to develop new product can improve the performance of NSD activities for services with high complexity levels. Furthermore, empirical findings demonstrate that inherent complexity is a factor that should be taken into consideration when studying service innovation activities.

The body of NSD related research has steadily increased over the course of the last 30 years. Despite its current size, numerous gaps still exist and calls for fortifications to its theoretical foundations are still made (Drejer, 2004). Besides delivering a theoretical contribution to extant literature, the proposed research framework strives to investigate and analyse an area of large economic importance and produce findings with relevance to service development professionals. The practical contribution is directed towards a wider audience of service professionals including business leaders, executives, partners, managers, and other decision makers in the service sector. It should enable these service professionals in seeing the strategic implications of organisational decisions involving factors that contribute to innovation (e.g. corporate culture, communication, cross-functional work and leadership) both in the short and longer term. It should further provide a framework for the assessment of complexity in the context of a service organisation. Such a framework can assist service managers to benchmark the required level of formality not only against other successful service firms but also against product manufacturers, operating at a comparable level of complexity. Awareness of organisational complexity can also provide service practitioners with an enhanced understanding of the implications of organisational change. This is relevant, as practitioners can more easily link organisational change to changes in complexity from an innovation point of view but also make use of a broader range of comparators when observing innovation best practice across industry sectors.

2. Theoretical Background

Chapter 2 of this dissertation provides a structured overview of the theoretical background of the study. Innovation research is the main research field that this study falls into. In addition, elements from both contingency theory and complexity theory are relevant foundations of theory developed in this dissertation and outlined in the chapter. Important aspects relating to service innovation and complexity are systematically defined and analysed in the context of the research objectives. Furthermore, the link to NPD theory is explained in depth in order to provide background for the concepts behind measures used and factors included in the research model. The section closes with a discussion of new service development success and the challenges involved in service innovation. This discussion emphasises the practical relevance of this research, as service success is a primary generic objective behind the vast majority of NSD activities. Yet, a large number of service innovations fail to meet ex-ante expectations, creating high relevance for structural and organisational factors that lead to improved service development outcomes.

2.1. Foundations

This research is grounded in three major organisational research areas, which have constantly evolved over the past four decades: innovation research, contingency theory, and complexity theory. Researchers widely agree on the fact that organisations are subject to constant change. Change can be driven from within the organisation or through external circumstances. As such, organisations can use innovation strategies to create a competitive advantage (Crossan & Apaydin, 2010) in the market place but equally be forced to innovate in order to sustain. The conditions that drive organisational change and the organisational structures that deal with these conditions in a most effective manner are analysed and evaluated as part of contingency theory. The application of complexity theory to organisations leads to a view of organisations as systems of interacting and interdependent functions, which can vary in depth and breadth and adapt to changes in their environment. This research purposely builds on elements of all three research streams in order to evaluate the impact of organisational complexity on service innovation.

2.1.1. Innovation Research

The study of innovations has a long tradition and can be traced back to some of the work done by Schumpeter during the first half of the twentieth century (1912, 1942). Despite the long history, a sizeable body of literature on organisational innovation has only developed since the beginning of the 1970s. Definitions of innovation exist in abundance. In a report on innovation issued by the European Commission (1995, p. 4) innovation it defined as "*…synonym for the successful production, assimilation and exploitation of novelty in the economic and social spheres.*" More concretely, innovation is characterised as the driving force behind the renewal or enlargement of products, services, and markets. It further relates to and constitutes new methods and processes as well as organisational changes. Behara (2000, p. 138) defines innovation as "*…the successful commercialization of new products and services.*"

Whereas the term innovation theory is frequently found in relation to knowledge and theories that have been formed around innovation in general and innovation processes, innovation types, and innovation levels more specifically (Gopalakrishnan & Damanpour, 1997), it remains a somewhat generic concept without clear demarcation or equable direction. Gatignon et al. (2002) point out that despite more than three decades of research, scholars of innovation frequently confuse concepts. Issues regarding the demarcation or attribution to a research discipline have been subsumed by Downs and Mohr (1976, p. 700), who state that "*…the study of innovation has not been confined to any single discipline but is being explored in fields as diverse as anthropology and economics.*" Besides research on NSD, the breadth of disciplines within innovation research includes NPD, marketing, operations management (with quality and technology management as sub-categories), organisational behaviour, strategic management, and economics (Hauser, Tellis, & Griffin, 2006). This study uses the term innovation theory tantamount to the knowledge within the body of empirical study of and research on innovation.

Despite innovation literature being described as a 'fragmented corpus' (Adams, Bessant, & Phelps, 2006, p. 22), innovation research can be divided into two distinct categories. One school of thoughts sees *innovation as a process* and tries to answer questions as to how new products and services come about (Crossan & Apaydin, 2010). Questions that are being addressed evolve around the drivers of innovation, to locus of innovation, as well as the dimensions in which innovation takes place. Researchers adhering to the other school of thought, in contrast, consider *innovation as an outcome* and strive to answer the question of what results from innovation

processes. Regardless of the difficulties to make a clear distinction between the two, the fundamental viewpoints remain separate.

The sources of successful innovation have been of substantial interest to the innovation research community for decades. Project SAPPHO[7] in the 1980s marked a milestone in this debate, as it linked innovations with a market for products and services (Radosevic & Yoruk, 2012). Factors that contribute to successful innovation activities in products and services have been extensively studied since.
The perspective on innovation taken throughout this thesis considers innovation as a multi-dimensional construct, overarching both industries and organisations. Figure 2-1 visualises four dimensions that are to some extent explored in this dissertation. The vertical divide in the centre separates the industry level from the organisational level. Innovation takes place in form of newly developed products and services, depending on the respective industry. Whereas knowledge on the development of new products was traditionally seen as distinct from new service development knowledge, the classical dichotomy between products and services is shifting towards a product-service-continuum, or a 'servitization of business', described as creation process of bundles of products and services marketed by organisations from a traditional pure product background (Vandermerwe & Rada, 1988). The term 'product-service-continuum' was first introduced by Rathmell (1966) but it hasn't been until much later that it entered into the focus of innovation researchers.

Within the organisational dimension, innovation affects both processes and organisational structures. The cross-over between these two categories is embodied through higher innovation levels resulting in a combination of process and structural change.

[7] The project name SAPPHO stands for Scientific Activity Predictor from Patterns with Heuristic Origins.

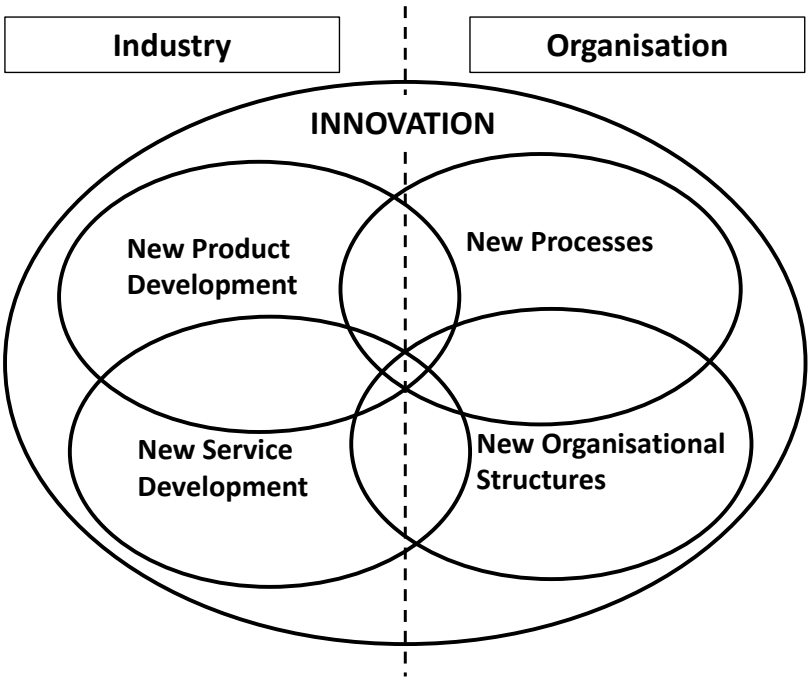


Figure 2-1: Dimensions of Innovation

Notwithstanding its fragmented and multi-disciplinary nature (Adams et al., 2006), innovation research and theory still represent a striving academic field, which addresses a phenomenon of high economic importance and which captures both interest from academics and practitioners. Whereas innovation theory represents the main theoretical foothold of this thesis, it is also the primary area that this research strives to contribute to.

2.1.2. Contingency Theory

The second theoretical pillar this research builds upon is contingency theory. Contingency theory states, that no single organisational structure can be highly effective for all organisations (Donaldson, 1996). The reasoning behind this finding can be seen in the existence of a number of extrinsic factors (e.g. technology or organisational environment) and intrinsic factors (e.g. organisational size and capabilities), named contingency factors. These factors can result in ideal organisational structures leaning more towards mechanistic and hierarchical structures when organisational conditions reflect high degrees of stability or towards flexible, loosely defined structures in case of an environment being marked by change and innovation (Burns & Stalker, 1961). A vast contribution of contingency theory was to establish that organisations in differing environmental conditions require separate modes of organisation and management in order to maximise their

effectiveness. Hatch (1997, p. 77) summarises the organisational requirement postulated in contingency theory by stating that "*…the most effective way to organize is contingent upon conditions of complexity and change in the environmen*t". Whereas innovation itself is generally associated with unstable and changing environments calling for flexible, organic organisational structures, the way in which research has addressed innovation has long been static in nature and did not consider conditions of complexity or the level of environmental change.

Some researchers have followed an approach based on contingency to explore the development of new products (Atuahene-Gima, 1995; Moorman & Slotegraaf, 1999; Souder, Sherman, & Davies-Cooper, 1998; Tsai, 2009) or services (Damanpour, 1996; Storey & Hull, 2010). Whereas contingency theory in a narrow context focuses on factors external to the organisation, factors such as complexity include both an internal and an external dimension. Furthermore, the aforementioned studies have extended the scope of contingencies to factors that exhibit moderating influences on other factors or relationships. Contingencies addressed in this thesis are tied to organisational complexity, defined as a multi-dimensional construct which is both external and inherent to the organisation, its processes, and its capabilities to organise and manage innovation activities.

2.1.3. Complexity Theory

The theory of complexity is not a coherent, unified single theory, but an aggregation of several theoretical streams, which mainly originate in natural sciences such as biology, chemistry, maths, or physics (Mitleton-Kelly, 2003, p. 23). Whereas contingency theory revolves around the effectiveness of organisational structures at a given influence of contingency factors such as size, organisational capabilities, or technology, complexity theory in an organisational context focuses on organisational behaviours and adaptation of organisations upon contingency factors. Some scholars, however, see complexity itself as a major contingency for an organisation (Blau, 1972), with both an organisational and external/environmental dimension. Anderson (1999) states that complexity in organisational studies commonly characterises both organisations and their environment. Given that organisations need to adapt to the specific conditions of their environment, this perspective is also adopted in this thesis. Complexity has been found to exhibit an important influence on innovation processes, organisational form and coordination (Hobday, 1998). Complex products and systems (CoPS) reveal a larger degree of informational

uncertainty and risk as well as increased difficulty in coordination and product management compared to simple products and systems (Hobday, 1998).

Complexity theory can be considered a useful approach to understanding and promoting organisational change behaviours (Burnes, 2005). The ability to change is seen as a critical success factor for organisations, whereby internal and external influences urge organisations to continuously change. McCarthy et al. (2010, p. 619) argue that managers who understand the endogenous and exogenous nature of velocity homology conditions, defined as a situational degree of coherence in rate and direction of change of velocity dimensions, have the advantage of being able to proactively influence both direction and speed of environmental change dimensions according to organisational requirements. Brown and Eisenhardt (1997, p. 32) describe the evolution of organisations over time as follows:

> *"Continuously changing organizations are likely to be complex adaptive systems with semi structures that poise the organization on the edge of order and chaos and links in time that force simultaneous attention and linkage among past, present, and future. These organizations seem to grow over time through a series of sequenced steps, and they are associated with success in highly competitive, high-velocity environments."*

Organisational complexity theory can be seen as a branch of general complexity theory, focussing on organisations and organisational decision making. A number of key themes are derived from natural sciences such as physics, mathematics, or biology. A good example for the applicability of cognate knowledge in complexity research can be seen in the relevance of Kauffman's NK model (Kauffman & Levin, 1987) in organisations research. The model describes biological organisms as complex adaptive systems (CAS), and models evolution over time. Complexity is characterised by the number of elements N within the system and the degree of interdependence K. The system is visualised as a tuneable rugged fitness landscape, whereby fitness relates to the ability to overcome interdependence driven ruggedness by jumping at different lengths along the system path. In the context of innovation, an organisation would be considered at a high fitness level, if successful innovation activities lead to a competitive advantage in the market place and high returns.

Page (2010) relates complexity to the *number of parts in a system* as well as their *degree of interaction*. The term complexity denotes an increasing level of difficulty to

describe or explain a system of parts, both in terms of the characteristics of the system as a static entity and its behaviours or predictability of its proceeding. The difficulty to model and predict the development of new service activities, which is embodied in the lack of concise models of the development process and academic dissonance regarding structural requirements and success factors, therefore indicate that NSD in general can be classified as complex. Complexity in the development of new services is the key topic of this research. Assuming Page's key drivers of complexity, namely the number of components within a system and the level of their interaction, complexity is believed to differ across service types and across service development activities. A key thesis of this dissertation is that by addressing the inherent level of complexity of a service, implications for the best development approach can be derived.

2.1.3.1. Complex Adaptive Systems

Complex adaptive systems have been described as "*…a genuinely new way of simplifying the complex*" (Anderson, 1999, p. 220). The difference between a *complex system* and a *complex adaptive system* is that in the former, entities follow fixed rules whereas in the latter, entities adapt (Page, 2010, p. 25). Adaption processes within a system can be considered in terms of two aspects: *ability* and *time*. Complex systems either have the ability to adapt or they remain static with regards to adaptive processes that take place in response to internal or external influences. Interactions between system elements, the system whole and its environment, however, still take place and are subject of study in complex systems theory (McCarthy, 2004). There are numerous definitions for complexity, but the ability to evolve and adapt marks the distinction between complex systems and CASs. Gell-Mann (1994, p. 21) postulates that CASs widely differ along their physical attributes but share a resemblance in terms of the way in which they handle information. Page (2010, p. 6) defines complex systems more loosely as "*…collections of diverse, connected, interdependent entities, whose behaviour is determined by roles, which may adapt, but need not.*" McCarthy et al. (2006, p. 438) describe that the study of CASs is interested in how systems learn and create new decision rules, structures, and behaviours. The authors name nonlinearity, self-organisation, and emergence as mutually dependent phenomena that define and characterise CASs.

The second aspect when looking at adaptation is time. Adaptation processes take place on the component level within a system. Hence it is the individual components

that respond to particular circumstances, constellations, or changes within the environment. The system adapts as a consequence of changes in character or behaviour of inherent elements and components (Page, 2010). Depending on the type, nature, and number of elements reflecting adaptive behaviours, system level responses can vary in time. A system can therefore be considered a complex system, as long as no adaptive processes take place with knock-on impact on the system level. The introduction of new components into the system can lead to the appearance of adaptive processes, which are evaluated using CAS frameworks. Within the study of innovation, the consideration of organisations as CAS is equipollent for both organisations producing physical goods and services. Whereas both types of organisations can be considered complex adaptive systems when taking a longitudinal perspective, it can be argued that both NPD and NSD are processes taking place in complex systems, whereas the full extent of the introduction of new products and services into the market place, the success achieved, and the impact on market, customer demand, and competition are all related to a series of adaptive processes, which would require a CAS perspective in order to be assessed holistically.

For the purpose of this research, adaptive processes are widely excluded, giving way to the study of NSD within a complex systems context. The main reason for doing so is to allow focussing on static, system-inherent levels of complexity within the organisational context of NSD. Frizelle and Woodcock (1995) use a similar approach for assessing complexity in a manufacturing system. The exclusion of the time component of complexity and related adaptation processes does not capture the dynamic element within organisations as complex systems but facilitates the comparison of complexity-related dimensions at a single point in time. Whereas service improvements or corrective measures addressing service failures need to include elements related to evolving change amongst the agents within the service system (e.g. staff members of various functions, management, customers), this dissertation factors out emergence and adaptation during the service development process in order to look at systemic properties, namely complexity attributes, that are assessed and analysed with regards to their impact on the NSD process.

2.1.3.2. Complexity in Systems Theory

As contemporary complexity research focuses to a large extent on evolutionary processes and models of behaviour in complex systems, CAS theory is often

equated with complexity theory. Yet, it should be pointed out that a CAS is overarching and more comprehensive compared to a complex system, as it comprises the latter but also focuses on interplay between system and system environment (Stacey, 1995). The ability to evolve and adept is not necessarily included in the definition of a complex system, which consists of a number of elements or system components, a degree of interconnection and diversity. Taking the multidisciplinary general approach of systems theory, complexity can be seen as a static attribute of a system in an equilibrium state, which again is driven by system parameters such as the number of parts and the relationships between parts (Manson, 2001). It is both a theoretical and methodological distinction whether or not to add a time component to the study of complexity and thereby attributing a strong focus to evolving and emerging behaviours within a system. This research leans towards a systems theory approach of complexity and excludes analysis of evolving structures and behaviours that a CAS approach would endorse.

The reason for this going down this pathway is twofold. First, relative inherent system complexity is reflected in a number of organisational dimensions and seen as an important factor for NSD, that, at least in the short term, has to be taken as datum when making important NSD decisions. As managers plan, develop and implement new services for their organisations, they use structures and processes which, to their best knowledge, are most appropriate and effective. Decisions are thus made in the context of the organisation's internal level of complexity, which include knowledge of behaviour and interaction of system inherent elements, but are likely to fail in capturing adaptive processes which originate in the service introduction as such. For this reason a static systems theory based approach seems adequate in order to capture the parameters that lead to success, at least in the short-term. It is assumed that an organisation developing a new product or service is in an equilibrium state for the time period of the development. The process outcome can lead to strong shifts within the organisation and initiate change, which itself can cause a need for further action. The resulting dynamic may push an organisation outside its equilibrium state. Yet, consequential changes are to be seen separately from the initial activity, which is analysed from a static perspective.

Second, organisations use continuous change as a means to compete (Brown & Eisenhardt, 1997). Organisations themselves can be considered complex adaptive systems, as they possess the ability to evolve and completely alter what they are, what they do and how they do it over a period of time. The time required is a key to the argument out-ruling the CAS perspective in this dissertation in favour of a relative system complexity based approach. A longitudinal evaluation of the impact of

complexity within an organisational context will most likely not be able to avoid evolutionary processes and learning, as both undoubtedly take place over time. Organisations can go from order to chaos and completely change their business model. Organisational evolution, in this context, is likely to be impacted by external factors such as the market environment. The latter itself can be seen as a CAS, making the organisation a sub-system, which reacts and adapts. Despite recent increases in the speed of economic cycles or introduction of new technologies, adaptive processes on the organisational or industry level are considered to take more time than decisions made during NSD, creating a case of static system level view of complexity.

Organisational studies often apply concepts from a variety of theories. Whereas innovation theory, contingency theory and complexity theory are considered the main theoretical foundations of this dissertation, further theories such as organisational strategy, resource-based theory (RBT), or management theory are also related to NSD as explored as a central theme in this paper, especially with regards to the antecedents of new service performance. Kleinschmidt, De Brentani and Salomo (2007), for instance, present an in-depth discussion of RBT in the context of organisational innovation and demonstrate its applicability. As the theoretical framework of this thesis only applies some fractional concepts of these theories without making explicitly using their concepts or themes, no further reference is made to these theories. Both focus and main contribution of this thesis are considered to be located within the larger body of innovation studies and theories, thereby drawing on concepts of both contingency theory and complexity theory.

2.2. Service Research

Services are defined as the main research object of this study. The increasing importance of the service sector in the second half of the twentieth century has resulted in great interest in services in general, but also reflected on interest in the origins and processes supporting service innovation and the antecedents of service success (Nijssen et al., 2006). Within the body of innovation research, manufacturing is still said to be the dominating research field (Drejer, 2004). Despite considerable growth in service related research, researcher deplore that service models are difficult to use in applied research due to their generic nature combined with a focus on highly specific aspects (Ganz et al., 2011, p. 19). This section provides an

overview of the research object with some of the difficulties and controversies relating to the study of services.

2.2.1. Services Characteristics

Arriving at a concrete definition of services including a classification or taxonomy can be challenging (Metters & Marucheck, 2007). Yet, a way to classify organisations provides a structured approach to the study of diversity and acts as catalyst to attaining an understanding of the laws and relationships of groups containing different varieties (McCarthy et al., 2000, p. 92). The term service is commonly used to refer to an added value activity that is carried out for a client (Gadrey et al., 1995). Sampson and Froehle (2006) suggest that services comprise all types of business activities that are not based on manufacturing or extraction processes (e.g. oil and gas, mining, agriculture). If the condition of adding value and thereby creating a benefit for a second party is fulfilled, the service attains an intrinsic value and can thus be referred to as economic good, being traded in the market place alongside products.

Unlike physical products, which can be seen as the output or end result of one or several coordinated processes, involving the transformation of a physical resource or commodity, intangible products are constituted through the process itself. Services fall into the category of intangible products. Software and licences are examples of intangible products that do not necessarily reveal service attributes (Danaher, 1997; Nilsson-Witell & Fundin, 2005). Following the applied logic of this paper, software would only be seen as a service, if it was custom made, modified or integrated according to the individual requirements of a customer. Licences represent specific rights that entitle the licence holder to the use or exploitation of a tangible or intangible object. Whereas licences mostly share characteristics similar to those of products, the development of a licence is very similar to NSD activities. As intangible products vary widely from physical products in terms of their creation and delivery, the differences call for a separate research approach when assessing innovation activities even though services and products may share commonalities such as regional markets or target customers. The particularities of non-material products create additional research opportunities that have been addressed to some extent but still require further exploration.

Easingwood (1986) and de Brentani (1989) were amongst the first researchers to study the success factors of NSD. Both researchers based their studies on four

specific characteristics of services as identified by Zeithaml, Parasuraman, and Berry (1986):

- Intangibility,
- Simultaneity of performance (production) and consumption,
- Heterogeneity in character,
- Perishability and non-stockability.

Intangibility of services creates a difficulty for customers to analyse and examine services prior to delivery or consumption. Hence, contractual arrangements are used to pre-specify the agreed-upon deliverables of a service. A babysitter, for example, may work based on specific instructions provided by parents, who intend to get adequate care for their child. A verbal agreement could specify when and what the child eats, when it goes to be, how much television is allowed etc. In return, a financial compensation is paid to the babysitter for services rendered. Intangibility provides an uncertainty as to how well the service is delivered and parents may find out retrospectively that their instructions were not followed. Depending on the complexity or the level of innovation of a new service, the definition of clear deliverables can be difficult. An aspect related to the intangibility of services creating a demarcation from physical products is customer reliance on parameters such as experience, company image and corporate reputation when selecting a service provider. Objective assessment of service performance is only possible after a service has been delivered.

A further characteristic of services linked to intangibility is that imitation of services by competitor firms is relatively easy (Johne & Storey, 1998). Cowell (1988) links this characteristic to a lack of patenting and copyrighting. He argues that because services can only be protected from being copied to a limited extent, R&D expenditures and investment in the creation of new services is generally low. Ettlie and Rosenthal (2011) recently confirmed this finding, stating that R&D spending in the U.S. amounts to less than 10% of the total national investment.

From a NSD view point, the *simultaneity* of production and consumption usually implies that NSD researchers tend to focus on the service pre-requisites, such as service environment, trained service staff, and clearly defined service processes and concepts rather than the delivery of the actual service (Edvardsson & Olsson, 1996). Related to the simultaneity of production and consumption of a service is the difficulty to perform rigorous testing prior to launching new services and to implement regular quality checks prior to customer delivery. The separation between a successful service and a poor service can be a matter of staff attitudes and behaviours,

notwithstanding prior training and service protocol. Simultaneity, however, also entails opportunities for a service company to receive direct customer feedback and proactively respond before it is too late.

Services, to a considerable extent, are dependent on personal characteristics of the agents delivering the service – a fact which is also reflected in the characteristic of *heterogeneity*. Services vary considerably more in quality and type than products. It is, however, also significantly more difficult to measure quality and consistency. For organisations in the service sector, this creates a challenge to create brand awareness. Brand awareness is not only vital from a sales point of view, but also important when attracting qualified staff, as one of the core values of a service firm.

The discussion of service characteristics has already touched on some of the capabilities that are processed during service delivery. These capabilities are substantialised on three levels (Gadrey et al., 1995), which can be classified as service dimensions.

2.2.2. Service Dimensions

The above outlined unique characteristics make services a multi-faceted concept, which covers several dimensions. Bullinger, Fähnrich, and Meiren (2003) suggest a sub-division of the service concept into a *i) structural dimension*, *ii) a process dimension*, and *iii) a service outcome dimension*.

2.2.2.1. Service Structure

Service structure as a service dimension is a broad concept and comprises all structural variables that constitute the boundaries of the service process and determine its order. The service structure is jointly developed with the service process and determines its efficiency and scope. In a hair salon, for example, the service structure specifies which step of the treatment is applied in which order and to what level of detail, accuracy and quality.

Whereas the service outcome can vary according to specific customer requirements, the service structure needs to incorporate a level of flexibility if a non-standardised service outcome is desired. Failure to sufficiently address the service structure during the development process is likely to result in service inefficiencies, which negatively impact service performance. Yet, a necessity to alter the service structure can also emerge after service introduction, linked to a need to respond to customer demand and preserve competitive advantage. Modifications of the service structure have a

knock-on effect on the service process, highlighting strong inter-linkages between structure and process as service dimensions.

2.2.2.2. Service Process

Due to the characteristic of intangibility, underlying *service processes* play a key role for both creation and execution of a service. The following statement underlines how the service emergence is impacted by its fundamental characteristics (Johne & Storey, 1998, p. 201):

> "*While NSD has to follow the same generic process as NPD, the relative importance of each stage and how each stage is carried out is affected by the unique characteristics of services.*"

Boone (2000) analysed how product and process innovation in a NSD context are interlinked. According to her findings, process technology is often altered without the underlying service process being revised. In order to achieve a new service product, the introduction of new service technology needs to be accompanied by process innovation.

Process development activities entail the fundamental organisation of business processes. Process development is located within the core of NPD / NSD and therefore represents a focal point for this investigation. Knowledge of processes is essential in order to plan, structure and analyse the formal innovation activities in product and service firms. In order to measure performance and control activities, it is important to have a level of consistency in the structure of the development process. De Brentani (1989) argues that the level of systematisation in the development of new products is by far greater compared to new services, with other researchers supporting this view in more recent studies. Edvardsson and Haglund (1995) made and attempt to map the phases of NSD, but experienced difficulties caused through overlapping and merging of phases combined with improvisation.

In their efficient product/service design model (EPSD), Verma et al. (2001) provide a conceptual basis for integrating operational complexity into an analysis scheme. Whereas product cost information and customer preferences are considered to be amongst the most relevant indicators regarding efficient service design, operational difficulty has to be considered from the very beginning of the NSD process. Without focussing on organisation specific operations capabilities, management is likely to fail when addressing customer requirements and expectations in terms of service quality and timing. Verma et al. (2001) produce a conclusive argument around the

importance of operational variables in the design process of new services, however, the interrelations between operational complexity and factors supporting NSD remain largely unexplored.

Creating and organising the service process dimension is a key task for service innovation activities (Tatikonda & Zeithaml, 2002). Strong inter-linkages between service dimensions can lead to demarcation difficulties, especially when looking at the service outcome, which is highly entwined with the service process (Fliess & Kleinaltenkamp, 2004).

2.2.2.3. Service Outcome

The distinguishing element of the *service outcome* compared to the service process is customer involvement. As services and related delivery systems are closely interlinked, customer satisfaction and the perception of service quality will invariably depend on the quality of the service process (Cowell, 1988). NSD activities entail the creation of service process structures. For this reason, the analysis of how new service processes are planned and executed is likely to deliver answers about performance drivers in NSD and performance measurement.
The service characteristic of simultaneity proclaims that services are created and consumed at the customer interface. Whereas this statement generally holds true for a general description of services, a distinction can be made with regards to the degree of customer involvement. A service can be rendered to a large extent in the absence of a customer and only be transferred or consumed at the end of the service process. At the opposite extreme, a customer can be highly involved in the entire service process and be able to request modifications or redefine the targeted service outcome during service delivery. Customer involvement can have a strong influence on the service outcome, affecting both service structure and service process.

A further aspect of the service outcome is the level of individualisation or customisation of the service. It relates to the extent to which a service is standardised or tailored to the specific needs and requirements of the customer. A software firm, for example, may have a number of standardized solutions on offer, that are sold to different customers with a minimum level of change to the software (e.g. adding a corporate logo to standard forms of databases). Yet, if a customer requires a very specific solution, the level of adaptation can be high and result in an almost entirely new program. Customisation can be part of the service's unique selling proposition,

especially in situations where specific solutions are called for. At the same time, high degrees of customisation necessarily reduce the capacity for standardisation and create higher demand towards the skill set of the service agent delivering the service. Services thus differ in the skill and knowledge required for their delivery, whereby a distinction can be made between implicit and explicit amounts of required knowledge.

2.2.2.4. Knowledge Intensity

Knowledge intensity reflects the inherent skill level required to deliver a service. It has implications for both the service development process and the operational service level, dealing with staffing and organisation of service personnel. Whereas higher knowledge intensity puts a strain on the staffing process, the impact on the NSD process is not directional. The NSD process has to recognise the level of required knowledge and take subsequent staffing requirements into consideration in order to deliver a targeted service quality. The development process as such does not necessarily have to become increasingly complicated if knowledge intensity is high.

Another feature of knowledge intensity is that it directly relates to the value of the service. An increased level of complication requires specialised skills which are generally valued higher than more general service skills. Knowledge intensity hence can be understood as one of the value drivers of the service outcome. A tax consultant for a small regional business requires a lower level of specialised knowledge than a firm, dealing with an international tax strategy for a complex global entity. The difference in the service outcome is a function of knowledge intensity, which is also reflected in the cost of the respective service.

A research stream within the service innovation literature has focussed on knowledge intensive business services (KIBS). A reason for this classification is that KIBS share distinct patterns and communalities and therefore create a sub-population within the service field that can be researched more effectively and produce relevant research results.

Knowledge intensity is a characteristic that can relate to both products and services. In both cases amounts of knowledge required to produce a product or service can differ significantly. It is interesting to explore similarities and differences between products and services. Whereas products and services are clearly distinct concepts, the process of for their creation can reveal strong communalities, which as such is linked to the discussion around the product-service continuum.

2.2.3. Dichotomy vs. Product-Service Continuum

Products and services are often depicted as two antipodal economic goods, separated through tangibility. Researchers often refer to a dichotomy between products and services in order to underline the differences in character. Despite a clear difference in definition, the boundaries are in reality often fluent and products and services merge into one and another seamlessly. Rathmell (1966) places products and services alongside the product-service continuum, a bipolar scale reaching from pure products on one side to pure services on the other. He uses the term goods-service continuum, referring to an ordinal scale on which physical products and intangible services are placed. As both products and services are understood as economic goods, the term is altered to product-service continuum. A commodity is close to being a pure product, whereas education can be places towards the opposite end of the scale. The dichotomy between products and services is valid for economic goods at both extremes of the scale. However, the majority of goods reveal mixed characteristics such as goods with service support or services facilitating goods (Rathmell, 1966, p. 34). Looking at the dichotomy between products and services from a marketing perspective, Winsor, Sheth, and Manolis (2004, p. 249) state that "*…despite the considerable evolution of marketing thought and theory, the distinction between physical goods and nonphysical services remains somewhat underdeveloped*."

Following the line of thought and argumentation of this thesis, both validity and usefulness of the dichotomy and the product-service continuum concepts are recognised within their respective remits. It is assumed that the apparent contradictory perception adds to the problem of researchers to grasp services in NSD research. Both extremes of the continuum are clearly distinct categories, which are useful for classification purposes but cannot capture the diversity in products and services offered in the market. When looking at products, it seems easier to exclude the service element and focus on the tangible end result. In a service context, however, this simplification can be misleading. Taking the example of a fast food chain restaurant, it is obvious that the service component plays a major role. Yet, isn't it easy to divert the focus of attention to the food, as the tangible element of the overall experience? The food element is within limits storable, comparable and can be consumed outside of the restaurant or taken home. The challenge for NSD researchers is to overcome this type of bias and blind out product components that are inherent to some service experiences.

Some researchers point towards conceptual issues in the study of innovation (Downs & Mohr, 1976). One of these issues revolves around different interpretations of the innovation concept that can impose tacit comparability problems between research studies. In order to overcome conceptual issues, researchers need to be specific in the definition of the research object and contextual variables they address.

2.2.4. Research Issues

Problems in researching new services can be considered one of the reasons why results in the NSD literature are less homogeneous and subject to a lack of concurrence amongst researchers compared to the literature on physical product innovations (Edgett & Parkinson, 1994). Issues around the study of services have been identified early. Cowell (1988, p. 307) speaks of 'researchability issues' in services, which he links to "*fuzziness and ambiguity of the service concept*" as well as the unique service characteristics of perishability and intangibility. Chopra et al. (2004, p. 13) state that "*Services are difficult to inventory so that variability must be buffered by capacity or time.*" This feature stresses the importance of the service process, which often equates to the service product, and puts emphasis on its importance throughout all phases of the new service development process. Simultaneity as another unique service characteristic expresses concurrence of service delivery and consumption at the customer interface, resulting in a deep integration of service functions into the process. Whereas the customer domain in firms producing physical products is commonly reserved to the marketing function, service personnel being responsible for carrying out service operations have significant customer exposure. This underlines the importance of service staff as a key agent of the services process. Related to the service characteristic of heterogeneity is the difficulty to achieve and maintain a standardised quality control process. Whereas in manufacturing process quality is regularly linked to standardisation, the latter is possible in a service context to a much more limited extent. Fliess and Kleinaltenkamp (2004) offer the customer-induced nature of the service process as a possible explanation for the difficulty to standardise services. A challenge created by the joint existence of simultaneity and heterogeneity as service characteristics is the complicacy to classify what constitutes a new service (Easingwood, 1986). As customers are often closely involved in the service process, the individual delivering the service through interaction with the customer can effectively create service innovation as part of an on-going service process. In such

cases, standardisation, marketing, or process documentation is done ex-post to the actual service innovation process.

Service characteristics combined with an overwhelming variety amongst services are hypothesised to be a driving force behind difficulties to research new services. Some researchers suggest that cross-sectional research designs are inappropriate for studying of new services (Edgett & Parkinson, 1994). Whereas single service industry studies can overcome some of the service inherent difficulties as outlined above, they are subject to deficits with regards to generalisability of research findings, limiting their value. The approach taken in this study is purposely broad in order to allow flexibilities for researching general relationships and include options for control variables, which can be separately analysed.

2.3. Definitions

Innovation research does not suffer from a lack of definitions and demarcations of research disciplines. Yet, a rigorous piece of research needs to precisely specify the research object and context in order to achieve clarity of the research agenda and enable evaluation of results by external parties. The following section is not meant to provide novel definitions of the research context. Instead, the main objective is to introduce the terminology of this study and establish ground rules that are the basis of a deeper understanding of the work done in order to avoid ambiguity or misinterpretation.

2.3.1. New Services and Service Innovation

Similar to the term ‘new product’ being commonly used in the corporate and academic world to characterise a product that is to some extent different from a preceding version of itself or not having had a predecessor at all, the term ‘new service’ is also open to interpretation and subject to a subliminal lack of clarity in terms of its precise meaning. Due to the magnitude in scope of the definition of a service, a new service comprises a wide range of activities around the service term.
In order to assess the full scale of possible new services, it is useful to look at extremes on both ends of the scale. In a situation, in which an established service company is mandated to provide a repeated standard service to an existing client, the service as such would generally not classify as a new service. At the opposite end of the scale, a start-up firm setting-up a new technology business, defining an

innovative service process and offering an entirely new service product would score highly in terms of newness of business activity and might even create an entirely new market or market segment. The latter construct represents a disruptive innovation and classifies as a new-to-the-word service, given that all parameters of the service concept are essentially new. Veryzer (1998) uses a similar logic to assess the innovativeness of new products. In general terms, the way in which products and service newness can be classified is very similar. Some researchers also consider the work 'product' as a generic term, used equipollent for physical/manufactured goods and services (De Brentani, 2001). A new service introduction within the new-to-the-world category can be considered a radical or disruptive innovation and requires both a conceptually new idea as well as a new market. As disruptive innovations are generally rare, it is considerably more difficult to empirically address this category from a research point of view (Ettlie, Bridges, & O'Keefe, 1984). The majority of new service introductions are constituted through incremental innovations by modifications of the service delivery process or alterations in service dimensions that induce a customer perception of newness (Ali, 1994; Dewar & Dutton, 1986).

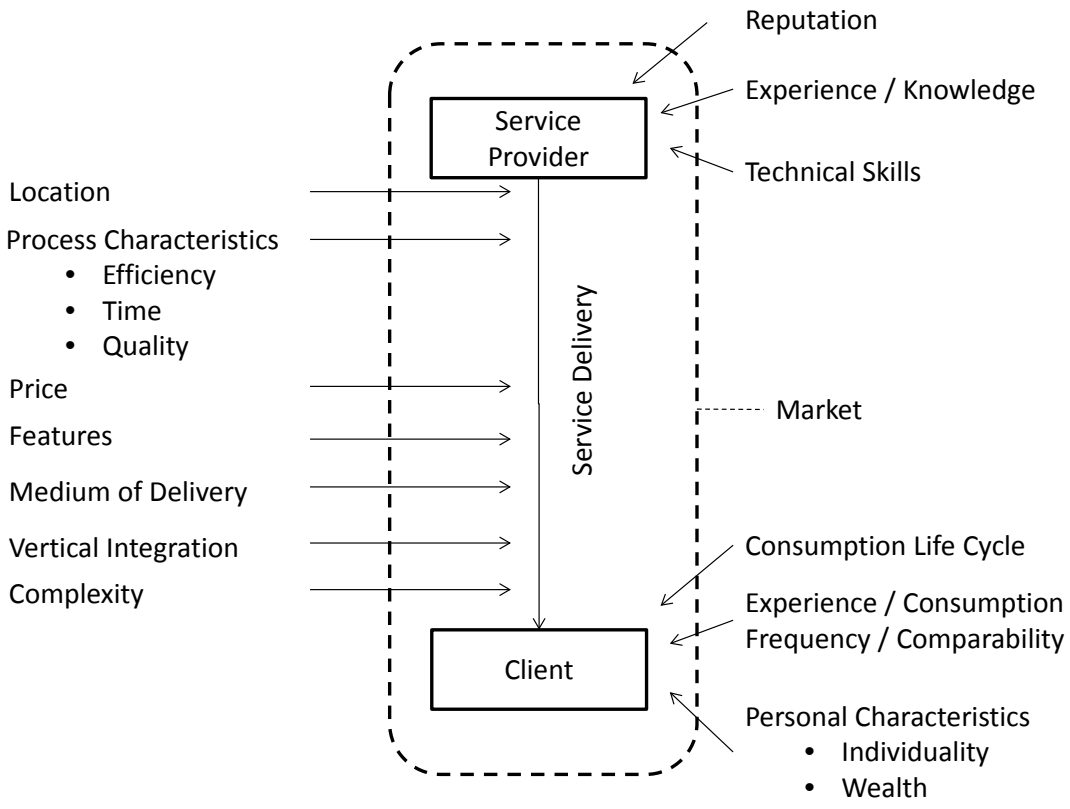


Figure 2-2: New Service Dimensions

Figure 2-2 depicts the multitude of dimensions around a service. Similar to the multidimensional understanding of new product development as outlined by Trott (2002), a change within only one service dimension can already be understood as a new service, despite a possible lack of inherent innovation.

Other possible ways of looking at new services can be derived by taking a micro or macro perspective. The micro perspective revolves around the corporate entity or the service provider. Whereas the service strategy focuses on the type of service, it's positioning and value proposition to the customer, a number of factors such as reputation, experience, and technical skills are developed over time and show a higher level of service maturity. On the other hand, the macro perspective is driven by the market and customers constituting it. From a strategic perspective, certain factors can be targeted such as specific client groups or market layers. Yet, a number of market factors such as life-cycle stage, competition, and saturation have to be taken as extrinsic data and can only be influenced over a longer time horizon.

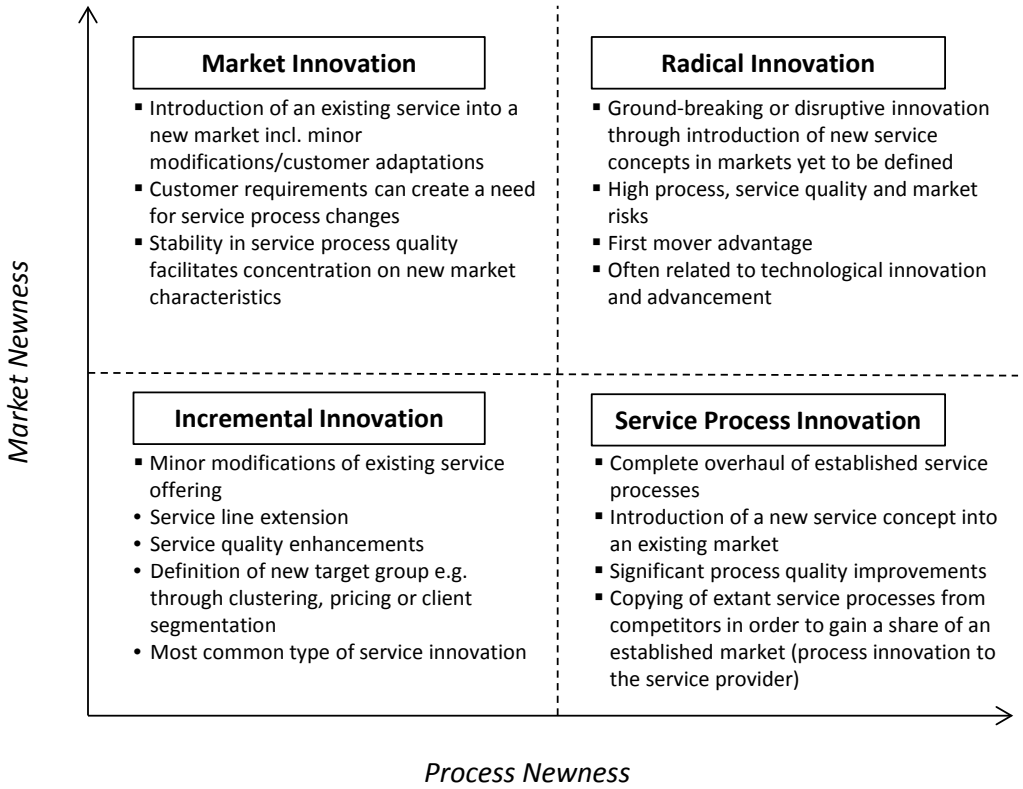


Figure 2-3: Service Innovation Categories[8]

[8] Concepts of newness and innovation categories in Figure 2-3 are adapted from Tatikonda & Zeithaml (2002) and Menor et al. (2002).

A classification of different types of new services according to market newness and process newness is depicted in Figure 2-3.[9] Whereas innovation is usually considered to be related to the discovery or creation of novel concepts that were not pre-existent, service innovation on a corporate level also takes newness to the service provider into account. If a service company tries to produce an exact copy of an existing service that is successfully marketed by a competitor, the company still has to deliver substantial amounts of innovation through process development work, subject to the complexity of the aspired service or service concept.

Gadrey et al. (1995, p. 5) classify services according to the type of problem or issue investigated. According to their definition, services grant "*…accessibility of a bundle of capabilities to execute a 'repair' activity or 'treatment'*" for problems that are either new to the firm or market or for reoccurring issues that are readdressed. The degree of inherent innovation is higher in the first case, as no prior knowledge exists for the service provider to build on.

2.3.1.1. Project versus Programme Level

Product and service innovation activities can also differ in scope. A commonly made distinction therefore separates innovations at project versus programme level. Kelly and Storey (1999) point out that NSD success on a programme level relies and a succession of service successes on a project level rather than one-off success. It is therefore more challenging and difficult to achieve. A project innovation focuses on a single product or service (e.g. an architecture firm developing a specialisation for environmental sustainable construction), whereas a programme innovation consists of a number of serial innovations (e.g. a fast-food chain restaurant introducing a new range of healthy snacks), which share a common concept. Programme innovations can take place over a longer period of time and include minor modifications to the product or service on offer.

Whereas both project level and programme level analysis is commonly applied in NSD research, the programme level represents a restriction to the level of analysis, as not all service development activities reveal consecutive innovation patterns. Yet, proponents of the programme level approach argue that the macro perspective of the

[9] The classification of SI adopts basic service marketing concepts, which are equally valid in a service innovation or NPD context (Lovelock, 1983, 1984; Lovelock & Wirtz, 2007).

programme level provides a filter for organisations with an overarching culture for development activities and an orientation towards development activities (Alam, 2002). Yet, the project level is chosen for the analysis in this thesis, as the intention is to capture a wide range of service firms and service development activities without predefined analysis criteria.

2.3.1.2. Level of Innovativeness

The level of innovativeness has received high amounts of attention within the body of innovation research (Avlonitis, Papastathopoulou, & Gounaris, 2001; Kleinschmidt & Cooper, 1991; Langerak & Hultink, 2006; Swink, 2000). Innovativeness explains the degree of newness of both products and services. On a bipolar scale, innovativeness reaches from ground-breaking, radical innovations to minor conceptual changes or modifications. In a service context, variations of the following five levels of innovativeness are frequently used[10]:

- New to the world-service (radical innovation)
- New service to the service firm
- Significant change or improvement of an existing service concept
- Modification of a service process
- Minor change of an existing service (incremental innovation)

Research shows that the requirements in developing new products and services substantially differ between incremental innovations and radical innovations (McDermott & O'Connor, 2002). Kleinschmidt and Cooper (1991) present evidence for a U-shaped relationship between the level of innovativeness and product performance, indicating that both radical and incremental innovations are more successful than those in the middle of the scale. Other researchers suggest a moderating role of the degree of innovativeness (Olson, Walker, & Ruekert, 1995).
The level of innovativeness for the purpose of this thesis is defined as a combination of *a) the inherent newness of a service introduction* and *b) the level of change and modification involved in the innovation*. Whereas it can be argued that on the extreme end of innovation (radical innovations), a new service results in a substantial change to the organisation, the distinction is less pronounced for incremental innovations. Also, the academic debate shows empirical confusion on the impact of innovation on

[10] As an example, Kleinschmidt and Cooper (1991) use six categories of innovativeness including line extensions, repositionings, and cost reductions.

organisational outcomes. Gatignon et al. (2002) state that whereas some discontinuous innovations have destabilising effects on organisations, others do not. In recognition of the relevance of this discussion, the degree of innovativeness is implemented into the research design of this dissertation in order to create opportunities for related data analysis, such as the inclusion of a related control variable into the structural model.

2.3.2. Complexity

Complexity is a higher multidimensional construct, consisting of an abundance of facets. The term complexity is frequently used in both scientific and practical language. Colloquially, the term complexity is used when one struggles to find simple explanations for circumstances, issues, models or systems (Page, 2010). Burnes (2005) asserts that many authors of articles including empirical research use the term complexity as a metaphor. Looking at complexity from a scientific angle, a multitude of proposed definitions can be found, indicating difficulties of scholars and theorists to agree on a singular definition or propose clear demarcations. Most definitions are on their own conceptually valid, but neither mutually exclusive nor collectively exhaustive (Maguire & McKelvey, 1999). Researchers express this issue by giving preference to the utilisation of the term 'complexity theories' instead of 'complexity theory' (Black, 2000; Burnes, 2005). A possible conclusion is that complexity contains a myriad of features and attributes which create a challenge when trying to elucidate or define.

Amongst the theorists of complexity, Page (2010) sees the abundance of definitions rather as a weakness than a strength and offers two characterisations of complexity. Firstly, "*…complexity cannot be easily Described, Evolved, Engineered, or Predicted*" (Page, 2010, p. 32)[11]. He further places complexity between order and randomness, excluding the possibility that it can be associated with either of the two extremes.

The definition of complexity used in this dissertation is closer to applied theory and oriented towards similar concepts used in organisational research. Tatikonda and Rosenthal (2000, p. 78), for example, define project complexity as "*…the nature, quantity, and magnitude of organizational subtasks and subtask interactions posed by the project*". This definition encompasses three project characteristics other than project size, namely interdependence between process components, newness of project objectives, and difficulty of the project objectives. As a composite measure,

[11] Page (2010) describes complexity as DEEP, which is the acronym for the difficulty to be described, evolved, engineered or predicted.

the approach to project complexity is similar to the service complexity approach adopted in this thesis, in that the aggregation of various elements of complexity leads to an assessment of an overall level of complexity.

2.3.3. Service Complexity

Whereas most of the aforementioned definitions are commonly used in NSD research, the term service complexity is not a set expression. Service complexity, as employed throughout this dissertation, is not only defined as the inherent level of diversity and breadth of a service offering, but as the sum of the core factors that interact with the objective of producing/delivering a service offering to a customer base as well as the nature of the service outcome. This definition is much broader in scope than the commonly used depiction of complexity as the sum of services on offer and encompasses the multi-faceted process dimension of a service. When practitioners look at complexity, they tend to focus on a particular service type or organisation. From their point of view, managing or handling complexity is related to streamlining individual processes and putting the service offering in line with customer demand. Confusion from sides of the customer, being confronted with an overwhelming selection of service types, for instance, is a standard example for a negative association of service complexity which practitioners attempt to mitigate or control. Yet, the actual issue in this example is related to service diversity rather than complexity. From an academic perspective, the angle of addressing services predominantly focuses on basic general principles that hold for the entire scope of the service dimension. The vast diversity of services therefore requires a more comprehensive understanding of complexity, covering both service and service process dimensions. In order to assess the impact of firm individual characteristics and attributes of specific service types on NSD processes, key drivers of service complexity will be tested with respect to their predictive and explanatory power as part of this research.

The definition of service complexity used in this thesis follows the general logic of complexity theory, being cognisant of the fact that complexity theory researchers do not agree on a single definition of complexity. Following Simon (1996), a complex system consists of a large number of interacting parts. Gatignon et al. (2002) relate product complexity to the number of subsystems of the product. In the organisational context of a service firm, this definition needs to be extended in order to capture the dependencies of the various parts of a service system including sub-services. Hence,

this dissertation defines a complex service as an open system consisting of a large number of interconnected, co-evolving elements that interact, interdepend, and exchange information with a common purpose. This definition encompasses process complexity but is considerable wider in scope. It also includes the number and the individual characteristics of the process agents as well as the organisational environment. Daft (1992) suggests three complexity dimensions within organisations: *i) vertical*, *ii) horizontal*, and *iii) spatial complexity*. Whereas vertical complexity describes the organisational hierarchy structure, horizontal complexity relates to the plurality of specialised functions and departments within an organisation as well as the number of staff within an organisation on the same project. Spatial complexity relates to the number of organisational sites and the geographical distance between them.

A complexity factor which is closely linked with the service environment but tends to be neglected in complexity theory is customer involvement. In their comprehensive literature review, Johne and Storey (1998, p. 186) note that "*…interaction is the distinguishing feature of service offerings*". Due to the fact that services are most often delivered at the customer interface, a varying degree of participation of the customer in the service process can also influence service complexity. Customer involvement depends on the focus of the service organisation, its strategy, skill set, as well as the general service infrastructure. Hence not every customer will be given an opportunity to change service requirements during the delivery process or be involved in it. A further aspect with direct influence on service complexity is regulations and legal requirements. Unlike customer involvement it is mostly beyond the scope of influence from sides of the organisation but linked to the strategic choice of which industry or market segment to do business in.

De Brentani (1995a, p. 215) suggests that firm size is a key indicator for organisational complexity. She names large hierarchical structures, wide product lines and geographic dispersion as features of high complexity in organisations, all of which are linked to organisational size and are considered as complexity dimensions in the empirical part of this dissertation.

2.3.4. Complexity, Complicatedness, and Diversity

In order to provide clarity of a number of related but substantially different concepts, this section explains the relationship between complexity, complicatedness, and diversity and concludes the chapter on definitions used in this thesis. To emphasise the differences between the three concepts, four examples of

professions/organisations are illustrated. The use of simplified examples is commonplace in dealing with demarcations of concepts like complexity, complicatedness and diversity. Page (2010) uses the example of an automatic vs. a manual transmission, Tang & Salminen (2001) emphasise differences by using products like a VCR control and a mobile phone. Danaher & Mattsson (1996) show that a hotel, a conference and a restaurant represent services, operating at differing levels of complexity. The practical examples chosen in this section describe services, all of which reveal differing degrees for each of the three concepts discussed in this section: *a) a specialised trader in the financial services/commodities sector*, *b) a profession within the hotel, restaurant and catering sector* (HORECA), *c) a logistics company*, and *d) a private hospital*.

Details for the chosen examples are outlined in the following:

a) *Professional trader*: The role of a professional trader requires a specific skill set in order to execute a highly specialised role (e.g. holding long or short positions, delta or gamma hedging, day-trading). The task involves a high degree of complication, which cannot be managed successfully without an appropriate skill set. These skills might be rare to find and impose a high requirement when trying to create or staff a new business. The operational set-up, however, can be minimalistic. Communication as well as trading is done online and does not require a sophisticated organisational structure, coordination of staff, or infrastructure. As such, the complexity of the role/profession can be considered low. Diversity varies according to the task being executed/products being traded.

b) *HORECA business*: In general terms, the required skill set within this profession is lower compared to the previous example. Whereas an education is also required, the complication of tasks can mostly be considered moderate. Complexity varies dependent on the organisational set-up (organisational size) and the involved processes (driven by the product level offered). The distinguishing feature is the amount of diversity of the offer. Usually a wide range of choices is available which result in high diversity. Yet, the impact on both complicatedness and complexity can be low and only increase moderately linked to changes in diversity.[12]

c) *Logistics company*: Similarly to the previous example, complication of the tasks involved is moderate to low. Infrastructural requirements, however, can be substantial and include storage/handling facilities and operating equipment

[12] Diversity in this context is used synonymously to product variety.

such as containers and a fleet of trucks or vessels. Complexity is driven through coordination work and interfaces between different functions involved in the process and can therefore considered medium to high. Diversity depends on the range of services offered.

d) *Private hospital*: The level of complication ranges from low (e.g. cleaning staff) to high (specialist medical professions). Infrastructural requirements are high and create together with a medium sized organisation and various interconnected functions an environment of high complexity. Dependent on the service level offered, diversity is considered to range between medium to high.

The four examples provide an overview of the demarcation between complexity, complicatedness, and diversity. Tang and Salminen (2001) illustrate the difference between complexity and complicatedness by using the example of a standard and automatic car transmission. An automatic transmission includes a larger number of parts and intricate linkages and is therefore more complex. In terms of complicatedness, the manual transmission is less complicated to drivers and more complicated to mechanics to operate. Complicatedness is then defined as "*…the degree to which a decision unit for the system is able to manage the level of complexity presented by the system*" (Tang & Salminen, 2001, p. 3).[13] Hereby, the decision unit can be a person or another system.

The concept of diversity is intuitively easier to separate from the other two, yet, it is theoretically linked. Page (2010) defines three types of diversity: *i) diversity of types and kinds*, *ii) diversity within a type* (variation), and *iii) diversity of composition*. Applied in a services context, *diversity of types and kinds i)* relates to different types services offered by the same or different organisations. Chase and Apt (2007) stress the difficulty of identifying general principles in the management of service operations due to high level of diversity amongst services. High levels of diversity of types and kinds amongst services have raised the question if the same principles and processes used to develop new services are generally applicable for all services. *Diversity within a type ii)* captures service attributes and characteristics such as service level and service quality. Services can be distinguished by differences within a type when comparing services offered by different firms but also within the same service firms, if an organisation offers the same service with different attributes or

[13] It can be argued that a transmission as a static system is also not complex, as the interaction of the components is mechanistic, predictable and does not show any form of adaptation. See Page (2010, p. 20) for a detailed discussion on complexity.

characteristics. Lastly, *diversity of composition iii)* relates to the arrangement of service process steps. These again are likely to differ between service organisations and can have a substantial impact on the service result or outcome of the service process.

Practitioners in new service development make efforts to control both complicatedness and complexity in order to improve the outcome of the process and enhance service performance both in terms of efficiency and market success. Diversity is a driver of innovation and productivity (Page, 2010) and can be consciously used to achieve a competitive advantage. Given that diversity is linked to complexity and complicatedness, the level and remit to which is employed from a strategic perspective needs to be consciously chosen by practitioners, especially when complicatedness and complexity are matters that affect the performance of a service operation.

2.4. Related Research in NPD and NSD

Processes used in the development of new products and services have been intensively studied over the past four decades. Whereas the amount of literature on product innovation and NPD is vast (Clark & Fujimoto, 1991; Krishnan & Ulrich, 2001)[14], scholars continue to bemoan low volumes of service innovation literature (Ettlie & Rosenthal, 2011; Ordanini & Parasuraman, 2011), inadequately reflecting the paramount importance of services within developed economies. Ostrom et al. (2010) visualise the importance of services in modern economies by emphasising that the gross domestic product (GDP) of the world's most advanced economies is made up to over 70% by services and emerging economies like China already attain a service share in their GDP in excess of 40%.

Contextual variables play a key role in the development of new products and have been found to influence an organisation's ability to innovate (Drazin & Schoonhoven, 1996). In the well-established area of NPD research, two interlinked key topics are the *drivers of success* in development projects and the *measurement of development performance* (Cooper, 1994a). Given that the attention dedicated to the development of new services and knowledge of service emergence processes is much lesser in

[14] See Shane and Ulrich (2004) for a comprehensive review of 50 years of research on innovation and NPD in Management Science.

scope compared to new physical products (Menor et al., 2002), it is worth exploring the main differences between the two research areas in order to further evaluate if and how NSD could benefit from extant knowledge on NPD. Furthermore, this section strives to provide an overview of the knowledge on service innovation that provides the basis for the theoretical framework of this thesis. The chapter starts by introducing the main research streams within the NSD literature. This is followed by a section that highlights how service literature explains the locus of service innovation, processes, and particularities. The relationship between NPD and NSD literature is discussed in section 2.4.3. The literature review is subsequently concluded by a section on service performance.

2.4.1. Research Streams

During the early stages of organisations-related innovation research in the 1980s, most research focused on the emergence of new products, yet frequently without explicitly excluding services or service products. As outlined by Brown and Eisenhardt (1995), innovation research can be subdivided into economics-oriented work and organisations-oriented work. Whereas the former evaluates cross-industrial differences in innovation (Adler, 1989), the latter focuses on the organisational perspective of innovation and is hence more relevant within the context of this dissertation. Researchers have endeavoured to understand innovation in an organisational context, explain related processes, find structural conditions that enhance the likelihood of success, and uncover causal relationships between successful innovation and factors internal and external to the organisation [e.g. Cooper (1990, 1994a), Clark & Fujimoto (1991), De Brentani (1989, 1991)]. With regard to the development of services, a number of research streams have addressed service innovation from different angles, underlining the multi-disciplinary nature of service research.

Whereas marketing (Cowell, 1988) and service marketing (Bowers, 1989; Scheuing & Johnson, 1989b) researchers were amongst the first to address service processes and to propose structured service delivery models (Johnson et al., 2000), operations management scholars have also increasingly focussed on NSD (Froehle et al., 2000; Menor et al., 2002; Metters & Marucheck, 2007) for more than a decade.

A further school of thought has evaluated service innovation from a technological angle, focussing on service related R&D activities (Djellah et al., 2003; Gadrey et al., 1995; Miles, 2007) and service engineering. Bullinger et al. (2003) consider service engineering a discipline that has developed in Germany and Israel parallel to NSD

research in the UK and U.S. since the 1980s. It is defined as a "*…technical discipline concerned with the systematic development and design of services using suitable procedures, methods and tools*" (p. 2). Despite a general consensus that services R&D is underestimated, further growth in services R&D activities is expected, even if disproportionally smaller compared to the prevalence and economic importance of services in advanced economies (Ettlie & Rosenthal, 2011; Miles, 2007).

A holistic consideration of the complex area of NSD will not be able to only draw upon one of the aforementioned research streams. Therefore, a multi-disciplinary perspective has been taken in this research thesis, using key principles of service marketing, service operations, innovation research and impulses from other streams relating to technology and physical products. Furthermore, as NSD is seen as an organisational activity that relies on a multitude of organisational resources such as investment capital, human capital, and intellectual capital (Froehle & Roth, 2007), some aspects are taken from resource-based theory. Services from the delivery of a newspaper to neuro-scientific research reveal a very high component of people involvement, making the human resource aspect a crucial component of the service delivery process. Resource-based theory and the resource-based view of the firm (RBV) are schools of thought, proclaiming that organisational performance and success is a function of available resources and an organisation can only sustain a competitive advantage if it manages to preserve these resources by safeguarding characteristics such as rareness, inimitability and non-substitutability (Barney, 1991; Wernerfeld, 1984).

2.4.2. Understanding New Service Development

When talking about new service development, the scope of innovation activities around the corporate offering of firms is vast. These innovations reach from incremental modifications of existing services for a known client base to radical or ground-breaking introductions of entirely new services to prospect new clients. As the boundaries are fluent and most companies typically engage in a variety of activities in order to maintain a sustainable position within competitive markets (Crossan & Apaydin, 2010), most research covers a large bandwidth of NSD activities (Johne & Storey, 1998). Due to the fact that NSD activities take place in several different categories of 'newness', an aggregated view can be prone to biases and hence impact the predictive and external validity of the research (Menor et al., 2002).

The intention behind this section is to provide a deeper understanding of the locus and facets of service innovation in organisations. It strives to portrait new service development as an undertaking that, like NPD, is formally optional, as firms can freely choose whether or not to pursue it, e.g. as part of a strategic or marketing agenda. Yet, NSD can also be seen as a necessity for organisations to remain competitive and sustain in the market place.

2.4.2.1. Organisational Reasons for NSD

Many service researchers have stressed the high importance of NSD activities, especially in growing service economies (Fitzsimmons & Fitzsimmons, 2000; Tatikonda & Zeithaml, 2002). Johne and Storey (1998) argue that as services are intangible, imitation by competitors can take place at greater ease compared to physical products. This reinforces the necessity to maintain customer relationships, market positive customer experiences and attach them to the corporation through branding and customer retention activies. Atuahene-Gima (1996) presents evidence for a negative impact of technology synergy on the success rate of NSD. This means that new services, which in terms of technology are closely related to existing services, reveal lower success rates compared to more innovative or radical new service introductions. In the latter case, competitors are less likely to be in a position to quickly copy the newly offered service (De Brentani, 2001).

Besides reacting to competitive pressures, the motivation behind the development of new services, like in NPD, can be manifold. Whereas services are not necessarily subject to the same ageing process and life cycle as products, a need for modernisation driven by changes in customer demand and preferences combined with competitor behaviour can be perceived as being very similar to the product world. Booz Allen & Hamilton (1982) have found that the reasons for new service introductions are often specific to the particular industry sector of the service firm. Whereas IT and telecommunication companies need to introduce new technologies to their service offering in order to keep pace with industry standards, companies in the travel, hotel and food service industry create promotional new service offers to increase capacity utilisation in off-seasons and down times. Hence, NSD serves a variety of strategic purposes within service firms.

In their study of product performance in the financial service industry, Storey and Easingwood (1999) focus on four main organisational benefits of NSD: *1) increased profitability of existing services*, *2) broadening of the customer basis*, *3) improved*

customer loyalty, and *4) access to markets of opportunity*. They point out, however, that controlled processes and an acceptable success rate of NSD activities represent the foundation in order to realise these benefits for any organisation in the service sector. Easingwood (1986) argues that the additional contribution from new services in terms of revenue is smaller than the contribution of new products due to cannibalisation effects between new and existing services. This finding points towards a fundamental difference between products and services and simultaneously shows that organisations in the service sector are likely to face stronger strategic limitations compared to firms producing physical products in terms of their capabilities to achieve organic growth.

In their study of global product development, Kleinschmidt et al. (2007) conclude that developing new products and global expansion are, despite being highly interrelated, the two main business strategies that will lead to a competitive advantage and therefore support business sustainability. In most scenarios, global expansion within service firms leads to an increase in organisational size, as services cannot simply be exported to a new country but require local service delivery agents. This, again, is linked to the particular characteristics of services such as intangibility and simultaneity of service performance and consumption. Competitive advantage of global expansion can arise indirectly due to increased recognition of a brand name and first mover advantages resulting from fast introduction of established service concepts in new markets. Yet, direct financial rewards of global service expansion can be considered below those of new products, given lower amounts of economies of scale and scope. A global expansion strategy within service firms therefore needs to be considered in the light of potential risks to the service organisation as a whole.
In order to address risks in service innovation activities, organisations try to make use of learning and past experience when addressing service innovation. Contrary to the normal perception that organisational innovation activities benefit from past experience, Karim (2009) presents evidence for constraint organisational memory, suggesting that past experiences do not impact future innovation. NSD researchers have also addressed this point, trying to find organisational concepts and processes that enhance the efficiency of service innovation activities.

2.4.2.2. Organisation, Stages, and Phases

The services literature reveals some debate around optimal structures and planning processes of NSD activities. Whereas some scholars argue that NSD activities are

highly complex and thus require formal organisation (Edvardsson et al., 1995; Scheuing & Johnson, 1989b), others share the opinion that the development of new services happens in complete absence of formal processes and is therefore due to intuition and chance (Langeard et al., 1986; Menor et al., 2002). Adhering to the former group, De Brentani (1995a, p. 220) points out that "*…the importance of establishing a systematic, market-driven and high-involvement process for evaluating, developing and launching new services cannot be overstated*", especially for larger firms with wide client and product bases and more complex operations. Given the level of uncertainty found within new service development activities in practice, it becomes evident that there are still numerous lessons for service managers to be learned with regards to the objective of achieving a reduced failure rate of new service introductions. However, as NSD research is less advanced than NPD, often considered its generic equivalent (Johne & Storey, 1998), blueprints for structural best practise or performance measurement and control mechanisms that apply to all service types are either inexistent or considerably less developed within the literature.

A simplistic division of the process flow of NSD activities delivers three consecutive macro stages: a front end, a back end, and the service introduction/launch (Tatikonda & Zeithaml, 2002). At the front end, the identification of viable new service ideas is a demanding task and requires detailed knowledge of market factors and organisational capabilities as well as entrepreneurial skills. The front-end of innovation programmes has often been characterised as fuzzy (Cooper, 1994b; Verworn, Herstatt, & Nagahira, 2008), given that concept planning activities frequently happen in a random and unstructured order. The front end has also been found to be heavily marketing dominated, also within service firms (Tatikonda & Zeithaml, 2002). The back end in terms of development activities is generally shorter for services than new products. High emphasis is placed on strategies surrounding new service initiation and the required level of formalisation. Kelly and Storey (1999, p. 45) define initiation strategies as "…*methods and approaches service firms adopt in generating and screening ideas for new services*". Researchers analysing NSD processes in practise have found that idea generation for new services is often undertaken on an ad-hoc basis rather than as a planned and structured activity (Dolfsma, 2004; Kelly & Storey, 1999). As a consequence, the process of screening new service ideas frequently fails to deliver optimal support for a corporate new service strategy.

The sub-division of NSD processes into sequential development stages has received high levels of general acceptance. Yet, some researchers argue that NSD project phases overlap and therefore cannot be clearly identified (Edvardsson et al., 1995). NSD research, to a large extent, draws on findings from product development research, which heavily focuses on the manufacturing industry. Hence the first models which attempted to structure and explain the organisation of NSD were derivatives of NPD models, adapted for service particularities. Whereas researchers have put emphasis on different stages and proposed additional steps, a seven step model, similar to the NPD model suggested by Booz Allen & Hamilton (1982) can be extracted from a number of NSD models (Scheuing & Johnson, 1989b). Figure 2-4 depicts the generic model of NSD.

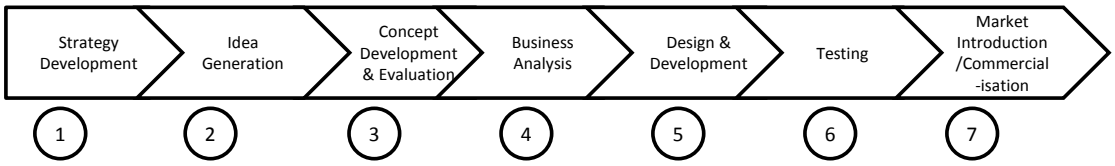


Figure 2-4: NPD Derived Generic NSD Model[15]

The model starts with the *development of a strategy* for a new service that fits the overall strategy of the business or might, as an outcome, trigger a reformulation of the business previous business strategy.

Whereas *idea generation* is shown as step two in the model, it is possible that a new service idea is not formally developed but occurs randomly in the process of regular business routine. The formalisation of a new service idea takes place during the *concept development* stage, which also includes screening and evaluation. Establishing a link between the new service idea and the organisation is done as part of the *business analysis* stage. This stage evaluates expected profitability i.e. through modelling of a business case for the new service. It also strives to determine if the business is capable of delivering the service idea based on extant structures, resources and competences.

It is not until the fifth stage of the process that *design and development* of the service take place. Given the intangible nature of services, a clear demarcation between concept development and service development can be unobservable. Therefore it is possible that an increased emphasis on the concept development stage creates redundancy to steps included in the design and development stage. As services are

[15] Adapted from Scheuing & Johnson (1989b).

delivered at the customer interface, *testing* is commonly not done as rigorously compared to the development of physical products. A study by Bowers (1989) shows that the test phase is the least applied phase amongst a cross-sectional sample including financial institutions and hospitals. Therefore, the *market introduction* stage often reveals shortcomings in the service design or service delivery process, which require post-launch rectification.

The generic seven step NSD model can also be depicted in an aggregated format as a three stage process, including a *front end*, the actual *development stage* and a *back end*, comprising testing and market introduction. Exhibit 2-1 shows how NSD stages and the seven step model interrelate and break down into process tasks.

Exhibit 2-1: Aggregation and Subdivision of 7-Stage Generic NSD Model[16]

Stage	7-Spep Model Phase	Detailed Process Tasks
Pre-Development Stage / **Front End**	1) Strategy Development	- identify core service strategy - position company amongst competitor offerings - establish organisational capabilities for innovation
	2) Idea Generation	- screen market for customer needs and requirements - evaluate multiple new service ideas - check fit of new service idea with business strategy
Development Stage **Process Delivery**	3) Concept Development & Evaluation	- develop business concept around new service idea - determine strategic positioning - evaluate mid- and long-term potential of new service
	4) Business Analysis	- analyse organisational capabilities for delivering new service - evaluate growth requirements - deterime fit with existing service offering
	5) Design & Development	- outline service and service delivery process - evaluate feasibility and service outcome - develop service process model - develop service marketing concept
Post-Development Stage **Back End**	6) Testing	- deliver and re-produce service - test service outcome and service quality - run service trials with test customer base
	7) Market Introduction / Commercialisation	- launch service introduction - roll-out service marketing concept - establish need for process modification based on customer feedback

The seven stage NSD model adapted from product development is not undisputed. In their review of new service development literature John and Storey (1998) ascertain that academia has not yet seen a conclusive theoretical model specialising

[16] The illustration of the generic seven step model in an aggregated three stage model is adapted from Tatikonda and Zeithaml (2002), who use an overview of archetypical macro-stages in order to depict the temporal sequence of steps in NSD.

in NSD activities. Also, as empirical findings demonstrate, a large number of service organisations do not follow structured formal processes when developing new services. In Scheuing and Johnson's (1989a) survey of NSD activities in U.S. financial service organisations, just over 50 percent of respondents indicated the use of structured NSD processes, confirming the view of some researchers that new services are developed rather by happenstance than through formal application of development activities.
Johnson et al. (2000, p. 18) propose a cyclical NSD model and argue that service development processes are highly iterative and non-linear. Their conceptual tool is divided into four main phases: *a) design*, *b) analysis*, *c) development*, and *d) full launch*. It also includes several enablers in order to emphasise the importance of agents in the process, organisational infrastructure, and systems/technologies.

The required degree of formality of the NSD process has been subject to considerable debate amongst academics. Bowers (1989) creates an argument for more structured processes in NSD. Especially the difficulty of ex-ante of market testing can create issues around adequate incorporation of consumer expectations in new services. A newly created real estate firm, for example, would struggle to test the ability of staff marketing and selling houses prior to landing a first mandate. In case of competency driven staffing issues, negative client feedback may not be changeable. This can create significant burdens during the difficult start-up phase of a service organisation. Bowers therefore recommends embedding sufficient flexibility and sensitivity in the service process so that external factors such as consumer feedback and criticism can be taken into account during or after initial service delivery. Johnson et al. (2000) propose that ad-hoc creativity provide compensation for the lack of a formal NSD planning phase. In a related context, Moorman and Miner (1998, p. 15) state that improvisation as a strategy of emergent learning has the potential to act as substitute for planning.

Given the level of ambiguity surrounding the role of structure, planning, and formality in the development of new services, this thesis aims to make a contribution to the debate by analysing the effect of the degree of structure and formality on the NSD process. An indicator for NSD routine, experience, and process formality is the availability of a dedicated locus for NSD within an organisation. Whereas R&D departments and product development functions are common in manufacturing environments of firms frequently introducing physical products, finding dedicated innovation facilities is considerably rarer amongst service firms (Miles, 2007).

2.4.2.3. Location of NSD within Service Firms

While product development in manufacturing firms can often be found in specialised departments, it is less evident where the organisational home of service development activities is to be placed. NPD activities in manufacturing are mostly cross-functional, and therefore can be found in a number of organisational sub-units or departments. The coordination of the development, however, is frequently found in a central unit, which might have a strategic or technical focus, depending on the type of product and the level of development and manufacturing complexity. Miles (2007) finds that especially in larger organisations (more than 250 employees), R&D activities differ widely between manufacturing and service companies. Whereas 69 percent of the former have continuous R&D activities, only 34 percent of larger service firms have permanent NSD activities. This finding correlates with the perceived lack of specialisation in NSD and a dedicated department within a majority of service firm. In their study of NSD in financial service firms, Scheuing and Johnson (1989a) find that the marketing function is predominantly commissioned to establish if there is a market need for new service products and develop a strategy to satisfy this need.

It can be argued that the comparatively lower degree of R&D specialisation in services is part of the general nature of NSD and the void of dedicated specialists is filled by ad hoc project teams consisting of general management, marketing, sales, and operations staff. Hence, in absence of a R&D/NSD department, development of new services is project-based and takes place cross-functionally, involving several departments within service firms. Yet, little evidence can be found that systematically links the level of specialisation to the outcome of new service development and therefore this research strives to provide additional insights into this aspect of NSD.

2.4.2.4. Knowledge Intensity and Sectoral Particularities

Due to their intangible nature, services highly depend on knowledge, skills, and experience of individuals involved in their delivery. The dissemination of a knowledge-based society combined with an increase in the economic importance of the service sector has given rise to knowledge and technology intensive services (Miles, 2007). Knowledge intensive business services (KIBS) are considered a highly innovative sub-category of services, which act as facilitator, carrier or source of innovation (Den Hertog, 2000, p. 491). The range of services subsumed under the

term KIBS is broad. Whereas most professional service types (e.g. financial, advisory, or consulting services) fall into the category of KIBS, notwithstanding of their inherent technology content, services from other sectors such as building and construction services, environmental services, marketing and advertisement services are also considered KIBS (Den Hertog, 2000; Miles et al., 1995), as they include a highly professional component.

Knowledge can be seen as connector between the delivery of services and the manufacture of physical goods. In both scenarios, agents apply knowledge to create value, irrespective of the physical or intangible nature of the outcome. The distinction hereby lies in the way knowledge is applied. Miles (2008) stresses the communalities between certain service organisations and high-technology manufacturing firms. Whereas in a traditional manufacturing approach, knowledge is commonly generated through formally organised R&D structures, these structures can be found only to a substantially smaller extent amongst service firms (Miles, 2007). One reason for this finding is in the fact that service firms reveal knowledge in their activity but generally apply shorter process chains, especially when compared to manufacturing organisations. Despite generic differences, similarities can be found especially between knowledge intensive service firms and high-technology firms producing physical products. Innovation activities in both organisation types take place widely disconnected from subsequent activities and process chains. Whereas exploitation of high-technology is done in a more structured way during the development phase, the initial knowledge generation through research as a creative process is commonly organised via less formal processes. As services are highly process driven, Behara (2000) compares process innovation efforts with knowledge management activities. Organisational efforts to manage process innovation knowledge help to address the knowledge and information-based intangibility of services and provide structure to the innovation process without limiting its creative nature.

Knowledge intensity is not only a factor that distinguishes certain service types from manufacturing firms. It also marks differences between service sectors. When looking at the body of service innovation studies, it becomes apparent that large amount of research concentrates on financial services (Johne & Storey, 1998). These services generally reveal a high degree of standardisation, internal quality control, and sometimes product-like features (e.g. credit cards, ATMs). The close proximity between products and financial services has enabled researchers to address services with methods and theoretical models adapted from NPD research.

Many of the developed models were created for specific service sectors but have not been tested in a wider, heterogeneous service industry context. This gives raise to concerns regarding the applicability of service industry sector specific findings across other service sectors (Howells & Tether, 2004). Langerak and Hultink (2006) suggest that some difficulties in the analysis of service innovation are created through confounding efforts of unmeasured industry-level factors.

Aspects related to knowledge intensity and service sector specific characteristics, which are closely entwined, represent a challenge in the study of service innovation. A decision is required in the research design whether to exclude the aforementioned confounding effects through addressing a more homogeneous service segment with similar levels of knowledge intensity, or find other means in order to cope with vast service diversity and the challenge of inter-sectoral service particularities. Whereas the former approach has advantages in terms of ease of implementation and internal consistency, it is assumed that the research gap between NSD and NPD research can only be narrowed through research that holistically captures the concept of services without imposing narrow limitations to the service term. This thesis therefore strives to include a wide array of services with different levels of required knowledge across different service sectors and does not create limitations according to innovativeness, by focussing on service innovations and excluding process level innovations. Unlike in product development, a service is constituted through its delivery process and a change of the latter is likely to lead to perceivable differences in the service outcome, whereas a change in the production process of a tangible product might only alter the structure of process inputs versus outputs, without significant effects to the product itself.

2.4.3. New Product Development

Within the substantial body of innovation research, literature on product development is vast and continuously growing. Because of shorter product cycles,[17] international competition, technological advancement and a high degree of external customer expectations towards products, modern firms face a constant challenge of having to rethink their product offer and update their product strategy. Both researchers and practitioners are asking questions such as: '*What makes some products more*

[17] Bayus (1994) states that the notion of reduced product cycles is conventional wisdom. In fact, his findings provide evidence for the rate of product introduction exceeding the rate at which companies remove products from the market.

successful than others?' or '*How does product development need to be planned and executed in order to maximise product success?*'. NPD researchers have addressed these questions from various angles. Several key topics have emerged over the past three decades within organizations oriented research on innovation:

- *Organisational structure* (Ancona & Caldwell, 1992; Ayers, Dahlstrom, & Skinner, 1997; Dalton et al., 1980; Tatikonda & Montoya-Weiss, 2001),
- *New technologies* (Balachandra & Friar, 1999; Tatikonda & Stock, 2003),
- *Communication* (Crawford, 1984; Ebadi & Utterback, 1984; Van den Bulte & Moenaert, 1998),
- *Management support* (Clark & Fujimoto, 1991; Cooper, 1988; Swink, 2000),
- *Timing/time to market* (Kivisaari, 1991; Schilling & Hill, 1998).

In terms of practical realisation of a product idea, R&D activities as well as project and operations management are enormously important as they exhibit a substantial impact on future organisational performance and success. Researchers have analysed the complex product innovation framework from different perspective. For instance, strategic considerations prior to a product decision have been critically examined, as selecting the right products is a key factor determining the overall level of success (Ali, Kalwani, & Kovenock, 1993; Ayag, 2005). Equally important is the execution of the development process, which affects and involves most areas of a business and is responsible for delivering a product that meets strategic and organizational targets such as customer requirements, quality, timing and costs.

Successful new products drive both financial and market performance of an organisation (Swink, 2000). Following Dostaler (2002, p. 1) performance of new product development[18] can be understood as "*…a multidimensional concept including the performance of the development process itself, the performance of the product and financial performance.*" Financial performance is generally considered the result from product development and reflects its degree of success. Cooper and Kleinschmidt (1987) argue that for companies entering new markets, learning generated through product development is more essential than financial performance and hence financial success is not an adequate performance measure. Brown and Eisenhardt (1995) consider it the outcome of process and product performance. A commonly used approach of measuring financial performance is to analyse the impact of exploratory variables on performance using tests against a null hypothesis,

[18] Although modifications of existing products do not technically classify as new products, it can be argued that they contribute to the marketability of an organisation's product portfolio and thereby contribute to a firm's long-term sustainability.

whilst controlling their independence (Capon, Farley, & Hoenig, 1990). Capon et al. (1990, p. 1143) summarise this as follows:

> *"Because it is generally infeasible to establish true experimental controls in studying financial performance, authors typically estimate the impact of a particular factor on performance, using statistical techniques to hold other factors constant."*

Cost targets relating to investment and product/unit costs are commonly used in order to calculate the expected ex-ante profitability of a project. In situations where problems occur during the operational development process, consequences can affect product quality, introduction timing, and result in trade-offs with regard to planned cost targets (Everaert & Bruggeman, 2002; Graves, 1989; Swink, Talluri, & Pandejpong, 2006). Whether or not a trade-off between quality/timing and costs can be made generally depends on the severity of the problem. In cases where additional internal or external resources can be used to reduce the scope of a problem, a trade-off leads to reduced profitability of the NPD project (Bayus, 1997). Financial indicators such as EVA (Economic Value Added) or ROI (Return on Investment) as measures of NPD performance are not generally accepted (Loch & Tapper, 2002). In a study of R&D portfolio methods in new product development, Cooper at al. (1999) found that when selecting from a number of product development activities, strategic considerations outperform financial indices.

In an attempt to provide organisations with means to measure product development activities and thereby help to achieve pre-defined targets, a number of researchers suggest structural and diagnostic audit tools (Chiesa, Coughlan, & Voss, 1996; Cooper; Radnor & Noke, 2002; Rickards & Bessant, 1980). The range of tools comprises structural control models, such as Cooper's (1996) *Stage-Gate Model* or self-audit tools such as Radnor and Noke's (2002) *Innovation Compass*. With regard to the former, Cooper (1996) suggests rigid entry gates that precede each next higher stage of the process. These gates serve as quality checkpoints but also 'go/kill decision points', which can stop the proceeding of a project. Audit tools work in a complementary way, assisting companies in measuring "*…gaps between current and desired performance*" (Radnor & Noke, 2002, p. 122).

As a result of intense investigations of NPD, researchers have identified a broad array of factors that drive success and failure of new products. Zirger and Maidique

(1990) report performance impacts of the following five factors that were extracted from an encompassing study of high tech product innovation:

(1) Quality and capabilities of an organisation's R&D department,
(2) Technical product performance,
(3) Customer value and appreciation,
(4) Synergies to existing competences within the organisation, and
(5) Management support throughout product planning and launch.

These factors emphasise that new product development is a multi-disciplinary venture that can be analysed from various angles and perspectives. Krishnan and Ulrich (2001) propose four common categories, which encompass the major research perspectives taken by scholars within the NPD research community: *marketing i)*, *organisations ii)*, *engineering design iii)*, and *operations management iv)*. Due to the generic breadth of the topic, many academics have called for a model that integrates the different perspectives. Yet, limitations resulting from a multi-disciplinary approach have also provoked criticism or raised concerns within the research community.

As part of the study of NPD success, researchers have examined how product development processes are formally organised. Generally accepted findings are that NPD takes place as an organised and structured set of sequential activities (Bonner, Ruekert, & Walker, 2002). Research delivered a number of suggestions as to how to best structure the process, e.g. through division in phases or stages. A frequently utilised model is a life-cycle approach, which divides NPD in sequential phases: *1) project selection*, *2) project execution*, and *3) implementation* (Pillai, Joshi, & Rao, 2002).[19] Whereas this generic phase model has been found useful in the context of smaller development projects with straightforward levels of complexity, many NPD projects reveal overlapping structures, feedback loops, improvisation or even a degree of chaos (Cheng & VandeVen, 1996; McCarthy et al., 2006). Therefore a simplified mapping via a linear process structure fails to encompass the full scope of NPD activities. McCarthy et al. (2006) identified three decision levels, accounting for firm hierarchy and project phase: *strategic decisions i)*, *review decisions ii)*, and *in-stage decisions iii)*. Given the previously outlined differences between products and services, there is substantial scope for testing product knowledge in a service context, offering fertile grounds for further empirical research.

[19] See Cooper's *Stage-Gate Model* for an alternative and frequently cited linear NDP framework (Cooper, 1990, 1996).

2.4.3.1. Links between NPD and NSD

Services have generally been researched to a lesser extent than products and research findings seem to be less conclusive. The difficulty to address services with common tools of innovation researchers has been named the '*services are different issue*' (Easingwood, 1986; Foxall, 1984). One of the first researchers to address the disparity of research in product development versus service development was Easingwood (1986). He examined the influence of service characteristics on the development process. Further research has subsequently brought up the question if and to what extent NPD knowledge applies in a service context. Answers to this question reveal how the theoretical bodies of research on NPD and NSD are interlinked.

Extant literature contains a number of communalities between NPD and NSD, even if at times not directly denoted as such. For example, product support was identified as an important driver of product success (Cooper & Kleinschmidt, 1987), despite support activities formally classifying as services. Atuahene-Gima (1996) analysed the differences in success factors between NPD and NSD.[20] His results suggest a number of coherences and similarities, but factors were ordered differently in terms of their relative importance. As an example, product innovation advantage was identified as the most important success factor in product innovation, but only ranked third in NSD. For service firms, innovation activities around the human resource strategy were the primary success driver, and contrarily, only ranked third in NPD.

In contrast to the detailed work on NPD, processes used in developing new services can still be considered under-researched. Johne and Storey (1998, p. 190) postulate that: *"Process development may go beyond simple cost reduction. It may involve a fundamental rethink and redesign of business processed.*" In order to study performance of NSD, it is crucial to examine the structure of the service development process. The comparison with established processes in NPD is assumed to lead to insights with the potential of contributing to knowledge on both NPD and NSD, but also likely to entail practical relevance for service management professionals.

[20] Atuahene-Gima (1996) bases his findings on evidence found through survey results of 300 manufacturing companies and 300 service companies in Australia.

2.4.3.2. Assimilation and Demarcation Approach

Whereas NSD research is sometimes considered a mirror image of NPD research with certain limitations, a potentially reduced focus, and variations in relative procedural structures, early discussions of both research streams were marked by two bipolar views, namely the *assimilation* and *demarcation approach*. Miles (2007, p. 262) describes the assimilation approach as follows:

> *"The Assimilation Approach assumes that most economic attributes of services are fundamentally similar to those of manufacturing sectors. Any differences are matters of degree, usually being relatively minor quantitative variations along one or other continuum (such as firm size). Both services and manufacturing can thus be effectively studied and statistically documented according to methods and concepts developed for manufacturing."*

Researchers supporting the assimilation approach consider innovation in products and services to be based on a similar set of structural indicators with differences in relative potency (Atuahene-Gima, 1996; Cooper & De Brentani, 1991). Proponents of the demarcation approach, in contrast, point towards conceptual and structural differences between products and services and argue that models and concepts need to be specifically designed for each research area (Dolfsma, 2004; Nijssen et al., 2006). However, this stands in contradiction to other findings, stating that the gaps between manufacturing and services are becoming increasingly narrow (Miles, 2007).[21]

Academic interest in a model that synthesises new product and new service research findings (Drejer, 2004; Nijssen et al., 2006) is still high. Yet, very few articles exist that successfully bridge the gap between products and services and can be considered genuine representatives of a synthesis approach to product and service innovation. Hipp and Grupp (2005, p. 532) summarise the views of a number of researchers, suggesting that more research needs to jointly analyse manufacturing and service firms. Instead of industry classifications, both researchers suggest groupings by '*service products*', as it allows an improved account of product-accompanying services.

[21] In this context, also see section 2.2.3 as well as the discussion on the 'Servitization of Business' in Vandermerwe and Rada (1988).

Den Hertog (2000, p. 494) postulates that "…*a continuum rather than a strict distinction between manufacturing firms and service firms – and the innovation models used for them – seems appropriate when discussing firm innovation.*" Yet, difficulties to operationalise such an approach are likely to remain. The hypotheses of this thesis strive to reduce the gap between product and service innovation research and help to explain why product innovation is better understood than service innovation.

2.4.4. NSD Success

Researchers have attempted to explore the reasons for success and failure in new services. The literature reveals a multitude of methodological research approaches, comprising single case studies of success and failure, studies of successful or failed service introductions and comparative analysis of both successful and unsuccessful service innovations (Edgett & Parkinson, 1994). This thesis follows the latter approach and measures service performance as key outcome of the NSD process. Factors around the organisation and structure of the innovation process are evaluated with regards to their predictive power on service success.

Despite the reoccurring notion that not enough research has been conducted on NSD (Ordanini & Parasuraman, 2011), the extant body of literature is sizable and much has been written on factors that positively correlate to the success rate of new services. It needs to be highlighted, however, that given rapid new developments and change within the economy, some success factors identified in early studies might be of reduced relevance in current markets and service innovation at the present date. Brown and Eisenhardt (1997), for instance, postulate that development speed and flexibility is significantly more relevant than in the 1970s, when a number of major organisational theories such as transaction cost economics, agency theory, and organisational ecology became very popular and majorly influenced research at the time. Due to internet-based media, news on service innovation travels faster today compared to twenty years ago. A new financial service such as a managed investment fund or trust may receive strong publicity and urge other banks or financial institutions to rapidly develop a similar service. Time to market driven by the speed of NSD can prove to be a critical success factor for service firms, today more than in the past. Johne and Storey (1998, p. 209) describe the multi-dimensional nature of service development by the following statement:

> *"…project success or failure can rarely be explained in term of managing one or two supporting activities brilliantly. Explanations of*

> *project success are multi-factored. A host of important support activities need to be managed competently and in a balanced and well coordinated manner."*

Approaching NSD from an operational angle, Froehle et al. (2000) find that IT choices are significantly related to both the velocity and the effectiveness of NSD processes. As both development speed and effectiveness correlate to the level of success of new services in the market place, this finding provides justification for investment in IT infrastructure as part of the NSD process.

De Brentani (2001) analysed success factors in NSD with regard to the level of innovativeness of services. She presents evidence that *a) meeting customer needs and requirements*, *b) involving highly qualified expert staff*, and *c) implementation of a formally planned launch programme* are primer success factors for all types of service innovation, without particular dependency on service newness. A number of factors, however, are found to depend on the level of innovation. For incremental innovations, a strong corporate fit of new services with the existing service offering, formal stage-gate processes especially during the front-end and design stage, and avoidance of differentiation efforts, which lead to high cost structures of unnecessary levels of complexity are positively correlated to new service success. Radical service innovations, in contrast, are found to strongly benefit from a corporate culture that encourages creativity, a market need for the new service type, as well as a marketing concept tailored to the new service (De Brentani, 2001, p. 184).
In some earlier research on technological process innovation, Dewar and Dutton (1986, p. 1423) present evidence for a positive correlation between organisational complexity, defined as "*…the number of different organisational specialitie*s" and radical innovations. The finding is explained by higher depth of knowledge that is required in order to bring about innovation which can exhibit an urge for radical change within the organisation in its entirety. Also, as a higher number of organisational competencies are involved in disruptive innovations, organisations that are more effectively prepared to handle complexity e.g. through specialised technical staff resources or larger organisational size, are more likely to succeed in radical innovation.

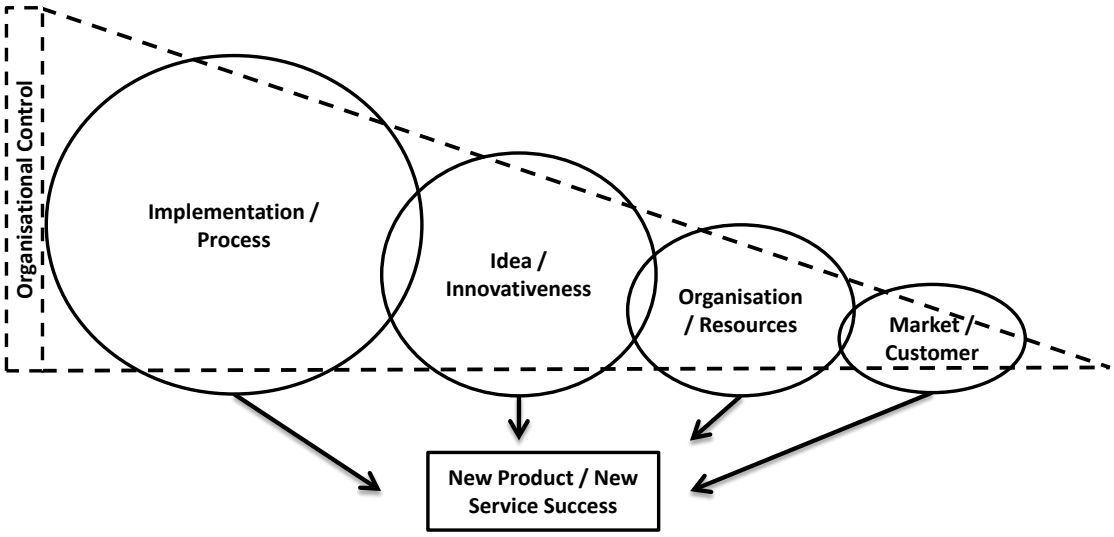


Figure 2-5: NPD/NSD Success Factor Categories

Across the NSD and NPD literature, references to success factors are widespread. A classification of factors, which includes control levels as a distinction between intrinsic and extrinsic elements however, appears useful from a both strategic and operational considerations. Figure 2-5 shows four categories of success factors, which will include the majority of success factors come by in literature. Nijssen et al. (2006) suggest that service firms, who are willing to cannibalise existing organisational routines as well as investments, are more likely to enhance their innovation potential, thereby increasingly benefitting from NSD activities.

The four categories of success factors shown in Figure 2-5 are ordered by decreasing organisational influence. The *market and customer dimension i)* is most difficult to be influenced. Hence, organisations analyse market conditions, customer preferences and requirements when planning new products and services. Readiness of market and customers can be crucial for new product and service success. Whereas lateness of introduction is commonly considered to be a common failure in terms of timing, it is also possible that the product's or service's innovativeness exceeds the receptiveness of market and customers and hence early introductions can also be associated with failure.

Organisational resources ii) are generally influenceable but in the short term can also be considered a datum in terms of organisational control. A restaurant, which has identified its location to be an issue, may consider moving to a better location. Yet, the infrastructure around the location cannot easily be changed or at short notice.

Other organisational factors, such as fit, are more susceptible and subject to strategic considerations.

The *new service or product idea iii)* is based on organisational capabilities, but also depends on an organisation's willingness, openness, and determinateness to allow and proactively pursue innovation and change.

Most relevant from an operations research point of view is the procedural *implementation of new product and service ventures iv)*. In a situation where two comparable organisations are working on a similar innovation, operational processes are major determinants of success. Organisations fully control their operations and thus implementation of a new service or process is more likely to face external constraints rather than internal resistance beyond organisational influence. High levels of organisational control put the onus on operational management and success is based on process layout and effective decision making on an operational basis. Thus, the evaluation of structural factors which have been found to contribute to NPD performance is very relevant in settings with high levels of organisational control.

The categorisation of success factors visualised in Figure 2-5 can be applied to success factors suggested by other innovation researchers. Cooper (1980, 1988, 1994a) suggests the following eight factors, which positively impact innovation performance:

- Product superiority *iii),*
- Market orientation *i),*
- Up-front decision making *iii) & iv),*
- Product definition *iv),*
- Cross-functionality and team work *iv),*
- Dedicated resources *ii) & iv),*
- Quality of execution *iv), and*
- Development process structure *iv).*

Whereas product superiority as Cooper's number one success factor is clearly related to the product idea and the level of innovativeness, the list above shows that most success factors are either fully operational in nature or have some operational component. The numbers in bracket link Cooper's (1980, 1988, 1994a) performance factors to the categories shown in Figure 2-5. Especially in a service context, most factors have an implementation and process element, over which organisations

exhibit high levels of control. Organisational control matters from an operational point of view, as decisions and process structures, taken or implemented on a practical level have a direct impact on service success. Factors over which organisations have little control can also be crucial for innovation performance, but depend more on vision and strategy than operational excellence. Further research in this area, especially linked to the development of new services, can be considered helpful in order to reach a better understanding of how to increase the success rate of organisational innovation within the remit of organisational control. Additionally, it serves a dual purpose of delivering a practical and theoretical contribution to knowledge.

2.4.4.1. Structure and Formality

New product and service innovation activities are crucial in terms of continuation and sustainability of modern firms. Whereas a superficial discussion of the topic is likely to trigger the perception of development work being idiosyncratic, un-programmable and uniquely configured, reality shows common processes, approaches and constituent patterns for both NPD and NSD (Adler et al., 1995). NSD process structure has been identified as an important success factor in the development of new services (Bowers, 1989; Cooper et al., 1994). Froehle et al. (2000) support formalisation from a speed to market view point. Especially in highly competitive market structures, development speed is an important success factor. Yet, many questions on practical implementation of effective structural approaches to NSD remain and researchers state that the level of formality in the development of new services is unusually low, especially compared to NPD.

Besides researchers supporting NSD process formality, a number scholars have aired opposing views based on their respective research findings (Martin & Horne, 1993). De Brentani (1989, p. 239) attests that numerous firms use a '*hit and miss approach*' to NSD, which is supported by Edvardsson and Haglund (1995, p. 34) who describe NSD practice, where "*…many of the more important decisions taken during the development process have been taken 'out of order'*". The argument against a planned and structured approach is related to conflicts between formalisation and creativity, the latter of which is often considered the body and soul of innovation. Yet, Edvardsson and Haglund conclude that due to the high level of complexity of the NSD process, service innovation activities benefit both from an element of formality and happenstance in order to be successful.

Whereas the list of advantages and disadvantages of structure and formality in NSD is long and the above discussion indicates that academics are in disarray over its actual impact on NSD, many views are based on studies specific to certain industries, which may not capture the full diversity of services (De Brentani, 1989).
Johnson et al. (2000) propose three categories for NSD process models: *a) Partial Models*, focussing on specific aspects of the NSD process but lacking a holistic NSD view*. b) Translational Models*, a systematic, formalised seven stage process model, adopted from a manufacturing NPD context. *c) Comprehensive Models*, looking at the entirety of the NSD process, including interactions between various activity streams, feedback loops or modification cycles (Tax & Stuart, 1997). Johne and Storey (1998, p. 201) state that it is plausible that project size or investment levels are positively related to sophisticated and formal development processes, but no empirical evidence has so far confirmed this assumption.

The discussion suggests that structure and formality are more often associated with superior NSD performance than not. Conceptual and operational difficulties to measure and compare the formality of service innovation activities may be seen as reasons for some of the controversy within the debate. Little empirical work exists relating structure and formality to other organisational aspects that are linked to complexity. In doing so, the theoretical framework of this thesis tries to establish a logic that links structure and formality as a widely accepted success factor within the NPD literature to conditions of service innovation, that reveal similar behavioural patterns and characteristics, based on inherent levels of service complexity.

2.4.4.2. Service Quality

The quality of a service and especially the quality of a newly introduced services has been identified as one of the key success factors in the service industry (De Brentani, 1995a; Easingwood & Storey, 1991). A literature stream relating to service quality (SERVQUAL) has emerged over the past three decades, specialising on all aspects of service quality, its effects on the service provider, and the relationship with the customer (Parasuraman, Zeithaml, & Berry, 1988; Zeithaml, Berry, & Parasuraman, 1996). Whereas the customer dimension is the focal point of SERVQUAL, its impact on other stakeholders of a service organisation such as employees, owners (Edvardsson & Olsson, 1996), local communities or the environment are also taken into consideration.

Poor service quality can be seen as a direct reason of service failure or bad service performance. A car repair workshop that does not deliver the expected outcome in terms of quality of repair will over time lose business, even if it was working with an innovative service model. Service performance in this context comprises several dimensions of success such as financial success, market success, attraction of new customers, and the creation of a competitive advantage. Johnston and Hewa (1997) show that costs related to fixing service failure are of direct and indirect nature. Whereas service providers have the advantage of operating at the client interface and can therefore more easily collect customer feedback information compared to producers of physical products, direct costs involved in removing service quality problems have a strong impact on the profitability of a service. Furthermore, indirect costs of losing customers and having to attract new customers create risks to the overall business model of a service firm. It is therefore important to address service quality as a priority during the NSD process, as in-build structures are more easily changed upfront than retrospectively modified, at the risk of incurring high recovery or adaptation costs.

2.4.4.3. Service Experience and Customer Involvement

The service characteristic of simultaneity places increased significance on the customer dimension. Whereas customer relationships represent vital factors in terms of achieving product success or failure, they also constitute an integral part of the service delivery process. Once a new service concept is created and ready to be executed, customers take part in the delivery process and most often consume the service simultaneously. Customer cognition creates service experiences and is one of the deciding factors for service appreciation and ultimately service success. Due to the customer being directly involved in the process, service providers have the opportunity to adept or modify the service process immediately when direct feedback is received. The higher the level of process standardisation and the less receptive the service provider, this opportunity can easily be missed.

Some research studies have only included service sectors with off-the-shelf products, which offer some level of standardisation (Easingwood, 1986), such as financial services, retail, HORECA, or transportation. Yet, other researchers argue that firms offering services that are tailored to specific customer needs, such as professional or medical services, adopt codification strategies which turn tacit knowledge into explicit knowledge (Storey & Hull, 2010). By employing this type of strategy, both

standardisation and economies of reuse are created. Standardisation in professional and medical services is vital in order to assure quality or service operations and conformance of operating procedures. The sample of organisations explored in this dissertation is therefore not restricted or limited to a particular service sector or type and tries to capture a broad range of services.

2.4.4.4. Success Measurement

Measurement of success in new service development activities reveals generic similarities to success measurement in NPD. Numerous measures exist and are applied, yet, from a practical perspective, managers need to be aware of the appropriate type of measure and also adequate measurement timing in order to ensure relevance and correctness of the delivered measurements (Veryzer, 1998). Looking at the multiple facets of service success, it becomes apparent that a single measure cannot suffice to gage its full dimensionality. In terms of the multiple dimensions of innovation success, Griffin and Page (1996) compare the measurement of success to the measurement strategy implementation. Again, several elements of implementation of strategy need to be measured in order to assess the overall degree of successfulness. Following this logic of argumentation, Griffin and Page (1996) suggest to measure success along three dimensions:

- *Customer satisfaction,*
- *Technical advantage, and*
- *Financial return.*

Although financial measures such as sales, ROI and profit margin/contribution and deduced growth ratios are the most frequently applied means of measuring NPD and NSD success (Page, 1993), they tend to have a backward focus and might not be appropriate to capture future trends and developments as well as general market movements. Non-financial measures such as market share analysis, competitor benchmarking, customer satisfaction ratings, and the assessment of technological capabilities and leadership also need to be taken into account in order to provide a holistic success measurement of an organisation.

Depending on the nature and type of innovation, the measurement level (company level, project level, or programme level) can also be taken into consideration. Some measures are located on the service-level and include technical process performance, process effectiveness (and cost), overall development cost, and time to market (Griffin & Page, 1996).

A commonly applied method of measuring success is to ask respondents to rate the overall innovation project as a success or failure and determine gradual differences via separate questions. Johne and Storey (1998) criticise this approach as not being truly scientific, as findings are not replicable and ignore controls of contextual variables such as initial NSD purpose or precise assessment criteria.

Looking at success measurement from an applied perspective, Voss (1992) finds that few organisation actively measure the success of their NSD activities. He suggests success measurement on both service and service innovation level. By measuring NSD performance with indicators such as development speed, innovation effectiveness[22], and cost-based measures, organisations can gain valuable insights into their processes and organisational factors, which influence the success rate of innovation projects. Voss further suggests benchmarking of performance indicators with competitors.

Measurement of NSD success is subject to limitations in its ability to assist organisations in increasing profitability of a given service innovation project. This statement does not refer to the realisation of learning effects which create ex-post NSD knowhow based certain development areas that turned out less profitable than expected. In such scenarios, performance measurement acts as control instrument and can lead to process improvements, thereby enhancing the overall outcome of the NSD project. The conscious effort to define measurement scales is likely to lead to an increased sensitivity regarding various dimensions of service success. As a result, discrepancies are already highlighted during the development process and corrective action can be taken. Furthermore, eventual risks can be identified before the new service is implemented, thereby helping to control overall company risk of NSD activities.

2.4.4.5. Organisational Challenges of NSD

Whereas NSD is essential for a majority of firms in the service sector in order to remain competitive and secure long-term sustainability, organisational challenges related to NSD can be considerable and need to be addressed as part of a NSD strategy. In their study of failed new service introductions, Johnston and Hewa (1997) point out that failed service introductions represent a risk to the entire service

[22] New service development effectiveness entails the rate and number of successful new service introductions of an organisation within a predefined timeframe (Voss, 1992).

organisation. Whereas a number of recovery strategies exist and can be applied to mitigate the impact of service failure, costs to a service organisation and damage of reputation and customer base still remain considerable. Cannibalisation effects within a portfolio of services are likely to be perceived as a smaller issue compared to complete service failure, yet such effects cause risks to a service organisation, if combined margins fail to recover development costs or investment in service innovation.

Competitive pressures urge firms to quickly introduce new products and services. The benefit of achieving an innovation premium or increased pricing flexibilities that result from successful innovation activities needs to be carefully weighed against risks of failed service innovation attempts. Risk assessment needs to take place at the beginning of a NSD project, but on-going monitoring and risk checks need to be conducted during all stages of a development activity.

Successful NSD activities have been found to help firms create strategic and competitive advantages. Firms can chose to innovate following intrinsic motivation such as growth or innovation strategies or react to external forces stemming from the competitive environment or changes in consumer tastes, preferences, and technology. Similarly to the development of physical products, a large number of NSD projects have been found to either fail or perform below ex-ante expectations. For this reason, the search of contextual factors and variables that enhance the chances of successful service innovation activities has been on the agenda of both academics and practitioners. Whereas theoretical findings often are not directly transferrable into practice, general theoretical concepts can serve practitioners as indicators and assist in the organisation of NSD activities in practice. Based on the theoretical background outlined in this chapter, this thesis proposes a framework that re-evaluates a number of NSD performance factors in a novel context in order to derive theoretical findings that assist service managers to handle the challenges of innovation and succeed in new service development activities.

Findings derived from a detailed review of both NSD and NPD literature provide the basis for further conceptualisation of the research idea and the development of the key theses and hypotheses of this thesis. The main objective of chapter 2 was to provide a structured overview of the theoretical background of the dissertation and introduce past research results that this study is based upon. A key take away from the literature review is that despite the body of literature on NSD being sizable, NPD

appears to be researched in more depth and with a higher degree of coherence of research results. This finding fuels the motivation behind this thesis to analyse NSD under the moderating influence of service inherent complexity and provide both an addition to NSD theory as well as practical guidance to service operations professionals. It is also important to emphasise that the lively academic debate surrounding NSD activities mirrors the economic importance of service innovation on the practical level and the on-going need for further research, which is addressed in this thesis.

3. Conceptualisation

Based on the discussion of extant research issues, the underlying theory of this dissertation is developed and presented in chapter 3. The conceptual model and research framework is based on a moderated model of established structural and organisational factors, which researchers have identified as success factors in product innovation but which were subject to mixed results in service innovation. The research framework introduces service complexity as a contingency factor upon the previously described relationship. Four factors were defined as independent variables, including *Process Formality*, *Development Culture*, *Timing Plans*, and *Project Leadership* as well two complexity constructs, namely *Organisational Complexity* and *Process Complexity*. The main objective of the section is to introduce the research hypotheses of this dissertation and provide context for their relevance and underlying logic.

3.1. Theory Development

The initial impulse and motivation for this thesis is grounded in management practice. The involvement in new product development projects in the automotive industry created a strong interest in innovation processes. Clark and Fujimoto (1991, p. 9) describe what they call the 'peculiar characteristics' of product innovation in the automobile industry as a process involving high levels of product complexity, externally complicated through changing markets. New products are subject to high expectations, both internal and external to the firm towards quality, profitability, price/cost and product performance. The subsequent study of the NPD literature confirmed a number of findings from practical experience. First and foremost, innovation is vital for corporate sustainability in today's changing market conditions characterised by competitive pressures and shortening cycle times (Gatignon et al., 2002; Martínez Sánchez & Pérez Pérez, 2003; Wheelwright & Clark, 1995). Knowledge of innovation processes can provide substantial improvement of the outcome of innovation activities. Meyer et al. (1997, p. 88) point out that "*…systematic and continuous learning about how a firm creates new products is the basis for more rapid and commercially successful product development.*"

The body of literature on NPD is vast and fairly comprehensive. Montoya-Weiss and Calantone (1994, p. 398) state that there is remarkable consistency in NPD research results, despite strong methodological and conceptual variability between studies.

The increasing importance of services, also found in the automotive sector, fuelled a curiosity to compare theoretical findings from the development of physical products with those of the development of new services. Besides the fact that NSD is researched to a much lesser extent than product innovation (Easingwood, 1986; Tatikonda & Zeithaml, 2002), two key findings regarding the service innovation literature are that the understanding of service innovation in general and underlying structures and processes in particular is considerable lower compared to NPD (Menor et al., 2002). Drejer (2004), for instance, deplores weaknesses in the theoretical foundation of new service development research. Research reveals tendencies of service managers, who often refrain from explicitly organising service innovation in favour of ad-hoc processes (De Jong & Vermeulen, 2003).

The study of services has further brought to light a tremendous diversity amongst services and service firms, which reaches from simple one-person service organisations to large multinational service firms, which thousands of employees. Familiarity with complex NPD projects in the automotive industry and comparision to the descibed process of new service emergence in the dedicated literature resulted in the key hypothesis of this thesis. This dissertation explores the assumption that a significant difference between NPD and NSD is driven by structural differences within the level of inherent complexity. Complexity hereby is seen as a multi-dimensional construct with an organisational, a process, and an environmental component. This led to the assumption that the distinguishing factor between a manufacturer and a service firm from a innovation perspective is not to be seen in the offering being of physical or intangible nature but the actual levels of complexity differing between the firms. This hypothesis does not exclude the possibility of a high correlation between the degree of complexity and the business segment/sector, but presumes that companies operating at similar levels of complexity reveal higher degrees of consistency in their innovation activities than firms classified by sector in general. With regards to factors contributing to performance found in applied innovation research, the assumptions were extended to hypothesise that the relationship between organisational factors related to superior NPD project performance and NSD performance are contingent on the degree of complexity that the organisation is exposed to. Efforts to visualise presumptions and hypotheses led to the creation of a contextual research framework.

3.2. Research Framework

In order to consolidate theoretical findings and build substantiated theory, a basic research framework was developed. The framework visualises the main hypothesis of this thesis and serves as basis for further refinement. The theoretical research framework incorporates a moderated model of success factors related to NSD process organisation. Internal service complexity is seen as a contingency factor, determining the adequate approach to NSD. The research questions addressed in this dissertation are based on the research framework depicted in Figure 3-1. The role of contextual variables relating to NSD process organisation and their effect on the success rate of new service introductions has so far not been clearly determined.

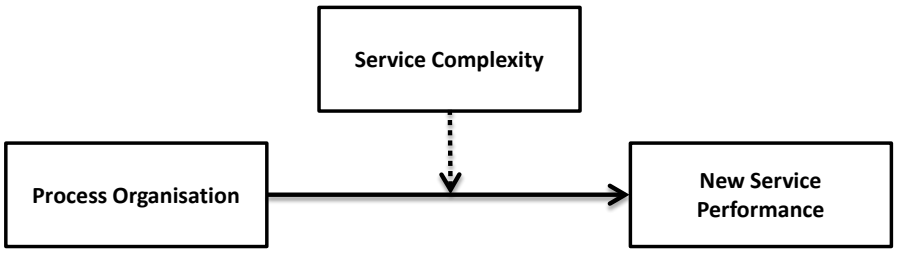


Figure 3-1: Research Framework

The research framework introduces complexity as moderating variable. The assumption of a moderating influence is based on the observation, that some services can operate within a minimal organisational shell compared to manufacturing organisations and these differences are associated with different levels of complexity. Factors supporting new service performance are assumed to exhibit different impacts on service performance, depending on the level of service complexity. The introduction of a moderating function through a third variable follows Baron and Kenny's (1986, p. 1173) definition of moderation, who state that moderating variables partition "*…a focal independent variable into subgroups that establish its domains of maximal effectiveness in regards to a given dependant variable.*" From a practical view point, the research framework establishes a classification of service organisations according to their inherent level of complexity. Accordingly, the adequate tuning of factors related to NSD process organisation under the base premise of maximising NSD performance is contingent upon service complexity. The applied research concept and methodology are based on a moderated causal relationship of contextual variables relating to process organisation performance of new service development process. Whereas the performance drivers

identified as antecedents of innovation performance are well researched within the NPD literature and to a smaller extent within the NSD literature, interaction by complexity represents a new concept. A foreseen difficulty lies within the definition and measurement of service complexity, which has been subject to considerable debate in the related literature (Clark & Jacques, 2012; Vesterby, 2008).

The extension of the framework relates to concepts which are subsumed under *Process Organisation*, *Complexity*, and *NSD Outcome*. Figure 3-2 shows the extended research framework with both first and second order constructs. Four concepts have been identified as independent variables related to *Process Organisation* based on performance determinants, identified in the innovation literature. *Service Complexity* is subdivided into organisational complexity and process complexity. *Service Performance* is defined as dependent variable, comprising financial performance, sales performance, and market performance.

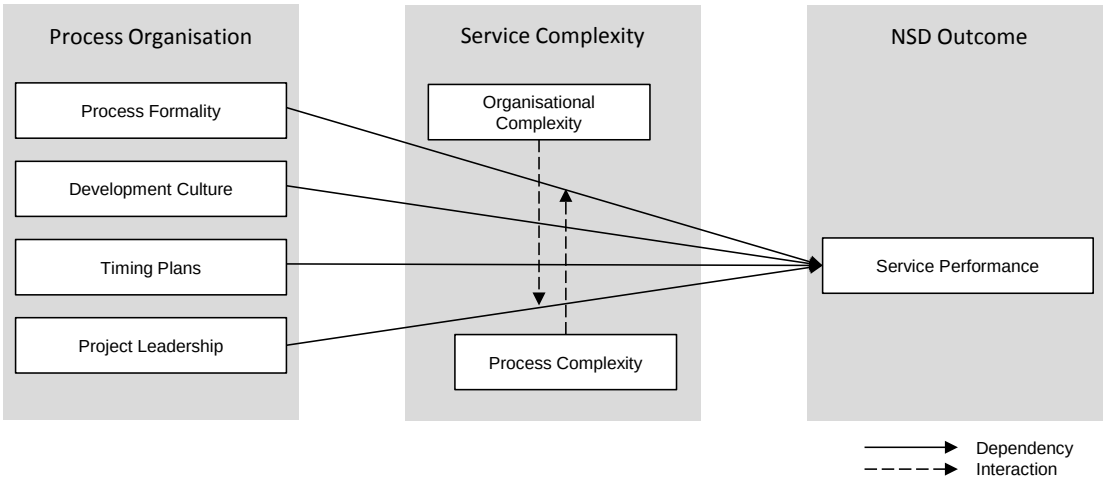


Figure 3-2: Extended Research Framework

The theoretical framework shown in Figure 3-2 was used throughout the research process and also served as basis for deriving the research hypotheses.

3.3. Research Hypotheses

New service development exerts a strategic role in multitudinous service organisations and can substantially impact long-term organisational sustainability (Froehle et al., 2000). Yet, NSD research seems to be heterogeneous in nature and research findings yield limited applicability across service sectors. NSD research findings reveal significant sectoral variations (Howells & Tether, 2004). The difficulty

of dealing with industry sectoral particularities can be seen as a reason behind the large number of service industry specific studies, which has been criticised for a lack of general validity. Whereas industry studies have generated valuable and profound insights into NSD and helped to shed light on a research field, which is often said to be under researched, one specific shortfall is the ambiguity around the applicability of findings across industry sectors. This issue was directly addressed through the hypotheses expounded in this paper. If services within a particular industry sector follow congeneric patterns but services overall are highly diverse and sector-specific findings do not apply to all service types, the existence of an independent variable driving the heterogeneity of services is conclusive and will be explored in more depth in this dissertation.

The large size and economic importance of today's service sector is related to the wide definition of the service term, comprising all sorts of value adding, non-physical activities carried out in the market place. To contrast two very different types of services, a self-employed professional cleaner equally classifies as service as a brain-surgical department of a medical institution. Following the logic of complex systems theory outlined in section 2.1.3.2, the higher number of system inherent elements or components in a clinic is associated with higher levels of complexity compared to a one-person operation. The aforementioned service examples are chosen to underline how inherent complexity levels can vary amongst services. It is furthermore assumed that complexity drives the way in which successful new services are developed. A successful approach to NSD is thus assumed to be contingent upon inherent service complexity. The practical implications of this hypothesis are vast yet complicated with regards to organisational implementation. A classification or rating of the degree of complexity that a service organisation operates at could help deliver valuable insights as to how NSD activities should be organised in order to maximise both their efficiency and effectiveness. Comparators do not necessarily have to be selected from within the same industry or sector. Organisations which operate successfully at a similar level of complexity can serve as benchmark for delivering insights into successful organisation of innovation processes, valid for both products and services.

The base hypothesis of this paper is formulated as follows:

HYPOTHESIS 0: *Complexity moderates relative service process organisation and services with high degrees of complexity are more positively associated to the determinants of NPD performance than services of low complexity*

The base hypothesis (H0) formulates the key assumption behind the basic theoretical research framework (Figure 3-1). The existence of interaction effects driven by service complexity in the relationship between some of the success factors that have been positively associated with innovation performance in NPD and NSD to some extent would provide additional insight into the NSD process and shed light on the differences of innovation in products and services. H0 assumes that an increased level of complexity leads to a stronger correlation between structural variables relating to the NSD process and new service performance. H0 would be supported by positive test results for the individual relationships tested as part of the extended theoretical framework (Figure 3-2). H0 is also linked to an examination of the relationship between products and services, as many factors contributing to performance are carried over from the NPD research literature. Scholars have found NPD to be the better researched academic field, as a number of cross-industry studies have let to results, which are broadly accepted by the research community (Montoya-Weiss & Calantone, 1994).

Whereas inherent complexity of the new product development process is also considered a relevant factor, it is assumed to have a smaller impact compared to service innovation processes. The entry level complexity amongst organisations producing physical products such as manufacturing firms is presumed to be considerably higher compared to many service firms. A possible explanation is that even relatively simple products rate on a higher complexity level than a simple service, due to longer process chains. The notion of economic importance relates to the fact that due to scale efficiencies in product manufacturing, simple products made by individuals do not have the same significance for the industry as the equivalent in the service industry. To provide an example, the production of metal bottle caps is significantly simpler than the production of an aircraft. However, on an industrial scale, the development of a new type of metal bottle caps requires coordination of concept planning, research and development activities, production planning, and sales planning. An uncoordinated ad-hoc process to NPD in both scenarios seems to be inadequate, despite obvious differences in product complexity.

The base hypothesis suggests a new synthesised view of NSD and NPD, implying that depending on the level of service complexity, both the assimilation approach and

the demarcation approach are valid given a varying degree of complexity. H1 states that the development of complex new services follows patterns similar to those in the development of new products. Support for H0 would be in line with Storey and Hull's (Storey & Hull, 2010, p. 156) postulation that a 'one size fits all approach to NSD' is inappropriate. The implied solution is that an adequate approach to NSD depends on inherent service complexity levels, with highly complex services benefitting to a stronger extent from planned and structured process organisation as found in NPD compared to simple services.

The subsequent set of hypotheses tests the relationship between the contextual variables related to the NSD process and service performance. The relationship is assumed to be contingent on two dimensions of service complexity, namely organisational complexity and process complexity. In order to assess the relevance of NPD knowledge in the service context, a number of key findings of the NPD literature will be tested in a service context. These findings include factors, which have been positively associated with NPD performance such as *Process Formality, Development Culture,* use of *Timing Plans,* and *Project Leadership.*

HYPOTHESIS 1_a *Process formality is more positively related to service performance under the moderating influence of organisational complexity*

HYPOTHESIS 1_b *Process formality is more positively related to service performance under the moderating influence process complexity*

The two variants of Hypothesis 1 (H1) assert the existence of a moderating influence of complexity on *Process Formality* as an NSD success factor. De Brentani (2001) presents evidence for the implementation of a formally planned launch program as a global success factor in NSD. The term global success factor, in this context, is associated with different degrees of innovativeness. Whereas some success factors identified show differences according to service innovativeness, formal launch planning is considered a success factor unrelated to the level of innovation. This contrasts with findings by Martin and Horne (1993) who, based on a series of in-depth interviews, find no evidence for a correlation between strategic formal process execution and NSD success rate. Whereas findings supporting process formality were often derived from a panel of organisations offering industrial services (De

Brentani, 1995b), Martin and Horne's (1993) sample consisted of managers from different service categories and hence varying levels of complexity.

Whereas *Process Formality* relates to the structure of the NSD process, Hypotheses 2 (H2) address the time dimension of service innovation, pertaining to the existence, use, and adherence to *Timing Plans.* Whereas timing plans are commonly utilized in formalized development processes, a separation of *Timing Plans* and *Process Formality* was intentionally made, as development speed has been found to be an important driver of NSD success (Froehle et al., 2000; Langerak & Hultink, 2006) and can be gaged and controlled by the use of timing plans.

HYPOTHESIS 2_a *The use of timing plans is more positively related to service performance under the moderating influence organisational complexity*

HYPOTHESIS 2_b *The use of timing plans is more positively related to service performance under the moderating influence process complexity*

Hypotheses 3 (H3) evolve around cultural factors within organisations that have been found act as determinants of NPD success. *Development Culture* includes a number of aspects that Thwaites (1992) subsumes under the term 'cultural dimension of innovation', namely management style, organisation structures, and leadership. The concept *Development Culture* has been positively associated with NSD performance and includes factors such as senior management support and involvement (Atuahene-Gima, 1996; Drew, 1995; Edgett & Jones, 1991), NSD experience (Edgett, 1996; Martin & Horne, 1993), and a corporate culture geared towards innovation (De Brentani, 2001; Johnson et al., 2000). Successful new services have been associated with experienced developments teams and expert-driven, supported, and highly involved environments (De Brentani, 1993). Edgett (1996) further presents evidence for a causal relationship between the frequency of NSD and the quality of its execution. H3 also assume interaction through complexity within the relationship of the aforementioned factors and service performance. H3 assert that through a moderating influence of service complexity *Development Culture* has a stronger impact on the NSD outcome in case of highly complex new services compared to less complex services:

HYPOTHESIS 3_a *Development culture is more positively related to service performance under the moderating influence organisational complexity*

HYPOTHESIS 3_b *Development culture is more positively related to service performance under the moderating influence process complexity*

The last set of hypotheses revolves around the way in which NSD projects are managed. As in NPD, project leaders play a key role in a large number of NSD projects. Several researchers have found support for a positive influence of *Project Leadership* in and innovation context (Cooper & Kleinschmidt, 1995; Edvardsson et al., 1995). Whereas the existence of a project leader is more common in product development, H4 assumes that the relationship is moderated through complexity in service innovation.

HYPOTHESIS 4_a *Project leadership is more positively related to service performance under the moderating influence organisational complexity*

HYPOTHESIS 4_b *Project leadership is more positively related to service performance under the moderating influence process complexity*

The key hypothesis of this thesis is that NSD process organisational factors which are positively associated with superior NPD performance can deliver significant benefits in the development of new services, if organisations reveal an appropriate level of inherent service complexity. An innovative service provider, such as a financial services firm (e.g. banks, insurance companies, financial advisory or investment firms), is likely to have a number of processes in place, that assist project managers in creating and introducing new services. It is assumed that these processes are linked service success, yet, the relationship differs between complex firms, such as large banks and less complex firms, such as a self-employed financial service advisor. Ulrich and Ellison (1999, p. 643) argue that producers of complex products focus their attention on elements yielding the greatest return and resulting focus leads to specialisation and development of specific capabilities. H0 aims to assess if this statement can be empirically supported in a service context. Whereas findings within NPD research generally document evidence of a significant positive

relationship between factors related to process organisation and new product success, findings within the NSD literature are heterogeneous and also include weak or negative evidence. The research hypotheses listed above are based on findings gained from the review of NPD and NSD literature, as reviewed in section 2.4. The scope for exploratory and explanatory research in innovation, especially in NSD research still seems vast. Explanatory models conceptualising and integrating present research findings are often called for in literature (Drejer, 2004). The service complexity model, outlined in this dissertation, is considered a next step towards an explanation of the conceptual structure and nature of new service development activities.

The hypotheses developed in this section are embedded in a conceptual research framework that was developed to address a gap in NSD research and to shed light on a number of questions which are of high practical relevance across the service sector. The main hypothesis explored in this dissertation is that service inherent complexity moderates the relationship between structural support factors of the service innovation process and service performance, measuring the degree of successfulness of the new service introduction. Four independent variables relating to *Process Formality*, use and adherence to *Timing Plans*, availability and role of a *Project Leader*, as well as *Development Culture* as a concept capturing how well an organisation is aligned to innovation activities were defined as independent variables and tested. Service complexity was split into *Organisational Complexity* and *Process Complexity*. In order to test the hypotheses, a rigorous research methodology was followed, which is outlined in the next section of this dissertation.

4. Methodology

The objective of chapter 4 is to outline the applied research methodology including the sample composition, data collection, and empirical observation. The section commences with a general overview of the research process. The empirical research process followed a sequential four step approach. The first step entails the definition of measurement items and research scales. In a second step, data collection was planned via development and piloting of a self-administered online survey questionnaire. The sample used in this thesis was defined following a multi-stage cluster sampling process. In accordance with the research objective to deliver generalizable findings from within a wider service context, efforts were made to abstain from restrictions to the sample. Thus, the research sample was both cross-sectional and multinational in nature. The last step outlines the actual data collection process. The development of measures and composition of the research questionnaire is outlined in context of the chosen research sample. The section includes a discussion of potential sources of measurement errors and mitigation put in place. Section 4.3 provides a comprehensive overview of the design of the survey questionnaire, followed by a discussion of the research sample in section 4.4 The chapter ends with a detailed description of the data collection process, the achieved response rate, and an evaluation of potential error sources related to data collection.

4.1. Research Process

The empirical part of the research process applied in this thesis follows a sequential four phase approach, as depicted in Figure 4-1. The phases are outlined in section 4.2 to 4.5 of this chapter. Building on a conceptual framework, the first step of the methodology entails development and collation of measurement items and scales. These are used in the second phase, which comprises the creation of a self-administered survey questionnaire using online survey software. In order to address measurement error and avoid other research biases, a pilot study of the questionnaire was conducted. The pilot used several methods such as a structured discussion of questionnaire items, accompanied completion of the survey and self-administered completion with a subsequent feedback discussion. The pilot survey led to a number of survey modifications and resulted in the final format of the survey questionnaire.

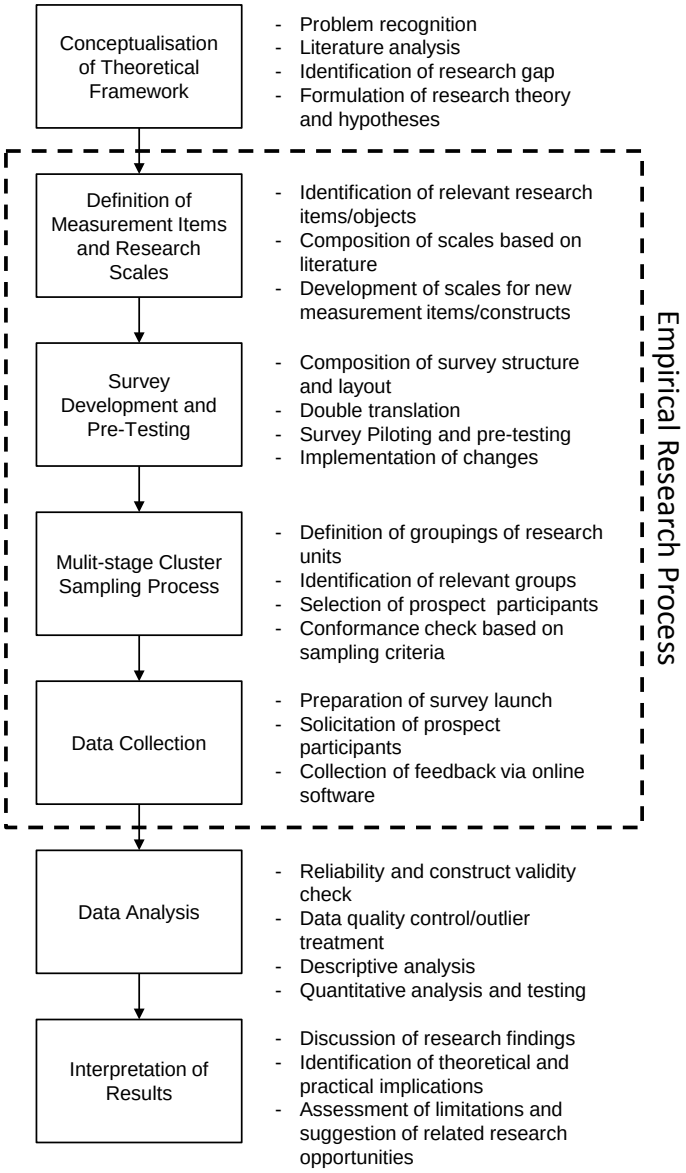


Figure 4-1: Empirical Research Process Structure

Phase three of the research process consists of the sampling process. Multi-stage cluster sampling was used to derive a sample of 2’068 new service development professionals via professional online network interest groups. Data collection took place in phase four and was carried out during an eight week period. Prospect participants were contacted via a group messaging service that saved a message in the contract’s personal inbox but also forwarded the email-based solicitation letter to the contact’s personal email account. A total of 430 respondents attempted completion of the survey questionnaire. Due to a high non-completion rate and a number of disqualified respondents, the final number of usable responses collected amounts to 208, which were evaluated during the data analysis phase.

4.1.1. Unit of Analysis

The documentation of the research process starts with a specification of the unit of observation or analysis, which is especially important in nomothetic quantitative research designs, as applied in this thesis. Technically there is a difference between the unit of analysis and the unit of observation, in that the unit of observation relates to the observed elements that deliver data to be recorded and the unit of analysis does not necessarily have to correspond to these elements. In the context of organisations, however, organisational behaviour is commonly observed amongst employees and then conferred upon the organisation as unit of analysis. The unit of analysis of this study is tied to the organisational level and refers to a concrete NSD situation and the outcome of a particular service innovation activity carried out by a service organisation. Researchers have attested an existing lack of firm level research within the study of innovation (Harmancioglu, Droge, & Calantone, 2009). Individuals were contacted based on membership in service innovation related interest groups. Prospect participant profiles were screened to assess that survey participants qualified to the study through prior experience with the development of new services. Meeting the sample requirements in terms of service experience was not only based on present roles but also included past work engagement of the individual/contact.[23] Given a large variety of personal backgrounds and employment histories, random cross-overs of organisations were possible and not specifically ruled out as part of the research process design. New service development activities encompassing new services with varying degrees of innovativeness[24] can occur frequently, especially in larger organisations. The likelihood of collecting NSD examples of the same organisation from several participants, thereby changing the unit of analysis to the project level, was considered moderate to low. A sample restriction based on the full employment background of individuals, in contrast, would have resulted in a significant limitation of both the number of prospect candidates and NSD examples. For the same reason, the study desisted from including an instruction in the survey to only select a NSD example from the most recent employer. In order to stick to the organisation as unit of analysis, some selection efforts were made. If individuals with only one visible employer were found, similar cases including the same employer were subsequently excluded from sample. In summary, inclusion of multiple members within one organisation was tried to be

[23] See section 4.4.1 for more detail on sample definition and criteria.
[24] See section 2.3.1.2 for a more detailed discussion of the level of innovativeness.

avoided, yet the possibility was not entirely ruled out for individuals with longer employment histories.

Due to the fact that the unit of analysis is the organisation, lower stipulations regarding a required sample size exist. Nevertheless, without further restriction the population of all service organisations would be overwhelmingly large. Therefore, the sampling mechanism via a professional networking platform was utilised, allowing the definition of an adequate and independent sample based on the pre-defined unit of analysis.

4.1.2. Sequence

The methodology applied in this research thesis followed a constructive sequence, as commonly applied in innovation research studies (Easingwood, 1986; Storey & Hughes, 2013; Thwaites, 1992; Tsai, 2009). Given the predominantly deductive research approach followed in this dissertation, exploratory groundwork such as inductive research via case studies (Brown & Eisenhardt, 1997) or qualitative data gathering via multiple interview rounds (Froehle & Roth, 2007) was not conducted.

Exhibit 4-1: Sequence of Research Methodology

Research Phases and Process Steps	
Phase I	Background research
	- Literature review
	- Identification of research gap
Phase II	Theory building
	- Creation of conceptual framework
	- Definition of research hypotheses
Phase III	Survey design
	- Survey composition and design
	- Pilot study and pre-testing
	- Survey finalisation
Phase IV	Data Collection
	- Online survey distributed to network group members with NSD affiliation
	- Cross-sectional and multinational sample
	- Response rate 10%
Phase V	Data Analysis
	- Exploratory factor analysis
	- Confirmatory factor analysis
	- Moderated structural equation modelling (MSEM)
	- Test of research hypotheses
Phase VI	Interpretation and discussion of Results
	- Suggestions for future research

Theory development and literature review took the form of an iterative process and were carried out over a longer period of intense service innovation studies. They are therefore not considered to be part of the empirical research process. The full sequence of steps applied as part of the research methodology is outlined in Exhibit 4-1. Steps outlined as part of the empirical research in section 4.1 relate to Phase III (Survey Design) and Phase IV (Data Collection). Measurement unit development, survey composition, and pre-testing have been aggregated into a survey design phase. Data analysis and evaluation are added as two additional phases, consecutive to the empirical part of the research.

A clearly outlined research structure supports the entire research process and provides stability. Yet, due to on-going and intensive engagement with the subject matter, learning and new insights take place continuously and enrich the research process and impact research outcomes in general. This, however, also means that feedback loops and iterations take place and a targeted sequential process cannot be pursued at all times. Diversions from the planned process were at times considered necessary in order to avoid limitations to the creative evolvement of the research and facilitate learning effects. Yet, recourse to the outlined structure was immediately sought after a diversion in order to maintain stability and focus.

4.1.3. Quantitative Analysis Technique

Structural equation modelling (SEM) as a multivariate research technique has enormously grown in popularity amongst social scientists over the past three decades. It has been described as the 'technique of choice' of researchers across disciplines and a 'must' for social scientists (Hooper, Coughlan, & Mullen, 2008). SEM was chosen as the main multivariate research technique for analysing the theoretical structural model derived from the conceptual research framework. In order to establish a robust measurement model, this thesis combines SEM with exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), both of which were performed prior to analysing structural models using SEM. The software used for the analysis is IBM SPSS Statistics 20 and IBM SPSS Amos 20.[25]

[25] Both SPSS and Amos are statistical software, which were acquired by and are today part of IBM. The acronym SPSS stands for Statistical Package for the Social Sciences, and AMOS is short for Analysis of Moment Structures.

Kenny and Judd (1984, p. 201) describe estimation of latent variables in structural models as "…*a synthesis of factor analysis and multiple regression, with both estimation procedures conducted simultaneously*." The main reason for choosing SEM over other multivariate analysis techniques such as linear regression analysis is the fact that SEM can jointly explore the relationships of predictor variables on an endogenous variable. Whereas multivariate regression analysis can also evaluate the effect of several independent variables including moderator variables on a dependent variable, it does so by only looking at a single relationship at a time (Hair et al., 2009). These techniques are commonly referred to as first generation regression models. First generation multivariate analysis techniques are regression based approaches such as linear regression, discriminant analysis, canonical analysis as well as several analysis of variance techniques. Fornell (1987) describes that second generation models can also be used for first generation-type analysis, yet, they are marked by a more flexible interplay between theory and data analysis and require explicit knowledge about underlying theory. SEM as a second generation analysis tool allows the measurement of latent constructs via factors derived from a measurement model of hybrid structural models.

Haenlein and Kaplan (2004) see SEM as a more powerful extension of linear models, which can overcome three main limitations. First, SEM can handle more complex structures than regression-based approaches. Hair et al. (2009) state that this is particularly useful in scenarios where a dependent variable becomes an independent variable in a subsequent relationship. With regard to the general complexity that has to be processed in social sciences, some researchers argue that it would be artificial and inconsequential to study the effort of two variables in isolation (Jacoby, 1978). Second, SEM allows that constructs are specifically developed based on individual observations and integrated into a model rather than assumed to be directly measurable. Whereas the development of constructs or latent variables is also possible in first generation analysis techniques by using factor scores or summated scales, the latent variables are then treated in the same way as observed variables. The third advantage relates to the conjecture of measurement error. Whereas first generation models assume that variables are measured without error, measurement errors are explicitly considered in SEM, which enhances their general applicability in varied research contexts. As first generation models can be highly susceptible to measurement error, SEM based approaches have an advantage in terms of robustness of research findings.

SEM is increasingly used in empirical analysis of complex relationships in social sciences. The integration of latent constructs of the measurement model into a hybrid structural model has the advantage that measurement errors become an integral part of the model (Geffen & Straub, 2000). Furthermore, confirmatory factor analysis can be conducted within the same model that is used for hypothesis testing. The methodological advantages of SEM in modelling complex multivariate relationships including several dependency relationships and integrated measurement error combined with a general attractiveness of the graphical modelling interface create a strong argument for its use as quantitative technique in this study. As first and second order multivariate tools are closely interlinked, EFA as an initial step to consolidate variables observed in the survey questionnaire is considered a good approach to establish a robust measurement model, which serves as basis for further exploration using SEM.

4.2. Measures

Once a theory is developed, the starting point for empirical analysis work logically revolves around the identification and definition of measurement items. As part of the theory development phase, established concepts for NSD process factors have been screened and compared to validated concepts from the area of NPD research. These factors were put in context of service performance and service success in order to assess the existence and strength of relationships. In this context, an attempt was made to use established and validated measures and scales wherever possible and only refers to the development or modification of measures where established and proven measures were either unavailable or inadequately suitable in the chosen context of the research design.

4.2.1. Research Variables and Constructs

It is common place in scientific research that observed variables and constructs are closely interlinked. As outlined by DeVellis (2003), researchers are primarily interested in constructs rather than variables or research scales. Constructs are abstract concepts that help researchers to explain reality by creating and testing theories. As an abstract concept, assessment and measurement requires several variables that combined can capture the full extent of the construct. A felicitous illustration of the issue is made by Jacoby (1978, p. 93), who points out that he would not feel comfortable with an assessment of intelligence based on a single question. It

is therefore important to have a good selection of variables in place that entail sufficient power to describe a construct based on multiple facets thereof. DeVellis (2003) points out that a construct cannot be assessed directly. Referring back to the previous example, if a group of people were asked to rate their intelligence on a scale from one to five, answers would be generated but most certainly fail to reliably measure intelligence amongst group members and draw conclusions from it. Hence, variables should leave as little room as possible for personal interpretation and judgement. Subsequent to their measurement, all research variables are combined and condensed to a latent variable, which is the actual measurement item of the construct.

It is important that the construct is clearly defined prior to its actual measurement and assessment. If one was to link intelligence to success, the measurement concept would be flawed. Whereas it is likely that there is a positive relationship between intelligence and success, it cannot be concluded that successful people are intelligent or intelligent people are successful. The construct of intelligence can be related to abilities like logic, problem solving or abstraction but not success. In an ensuing step, sufficient variables need to be generated in order to sufficiently explain the construct.

Besides a clear definition of the construct to be measured, a key element of rigorous research is that variables used to define construct actually measure what they are intended to measure. Churchill (1979) states that research variables need to satisfy the standard measurement criteria of validity, reliability, and sensitivity in order to achieve quality research. Without meeting this premise even statistically significant research results are meaningless.

With one exception, the constructs that are used in the theoretical framework of this thesis are well established and validated. Both dependent and independent variables are based on these constructs, which mainly originate from NPD research, but have also been tested in a service context. Organisational complexity, as a moderating variable of the relationship between structural NSD success factors and new service performance is a partially new construct. Efforts have been made to understand how the topic of complexity in an organisational context has been approached in prior studies and make use of suggested concepts for measurement scales.

Numerous researchers have addressed the question of what makes one new service more successful than another. Service success is a key construct used in this thesis and defined as dependent variable. Success can have several dimensions (e.g.

financial, sales, or market) but the correlation between variables relating to success is generally high. The question about the 'what' relates to criteria that contribute to success. These are the independent variables of this thesis. Whereas service innovation researchers have suggested a large number of performance drivers or antecedents of success, suffering from a lack of consistency and general consent, the theoretical framework has only taken a few constructs which are positively associated with the organisation of successful NPD processes. The reason for taking a limited selection of performance constructs is twofold. First, structural factors have been positively tested in terms of a correlation with performance in NPD research. The same factors have delivered mixed findings in a service context. In order to test the research hypotheses, namely the relationship being contingent upon the level of organisational complexity, constructs have been chosen which exist in both research streams. Second, the constructs that are part of the conceptual framework are structural factors which relate to the organisational environment and the way in which new service development is organised. Factors outside this scope can be highly relevant for new service performance, but need to be evaluated in a different context.

4.2.1.1. Dependent Variable

Dependent variables are seen as predictable, as their behaviour is tied to states of other, independent variables. The outcome and performance of the NPD and NSD process is commonly used as dependant variable in innovation research studies (Atuahene-Gima, 1995; Griffin & Page, 1993, 1996). The approach to service performance measurement adopted in this thesis follows a method suggested by Cooper et al. (1994), which has been applied and validated by several other researchers (Avlonitis et al., 2001; Song, Song, & Di Benedetto, 2009; Song & Parry, 1997). Fourteen variables were measured and analysed through factor analysis. The concept measures performance on a bi-polar Likert-type scale relative to objective, anticipation or comparator projects. Service performance is defined by using three performance dimensions, *i) Financial Performance*, *ii) Sales Performance*, and *iii) Market Performance*. As a multidimensional measure, service performance as a dependent variable is linked to financial profitability, market performance, and success on the customer level. The aforementioned variables are aggregated to a single performance construct, measuring relative NSD success. Variables were all measured in terms of performance relative to ex-ante objectives and expectations of the service firm regarding the outcome of the new service development process. Whereas Johne and Storey (1998) criticize a number of success measures for

lacking reliability and ignoring contextual variables, the fact that the suggested scales have repeatedly delivered consistent findings with regards to service performance mitigates the criticism of non-repeatability of measures.

Table 4-1 shows measurement items which have been aggregated into service success, as dependant variable. *Financial Performance i)* is linked to revenue and profitability and can be seen as the most commonly used measure of service performance. *Sales Performance ii)* is measured through a combination of relative sales and relative attraction of new customers. Finally, *Market Performance iii)* is composed of the relative market share attained by the new service as well as a relative competitive advantage achieved. This measure also attempts to capture qualitative success factors that cannot be expressed in financial terms such as technological advantage or enhanced innovative capabilities.

Table 4-1: Service Performance and Success Measures

Construct	***Sub-dimension***	***Measure***	***Scale***
Service Performance	Financial Performance	Revenue	Relative revenue performance
		Profitability	Relative profitability performance
	Sales Performance	Sales	Relative sales performance
		New customers	Relative new customer attraction
	Market Performance	Market share	Relative market share development
		Competitive Advantage	Relative competitive advantage

All performance dimensions are highly correlated but capture distinct elements of a wider definition of service success. Measurement of innovation performance has received vast amounts of attention in both NPD and NSD. Brown and Eisenhardt (1995) have investigated innovation activities under the premise of a rational plan behind efforts of maximising performance, assuming a direct relationship behind rational planning, execution and innovation performance. The performance outcome is measured quantitatively using revenues, profitability or market share. The

comparison of success measures across NSD and NPD, in general, reveals a large degree of homogeneity. Further examples of NPD and NSD success measurement include De Brentani (2001) and Capon et al. (1990), both defining innovation success as dependent variable of their research.

4.2.1.2. Independent Variables

Independent variables in this thesis are defined as structural variables within the development process. These variables are commonly described as NSD success factors or antecedents of service performance. As previously outlined, NPD research has a longer history and provided rich grounds for adaptation of theories in a service context. The predefined independent variables were divided into four main constructs consisting of twelve underlying variables, based on findings identified through the literature. The first area relates to Process Formality of the development project. It includes the following components:

Process Formality

a) Planning
b) Structure
c) Phases
d) Formality

The second construct covers aspects that are linked to the utilisation of timing plans:

Timing Plans

e) Use of Timing Plans
f) Adherence to Timing Plans

The construct relating to project leadership is explained through the existence and the number of project leaders within one single development project:

Project Leadership

g) Availability of a Project Leader
h) Number of Project Leaders

Cooper and Kleinschmidt (1987) have analysed senior management support in NPD and distinguished between commitment, involvement and guidance/direction on the project level. The last construct comprises elements that relate to the organisational context in which new service development takes place. Besides measures relating to

senior management support, NSD experience and an organisational culture focussed on innovation is included:

Development Culture

i) Senior Management Support
j) Senior Management Involvement
k) NSD Frequency and Experience
l) Innovation Culture

Montoya-Weiss and Calantone (1994) consider resource factors equivalent to the compatibility of a firm's resource base with project innate requirements. An organisation that has sufficient resources dedicated to NSD can be considered to reach a high score within the *Development Culture* measurement construct.

Independent variables were measured in groups relating to the respective construct. The survey questionnaire contained 44 measurement items, some of which were negatively worded and subsequently re-coded. shows the measurement constructs and related research scales.

Table 4-2: Overview of Service Performance Driver Constructs

Construct	*Sub-dimension*	*Measure*	*Scale*
Process Formality	Planning	Thorough Process Planning	Agreement with statement
	Structure	Develpment Process Structure (neg)	Agreement with statement (re-coded)
	Phases	Formal Development Phases	Agreement with statement
	Formality	Formal Development Process (neg)	Agreement with statement
Timing Plans	Use of Timing Plans	Use of a NSD Timing Plan	Agreement with statement
	Adherence to Timing Plans	Timing Plan Adherence	Agreement with statement
Project Leadership	Availability of a Project Leader	Project Leader (neg)	Agreement with statement (re-coded)
	Number of Project Leaders	Multiple Project Leaders (neg)	Agreement with statement (re-coded)
Development Culture	Senior Management Support	Senior Management Support	Agreement with statement
	Senior Management Involvement	Active Senior Management	Agreement with statement
	NSD Frequency	NSD experience within the	Agreement with statement
	Innovation Culture	Company culture geared towards innovation	Agreement with statement

It should be emphasised that not all measures included are solely associated with positive research evidence in a service context. For some variables researchers attest weak or inexistent evidence as success factors. Martin and Horne (1993), for

instance, report results showing no evidence for a correlation between strategic planning or formal process execution and the success rate of NSD projects. Inclusion of such factors within the framework of this dissertation is based on two premises. First, research variables are meant to be assessed in a different context following the general assumptions included in the conceptual framework. Whereas research findings can differ depending on the research sample consisting of restricted sub-populations within the service sector or national samples, the test of moderating influences of service complexity is a new concept that is worth exploring for a large array of success factors. Second, variables included in the questionnaire are analysed and evaluated based on their respective factor loadings onto constructs as part of the confirmatory factor analysis. Therefore, natural factor reduction process is assumed to take place as part of the evaluation.

4.2.1.1. Moderating Variables

Service complexity is defined as moderating variable of the relationship between NSD performance factors and service success. Whereas this thesis was able to make use of validated scales for all other research variables, complexity as a measurement item is not a well-established concept and adequate measurement scales needed to be developed. A number of research projects have used concepts related to complexity (Chae, 2012; Danaher & Mattsson, 1996; Li et al., 2005; Stacey, 1995), yet, the scales used are not sufficiently encompassing in order to match the research agenda of this thesis.

Danaher and Mattsson (1996) have attempted to measure the complexity of different service delivery processes. In a simplistic model, the authors attribute complexity to:

a) Overall time-based duration of the service delivery process, and

b) Total number of sub-processes, as seen from a customer perspective.

Both measures are solely related to the service process. Therefore, they do not capture any wider aspects of complexity and can be considered insufficiently encompassing in order to measure complexity with as a multi-dimensional construct. Two complexity constructs have been developed in this thesis, based on established complexity concepts in the organisational literature (Kostova & Zaheer, 1999). *Organisational complexity* is driven by firm size (e.g. number of employees and countries, the organisation operates in), and organisational structure (e.g. number of hierarchy levels, level of centralisation, infrastructure). Blindenbach-Driessen and van den Ende (2006) point out that organisational context such as structure and capabilities is an important factor affecting service projects. Damanpour (1996)

confirms that as organisations grow in size, structural complexity increases. *Process complexity* is inherent to the service process. Thus it is driven by process length, interfaces, and interaction between service agents. Baldwin and Clark (1997) suggest process decomposition through modularity as an approach to organize complex processes. Suggested measurement coefficients include interfaces and a degree of coupling (Mikkola, 2006), whereby increased process length increases the likelihood of system element interaction. Whereas it is possible to define complexity constructs by making references to literature, a consolidated complexity construct turned out to be beyond the scope of this research. Attempts of measuring complexity holistically have been criticised of not being encompassing enough or failing to reflect the multi-dimensionality of complexity. Breaking out facets of complexity with stronger foundations regarding operational measurability was therefore considered an effective alternative.

4.2.1.2. Control Variables

In social research, control variables serve the dual purpose of reducing error terms in order to increase statistical significance and limiting the scope of additional explanatory relationships, which addresses internal validity issues (Schmitt & Klimoski, 1991). In this thesis, two types of control variables have been utilised. The first control is included in the research design and relates to the existence of relevant new service development experience. NSD experience is considered a key requirement for survey participants, as it unites to both the ability to assess service performance and describe structural conditions of the development process that are critical for analysis purposes. By selecting a cluster of professionals with interest in service innovation and screening experience and background of individuals to determine the potential for relevant NSD experience, the research design specifically controlled for service innovation experience. Additionally, the first question of the survey asked participants for their experience with service innovation programmes and included a disqualifying logic, filtering out individuals without service development experience.[26] Hence, NSD experience was controlled for as part of the research design of this study and served as a checking mechanism to assure adherence to sampling criteria.

The second type of control variables relates to measured variables that are treated differently to other observed variables as part of the primary analysis. Becker (2005,

[26] There were 30 individuals who attempted to complete the survey but were ruled out via the disqualifying logic used to control for NSD experience.

p. 275) states that applying such a control process "*…mathematically partials the effect […] from the other variables included in the analysis*". This can be used to test and rule out alternative explanations. Three control variables of this type were defined in this thesis. The first control variable is the degree of innovativeness. Research studies have addressed the degree of innovativeness both as success factor (Kleinschmidt & Cooper, 1991) and moderator, influencing the relationship between antecedents of service success and NSD performance (De Brentani, 2001; Langerak & Hultink, 2006). Kleinschmidt and Cooper (1991) report a U-shaped relationship between innovativeness and new service success, signifying that both highly innovative new services and new services with a low degree of innovativeness outperform services with medium levels of innovation. De Brentani (2001) shows that the degree of innovativeness moderates the relationship between service success factors and new service performance. Whereas highly innovative services mainly benefit from high degrees of corporate culture, incremental innovations benefit from installing formal stage-gate processes and leveraging of a firm's unique competencies.

Oke's (2007) research results of innovation management practices in service organisations suggest that the degree of innovativeness influences the managerial approach to NSD. According to his findings, radical innovations use a more formal development process than incremental innovations, as management attention is focussed more intensely on the former than the latter. The implication for this research is that in order to not incorporate a bias resulting from the innovation type, provisions allowing for control of innovativeness need to be included. The degree of innovativeness expresses how '*new*' a service is, both to the organisation introducing it and to the market. It can be argued that true innovation is difficult to plan and operationalize and hence the majority of new services have a medium to low degree of innovation. This logic, however, also implies that innovativeness is likely to impact NSD processes in some way and could therefore interfere with other causal relationships. Hence, the degree of innovativeness has also been defined as control variable in this research. A dummy variable was created based on individual judgement of newness of the service developed. Thereby, radical innovations (new to the world service) were coded '1' and innovations of a lower degree '0'. The reason for introducing a dummy variable instead of using the more refined measure obtained from the survey questionnaire was related to difficulties of obtaining objective assessment of innovativeness (Damanpour, 1996).

The second control variable measured in the research design is service experience. Organisations with an innovation culture and high levels of experience in introducing new services are likely to apply processes that differ from those used by firms developing a new service for the first time. Following the method applied by Damanpour (1996), a further dummy variable was created. Companies with two or more new service development projects were coded ‘1’ and companies with only one service innovation ‘0’.

The third control variable identified in this research is related to development facilities. Organisations where NSD is a regular activity are likely to have dedicated facilities and staff for planning and developing of new services. The research questionnaire included a question on dedicated development facilities. A binary categorical variable was used to control for the effect of organisational development capabilities, measured through the existence of dedicated service development facilities.

Control variables can fulfil a vital role within a research concept. An important requirement for a causal relationship between dependent and independent variable is a non-spurious relationship. This relates to a state in which the observed effect is not caused through the existence of a third common variable (Babbie, 2010). Hence, control variables are included in the research design in order to exclude the impact of spurious relationships between variables.

4.2.2. Research Scales

The ability to consolidate NSD research results is limited through substantial variability in findings across research studies. Yet, the factors analysed by service innovation scholars reveal a degree of conformity and interrelation. For this reason, measures and scales used in this thesis have to a large extent been adapted from a combination of established SI and NPD constructs.

The methodological approach to the development of research scales strongly followed widely applied practice in related research literature. Wherever possible, extant scales were used. The definition of complexity as a construct used in this research further required the extension of existing scales and definition of new scales and measurement items. Besides studying established approaches in literature, expert opinions and information received during face to face interviews was considered. The approach further followed the guidance on the development of research scales by Bearden, Netemeyer, and Mobley (1993).

Scores for independent variable measures were derived by using bi-polar five point Likert-type scales. Reverse coding was applied on some statements in order to check reliability of answers. Babbie (2010) stresses the advantages of Likert-type scales, which can easily be constructed, have intuitive appeal, provide a high degree of adaptability, and generally are associated with good reliability.
Validation of measurement scales was done following an approach outlined by Song et al. (2009). After the development and refinement of measurements and scales, instrument pre-testing as part of a pilot study resulted in further adjustments. Research scales were then validated by using factor analysis (Gerbing & Anderson, 1988).

Complexity as a research construct is considered a multidimensional domain. The dimensions of the research scale need to reflect hypothesised dimensionality of the construct (Bearden et al., 1993, p. 4). Whereas some researchers have attempted to empirically measure complexity in the literature, research scales used for complexity measurement in this thesis are only partly based on existing scales and include additional elements which were not previously validated.

4.2.3. Complexity Measurement

Since the beginning of complex systems research in the 1980s, scientists have strived to find ways of measuring complexity and comparing complexity across systems. Wolfram (2002) argues that complexity is located between order and randomness and despite common assumptions, it is possible to build models, based on simple underlying rules, that can give insight into complex behaviours. In order to derive a measurement scale for a service organisation's inherent level of complexity, a multiple factor rating scheme is proposed. The assessment is based on a number of organisational factors, entailing detailed information on the respective organisational structure, the type and nature of service processes and non-organisational/external factors. Table 4-3 shows the breakdown of the two investigated complexity constructs into five sub-dimensions and related measurement units.

Table 4-3: Service Complexity Dimensions and Measurements

Construct	*Sub-dimension*	*Measure*	*Scale*
Organisational Complexity	Size	Number of employees	Total number of employees
	Multinationality	International presence	Total number of countries with organisational presence
	Structure	Hierarchy levels	Number of hierarchy levels
Process Complexity	Process	Process components (sub-processes)	Number of process components (sub-processes)
	Interfaces	Functional units / departments involved in the process	Number of functional units / departments involved in the process

This thesis argues that the assessment of an organisation's inherent degree of service complexity is an important step towards understanding how innovation on the organisational level takes place. Furthermore, the research hypotheses put forward assume that the approach to successful NSD activities directly correlated to the degree of service complexity within an organisation.

4.2.4. Measurement Error

Measurement error arises as a result of issues surrounding the measurement concept and specifies the difference between the true value of the measurement and measured value (Couper, 2000). Reasons for measurement error are often related to the way in which answers are recorded. If data collection is based on interviews, it is possible that the researcher incorrectly records an answer by misinterpreting the response of the interviewee. This type of error is basically ruled out in a web-based survey questionnaire. Answers are directly entered into a system and professional survey software tools such as the one used for the data collection of this thesis are tested with regard to reliability of recording responses.

Another source of measurement error is correct recording of an incorrect answer. Reasons for this type of error can be found on the side of the respondent, who deliberately or unconsciously provides an incorrect answer. Deliberate distortion of responses is due to demotivation or conscious efforts to provide falsified answers. Given the length of the questionnaire and an average response time of over 18 minutes, it can be assumed that the likelihood of such error taking place is low. In both cases, efforts required to complete the questionnaire are high and would most likely result in a demotivated respondent terminating the survey prior to completion. This is reflected in the high non-completion rate of 8.8%. Furthermore, checks of internal consistency of responses were done and did not deliver an indication for

malicious intent. The internal consistency check does not completely rule out the chance of intentional erroneous answers, as it is possible that an individual would purposely chose an answer pattern that does not reflect the true value. As participants were not urged to provide responses by sending multiple reminders, no conclusive reason for this type motivation was identified and its likelihood is therefore assumed to be negligible.

A higher risk of measurement error originates from unconsciously provided incorrect answers. This can relate to comprehension difficulties, misunderstandings, or design problems such as poor wording of questions (Dillman, 2007). This type of error is important when surveys are executed in self-administered designs and respondents have no opportunity to ask for clarification. This issue was addressed by running a pilot of the questionnaire (see section 4.3.3), during which the questionnaire was completed in the presence of the researcher and respondents were prompted to flag issues regarding wording, comprehension, or unclear interpretability. A number of changes were made to the format and wording of questions in order to prevent measurement error.

4.3. Survey Questionnaire

A self-administered survey questionnaire was chosen as the best suited data collection method. After identifying the research sample, a web-based survey format was selected which included direct contacting of prospect respondents via group message and email. The questionnaire consisted of a total of 29 questions, some of which had multiple answers or options. All statements included in the questionnaire were listed in random order. Furthermore, the questionnaire did not explicitly provide construct names or variables. Neither did it reveal research hypotheses.

4.3.1. Questionnaire Design

The survey questionnaire was initially composed paper-based and included listings of questions by topic. After completion of the full set of questions, the survey was replicated on the SurveyGizmo platform, which offers advanced online survey software. The design of the survey followed suggestions by Dillman (2007) and Brace (2004) regarding design and structure.

In a paper comparing service and manufacturing R&D, Miles (2007) argues that R&D activities in service firms are often not recognised as such. This issue relates to both

service managers and service researchers. Service development can take place outside of conventional R&D departments, which either creates additional reasoning for the lack of formal recognition or, on the contrary, is driven by it. Miles (2007) creates a case for systematic bias in NSD research, which should be considered in the research design stage. It is therefore important that the research design includes a very broad definition of service development activities and informs survey participants of the widely defined scope in order to not create a case for tacit underlying restrictions to service development activities.

4.3.1.1. Layout

The questionnaire layout as part of the technical design realisation of the survey is considered essential metadata of the instrument design (Harkness et al., 2010, p. 51). As such, it is important to capture aspects relating to the target group as part of the survey design in order to increase its effectiveness. These aspects can be of cultural or technical nature and affect the survey result and its quality.

The SurveyGizmo survey tool offers a variety of layout features, which are described in detail in survey literature. A clear and appealing design results in an improved acceptance of the survey (Brace, 2004) and lower dropout quota (Deutskens et al., 2004). The welcome screen included the Durham University logo in order to demonstrate the affiliation of the research with the university and the academic background of the study. Furthermore, a clear and mandatory response path that disallows switching between survey sections helps the respondent to follow the logical flow of the questionnaire. The online format is helpful in this respect, as switching between sections is disabled. Dillman (2007) outlines the benefits of a respondent-friendly design. This advice was followed by attempting to keep the page length short and avoid scrolling. Additionally, a progress bar at the bottom of the page is a feature of the survey software which positively impacts the respondents' determination to work through the complete questionnaire.

Systems related aspects were also considered. Questionnaire functionality and layout were tested on both personal and tablet computer in order to guarantee a wide choice of access media.

4.3.1.2. Length

The survey length is considered critical in terms of the drop-out and incompletion rates. Prospect participants who have shown interest in the survey and started the

web browser to access the forms can easily be put off from completing the survey or lose interest if the survey length is considered excessive. Response burden is commonly defined as the effort required for completing a questionnaire (Rolstad, Adler, & Ryden, 2011). It increases with survey length, impacting completion rates and response quality. Whereas it is recommended to keep a survey short, a trade-off between maximising response rate/quality and including a larger number of relevant items in the questionnaire exists and needs to be balanced by the researcher. For online surveys, required response time exceeding 20 minutes is often seen as critical, especially in case of voluntary participation (Hugick & Best, 2008)

After the initial draft of the survey, all questions were critically evaluated with the objective of avoiding unnecessary repetition. Five questions were subsequently deleted resulting in a total of 29 survey questions. Four pilot participants, who completed the survey in the absence of the researcher, were asked to time the completion time. The reported time varied between fifteen and twenty minutes, which confirmed the researcher's expectations. In order to manage upfront participant expectation, a required response time between 15-20 minutes was mentioned in the survey invitation. The actual average response time of 212 participants was 18 minutes and 45 seconds and therefore within expected time frame. From a total of 217 completed questionnaires, the response time of five participants was deleted when calculating the average as the total length exceeded four hours. The survey did not include a time-out functionality. The required time for completion is provided by the survey tool and calculated as the total time elapsed from opening a session until submission of the completed survey. As participants could have kept the browser window open without actually working on the survey, response time above four hours were treated as outliers. All responses below ten minutes were checked for internal consistency in order to assess if participants had randomly answered the survey, which did not turn out to be the case.

4.3.1.3. Question Types

The final survey questionnaire was conducted in a self-administered online format and contained a total of 29 questions. The number of questions is not reflective of number of measurement items, as several interval scale items were included within one question. As the instruction and chosen anchors remained constant, up to ten variables were included within one question. Hence, the total number of variables that was derived from the survey far exceeded the number of questions.

Despite the attempt to only address respondents with NSD experience, it was chosen to implement a conditional question at the beginning of the survey in order to prevent disqualified responses.[27] Thus, the opening question included a disqualifying logic that would end the questionnaire and direct the respondent to a screen with a message explaining the exclusion criteria and thanking them for their willingness to participate. Table 4-4 shows all question types used in the survey and the number of variables derived from the questions.

Table 4-4: Survey Question Types

Question Type	Variable Type	Number of Questions	Number of Variables
5-Point Likert Scale	Continuous (Interval)	16	62
Numeric Response	Continuous (Ratio)	7	18
Multiple Choice	Categorical (Binary)	3	20
Dichotomous	Categorical (Binary)	2	2
Cascading Dropdown	Categorical (Nominal)	1	2
Total		29	104

The majority of questions (16 of 29) utilised a bi-polar five point Likert-type scale with a ‘not applicable’ option and commonly used anchors (‘strongly agree’ to ‘strongly disagree’). A total of 62 measurement items was generated via this question type.

Seven questions asked the respondent for numeric information. These questions were mainly used to generate data on NSD frequency, organisational size, process steps, and employees involved in the service delivery.

In addition, three multiple choice questions provided a pre-defined list of answers as well as comment box for an additional individual answer. This option was implemented in order to understand if important possible answers were omitted from the list. Whereas the use of such data is critical, as even answers that were repeatedly mentioned could not be treated as a separate variable, answers which added to a summated list were considered in the data evaluation. One question, for instance, related to different types of service regulations. In order to assess how highly a service is regulated, the sum score of all regulation types was taken. Individual answers from the category ‘Other – please specify’ were added to the score if not included in one of the other regulation categories.

A question on the industry sector used a cascading dropdown format. Depending on the choice of one of twelve top level service sector categories based on the Service Sectoral Classification List of the World Trade Organization (WTO), further

[27] Section 4.5.2 includes details regarding the effective outturn of the survey in terms of response.

specification in form of a list of 43 sub-categories was added. As the classification list already includes a category named ‘Other services not included elsewhere’, the question was made mandatory.

4.3.2. Structure and Format

The questionnaire was composed in a repeated measures design, including multiple response items for the same concept. The order of questions was chosen to start with more general questions on the experience with service innovation in order to introduce the participant to the topic, capture interest and set the scene (Brace, 2004). The order of questions then followed the sequential logic of the service development process and went through structural, managerial, and organisational criteria. This was followed by a section on the success and performance of the service outcome.

Order bias was considered in the construction of the survey, especially the process of composing Likert-type scale questions. Research shows that participants have a tendency to be biased towards the left-hand side of a self-administered scale (Friedman, Herskovitz, & Pollack, 1993). Acquiescence bias is also a topic to be considered and results in a tendency of respondents to agree rather than disagree with statements (Kalton & Schuman, 1982). Two measures have been implemented in the survey structure in order to reduce these biases. The order of the scale has been chosen to present the negative response on the left hand side. Brace (2004) mentions that in NPD research this type of question format is not uncommon. It provides the least favourable response pattern and therefore prevents overstated responses. Furthermore, a number of questions were negatively worded. This has the combined effect of the same question not being repeatedly asked without a change, providing a measure for internal consistency, and reducing the order bias through averaging.

Whereas in online surveys answer requirements can be pre-specified by the researcher in order to reduce the amount of unanswered questions, the format of the survey intentionally left a number of questions optional and only prompted the participant to complete. This was done with the intention to prevent guessing of data from sides of the participants in case information was unknown. Furthermore, a large number of variables included the option ‘not applicable’, which was coded as missing data. In addition to missing data issues, a risk of unintentional use of ‘not applicable’ instead of an answer on one of the extreme ends of the applied Likert scale (‘strongly

disagree' or 'strongly agree', in case of negatively worded statements) was noticed during the survey pilot. In a structured interview, based on the survey questionnaire, a respondent used 'not applicable' to describe a NSD project in which project leadership through a named project leader was not considered. The expected answer would have been a strong disagreement with the statement. Yet, the respondent felt that 'not applicable' was a better fit in order to express that project leadership was never considered rather than being a conscious choice of the project team. Hence, the intention behind the 'not applicable' option was to give participants a wider range of possible answers as well as a means of not answering mandatory questions. The advantages were considered to outweigh the issues arising from missing data and unintentional use of the 'not applicable' option.

One general challenge to be addressed by the survey structure was to facilitate responding for participants of mixed background. This issue is grounded in the cross-sectoral and cross-national survey design. Due to large differences between organisations included in the survey sample of the research, non-applicability of questions to respondent sub-groups represented a structural problem that could not be resolved through survey composition and design. The general issue was addressed during the survey pilot but not considered to result in systematic errors in the data.

4.3.3. Survey Pilot

The draft version of the survey questionnaire was tested in a small informal pilot study. An informal pilot is considered a minimum requirement for pre-testing a survey in order to eliminate design and structural errors and is recommended to be an integral part of an effective survey design (Brace, 2004, p. 163). A total of 16 service professionals from the researcher's professional network were asked to complete a paper based questionnaire and provide direct feedback. Participants in the pilot were briefed to report any understanding issues, ambiguities, or difficulties with the completion of the questionnaire. Due to the related discussion, completion time of participants who answered the questions in the presence of the researcher was not representative of the online situation.

A major objective of the pilot was to assess if questions were understood correctly and measuring what they were intended to measure (Dillman, 2007). Different interpretation possibilities and potential researcher bias was also evaluated as well as the overall impression respondents had of the survey and their motivation to

complete. A number of issues evolved around questions on organisation related factors. Questions regarding project management and organisational resources were re-phrased in order to improve clarity.

A second topic where concerns were highlighted refers to numeric answers regarding organisational size in terms of the number of employees locally and world-wide, as well as process description (number of service processes, number of sub-processes, and number of process steps). Issues were created due to different interpretation possibilities or inability to estimate the numbers from sides of the respondent. Two changes were implemented in the final questionnaire. First, the requirement to answer the question was amended to 'soft-required'. This online setting reminds the respondent to answer questions before moving on. Yet, the respondent can choose to continue without answering. This change was considered necessary in order to avoid discomfort of guessing or prevent the participant from frustration or disengagement with the questionnaire due to inability to provide an answer. It was deliberately chosen to leave questions on process details in the questionnaire. The reason behind this decision was to have the option to generate data on difficult questions. The possibility to discard questions at a later point in case of high levels of missing data or outliers would still be given after completion of the data collection. The only drawback was seen in the potential of the question to cause confusion and extend the length of the questionnaire.

The overall feedback of the pilot was positive. The idea to include a motivational prize draw was verbally discussed with the pilot group. The consent was that it would be a helpful incentive in order to create readiness for participation and reduce break-up rates. Yet, concerns about the general willingness of participants to participate in a voluntary survey via online invitation were raised. The volume of unsolicited survey invitations that pilot study participants receive on a regular basis was reported as excessive. Therefore willingness to participate would only be based on a generic interest in the topic, a participation incentive, a survey background that appears worth supporting or a combination of reasons. Indications of a commercial background to the study were considered to be a determent and therefore specifically addressed as part of survey solicitation. Furthermore, a personalised cover note was seen as an important factor determining willingness for participation.

4.3.4. Double Translation

Given the initial objective to address members of interest groups in an international and a German based professional network, the survey and the introductory cover note were translated into German. The German translation was considered to promote participation amongst prospect participants in Germany, Austria, and Switzerland. Translation accuracy is a key criterion for rigorous cross-cultural research (Cha, Kim, & Erlen, 2007). Brace (2004) suggests that the first important step to achieving a good translation is that the initial translation is carried out by a native speaker, who is familiar with the subject and research process. This was the case in the first translation of the research survey, as translating the questionnaire into the researcher's mother tongue fit the requirements. It also assisted in avoiding some of the issues of inadequate translations pointed out by Brislin (1970). A backward translation into English was then made by a bilingual translator. Whereas the comparison between the original and the backward translation did not result in change requirements of the translation, some formulations of the double translation were taken over in the final survey.

4.3.5. Ethics Clearance

In order to assess that the research method via survey questionnaire was adhering to the "Ensuring Sound Conduct in Research" policies of Durham University, a research ethics flow chart was completed. No ethical concerns were found for the research and approval via the Durham Business School Sub-Committee for Ethics was not required. The completed and signed process flowchart is presented in Appendix 1.

4.4. Sample

Sample frames in NSD research are often restricted to specific service types (Avlonitis et al., 2001; Menor & Roth, 2007; Storey & Easingwood, 1999; Thwaites, 1992) or national boundaries(De Brentani, 2001; Edgett, 1994; Storey & Kelly, 2001). Whereas this type of approach generally facilitates the definition of the research population, it can be argued that findings lack applicability in a context of other service types or countries. Despite added difficulties in cross-sectoral and multinational research designs (Harkness et al., 2010), it was purposely chosen to do sampling across different service sectors, in order to avoid exclusion of service sub

sectors. The aim hereby was to forgo a methodological restriction, which potentially impacts general validity of research findings.

The sample was defined via multi-stage cluster sampling. This method involves a repetition of listing and sampling, sometimes combined with stratification (Babbie, 2010). Bryman and Bell (2011) point out that this sampling technique is useful in the context of widely dispersed populations or populations covering large regional areas. The first stage of the sampling procedure covered the definition of grouping of research units. Groupings chosen consist of theme related interest groups in large professional online networks. Given that the professional networks selected do not impose any type of limitation towards its members in terms of sector or geographic affiliation, the objective of a cross-sectoral and multinational population is met. Interest groups serve as clusters from which the sample is drawn. The process of drawing the sample is based on automated selection of displayed group participants through the network. The selection is based on 'relevance' of the group member, which relates to member activity in the network. Based on 'relevance', the first 500 group members are displayed. For the selected groups, all displayed members who fulfilled the sampling criteria were invited to participate in the survey.

The applied cluster sampling process via professional network interest groups is considered a multi-stage approach, as it included *identification i)* of relevant interest groups, done by the researcher, *selection ii)* of displayed group member based on 'relevance', system generated by the network platform, and a *conformance check iii)* of group members based on pre-defined sampling criteria.

4.4.1. Definition and Criteria

In order to assess the qualification of potential survey participants, a process consisting of several process steps was followed. The first and obvious criterion is group membership. Only subscribed members of the seven service innovation related network groups had the chance of being contacted. Membership in several groups was checked prior to contacting individuals in order to avoid contacting the same individual via different groups.

The second criterion relates to service industry experience. Whereas it was considered highly likely that a member in a service innovation network group would have a service background, employment histories on personal user profiles were checked for service firms. A service firm in this context was broadly defined as a company operating in one of the twelve service sectors as listed in the General

Agreement on Trade in Services (GATS) of the WTO.[28] If a potential participant worked for an industrial company not being part of the service sector, the individual was still considered eligible for participation based on prior work experience.

Table 4-5: Job Titles of Prospect Participants

– CEO	– Owner
– Chief Innovation Officer	– Partner
– Creative Director	– Principal
– CTO	– Product Development Manager
– Director of Service Strategy	– Programme Manager
– Entrepreneur	– Project Leader
– Founder	– Project Manager
– Head Business Development	– R&D Manager
– Marketing Director	– Service Development Manager

The third and last check to assess the qualification of a survey participant relates to service development experience. Whereas the survey design also includes a specific question on NSD experience, which operates a disqualifying logic, terminating the survey questionnaire for participants without relevant experience, the participant selection tried to best possibly identify individuals with relevant experience. The assessment was based on the combination of job title and seniority within a service organisation. Table 4-5 shows a selection of common job titles of individuals that were invited to participate in the survey.

Whereas the job title alone does not represent a guarantee of the individual disposing of experience in service innovation and NSD, the interest in the topic and the group membership were again seen as strong indications of such experience.

4.4.2. Sample Size

The chosen population across seven NSD related interest groups in LinkedIn had a total of 7'578 members at the beginning of the data collection phase (see Table 4-6). Due to the number of displayed group members being limited to 500, a system-based pre-selection of members based on 'relevance' was made for the three largest groups, reducing the number to 2'469. As part of the individual selection process,

[28] The full list of service sector and sub-sector categories used in the questionnaire can be found in Appendix 2 on page 190.

401 members were considered unsuitable for the sample in terms of their experience and therefore excluded.

Table 4-6: Overview of Network Groups

Group Name		Total Members[1]	Visible Contacts	Included in Sample
Product and Service Innovators		4'790	500	424
Service Innovation Network		1'106	500	434
Consortium for Service Innovation		719	500	474
SERVSIG		427	427	255
Open Service Innovation		301	307	276
Service Research and Innovation Institute		194	194	176
Service Innovation (Subgroup of FEI Front End of Innovation)		41	41	29
Total		7'578	2'469	2'068

[1] At the start of the data collection period.

In total, 2'068 group members were contacted, constituting the complete sample size of this study.

4.4.3. Sampling Error

Sampling error can be defined as "*…the extent to which the precision of sample survey estimates is limited by the number of persons (or other units) surveyed*" (Dillman, 2007, p. 9). If a study attempts to predict patterns from a sample that is smaller than the entire population, sampling error is likely to appear to some extent. Whereas the sampling error relates to the research design, nonresponse error as a related form of bias is linked to the willingness to respond from sides of those individuals included in the sample.

In the context of this study, sampling error can be seen as the error resulting from the use of service innovation related network groups as part of the multi-stage cluster-sampling design. All individuals within the sample are assumed to possess a basic or even advanced level of NSD experience, which is considered to be the motivation

behind the individual's interest in the group. As outlined in Bryman and Bell (2011, p.182), "*…the primary sampling unit […] is not the units of the population to be sampled but groupings of those units*". The seven network groups, which were used as clusters in the sampling process, constitute the main restriction of the sampling process and potential source for sampling bias. The degree to which members of the service innovation groups are representative for the entire population of service development professionals in a cross-sectoral and multi-national design determines the amount of sampling bias that is part of the survey design and the applied data collection methodology. If the sample of members from the seven NSD related interest groups significantly differs from the total of members within the wider population of service development professionals, the study would be subject to high sampling bias, affecting the research results. It is assumed that the additional sampling steps do not further create an additional source of sampling bias. The selection of 500 members based on system-defined 'relevance' reflects personal choices and the level of activity of individuals within groups. It is conceivable that for groups with high amounts of members, especially the 'Product and Service Innovators' group (4'790 members) and the 'Service Innovation Network' (1'106 members), differences are marginal and the sample of displayed members is close to a random selection. Furthermore, the manual selection of group members based on individual profile attributes solely constitutes a check of whether the study criteria are met and is thus unlikely to result in additional sampling bias.

The main reason for choosing the multi-stage clustering method for the study is based on information access and availability of data combined with the key attribute of service development experience amongst group members. The possibility that members of a group entail an above average interest in their profession and reveal personal affinity to the overall topic includes a possibility of the group members differing from the entire population. Yet, this possibility was considered to be moderate to low prior to data collection and therefore not seen as a major interference factor for the study result.

4.5. Data Collection

Data collection took place over an eight week period. The survey questionnaire was created both paper-based for piloting and online by using a professional cloud-based

online survey tool.[29] As paper-based data collection and the online survey were fully separated, a mixed-mode data collection method was not applied. The initially envisaged collection process was altered during the collection period in reaction to a lack of response.

4.5.1. Collection Process

The initial data collection strategy was based on voluntary responses of members of service innovation related groups in professional online network groups. A link to the survey questionnaire was posted in the discussion forums of eight interest groups that specifically relate to service innovation and new service development within two professional online networks, LinkedIn and Xing.[30] The total number of members of the interest groups amounted to 7'904 at the time, when the survey links were posted. Notification of postings in discussion forums is an optional setting. Not all members are notified of new posts in the discussion forums. The response rate on surveys distributed in this manner can therefore not be directly compared to response rates of paper-based surveys distributed by mail or targeted email campaigns.

Three announcement reminders were planned over the duration of the collection period, which included information on the survey background. Furthermore, participation in a motivational prize draw was offered to incentivize participation. Dillman (2007) argues that a small monetary incentive stimulates compliance with the survey request due to reciprocity between the benefit rendered and received by the participant. Whereas a cash token benefit as used in paper based survey formats is not applicable in web-based survey designs, the idea of a prize draw seemed to fit the purpose of providing an incentive and avoiding risks of abuse. Evidence suggests that effectiveness of the cash advance incentive is higher compared to the offer of a chance to win after completion of the survey (Warriner et al., 1996), which was acknowledged in terms of its effect on response rate. Prize draw incentives, however, have been found to positively impact both response and completion rates (Bosnjak & Tuten, 2003) compared to 'no incentive' survey invitations. Deutskens et al. (2004) found that a higher chance of winning has a bigger motivational impact than the

[29] The online survey tool used for posting the survey is called SurveyGizmo. For additional information on the tool, please refer to the corporate website www.surveygizmo.com.

[30] Information on both online networking platforms can be found on the respective corporate websites www.linkedin.com and www.xing.com. Whereas LinkedIn reports over 200 million users as of Jan 2013 (LinkedIn, 2013a), Xing is mainly present in the German speaking market and reports over 12 million users at the end of 2012 (Xing, 2013).

monetary prize value. It has therefore been decided to offer three prizes instead of one high value prize, as initially foreseen.

The number of responses collected during the first week after the initial posting was below ten. Thus it was apparent that a survey announcement posting in interest groups would not attract sufficient attention in order to serve as sole data collection method, even with additional reminders. This led to a change of approach. Instead of general postings in group forums, LinkedIn members in seven interest groups were directly contacted via a messaging option for group members[31]. Two additional groups were identified and members in seven groups contacted.

The messaging option sends both a notification to the member profile of the respective person and forwards the message to the registered email account of the group member. Therefore, the method of directly approaching members via the messaging function can be considered an effective way of contacting selected individuals.

Issues around privacy and breach of network terms were considered prior to addressing individuals. LinkedIn has a spam policy as part of its user agreement (LinkedIn, 2013b), which forbids unsolicited contacting of members for promotional or marketing purposes as well as chain-letters or pyramid schemes. As the purpose of network groups is the professional exchange of knowledge and information on dedicated topics and themes, the possibility to conduct scientific research via interest groups has not been defined as inappropriate and related messaging added to the list of spam items. This was confirmed during an account check done by LinkedIn, which occurred in the middle of the data collection process. Due to the unusually high volume of messages sent to group members, the LinkedIn account from which messages were sent was temporarily blocked. After the check, full account functionality was re-established.

The process of directly contacting individuals via the group messaging service led to a significant improvement in the response rate. It was intentionally chosen to abstain from a second member contact as a reminder or follow-up to the survey invitation. Whereas this has been found to be a tool to significantly enhance response rates (Bryman & Bell, 2011; Millar & Dillman, 2011), network etiquette[32] asks for a way by which individuals can opt out from receiving further communication. As there is no optionality in the group settings for email notifications to opt-in or out from

[31] The messaging option for group members in Xing is only available to premium members. The search for participants via group messaging service was therefore only conducted in LinkedIn.

[32] The term network etiquette summarises a number of social conventions around the usage of electronic media.

participation in research surveys, the study abstained from any kind of reminder. Common research practice of sending up to four reminders including telephone contact as done by some researchers (Fey & Denison, 2003) can increase feedback but may also be a driver of respondent fatigue and was considered inappropriate in the network group context of the study.

The survey invitation that was sent out included a personalised salutation and reference to the prospect participant's membership in the respective research group. Dependent on the country of residence, age, and formality of personal presentation of the individual, prospect participants were addressed either on a first or last name basis. Academic titles were used based on the published education background. Personalisation has been found to be a strong tool to increase response rates compared to standardised communication (Dillman, 2007; Joinson, Woodley, & Reips, 2007). Yet, research suggests that the level of formality in salutations does not exhibit a significant impact on response rates (Pearson & Levine, 2003). As many research studies evaluating survey responses, however, are using samples based on university student or alumni groups (Joinson & Reips, 2007; Pearson & Levine, 2003), it can be questioned if the findings are representative for surveys, where the researchers has no connection to the respondents and the respondent group is further geographically dispersed. The survey was available in both English and German language and a German invitation was sent out besides the English solicitation to German speaking group members, based on location and profile information. Whereas formal salutations were considered mandatory in this context, they were also used to address individuals in other countries within the European Union in order to avoid the impression of inappropriateness or impoliteness.

Feedback and responses to the survey invitation were positive. Out of a total of 2'068 individuals contacted, only two individuals responded that they did not wish to participate or be further contacted. The option to make research results available to survey respondents was not specifically announced as part of the solicitation. Yet, a total of eleven survey participant asked to be provided with research results, once available. The survey was closed one week after contacting all members of the seven network groups, which fit the sampling criteria. Increasing the time frame of the survey could have provided further improvement in response rate, but did not match the set timeline of the research project. Further improvements could also have been achieved by altering the data collection process and include several reminder stages. Given assured anonymity of feedback, this would have resulted in individuals

receiving reminders, despite already haven taken part in the survey. Whereas data collection via the interest groups was considered a viable approach without violation of rules or terms of engagement of the network platform, it is not explicitly made available to group members or researchers. In consideration of these facts, a reminder option was intentionally declined as part of the collection process.

4.5.2. Response Rate

The initial process of collecting feedback via survey invitation postings in interest group forums was discarded due to a lack of responses. Dillman (2007, p. 259) recommends to abstain from mass distribution survey methods, as their use "*…seems destined to produce results fraught with nonresponse error*." Whereas the total number of group members of 7'578 would have represented a much higher sample size, difficulties to generate sufficient interest in the survey led to a methodical change.

The sample size after two selection processes amounted to 2'068 as described in section 4.4.2. Table 4-7 shows how people responded to the survey invitation. Data collection in total resulted in 430 responses, which equals a response rate of 20.8%.

Table 4-7: Response Overview

Sample Size (N)	2'068	100.0%
Disqualified	30	1.5%
Partially Completed	183	8.8%
Fully Completed (excluded)	9	0.4%
Fully Completed (useable)	208	10.1%
Total Responses	430	20.8%

A total of 30 respondents stated at the beginning of the survey questionnaire that they did not have past NSD experience. The disqualifying logic excluded them from participating. Answers of 183 participants who did not fully complete the survey were also not counted. The total of completed questionnaires amounts to 217, out of which 9 answers were excluded as participants has more than 10% missing values. Due to a significant level of terminations (8.8%) as well as unqualified responses and responses that were discarded due to high levels of missing data, the total number of valid answers amounts to 208, resulting in a net response rate of 10.1%. This response rate is considered low but acceptable for the purpose of this thesis, given

the sampling method and data collection process. Recent published work in the Journal of Operations management (Kim, Kumar, & Kumar, 2012), Technovation, (Verdu, Tamayo, & Ruiz-Moreno, 2012) or the Journal of Business Research (Camisón & Ana Villar-López, 2014) reveal response rates of 10.6%, 10.4%, and 6.7% respectively.

Research confirms that the response rate of online surveys is generally lower than the response rate of paper-based surveys (Bryman & Bell, 2011; Nulty, 2008; Vehovar, Lozar Manfreda, & Batagelj, 2000). Nulty (2008) reports that online response rates are on average 23% below the response rate of paper-based surveys, whereas Dommeyer at al. (2004) present a 32% lower response rate of online compared to paper-based in-class surveys. The response rate of this study does not meet the standards of survey researchers such as Mangione (1995, p. 61), who considers response rates below 50% not scientifically acceptable. Whereas an increase of the sample size and/or the response rate are generally considered a way to reduce both sampling error and non-response bias, Dillman (2007) points out that both measures do not result in a guaranteed reduction. An important aspect is to assess if the profile of those who did not respond to the survey significantly differs from those who responded. Given the high level of variation amongst the survey participants, it was assumed that there would not be a significant difference and the survey results would be acceptable for the objectives of this study. A further argument is put forward by Bryman and Bell (2011), who report articles that have been published in some of the most highly regarded journals with response rates between 21-25%. Given the drastic shift in the response pattern of prospect survey participants towards a significantly reduced response rates that Dillman describes (2007) combined with the general issue of response fatigue within highly researched populations, it can be assumed that future research will have to deal with response rates below the 20% mark with increased frequency. Research standards are commonly preoccupied with high response rates, indicating good data quality of survey research. It seems that research ethics are widely ignored when it comes to this topic. Researchers that include up to four written reminders and telephone contact in their data collection process are likely to achieve increased response rates (Mangione, 1995). It can be questioned, however, on what basis researchers can justify their claim to receiving a response entitling them to apply measures, which could be perceived as obtrusiveness or molestation by respondents other than having identified individuals through a sampling process and following general research objectives. When individuals are urged to respond via a multi-stage

escalation process of reminders, high response rates might be achievable but at the cost of disregard of personal privacy and a creation of research fatigue amongst respondents. Such methods do not comply with the applied research ethics of this dissertation.

4.5.3. Data Collection Errors and Biases

A general first point to note regarding data collection biases is that web-based surveys are subject to the same types of errors and biases as other surveys (Dillman, 2007). Besides sampling error, covered in section 4.4.3, and measurement error, described in section 4.2.4, the survey results can be impacted by two further error types, coverage error and nonresponse error.

4.5.3.1. Coverage

Coverage error is the error that occurs as a result of not reaching members that show distinct features within the population as a consequence of the research design. If a sample is drawn without providing all elements with an equal chance of entering into the sample, the sample would not be fully representative due to coverage error. In the context of online or internet studies, articles and textbooks that are more than five years old mention web access and availability of an email address as a major cause of coverage error affecting online surveys (Brace, 2004; Couper, 2000; Dillman, 2007). More recent work still reports these issues but recognises the enormous growth both dissemination and popularity of online media (Bryman & Bell, 2011).

Coverage issues that potentially affect this study relate to membership in professional online networks and knowledge of service innovation related interest groups in such networks. Whereas there are hardly any entry barriers that could restrict interested individuals from joining the sample clusters, knowledge about the existence of the groups is related to personal interest and search efforts, as there are no prompts, announcement or advertisement activities that would inform a passively interested individual of the group's existence. Basic membership in most professional online networks and LinkedIn in particular is free of charge. Group membership can be limited to individuals that meet the access criteria set by the respective group managers. Group management is done by individuals, mostly the originators of the network groups, who can restrict access and select members based on their professional background or motivation behind their membership application.

Especially for smaller organisations or firms which operate locally with a limited requirement to network, coverage errors would be relevant. Table 4-8 shows the distribution of survey participants by company size. In comparison to the equivalent distribution of the number of enterprises in the EU in 2012, it becomes apparent that the number of micro organisations is underrepresented. In a 2012 Eurostat report (ECORYS, 2012), the percentage of micro organisation was announced to account for 92.2% of the total number of enterprises within the European Union (EU).

Table 4-8: Organisation Feedback Pattern by Company Size

Classification	Employees	Frequency	Percent
Micro	<10	14	7%
Small	<50	29	14%
Mid-sized	<250	25	12%
Large	≥250	140	67%
Total		208	100%

Potential impacts of coverage errors were assumed to be insignificant, based on availability of access to online media (mainly internet and email). Coverage issued based on a disproportionate distribution of interest in service innovation related network groups could have been underestimated in the sampling approach and therefore needs to be considered as part of the data analysis and related discussion of results.

4.5.3.2. Nonresponse

Nonresponse error occurs when a substantial group of individuals in a survey-based research design does not respond to the questionnaire invitation and reveals characteristics that are significantly different to those of survey participants (Dillman, 2007). It is important to highlight that in order for nonresponse error to affect the study results, the characteristics of people not responding needs to be relevant in terms of the overall objectives and the purpose of the study. Nonresponse biases are common and represent an important issue for research applying a survey-based methodology, as they result in low response rates. With regard to mail surveys, Magione (1995) suggest that an increased vulnerability to nonresponse error exists, as it is very easy for a person to not respond. This vulnerability is even more pronounced amongst electronically distributed online survey formats (Nulty, 2008). Couper (2000, p. 474) even argues that "*…the problems of nonresponse will likely*

become increasingly prominent". Vehovar et al. (2000) report overall completion rates below 20% for internet based surveys, given a common problem of inefficient solicitation strategies for web-surveys.

A method of estimating nonresponse bias has been suggested by Armstrong and Overton (1977) and applied by researchers, testing for nonresponse bias in their dataset (Baker & Sinkula, 1999; Melton & Hartline, 2013; Verdu et al., 2012). The approach involves a comparison of answers from late responders to those from early responders by using independent t-tests. The assumption hereby is that responses from late respondents are close to non-respondents. By dividing total responses into three groups according to response time, an evaluation can be made if answers from late responders significantly differ from early responders. Both t-tests and Levene's test for assessing equality of covariance matrices (Field, 2009) were carried out and revealed no significant difference between responses between early and late responses. The test results suggest that non-response does not represent an issue, affecting further analysis of data collected as part of this dissertation.

Despite a common urge to achieve high response rates in social research (Babbie, 2010), some researchers suggest that nonresponse rates do not necessarily result in nonresponse bias and impact the validity of survey results (Keeter et al., 2000). Cutin, Presser and Singer (2000, p. 414) state that "*…bias is not a simple function of nonresponse level. It is a multiplicative function of the nonresponse level and the nonrespondents' distinctiveness.*" The distinctiveness was assessed through response rate comparison of subgroups. Groves (2006, p. 654) describes that following this technique, there is no indication of nonresponse bias if the researcher asserts that response rates are similar across subgroups. This was the case during the entire data collection period, as the response rates between interest groups did not show significant differences. It is debatable to which extent response rate comparisons across subgroups can be used to assess the absence of nonresponse bias, as response propensity and survey variables are likely to depend on further common causes (Groves, 2006). Yet, given the particularities of the research design and a general trend towards reduced response rates in online surveys (Lozar Manfreda et al., 2008), the general implication of the response comparison across subgroups has been taken as an indication that the low response rate of the study does not necessarily confirm the existence of nonresponse bias, which argumentum e contrario can also not be fully ruled out.

Chapter 4 provided an overview of the applied research methodology. An online questionnaire was used as data collection tool and represents the backbone of the study. In order to capture a wide diversity of NSD activities, the research sample was limited to a specific service industry sector or geographically restricted by focussing on a single country. The research sample was developed following a cross-sectional and multi-national cluster sampling approach. Service development professionals were selected based on specialised interest group forums in a professional online network. Out of 2’068 individuals contacted, 430 responses were collected (20.8%), out of which 208 were complete and usable for data analysis purposes, resulting in a net response rate of 10.1%. Whereas measures such as survey piloting or participant screening have been put in place in advance of data collection process, the following section starts with an overview of data evaluation and cleansing in order to obtain a solid data set that could be used for quantitative analysis.

5. Analysis

The following chapter focuses on the analysis of the dataset that was obtained through the empirical research questionnaire. Chapter 5 commences with an evaluation of the research concept and data quality as well as a preliminary analysis based on descriptive statistics. The evaluation of data quality indicated that quality levels overall were good. Tests for outliers were made across all research variables and the extent of missing values was assessed in order to determine and implement an adequate approach of dealing with missing data. These preparatory steps lead to the main deliverable of the section in form of quantitative testing of the data model. Factor analysis techniques are applied to the dataset to obtain a set of factors that are aligned to the research hypotheses, which are then tested through a moderated structural path model using Structural Equation Modelling (SEM).

5.1. Concept Evaluation

Data analysis performed as part of this thesis followed a four step approach. The first phase of the analysis entailed a detailed technical consideration of the research concepts used. Whereas it is crucial to address a number of important points such as validity, biases and measurement errors during the research design phase in order to exclude systematic errors from the applied research methodology, effective study outturns and data particularities can only be assessed as part of an ex-post analysis. Churchill (1979) postulates that a construct which exhausts the domain and is based on a purified research scale is content or face valid. In the context of this research, research constructs used are based on established measures and therefore considered content valid. Yet, a further validity check was considered necessary in order to assess the potential impact resulting from the modification of measurement. This section primarily focuses on construct reliability and validity of data, as a flawless application of quantitative research methods involving data analysis needs to be based on variables and constructs that are both reliable and valid.

5.1.1. Reliability

Reliability and consistency of the measures used in this thesis was assessed during the first phase of data analysis. One of the key functions of reliability checks of collected data is to assert that the data would not be subject to significant variation if

it was collected from the same respondent at a different time (Babbie, 2010). The research design includes a number of *internal consistency* measures for the same construct in order to be able to assess reliability. The questions asked were not identical, but based on the same general idea and also included negatively phrased questions, which were recoded as part of the data cleansing process. Data was collected via a self-administered online survey questionnaire. As a result of the applied collection method, correlation testing of answers stemming from the same respondents in form of the frequently used test-retest method was inapplicable. Furthermore, the total length of the survey was already considered to be close to the maximum that participants would be willing to go through, especially given the seniority of targeted survey respondents. Combined with assured confidentiality any further contacting of respondents for retest work was considered infeasible.
In order to mitigate the risk of low reliability of collected data, several internal consistency measures were included in the research design. These comprise a number or rephrased questions on the same topic as well as alternative question formats using inversion and negation.

A general rule regarding the design of a rigorous research project requires to establish internal reliability before addressing validity of measurement items, as consistency is seen as a necessary but insufficient condition in order to establish construct validity (Nunnally, 1978). Reliability of scales was assesses by using coefficient alpha (Cronbach, 1951) for all unidimensional scales. Researchers point out that coefficient alpha underestimates the true reliability of multi-dimensional scales (Cortina, 1993b; Osburn, 2000; Schmitt, 1996). Hence, scales of items relating to complexity were, as multi-dimensional constructs, not evaluated in terms of their reliability by using coefficient alpha but considered separately as part of EFA. Internal consistency ranged from excellent ($\alpha > 0.8$) to acceptable ($\alpha > 0.6$). The reliability score for *Project Leadership* had the lowest score with a Cronbach's alpha of 0.588.[33] Whereas reliability of the measure represents a concern, it was considered acceptable in the context of the study design (cross-sectional and multi-national sample), following a suggestion of Pedhazur and Schmelkin (1991). Measurement scales were further adjusted during the analysis phase using exploratory factor analysis.

[33] Cronbach alpha reliability scores for all unidimensional variables are included in Table 5-10 on p. 138.

5.1.2. Construct Validity

Validity of research variables and constructs is a primary concern when evaluating both appropriateness of research methodology and quality of research results. Validity is related to the measurement items used to model and test theory and expresses the "*… extent to which an empirical measure adequately reflects the real meaning of the concept under consideration*" (Babbie, 2010, p. 153). A general suggestion is to use established and validated measurement concepts instead of facing the challenge and related risks of developing new measurement items and scales (DeVellis, 2003). This suggestion was principally followed. Measurement items, as outlined in section 4.2, were based on research scales used across a number of studies in the product and service innovation literature. By doing so, content validity, as the assessment of correspondence between individual measures and concepts established through expert judgement, and pre-tests with multiple sub-populations, is assured (Hair et al., 2009). An overview table of means, standard variations, and intercorrelations is provided in Appendix 3 for all measurement variables. Yet, a number of modifications to measurement items were applied and resulted in a need for an ex-post validity assessment.

The assessment of construct validity is based on some of the guidelines suggested by Churchill (1979), namely correlation between measures and expected measure behaviour. Convergent construct validity was assessed by performing confirmatory factor analysis across three groups of constructs:

Construct Group a): Antecedents of NSD Performance
Construct Group b): Service Performance
Construct Group c): Complexity

The analysis of convergent validity generally confirmed related measurement variables, used to assess the constructs. The approach to separate the constructs into groups was adapted from Ayers et al. (1997), who have applied a phased scale assessment approach due to the number of items assessed. Latent factors were obtained via exploratory factor analysis using maximum likelihood factoring and promax rotation.[34] EFA is a multivariate technique usually used when the a-priori theoretical basis of both the number and common patterns amongst factors is unknown (Hurley et al., 1997). As further outlined in section 5.4.1.1, the reason for conducting EFA can be seen in the new composition of established research scales and a cross-sectional research design with higher levels of anticipated diversity

[34] The final pattern matrix including all factors is included in section 5.4.1.1.

amongst research objects, reducing overall consistency of answer patterns. Hayton et al. (2004) point out that factor retention decisions are amongst the most critical decisions affecting the robustness of a chosen research methodology. Thus, advantages of increased construct validation through retention of a reduced amount of measurement factors related to second order constructs was carefully balanced with potential risks arising from specifying too few factors. Factors were selected based on eigenvalues exceeding 1.0 applying Kaisers' rule.[35] Furthermore, components with negative cross-loadings were eliminated.

5.2. Data Quality

Despite the advantages provided through the structure of the online survey tool in terms of setting mandatory answering requirements to questions and specifying the output range, examination of data is important in order to establish a solid basis for further analysis. Data examination was done by using a number of graphical and descriptive techniques in SPSS. Quality checks included and assessment of face validity of data. The shape of the distribution was assessed via histograms of the measurement items. Furthermore, scatterplots were evaluated in order to assess the relationship between variables. The two main steps of the evaluation of data quality include the detection of outliers and corrective measures in dealing with missing values.

5.2.1. Detection of Outliers

Due to the online based questionnaire design, procedural data errors originating from incorrect data entry were minimised. Data was directly entered into the database during completion of the survey. The evaluation of descriptive statistics revealed a number of extreme values, which distorted the overall result. Such cases were individually reviewed and unrealistic values removed from the dataset.

In terms of the overall dataset, two variables were identified, where a number of participants seemingly struggled with comprehension problems. The first variable relates to the overall development time for the example of a new service development project chosen by the participant. The selection of an example was at

[35] Kaiser (1960) was a pioneer amongst scientists researching factor analysis methods and one of the researcher's suggesting to drop factors with an eigenvalue below 1.0. The commonly used rule has been named after him, despite other researchers having come up with similar findings and suggestions.

the discretion of the participant. However, the survey prompted the respondent to retain the same example for answering all survey questions in order to achieve consistency. The answer field indicated months as measurement unit for duration. Months were chosen as unit over other units such as days or weeks in order to capture cases where development time exceeded several months and to facilitate answering. During the survey pilot, a development time in weeks was found to be too complicated in case of long-term development projects. Respondents, however, revealed uncertainty in using fractions to describe development times below one month. A number of items showed zero months of development. These answers were recoded as missing values.

The second variable which showed unusual results was the number of affiliates or firm subsidiaries the new service development project described by survey participants. Answers, for which the number of affiliates exceeded the world-wide total number of employees of the organisation were deleted and also treated as missing values.

Two further adjustments were made to incorrect answers. In cases where the number of functional departments involved in the service delivery exceeded the total number of functional units of the organisation, the former was set to the total number of functions of the company. Furthermore, cases, where the total number of employees required for service delivery exceeded the total number of employees of the company were amended to the total number of employees. Whereas respondents might have attempted to capture the input of external staff in the service delivery process, this type of scenario was excluded in order to achieve a consistent answering pattern.

The general evaluation of outliers indicated no systematic error patterns or cases that revealed deliberate errors or incorrect answers. It was therefore concluded that the quality of the collected data was appropriate for subsequent data analysis work.

5.2.2. Treatment of Missing Values

The process used for the analysis and treatment of missing values follows a four step approach suggested by Hair et al. (2009). In a first step, the data process was evaluated. Missing data included in the dataset collected through the data process was not considered ignorable, as the underlying reason is not related to sampling related issues, the specific design of the data collection process or censored data.

Instead, reasons are assumed to be linked to non-response or selection of the 'not applicable' option.

The second step related to the evaluation of the extent of missing data. Variables with more than 10% missing values were excluded. This reduced the number of variables by five down to 98 variables. Following an approach by Kumar, Stern and Anderson (1993), individual cases with larger amounts of missing or doubtful data were also excluded from the analysis. The application of the same cut-off criterion for individual cases as used for variables resulted in a reduction of the effective sample size. Nine participants had more than 10% missing values in their total responses and were excluded from the dataset. The total sample size after deletion of participants with high levels of missing data was 208.

The third step of the missing data process relates to the empirical assessment of randomness in missing values across the dataset. Missing values were tested for randomness using Little's missing completely at random (MCAR) test. The null hypothesis underlying Little's MCAR rest is that all missing data are completely at random and not related to the data values. That is to say that the missing data does not include information about the nature and kind of missingness. As variables included in the survey were not of sensitive nature and responses were treated anonymously, a non-random or systematic pattern of missing values was not expected.

Table 5-1 shows univariate statistics for all variables for which the data process allowed for missing values. After the elimination of variables with missing values exceeding 10%, the table shows that six variables have above 5% missing values (Var00082 – Number of Sub-processes 8.7%, Var00085 - Employees for Service Delivery 8.7%, Var00073 – Countries 6.7%, Var00084 – Number of Departments 6.7%, Var00014 – Development Time 6.3%, Var00096 – Higher Education 5.3%), all of which (except for higher education) have high extreme values of 11 and above.

Table 5-1: Univariate Statistics

Variable	Name	N	Mean	Std. Deviation	Missing Count	Missing Percent	No. of Extremes[a] Low	No. of Extremes[a] High
NSD_Proj_Tot	Number of NSD projects - Total	208	30.53	142.915	0	0.0	0	24
NSD_Proj_5y	Number of NSD projects - Last 5y	208	13.58	39.383	0	0.0	0	23
NSD_Proj_12m	Number of NSD projects - Last 12m	208	3.65	8.533	0	0.0	0	16
Sus_IntroFreq	Sustainability Factors - NSD Frequency	208	3.11	1.117	0	0.0	0	0
Sus_ServQual	Sustainability Factors - Service Quality	208	4.72	.583	0	0.0		
Sus_Pricing	Sustainability Factors - Pricing	208	3.64	1.007	0	0.0	2	0
Sus_Brand	Sustainability Factors - Brand	208	3.95	.833	0	0.0	0	0
Sus_CRM	Sustainability Factors - CRM	208	4.38	.789	0	0.0	4	0
Sus_ClienEv	Sustainability Factors - Client Events	208	2.89	1.002	0	0.0	0	0
Sus_Marktg	Sustainability Factors - Marketing	208	3.46	1.016	0	0.0	5	0
Sus_Referrals	Sustainability Factors - Referrals	208	3.79	1.065	0	0.0	0	0
Sus_ASServ	Sustainability Factors - After-sales Services	208	4.25	.891	0	0.0	7	0
ProcDur	Development Process Duration (months)	208	10.597	7.7386	0	0.0	0	24
Planning1	Thorough Process Planning	208	3.73	1.056	0	0.0	0	0
Structure1	Formal Development Phases	208	3.67	1.262	0	0.0	0	0
Routines	Firm Routines for Development	208	3.33	1.204	0	0.0	0	0
TimingPlan	Use of a NSD Timing Plan	208	3.77	1.110	0	0.0	0	0
TimPlnAdh	Timing Plan Adherence	208	3.41	1.147	0	0.0	13	0
Milestone1	Use of Milestones and interim Targets	208	4.06	.971	0	0.0	20	0
ProcDocu1	Process Documentation	208	3.55	1.158	0	0.0	11	0
FixSequ	Adherence to Sequence of Development Steps	208	3.43	1.119	0	0.0	11	0
Structure2	Develpment Process Structure (neg)	208	3.48	1.503	0	0.0	0	0
Planning2	Process Planning through Intuition and Experience (neg)	208	2.68	1.262	0	0.0	0	0
Structure3	Formal Development Process (neg)	208	3.76	1.145	0	0.0	0	0
ProcDocu2	Process Documentation ex post	208	3.50	1.188	0	0.0	0	0
Milestone2	Use of Milestones and Interim Targets (neg)	208	3.85	1.027	0	0.0	0	0
ProcDocu3	Use of Process Documentation (neg)	208	3.77	1.181	0	0.0	0	0
Planning3	Thorough Process Planning (neg)	208	3.40	1.289	0	0.0	0	0
Planning4	Importance of the Development Process (neg)	208	3.35	1.284	0	0.0	0	0
ProjDec	Formal Project Sign-off	208	3.68	1.310	0	0.0	0	0
ProjLeader1	Project Leader	208	4.39	.867	0	0.0	8	0
ProjRole	Clearly Defined Project Roles	208	3.60	1.040	0	0.0	4	0
CrossFunct1	Cross-functional Project Team	208	4.23	.985	0	0.0	20	0
ProjAuton	Autonomous Project Decision-making	208	4.01	.978	0	0.0	23	0
DevDelivery	Service Development Staff Delivering Service (neg)	208	2.03	.983	0	0.0	0	0
Hierarchy	Project Hierarchy (neg)	208	3.58	1.185	0	0.0	15	0
SenMgmtSup1	Senior Management Support	208	4.49	.810	0	0.0	7	0
CrossFunct2	Cross-functional Project Team2	208	4.17	.947	0	0.0	15	0
ProjLeader2	Project Leader Authority	208	3.76	.899	0	0.0	3	0
CrossFunct3	Cross-functional Project Team (neg)	208	3.88	1.196	0	0.0	0	0
SenMgmtSup2	Active Senior Management	208	3.84	1.063	0	0.0	0	0
ProjLeader3	Project Leader (neg)	208	3.63	1.165	0	0.0	11	0
ProjLeader4	Multiple Project Leaders (neg)	208	3.44	1.218	0	0.0	0	0
SenMgmtSup3	Senior Management Support (neg)	208	4.11	1.081	0	0.0	20	0
DevExp	Development Knowledge Transfer	208	3.89	1.013	0	0.0	0	0
DevTeam1	Development Staff and Facilities	208	3.22	1.254	0	0.0	0	0
Resources1	Resource Requirements (neg)	208	4.01	1.021	0	0.0	26	0
DevCult	Organisational NSD Culture (neg)	208	2.38	1.230	0	0.0	0	0
Funding	Availability of Funding	208	2.84	1.107	0	0.0	0	0
DevRout	Strict Development Routines	208	2.77	1.194	0	0.0	0	0
Resources2	Development Staff and Facilities (neg)	208	3.35	1.186	0	0.0	0	0
DevTeam2	Organisational Impact of Development Activity	208	3.26	1.180	0	0.0	0	0
PreTest	Pre-testing	208	3.44	1.234	0	0.0	0	0
DevTeam3	Development Staff and Facilities 2 (neg)	208	3.88	1.002	0	0.0	26	0
ServImp	Service Importance for Sustainability	208	3.83	1.054	0	0.0	0	0
ServRisk	Service Risk (neg)	208	3.33	1.188	0	0.0	0	0
DevCult	Organisational NSD Culture	208	3.60	1.090	0	0.0	4	0
Emp_Ww	Size - Total Employees World-wide	208	26407.19	61977.438	0	0.0	0	40
Emp_Local	Size - Total Employees Local	208	1834.37	4861.510	0	0.0	0	38
Countr	Size - Total Countries with Presence	208	30.39	44.987	0	0.0	0	18
OrgHier	Number of Hierarchy Levels	208	7.22	7.995	0	0.0	0	14

Table 5-1 (continued)

Variable	Name	N	Mean	Std. Deviation	Missing Count	Missing Percent	No. of Extremes[a] Low	No. of Extremes[a] High
FucDept	Number of Functional Departments	208	13.61	21.879	0	0.0	0	34
Equip	Specialised Equipment	208	3.34	1.172	0	0.0	0	0
No_Subproc	Number of Sub-Processes	208	75.81	377.590	0	0.0	0	34
Deptm	Number of Functions Involved in Service Delivery	208	3.78	4.215	0	0.0	0	9
DelivEmpl	Number of Employees Required for Service Delivery	208	79.63	214.210	0	0.0	0	29
Edu4plus	Education - more than 4 y post secondary	208	57.79	34.942	0	0.0	0	0
CustInvolv	Customer Involvement	208	3.71	1.009	0	0.0	7	0
Customis	Customisation	208	3.36	1.017	0	0.0	5	0
Industry	Industry	208			0	0.0		
SubIndustry	Sub-Industry	208			0	0.0		

a. Number of cases outside the range (Q1 - 1.5*IQR, Q3 + 1.5*IQR).
b. . indicates that the inter-quartile range (IQR) is zero.

The cross-tabulation between Industry and variables with missing values above 5% shown in Table 5-2 indicates that a pattern between service industries and missing values is possible. For instance, Environmental Service show 50% missing values for two variables related to Process Duration (var00014) and Countries with Presence (var00073) in terms of local representation.

Table 5-2: Cross-Tabulation of Industry (Categorical) vs. Indicator Variables

				Industry Sector													
			Total	Business Services	Communication Serivces	Construction and related Engineering	Distribution Services	Educational Services	Environmental Services	Financial Serivces	Health and related Social Services	Tourism and Travel related Services	Recreational Cultural and Sporting	Transport Services	Other Services not included elsewhere
Development Process Duration [months]	Present	Count	195	62	23	6	2	12	1	16	15	6	3	6	43
		Percent	93.8	98.4	92.0	75.0	100.0	85.7	50.0	100.0	88.2	100.0	100.0	75.0	97.7
	Missing	% SysMis	5.8	0.0	8.0	25.0	0.0	14.3	50.0	0.0	11.8	0.0	0.0	25.0	2.3
		% 999.0	.5	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Size - Total Countries with Presence	Present	Count	194	60	23	8	2	14	1	16	16	4	3	8	39
		Percent	93.3	95.2	92.0	100.0	100.0	100.0	50.0	100.0	94.1	66.7	100.0	100.0	88.6
	Missing	% SysMis	6.7	4.8	8.0	0.0	0.0	0.0	50.0	0.0	5.9	33.3	0.0	0.0	11.4
Number of Sub-Processes	Present	Count	190	60	23	8	2	12	2	15	15	3	3	8	39
		Percent	91.3	95.2	92.0	100.0	100.0	85.7	100.0	93.8	88.2	50.0	100.0	100.0	88.6
	Missing	% SysMis	8.7	4.8	8.0	0.0	0.0	14.3	0.0	6.3	11.8	50.0	0.0	0.0	11.4
Number of Functions Involved in Service Delivery	Present	Count	194	60	23	8	2	13	2	14	15	5	3	7	42
		Percent	93.3	95.2	92.0	100.0	100.0	92.9	100.0	87.5	88.2	83.3	100.0	87.5	95.5
	Missing	% SysMis	6.7	4.8	8.0	0.0	0.0	7.1	0.0	12.5	11.8	16.7	0.0	12.5	4.5
Number of Employees Required for Service Delivery	Present	Count	190	60	24	8	2	12	2	14	13	5	3	7	40
		Percent	91.3	95.2	96.0	100.0	100.0	85.7	100.0	87.5	76.5	83.3	100.0	87.5	90.9
	Missing	% SysMis	8.7	4.8	4.0	0.0	0.0	14.3	0.0	12.5	23.5	16.7	0.0	12.5	9.1
Education [>4y post-secondary]	Present	Count	197	61	23	8	2	14	2	15	16	5	3	8	40
		Percent	94.7	96.8	92.0	100.0	100.0	100.0	100.0	93.8	94.1	83.3	100.0	100.0	90.9
	Missing	% SysMis	5.3	3.2	8.0	0.0	0.0	0.0	0.0	6.3	5.9	16.7	0.0	0.0	9.1

Indicator variables with less than 5% missing are not displayed.

The observations of the descriptive statistics and the cross-tabulated pattern are confirmed by the MCAR test, which shows a significance value below 0.05. The null hypothesis is therefore rejected and missing values not treated as MCAR. The interpretation of this result does not include procedural errors of the data process. Rather, patterns of missing data are a result of relationships between variables. One explanation is that the dataset includes variables, which do not substantially differ in terms of the concept they measure. Linked variables have been included in order to measure constructs but also check for internal consistency. Furthermore, the data process was intentionally kept broad, in order to capture a wide service spectrum and not focus on individual service industry types. The added variety is likely to produce effects similar to groupings that result in interdependencies of variables. Missing data is considered missing at random (MAR), as the data process is operating at random and the probability of missing values depends on observed values but not on missing values (Little & Rubin, 1987; cited in Schafer, 1999). Yet, the ultimate distribution of missing data is affected by dependencies between variables and cases with missing data are distinguishable from cases without missing data through patterns of distribution.

In the absence of MCAR data, Hair et al. (2009) suggest modelling-based approaches for further analysis. Multiple Imputation (MI) was applied in a fourth step in order to generate values for missing data.[36] For variables with fixed scales, full scales have been used to set a range for possible values. Variables with open scales have been constraint to the maximum number included in the dataset, in order to avoid the creation of outliers as part of the imputation process. Advantages of MI are that missing data is generated in a "*principled and statistically defensible manner*" and missing data uncertainty is incorporated into summary statistics (Schafer & Olsen, 1998, p. 24). In order to mitigate the risks of MI (i.e. inadequate representation of missing values), five imputations were calculated following Rubin's (1987) demonstration of imputation efficiency of this number at volumes of missing data above those found in the dataset analysed. MI is frequently employed in order to avoid a loss of observations, that could potentially introduce a bias in a dataset (Hollenstein, 2003).

The robustness of MI as a method to address missing values has been confirmed by several researchers (Schafer & Olsen, 1998), in particular in comparison to other techniques such as simple imputation (Donzé, 2001). Variables and observations that form the base dataset were completed via MI and were used in further analysis,

[36] The applied multiple imputation technique follows a concept suggested by Rubin (1987).

as both structural equation modelling (SEM) and multivariate methods require complete data.

5.3. Descriptive Analysis

Following data cleansing through deletion of out-of-range variables, outliers and incorrect responses, the sample of 208 responses was evaluated using descriptive statistics. The main purpose of the descriptive analysis is to explore the characteristics of the sample in advance of exploring causal relationships between variables and testing the research hypotheses of this dissertation using quantitative analysis techniques and inferential statistics. Descriptive statistics deliver a mere summarisation of sample observations (Babbie, 2010) which help the researcher to understand the data and draw conclusions in connection to the result of the quantitative analysis results. As this thesis utilised a sample draw in a cross-sectional and multi-national format, inferences about a larger population and generalisation of research findings need to consider the inherent characteristics of the dataset used in order to derive research findings.

5.3.1. Profile and Distribution of Survey Participants

Whereas the survey did not explicitly collect information on survey participants other than the service sector and sub-sector, the software used listed information about the country in which participants resided at the time of completion of the online questionnaire. Table 5-3 shows the distribution of survey respondents by country.

Table 5-3: Response Distribution by Country

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	United States	49	23.6	24.1	24.1
	Germany	37	17.8	18.2	42.4
	United Kingdom	18	8.7	8.9	51.2
	Netherlands	16	7.7	7.9	59.1
	Finland	12	5.8	5.9	65.0
	Switzerland	11	5.3	5.4	70.4
	France	8	3.8	3.9	74.4
	Canada	5	2.4	2.5	76.8
	Spain	5	2.4	2.5	79.3
	Europe	4	1.9	2.0	81.3
	Norway	4	1.9	2.0	83.3
	Brazil	3	1.4	1.5	84.7
	India	3	1.4	1.5	86.2
	Italy	3	1.4	1.5	87.7
	Sweden	3	1.4	1.5	89.2
	Australia	2	1.0	1.0	90.1
	Austria	2	1.0	1.0	91.1
	Denmark	2	1.0	1.0	92.1
	Greece	2	1.0	1.0	93.1
	Slovenia	2	1.0	1.0	94.1
	Chile	1	.5	.5	94.6
	Estonia	1	.5	.5	95.1
	Ireland	1	.5	.5	95.6
	Japan	1	.5	.5	96.1
	Lebanon	1	.5	.5	96.6
	Malaysia	1	.5	.5	97.0
	Pakistan	1	.5	.5	97.5
	Russian Federation	1	.5	.5	98.0
	South Africa	1	.5	.5	98.5
	Thailand	1	.5	.5	99.0
	Turkey	1	.5	.5	99.5
	United Arab Emirates	1	.5	.5	100.0
	Total	203	97.6	100.0	
Missing	999	5	2.4		
Total		208	100.0		

Due to the sample selection using a multi-stage cluster sampling approach via service innovation related interest groups in a leading international professional online network, the survey questionnaire was completed by participants from 32 countries, resulting in a truly multinational sample.[37]

The dual language format of the survey questionnaire is considered a factor explaining the high representation of Germany and Switzerland, with a combined percentage of 23.1% of all respondents. Representation of U.S. participants was the highest (24.1% of responses with available country information), related to a high percentage of U.S. members within the service innovation related interest groups.

[37] Country information was unavailable for five survey participants, presumably due to individual internet provider confidentiality settings.

Industry information of survey participants was a mandatory questionnaire field. A large number of studies within the body of service innovation literature address industry-specific samples. Yet, a cross-sectional survey design was purposely chosen in order to exclude industry-specific bias or answer patterns.

Table 5-4: Industry Composition of the Sample

ID1	Service Sector	ID2	Service Sub-Sector	Frequency	Percentage
1	Business Services	100	Professional Services	19	9%
		101	Computer and Related Services	26	13%
		102	Research and Development Services	6	3%
		103	Real Estate Services	2	1%
		104	Other Business Services	10	5%
	Sub-total - Business Services			**63**	**30%**
2	Communication Serivces	107	Telecommunication Services	20	10%
		108	Audiovisual Services	2	1%
		109	Other	19	9%
	Sub-total -			**41**	**20%**
3	Construction and related Engineering Services	112	Installation and Assembly Work	4	2%
	Sub-total - Construction and related Engineering Services			**4**	**2%**
4	Distribution Services	115	Commission Agents Services	0	0%
	Sub-total - Distribution Services			**0**	**0%**
5	Educational Services	122	Higher Education Services	12	6%
		123	Adult Education	2	1%
	Sub-total - Educational Services			**14**	**7%**
6	Environmental Services	125	Environmental Services	2	1%
	Sub-total - Environmental Services			**2**	**1%**
7	Financial Serivces	126	All Insurance and Insurance-related Services	5	2%
		127	Banking and other Financial Services	9	4%
	Sub-total - Financial Serivces			**14**	**7%**
8	Health and related Social Services	129	Hospital Services	3	1%
		130	Other Human Health Services	8	4%
		131	Social Services	2	1%
	Sub-total - Health and related Social Services			**13**	**6%**
9	Tourism and Travel related Services	133	Hotels Restaurants and Catering	2	1%
	Sub-total - Tourism and Travel related Services			**2**	**1%**
10	Recreational Cultural and Sporting Services	137	Entertainment Services	2	1%
		140	Sporting and other Recreational Services	1	0%
	Sub-total - Recreational Cultural and Sporting Services			**3**	**1%**
11	Transport Services	142	Transport Services	8	4%
	Sub-total - Transport Services			**8**	**4%**
12	Other Services not included elsewhere	143	Other Services not included elsewhere	44	21%
	Sub-total - Other Services not included elsewhere			**44**	**21%**
Total				**208**	**100%**

The industry composition of the sample is displayed in Table 5-4. The largest industry representation of survey respondents was in the Business Services (1) sector with 30%, followed by Communication Services (2) with 20%. Whereas Other Services (12) also accounted for 21%, it is assumed that a number of participants selected this category in order to not reveal information about their company or due to a lack of knowledge regarding the industry classification of their organisation.

The sample was in line with expectations, reflecting a high diversity of the sector. Whereas the distribution across different service industries indicated a good representation of the overall population through the sample, a higher number of small

service firms would have been desirable. This underrepresentation can be explained by a lower level of dedicated NSD professionals in small firms and therefore reduced interest in following NSD discussions online in professional interest groups. Implications of this finding are discussed in section 7.2 dealing with research limitations. Furthermore, section 7.4 addresses this issue as part of suggestions for further research with different sampling designs. The disperse industry distribution underlines the randomness of the sample selection. Due to the overall sample size and the uneven distribution by industry, sub-partitioning of the sample by industry and related analysis of patters by subgroup was infeasible, as subgroups of equal sizes are recommended and the minimum recommended cell size is 20 observations (Hair et al., 2009). Given an unequal profile within the industry population, equal groups can only be achieved through different sampling techniques, which would have not met the objectives of this research study but could provide an adjacent research opportunity.

5.3.2. Types and Frequency of Innovation

The degree of innovativeness has been addressed in various studies in the service innovation literature (Avlonitis et al., 2001; De Brentani, 2001; Gounaris, Papastathopoulou, & Avlonitis, 2003). Whereas this study does not distinguish between innovation types of NSD projects, information the degree of innovativeness was collected in order to control for eventual effects resulting from it.

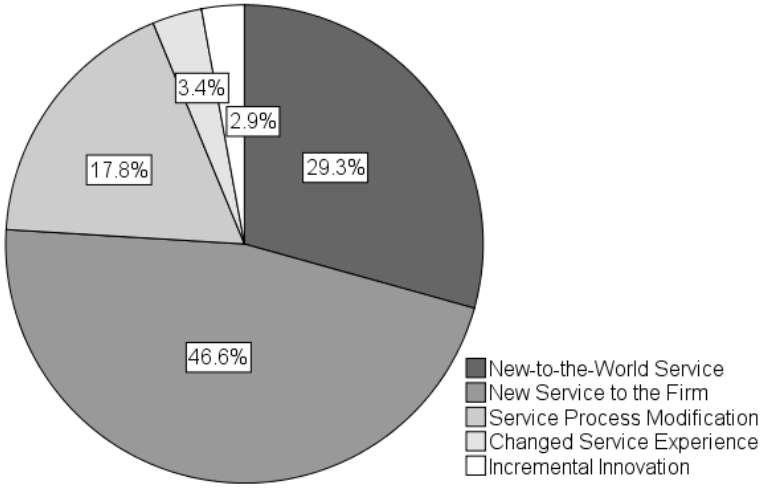


Figure 5-1: Innovation Type

The split of the sample by degree of innovativeness is visualised in Figure 5-1. The visualisation shows the highest type of innovation, as respondents had the option to select multiple categories which applied to their example. Whereas the majority of cases fall into the category of new to the firm service (46.6%), new-to-the world services make up the second largest group amongst all respondents with 29.3%. New-to-the-world service usually signifies the extreme end of the innovation scale used for disruptive innovations. Due to their significant economic and industry impact (DeTienne & Koberg, 2002), the percentage of radical innovations in reality is low. One possible explanation for the high percentage of highly innovative new services is that respondents who selected this innovation type wanted to express that the described kind of service that was introduced in the example of their choice previously did not exist in the respective format, structure, or remit. Kleinschmidt and Cooper (1991, p. 243) find that respondents tend to bias their answers towards more significant, interesting, and innovative statements. This finding can thus also be confirmed by the empirical findings of this study. De Brentani (2001), for example, analysed a convenience sample of 115 Canadian firms in the business service sector and classifies 43% of responses as discontinuous.

Table 5-5: Observed NSD Frequency

		Number of NSD Projects (Total)	Number of NSD Projects (last 5y)	Number of NSD Projects (last 12m)
N	Valid	208	208	208
Mean		30.53	13.58	3.65
Median		10.00	5.00	2.00
Mode		10	5	1
Std. Deviation		142.92	39.38	8.53
Skewness		12.87	9.89	8.27
Std. Error of Skewness		.169	.169	.169
Minimum		1	0	0
Maximum		2000	500	100

The frequency of service innovation activities is an indicator for NSD experience and know-how through learning effects. The survey questionnaire included three questions on NSD frequency. Participants were asked to provide the number of new service development projects within their organisation over a timeframe of one year, five years and in total. Table 5-5 shows the observed frequency statistics for the three variables measured.

All three categories reveal a large range, indicating strong differences in NSD activities between firms. For the question asking about the total number of NSD projects, some respondents only reported to have introduced one new service, whereas the maximum number of new service introductions reached 2'000. The question enquiring about new service introductions over the last five years and last twelve months reveals an answering range between zero and 500/100 new service introductions respectively. Table 5-5 also shows the differences in innovation activities between firms, which are reflected by large standard deviations within each category. Despite strong variations in NSD activities between firms, frequencies indicate that service innovations regularly occur, which underlines the importance of the activity. This finding is supported through the mean and mode values of 13.58 and 5.0 for service development activities within the last five years.

The analysis of innovation types and frequencies resulted in two main findings, which both reflect common findings within the service innovation literature. First, high degrees of innovativeness of new service introductions indicate that new services being introduced substantially differ from services already offered by organisations (De Brentani, 2001; Kleinschmidt & Cooper, 1991). NSD can be seen as an activity which is required in order for firms to sustain in the market place[38], underlining their strategic importance. Second, service development strongly varies between firms (Damanpour, 1991; Hipp & Grupp, 2005). Whereas some companies frequently change their service offering and introduce new services to the market place, others are able to exploit an established service for several years. Yet, NSD as a corporate activity regularly occurs, creating a basis for general interest in underlying processes and success factors amongst both practitioners and academics.

5.3.3. Sustainability Factors

The survey questionnaire collected information on nine sustainability factor for service organisations. The definition of sustainability is aligned to the common understanding of the word in a business or economics context, relating it to competencies such as stability, endurance, and long-term ability to maintain productive organisational capacity. Whereas NSD frequency as outlined in section

[38] Sustainability factors for service firms are discussed in section 5.3.3. The introduction of highly innovative new services can include both corporate growth activities such as an expansion of the service range or a change within the extant service offering.

5.3.2 is considered important for service firms, a number of other sustainability factors were rated higher in terms of their importance. Answers were collected on a five point Likert-type scale with anchors. Table 5-6 shows descriptive statistics for the nine sustainability factors included in the survey questionnaire.

Table 5-6: Sustainability Factors - Descriptive Statistics

	Range	Minimum	Maximum	Mean		Std. Deviation	Variance	Skewness[a]
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic
Service Quality	4	1	5	4.72	.040	.583	.339	-2.527
CRM	4	1	5	4.38	.055	.789	.623	-1.382
After-Sales Services	4	1	5	4.25	.062	.891	.795	-1.040
Brand	3	2	5	3.95	.058	.833	.693	-.416
Referrals	4	1	5	3.79	.074	1.065	1.134	-.417
Pricing	4	1	5	3.64	.070	1.007	1.014	-.287
Marketing	4	1	5	3.46	.070	1.016	1.032	-.188
NSD Frequency	4	1	5	3.11	.077	1.117	1.249	0.136
Client Events	4	1	5	2.89	.069	1.002	1.003	.243
Valid N (listwise)								

N=208

a. Skewness Std. Error=.169

Service Quality was the most important sustainability factor amongst participants of the survey, confirming general findings of researchers who have addressed service quality within the service literature (Cronin & Taylor, 1992; Gronroos, 1984; Landrum & Prybutok, 2004; Roth & Jackson, 1995). Parasurama, Zeithaml, and Berry (1988) propose a multiple-item scale for measuring service quality, named SERVQUAL, which has received wide attention in the services literature. Edvardsson (1997) points out that addressing service quality is an integral part of the service development process in order to achieve high quality new services. Hence, the confirmation of service quality as an important sustainability factor creates a supporting argument for Edvardsson's recommendation.

Customer Relationship Management (CRM) and *After-Sales Services* ranked second and third in terms of their mean sustainability score. Related to the service characteristic of simultaneity, the customer dimension is of paramount importance in order to achieve service success. Both CRM and After-Sales Services are processes supporting customer satisfaction with the services rendered. As services are executed at the client interface, the service concept needs to incorporate sufficient scope for managing the client relationship, receive feedback, and react to customer expectations and requirements in order to achieve high degrees of customer satisfaction and promote service performance.

5.3.4. New Service Success

The level of successfulness of new service development projects was measured in relative terms, dependent on a-priori expectations of the firm (Song et al., 2009). Descriptive statistics in Table 5-7 show that mean and mode across all service performance dimensions included in the survey questionnaire equals 3 ('meeting objectives'), whereas the average score for all variables is slightly above expectations.

Table 5-7: Service Performance - Descriptive Statistics

	Relative Revenue Performance	Relative Profit Performance	Relative Sales Performance	Relative Market Share	Relative Competitive Advantage	Relative New Customers
Mean	3.13	3.07	3.18	3.11	3.45	3.25
Median	3.00	3.00	3.00	3.00	3.00	3.00
Mode	3	3	3	3	3	3
Std. Deviation	.907	.920	.923	.788	.947	.881
Variance	.822	.846	.852	.621	.896	.775
Skewness[a]	.123	-.059	.010	.101	-.292	-.115
Range	4	4	4	4	4	4
Minimum	1	1	1	1	1	1
Maximum	5	5	5	5	5	5

N=208

a. Skewness Std. Error=.169

Table 5-8 shows frequencies of responses related to new service success. An interesting observation is that 49% of respondents have answered that the described new service development performed above expectations in terms of providing the organisation with a competitive advantage, compared to only 13% responding that the new service fell short of expectations. A possible explanation for this could be a bias of respondents towards more positive and interesting statements (Kleinschmidt & Cooper, 1991). Whereas financial performance measured through relative revenues and profitability of the new service was only slightly positive in overall terms, the finding relating to competitive advantages through NSD indicate that service innovation support long-term sustainability of a firm stronger than short-term financial goals and objectives.

Table 5-8: Relative Service Performance Frequencies

		Significantly below objectives	Below objectives	Meeting objectives	Above objectives	Significantly exceeding objectives	Total
Relative Revenue Performance	Freq.	6	39	100	47	16	208
	Percent	2.88	18.75	48.08	22.60	7.69	100
	Cum	2.88	21.63	69.71	92.31	100.00	
Relative Profit Performance	Freq.	10	39	98	49	12	208
	Percent	4.81	18.75	47.12	23.56	5.77	100
	Cum	4.81	23.56	70.67	94.23	100.00	
Relative Sales Performance	Freq.	6	39	91	56	16	208
	Percent	2.88	18.75	43.75	26.92	7.69	100
	Cum	2.88	21.63	65.38	92.31	100.00	
Relative Revenue Market Share	Freq.	4	33	116	46	9	208
	Percent	1.92	15.87	55.77	22.12	4.33	100
	Cum	1.92	17.79	73.56	95.67	100.00	
Relative Competitive Advantage	Freq.	6	22	79	74	27	208
	Percent	2.88	10.58	37.98	35.58	12.98	100
	Cum	2.88	13.46	51.44	87.02	100.00	
Relative Customer Growth	Freq.	6	28	98	61	15	208
	Percent	2.88	13.46	47.12	29.33	7.21	100
	Cum	2.88	16.35	63.46	92.79	100.00	

The service performance construct measured through relative success criteria is a key measure with regards to the hypotheses of this dissertation. Service performance is defined as dependent research variable and factors driving service success explored as part of the quantitative analysis of this thesis.

5.4. Quantitative Analysis

After an evaluation of different multivariate data analysis techniques, Structural Equation Modelling (SEM) was considered the best fitting multivariate research technique. The main reason is that the research is not of exploratory nature in that the concepts applied and tested have already been established. The research model builds on knowledge gained in new product and new service development research and introduces a new concept in order to evaluate the moderating impact of service complexity. Hence, a strong theoretical basis and a predefined measurement model provide the basis for the application of SEM, both of which are considered key requirements for its use and applicability (Hair et al., 2009).
Furthermore, the research model includes multiple interdependences between exogenous and endogenous constructs. SEM offers most flexibility and optionality in the analysis of multiple measure constructs compared to other interdependence techniques such as multiple regression analysis.

5.4.1. Factor Analysis

The study of NSD is frequently concerned with the identification of factors, which improve the success rates of service innovation projects. A magnitude of factors hereby needs to be condensed in order to derive relevant measures. The initial step of the quantitative analysis phase included consolidation of measurement variables into a measurement mode. Exploratory Factor Analysis (EFA) served as quantitative tool to examine relationships between variables, identify underlying patterns and derive a reduced set of unidimensional measures. These are used as latent factors in the analysis of a structural model using SEM (Gerbing & Anderson, 1988)[39]. Factor analysis serves a dual objective of identifying structure through data consolidation and reduce data (Hair et al., 2009). Whereas the utilisation of validated scales can already provide structured variables, the combination of scales across a number of

[39] Gerbing and Anderson (1988) propose a paradigm for deriving preliminary factor scores via EFA and using CFA to assess unidimensionality.

research findings represents a new composition of measurement items and requires restructuring of the anticipated measurement model and validation. Confirmatory Factor Analysis (CFA) was then conducted in SEM in order to evaluate the statistical model fit and thus validate the scales used for the measurement of the constructs used in the structural model. This process has the advantage of reducing measurement error that would otherwise affect the evaluation of the structural model.

5.4.1.1. Exploratory Factor Analysis

The initial research agenda was based on four success factor constructs used as independent variables, a consolidated performance construct serving as dependent variable, and two complexity constructs representing the moderating variables of this dissertation. Whereas the composition of dependent and independent constructs heavily relied on established research scales, the concept

of the moderating variable adapted components of complexity as suggested by researchers within the domain of innovation research but includes a higher degree of newness compared to the other constructs used. In order to assess overall correlation between variables and create the basis for a structural model, EFA was conducted with 64 observations and 17 assumed constructs. R-type factor analysis was performed in order to derive groupings of variables. It is the most common type of factor analysis according to Hair et al. (2009). EFA, as a multivariate technique, groups variables which load heavily onto one factor and uses derived factors as principal components describing the underlying dimensions at a minimum loss of information (Hair et al., 2009).

Factor analysis conducted used Maximum Likelihood factoring with oblique rotation (promax). As correlations between latent variables were expected, non-orthogonal (oblique) rotation was selected as the appropriate rotation method for EFA. Promax rotation was chosen over direct oblimin due to advantages in handling larger data sets and enhanced computation speed (Field, 2009). As an expectation about the components of latent constructs existed based on prior research findings but the amount of specific error variances was unknown (Hair et al., 2009), a common factor design was chosen over Principal Component Analysis (PCA), despite its popularity in a number of service innovation research studies (Avlonitis et al., 2001; De Brentani, 1991, 2001; Edgett & Parkinson, 1994). The assumption of an underlying causal model from which factors can be derived advocates the use of factor analysis over PCA (Field, 2009).

The adequacy of factor analysis at the given sample size turned out to be in the good range (between 0.7 and 0.8) following the Kaiser-Meyer-Olkin (KMO) test of sample adequacy (Kaiser, 1974). Furthermore, Bartlett's test of spherity χ^2 (253) = 1960.42 was highly significant for $p < 0.001$, indicating that factor analysis is appropriate. Both tests are shown in Table 5-9.

Table 5-9: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.758
Bartlett's Test of Sphericity	Approx. Chi-Square	1960.420
	df	253
	Sig.	.000

Two factors (development culture and organisational complexity) revealed communalities slightly below 0.4. As factors derived from common factor analysis are only based on the variance within a variable, that is shared between all variables of the analysis (Hair et al., 2009), low values indicate potential reliability weaknesses of the indicator. Process complexity includes one variable with a communality of 1.0, indicating a spurious solution. As the theoretical framework defines complexity as a moderator, the absence of a causal relationship between complexity and other variables is of no concern.

Factors were derived by applying the latent root criterion and thus on the basis of having an eigenvalue greater than 1 (Kaiser, 1960). Despite some critics accusing this criterion of being related to fundamental problems (Nunnally, 1978), Kaiser's rule is a commonly applied method within the innovation research literature (Astebro & Michela, 2005; Gatignon et al., 2002; Zirger & Maidique, 1990). Issues of an overestimation of factors based on sample size (Velicer, 1976) were considered to be outweighed by the strict elimination of variables based on factor loadings.

The seven factors combined accounted for 57.91% of the total variability in the descriptive variables of the intended measurement model. The process of eliminating variables from the factor model was iterative and based on low factor loadings and cross-loadings between factors. Froehle and Roth (2007) argue that such an iterative refinement process helps to ensure consistency of construct domains and definitions and applicability across multiple service sectors. The result of the elimination is shown in Table 5-10. For all factors, a minimum number of two explanatory variables was kept following common research practice (Churchill, 1979). All factors apart from

development culture have factor loadings above 0.6. Given a suggested threshold of 0.4 at a sample size of 200, high loadings within one factor signify good convergent validity. Furthermore, the combination of high factor loadings and the absence of cross-loadings indicate good convergent and discriminant validity.

Table 5-10: Pattern Matrix

Factor	Service Performance	Development Formality	Organisational Complexity	Process Complexity	Development Culture	Timing Plans	Project Leadership
Cronbach's Alpha	0.887	0.837	b.	b.	0.682	0.789	0.588
Service Success - Revenue	.964						
Service Success - Profit	.883						
Service Success - Sales Growth	.776						
Service Success - Market Share	.639						
Service Success - Competitive Advantage	.617						
SF Documentation3		.800					
SF Structure6		.781					
SF Planning5		.687					
SF Structure4		.644					
SF Structure1		.617					
Size - Total Employees World-wide			.852				
Size - Total Countries with Presence			.753				
Number of Hierarchy Levels			.610				
Number of Sub-Processes				1.019			
Number of Functions Involved in Service Delivery				.705			
MS Management Support1					.625		
MS Management Support2					.621		
OF Culture2					.571		
OF Frequency1					.529		
SF Planning2						1.006	
SF Planning3						.639	
MS Project Leader4							.648
MS Project Leader3							.645

Extraction Method: Maximum Likelihood.

a. Rotation converged in 6 iterations.

b. Cronbach's alpha scores not used as reliability measure for multi-dimensional constructs.

The pattern matrix in Table 5-10 also shows internal consistency for the factors derived. Cronbach's alpha is above 0.8 for Service Performance and Process Formality and above 0.7 for Timing Plans. Development Culture and Project leadership were below the recommended value of 0.7 (Nunnally, 1978). Whereas this could give reason for concern, reliability of all measurement items is assessed as part of CFA, where a measurement model fit is discussed in order to derive a view regarding internal consistency of measures. This includes the alpha scores for the two complexity factors, which are outside the acceptable range and require further investigation.

Convergent validity was assessed by analysing correlations between factors. Table 5-11 shows the factor correlation matrix for the seven factors derived. The highest correlations between factors are in the 0.4 range, indicating that the maximum level of shared variances is below 25%. Thus, convergent validity of the seven factors derived is good.

Table 5-11: Factor Correlation Matrix

Factor	1	2	3	4	5	6	7
Service Performance	1.000						
Process Formality	.126	1.000					
Organisational Complexity	.074	.023	1.000				
Process Complexity	.138	.131	.234	1.000			
Development Culture	.429	.147	-.033	.052	1.000		
Timing Plans	.170	.463	.076	.138	.205	1.000	
Project Leadership	.033	.263	.067	-.009	-.029	.026	1.000

Extraction Method: Maximum Likelihood.

Rotation Method: Promax with Kaiser Normalization.

Seven factors in total were derived from exploratory factor analysis of the measurement variables. These include a factor for NSD performance, used as the dependent variable, four NSD success factors (independent variables) as well as two moderating constructs for complexity measurement.

Service Success, as dependent variable, loaded on to a single factor. Therefore, further separation of service performance into financial performance, sales performance and market performance was not possible. Interestingly, the variable measuring relative performance with regards to the market share was dropped during EFA, due to a factor loading below 0.5.

Variables relating to process structure and planning loaded on to the factor named *Process Formality*. The use of *Timing Plans* created a separate factor in the analysis. Besides *Project Leadership*, the factor named *Development Culture* was composed of a mix of variables related to organisational innovation conditions and includes variables relating to senior management support, innovation culture and NSD experience, all of which loaded on to the same factor.

In summary, EFA delivered four latent factors for further analysis as independent variables, two complexity constructs, serving as moderating variables, and a single dependant variable, representing the degree of NSD success. Anderson and Gerbing

(1988, p. 416) point out that re-specification of the measurement model can be necessary as a response to non-convergence or in order to avoid an improper solution. A reassuring outcome of the EFA stage was that variables that loaded on to factors based on eigenvalues exceeding 1.0 were in line with expectations and conceptually meaningful. Both assessments of discriminant and convergent validity yielded good results. Yet, some concerns regarding reliability were raised through communality issues and some low alpha scores. The outcome of the EFA phase was integrated into a measurement model, which was validated and further tested for reliability using confirmatory factor analysis.

5.4.1.2. Confirmatory Factor Analysis

The structure of seven factors derived from the EFA phase was evaluated using Confirmatory Factor Analysis (CFA) through structural equation modelling. The objective of this step is to establish confirmation of the validity of the derived factor structure in order to assess statistical significance of the measurement model. Hair et al. (2009, p. 618) point out that despite it being a rigorous procedure, CFA does not prove a proposed model but rather confirms if the model is one of several possible models that fit the data. Specifying the measurement model is a critical step in CFA through SEM, as it represents the basis for evaluating a structural model and further testing via SEM.

Each latent construct shown in the measurement model based on factors derived via EFA. The observed variables are treated as reflective indicators of the assumed construct. The latent variable hence explains the observed variable combined with an error term, representing the observed unexplained variation.

The path diagram of the measurement model includes seven latent variables derived from EFA as well as the structural relationships between the measurement variables and the constructs. Covariances of residuals were added to the measurement model in order to improve overall model fit. In order to avoid conceptual implications of these model re-specifications, only residuals to one factor were allowed to be co-varied. Brown (2006) explains that when correlations between residual variables occur, some of their covariance is due to factors other than the common latent factor. The possibility to account for such correlations is a substantial advantage of SEM-based CFA approaches over EFA. Each construct is defined by at least two indicators, following common suggestions relating to the construction of constructs (Bollen, 1989; Geffen & Straub, 2000; Hair et al., 2009).

The measurement model generally reveals strong measurement relationships between variables (represented through rectangles) and constructs (depicted as ovals) with the exception of Project Leadership, where the dependence relationship is below 0.4. This imposes that the variable 'Project Leader 1' is only a moderate indicator for the latent construct. Yet, the average of both relationships is above 0.8, indicating that overall the construct is sufficiently explained by the measurement variable. A further visual check of the measurement model examines the covariances between latent constructs. The highest covariance is between Process Formality and Timing Plans and amounts to 0.50. As both constructs were initially assumed to be grouped under the second-order construct Planning and Formality, this confirms a-priori expectations. The covariance value of 0.50, however, is not significant enough to indicate multicollinearity issues.

The seven latent variables included in the measurement model were derived from EFA – service performance as the dependent variable, four independent variables, and two complexity constructs used to test for moderation effects. The path model created during CFA was used to calculate factor scores for the latent variables. The calculation was done in Amos, using Bayesian parameter estimation. Whereas Maximum Likelihood (ML) estimation generally assumes normality of distribution, multivariate distribution of the indicators constituting latent endogenous variables is likely to result in substantial deviation from normality, based on the size of structural equation coefficients and non-linear product term covariances (Moosbrugger, Schermelleh-Engel, & Klein, 1997). CFA results indicate non-linearity in product term covariances, indicating the appropriateness of an alternative parameter estimation method other than ML. Bayesian estimation is a multiple imputation method that is close to stochastic regression imputation (Arbuckle, 2012). Whereas ML parameter estimation is the more commonly used parameter estimation technique, both ML and Bayesian estimation are model-based inference methods, which are substantially different in their approach but generate similar output (Wall, 2009). With regard to the dataset that was used in this thesis, Bayesian parameter estimation has the advantage that the search for a solution can be restricted to admissible parameter values which occur due to negative variance in the factors. Bayesian estimation further takes into account that parameter values are only estimated but not known (Arbuckle, 2012). Smith and Naylor (1987) state that Bayesian methods have practical advantages in handling unusually shaped likelihoods over maximum likelihood approaches, as they do not rely on asymptotics. Yet, Maximum Likelihood parameter estimation is generally more frequently applied, due to increased conceptional and computational simplicity (Cortina, Chen, & Dunlap, 2001). Despite

the different approaches of both estimation methods, the results are almost identical. Hill (1990, p. 115) describes that "*…besides varying interpretations of probability, the only essential difference between schools is in the model itself.*" Bayes factor scores were required to calculate product scores for the moderation effects. The structural model, however, also includes the original latent factors and is therefore a hybrid model.

Model fit was established based on some of the criteria outlined by Hu and Bentler (1999) for the Maximum Likelihood (ML) method. Maximum Likelihood is one of the most widely used fitting functions, following the assumption of normally distributed observations (Hoogland & Boomsma, 1998). In terms of the assessment of absolute model fit, Johnson (2004) points out that the classical chi-square-based goodness-of-fit methods used in ML estimation can be inappropriate for assessing model fit in high dimensional settings. Whereas the application for alternative goodness-of-fit models is generally considered complicated, both the measurement and structural model used in this thesis are not highly complex in terms of their multi-dimensionality and therefore the application of ML model fit indicators seen as the best choice for assessing model fit. The chi-square value is a traditional measure for model fit and considered to be one of the most substantive tests of model fit for SEM approaches (Barrett, 2007). It measures the "*…magnitude of discrepancy between the sample and fitted covariances matrices*" (Hu & Bentler, 1999, p. 2). Due to limitations in case of larger sample sizes and the underlying assumption of multivariate normality (Hooper et al., 2008), alternative fit measures provide additional reliability when addressing model fit. Hair et al. (2009, p. 644) assert that for samples sizes below 250 in combination with a number of variables between twelve and 30 (the category, which the dataset and structural model used in this thesis falls into), the chi-square test is likely to deliver significant p-values even with good model fit. Hence, significant p-values of the chi-square test were generally not considered to indicate poor model fit and the relative chi-square index used as an alternative indicator. Compared to the absolute chi-square index, the relative index by degree of freedom adjusts for sample size and is therefore reported in this thesis.[40]

The cut-off criteria, which have been used to establish goodness-of-fit of the models are the Comparative Fit Index (CFI), and the Tucker-Lewis Index (TLI). Additionally, the standardised root mean square residual (SRMR) and the root mean squared

[40] The relative chi-square index, also named normed chi-square is also not undisputed as a fit measurement index. Kline (2011, p. 204) sees no relation to sample size in it and discourages its use due to a lack of statistical and logical foundation of the measure.

error of approximation (RMSEA) are reported. The suggested values for good model fit are ≥ 0.95 for both CFI and TLI and ≤ 0.06 for SRMR and RMSEA, whereas the cut-off values for satisfactory model fit are slightly lower at CFI and TLI ≥ 0.90 and SRMR and RSEMA ≤ 0.08 (Hu & Bentler, 1999). Furthermore, the ratio of chi-square by degree of freedom should be below the value of 2.5 for good fit and below the value of 3.0 for satisfactory fit.[41] Model fit cut-off indices only provide a guideline for establishing if the hypothesised model is adequately grounded in the observed data. Yet, good model fit does not a guarantee validity of research results. There are a number of additional factors that need to be considered such as sample size, types and ranges of data, as well as general acceptability of measurement scores (Schreiber et al., 2006). Especially sample size is a factor that can impact model fit. Whereas larger sample sizes are beneficial in order to establish statistical significance of anticipated relationships, it is generally detrimental to model fit measures (Hox & Bechger, 1998). Whereas Hox and Bechger (1998) report samples of about 200 observations as reasonable for multivariate models in simulation research, typical samples using ML estimation are typically around 400 (Hoogland & Boomsma, 1998). Yet, large samples can lead to over-sensitivities and indicate poor fit (Hair et al., 2009). An example for this level of sample size within the innovation literature is a study of global new product development programs by Kleinschmidt et al. (2007), who analysed a sample of 387 observations using SEM. Yet, Froehle et al. (2007) apply a SEM based path model approach based on a sample size of 175, indicating that sample sizes below 200 are not uncommon in service research. The discussion around an adequate sample size for SEM includes come controversy. Whereas some researchers do not shy away from the evaluation of small samples with SEM methods, it has been suggested that SEM analyses of samples below 200 should be outright rejected from publication unless if the population from which the sample is drawn is by itself small or restricted in size (Barrett, 2007, p. 820). With regard to the sample used in this thesis, the number of 208 valid observations meets the general acceptance criteria for SEM and is therefore considered adequate for the chosen methodology.

The measurement model reveals good fit statistics, indicating that the constructs obtained through self-reported scales are adequate both in terms of convergent and discriminant validity. Both CFI and TLI are well above 0.9 (0.956 and 0.944

[41] Wheaton et al. (1977, p. 99) even suggest a ratio of around 5 as an acceptable value, based on a sample size of 932 observations.

respectively), indicating that the absolute fit of the measurement model is close to the fit of an independence model and therefore good. The chi-square ratio by degree of freedom is 1.396 and thus far below the 2.5 cut-off criteria for good model fit. RMSEA equalling 0.044 and SRMR of 0.055 also meet the 0.06 limit and indicate that the data fits the model well. Good model fit of the measurement model is essential, as it represents the basis for both the derived latent factors and hybrid factor constructs, used in the structural model. Causalities in structural model paths can only be established on the basis of a model that can adequately reproduce the data without a requirement for further adjustment or re-specification.

Based on the ascertainment of appropriate model fit of the measurement model, the latent constructs were used to for the creation of a structural path model in order to test the hypotheses of this thesis.

5.4.2. Test of Hypotheses

This study recognises the deep level of analysis and the broadness of empirical findings that service researchers have delivered. NSD service performance drivers correspond to a limited extend to success factors relevant to the development of new products. Yet, findings show inconsistencies and a validated link between service performance and success factors is yet to be established. In order to analyse the relationship between these success factors and development performance, a mediated SEM path model was created as methodological research tool in order to analyse the hypothesis formulated in section 3.3. The model assumes contingency effects resulting from inherent service complexity. As such, it adds a new dimension to the on-going discussion and strives to overcome restrictions imposed through national or sectoral research designs.

5.4.2.1. Structural Model

The structural model that was developed prior to data collection included a number of additional factors and components, which were excluded from the analysis following exploratory factor analysis of collected data. Whereas the measurement items were derived from prior research on NSD success factors in synopsis with empirical results on NPD performance drivers, the combination of measurement items was new and resulted in a number of conceptual changes, such as a reduction in research constructs and related hypotheses. Whereas the nature of empirical research is likely to bring about unanticipated change, it was considered a more candid approach to stick to the factual research chronology rather than revise and reduce hypotheses ex-

post. In order to not compromise the rigour of the inductive research approach followed in this thesis, the sequence of EFA followed by CFA was purposely chosen. Anderson and Gerbing (1988, p. 412) describe this research approach as an 'ordered progression', which can be employed instead of a strict dichotomy between EFA and CFA. Despite building on extant theory in NSD, the research design included elements of scale development, especially with regards to complexity measurement. EFA is suggested to be more appropriate in these scenarios, as it reveals how well items load onto both anticipated and non-hypothesised factors (Hurley et al., 1997). All factors obtained through EFA were retained in the research model and are in line with the initial theoretical framework, despite a reduction in the overall number of factors. Kelloway (1995, p. 220) outlines the merits of a 'looser' strategy in cross-validation of model parameters in that it allows to focus on parameters of interest (constrained to equality) while freely estimating other parameters within the sample.[42]

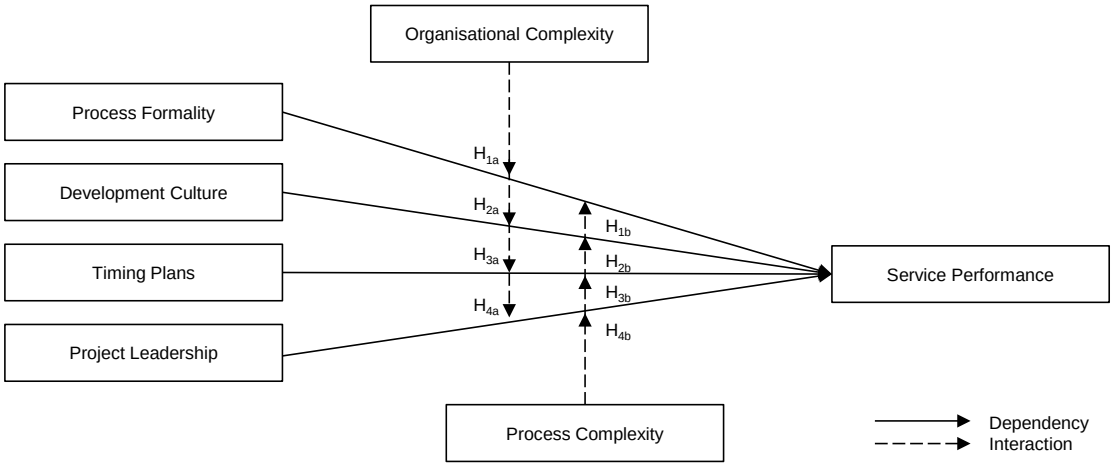


Figure 5-2: Theoretical Structural Path Model

The theoretical structural path model depicted in Figure 5-2 includes four antecedents of service performance. The relationships of the factors contributing to NSD performance are moderated by two complexity constructs, namely organisational and process complexity.

The theoretical structural path model differs from the structural path model composed for SEM analysis in Amos, as the interaction is depicted by arrows from the moderator to the relationship between predictor and dependent variable. The SEM model includes further variables, computed as product scores of the respective

[42] See MacCallum et al. (1994) for further information.

predictor and moderator. Thus eight additional variables were added to the SEM model. The research hypotheses are shown in the model along the interaction lines. Interaction is assumed for both moderators (process complexity and organisational complexity), resulting in eight updated research hypotheses.

A full structural path model was used for analysis purposes.[43] The dependent variable is constructed as a hybrid term and includes the underlying measurement variables. As the computation of the product terms required factor scores, these were also used as independent variables instead of hybrid constructs for consistency. All independent variables reveal covariances between the latent constructs. Analogous to correlations, covariances are defined as non-directional relationships between constructs (Weston & Gore, 2006). Given that the model only includes a single stream of unidirectional relationships (from the independent variables to service performance, as dependent variable, indicated by single-headed arrows), covariances are assumed between all independent variables including the moderators. Garson (2012, p. 20) states that SEM analysis customarily assumes correlation between independent predictor variables, unless there is theoretical reason for not doing so. SEM models frequently include more complex relationships, where directional paths involve several groups of independent variables. In such cases, only variables that are assumed to correlate to a certain extent are covaried within the measurement model. The possibility to include correlations of predictor variables is a feature of SEM, which recognises the effect of correlations but excludes them from the model. As such, the focus is on directional paths, which are explained through the model (Lei & Wu, 2007).

The structural path model scored highly in terms of the previously mentioned goodness-of-fit indicators. The reported overall fit indices are: Chi-square/df = 2.024; CFI = 0.982; TLI = 0.948; RSMEA = 0.016 and SRMR = 0.027. The overall fit of the model indicates unidimensionality of the constructs (Gerbing & Anderson, 1988), forming the basis for further analysis in SEM. It is important to underline, that SEM is a multivariate technique that is based on underlying theory (Hair et al., 2009; Kline, 2011). Whereas it can also be used to conduct confirmatory factor analysis, a priori theories and assumptions about relationships between variables represent a necessary condition.

[43] As outlined in section 5.4.2.3, the fully moderated structural path model is the second step towards the creation of a parsimonious structural model that was the end result of the data analysis stage.

5.4.2.2. Moderation

Moderator variables have been described as third variables, partitioning "*…a focal independent variable into subgroups that establish its domains of maximal effectiveness in regard to a given dependent variable*" (Baron & Kenny, 1986, p. 1173). As such, moderator variables impact the strength and/or direction of a relationship between an independent predictor variable and a dependent variable. Moderation is often also referred to as interaction. The two terms are used interchangeably in this thesis.

The existence of moderating effects of organisational complexity on the relationship between some of the antecedents of new service performance as developed within the body of literature on innovation research (e.g. Atuahene-Gima, 1996; Cooper & Kleinschmidt, 1995; De Brentani, 2001; Froehle et al., 2000) represents a key hypothesis of this dissertation. The assumption hereby is that mixed research findings regarding the success factors in NSD are due to differences in inherent complexity amongst the organisations included in the respective research samples. Findings of contingent relationships between NSD performance and success factors on complexity would be of general interest to both the research community and practitioners but also have implications for continued research on service success, as complexity as a measurement variable can be either directly included in the research design or treated as a control variable in order to mitigate its effect.

The development of social sciences has resulted in increased complexity of hypothesised relationships in research models (Cortina, 1993a) and has thus driven the popularity of SEM as an analysis tool. With regard to moderation and interaction analysis using SEM, Williams et al. (2009, p. 570) postulate that in contrast to the well-established methods to test for interaction effects in multiple regression analysis, "*…methods for analyzing moderation in structural equation models are continuing to evolve*". Yet, a large advantage of SEM based interaction analysis is that due to explicit control of measurement error, interpretive power of SEM interaction models is higher than in regression based techniques (Steinmetz, Davidov, & Schmidt, 2011). Kline (2011, p. 327) states that the "*…estimation of the interaction effects of continuous observed variables in SEM uses the same method as in moderated multiple regression* (MMR)." As such, the impact of a continuous moderating variable is modelled by creating a new variable as the cross-product term of the predictor (X) and the moderator (Z) (Little et al., 2007).

Following Judd and Kenny (1984), interaction effects can be formulated by the following equation:

$$Y = i + \alpha X + \beta Z + \gamma XZ + \varepsilon$$

whereby Y stands for a dependent or endogenous variable, which is explained by the independent variables X and Z plus a residual ε.[44] α, β, and γ are regression coefficients in the equation and i is the intercept of the regression equation.
A commonly found issue with product scores relates to convergence problems such as collinearity. The underlying reason for multicollinearity is the probability of a covariance between independent variable and moderator, and collinearity impedes the distinction between effects that are due to linear and interaction terms (Echambadi & Hess, 2007). Solutions frequently suggested in the literature are mean centering and residual centering. Echambadi and Hess (2007) argue that mean centering does not resolve the collinearity issues – it neither worsens or improves the analysis results. Following a suggestion by Lance (1988), standardisation of variables is likely to aid the interpretation of variables with arbitrary scales, by placing all variables on a common measurement scale. Standardisation helps to reduce correlations between interaction and linear effects but still maintains the information conveyed via the interaction effect. In a two-step approach, Bayes factors were first standardised and then used to compute cross-product terms for interaction.

Most approaches used in moderated structural equation models (MSEM) or latent moderated structural equations (LMS) go back to the original work of researchers such as Judd and Kenny (1984). Advances in statistical programs that are available to a broad research community have resulted in an increase in the application of MSEMs and LMSs. Yet, there are still critical voices regarding the appropriateness of such procedures and researchers have to balance quantitative elegance of methods with restrictions regarding usability and interpretability of research results (Cortina et al., 2001).

[44] The unexplained residual in SEM corresponds to the error term on the endogenous variable, for which reason it has been named ε.

5.4.2.3. Analysis and Model Re-Specification

The analysis of predicted relationships in SEM is based on a model structure, which includes measurement items and causal relationships in the form of regression paths. The actual analysis of the structural model and test of hypotheses was exercised once satisfactory model fit of both the measurement model and structural model were established.

Table 5-12: Means, Standard Deviations and Inter-correlations

		M	S.D.	1	2	3	4	5	6
1	Service Performance	.00	.75	__					
2	Process Formality	.05	.84	.139**	__				
3	Organisational Complexity	.47	35.94	.078**	.01	__			
4	Process Complexity	.17	4.09	.092**	.195**	.304**	__		
5	Development Culture	.00	.41	.573**	.163**	-.01	.106**	__	
6	Timing Plans	.04	.84	.201**	.557**	.049*	.148**	.270**	__
7	Project Leadership	.02	.54	.090**	.462**	.042*	.109**	.02	.146**

** Correlation significant for $P < 0.01$ level (1-tailed).
* Correlation significant for $P < 0.05$ level (1-tailed).

Inter-correlations of factors used in the structural model and descriptive statistics are presented in Table 5-12 for the observed latent variables. Discriminant validity was checked by examining the level of factor correlations. With the exception of *Process Formality* and *Timing Plans*, all inter-correlations of independent variables were below 0.5. Correlation of these factors was expected, as both factors are part of the same second order latent construct assumed as part of the initial theoretical framework relating to structured process organisation. The correlation is still below the suggested value of 0.85 (Brown, 2006, p. 32), therefore not indicating discriminant validity issues of latent factors within the model.

Whereas model specification or model building involves the addition of paths to an underspecified model also referred to as null model, model analysis in SEM typically starts with an over-identified model, which includes paths for all hypotheses to be evaluated. Model fit is typically high in an over-identified models as chi-square increases with the addition of complementary paths (Kline, 2011). In over-identified models several solutions for path relationships between parameters are included, of which only some represent an optimal solution. The process of modifying the model by deleting not required paths is a way of achieving a just-identified model. The

underlying logic of model trimming is that a path which is not statistically significant has a zero or null relationship and should therefore be deleted. Critics of model trimming point out that model trimming can lead to a reduction of the total direct and indirect effects explaining a variable (Peyrot, 1996) or give rise to the issue of significance by chance (Kline, 2011). Therefore, only interaction effects, which in themselves do not add further explanation to the model, were dropped. When deciding on model re-specification, it is further important to avoid errors, which can affect general model validity and produce biased or misleading results. In a moderated model, the individual components used to derive the product score cannot be omitted, as it represents the interaction only when the effect of the components is partialed out (Cohen, 1978). Whisman and McClelland (2005, p. 113) explain that "*…leaving out the individual components in the regression model inherently confounds the additive and multiplicative effects*".

In an effort to determine the most parsimonious model, which fully explains the collected empirical data and supports the process of testing the theory underlying this research, a two-step process as suggested by Anderson and Gerbing (1988) was applied. This involved the creation of a structural model that reflected the latent constructs that were derived via EFA and validated through CFA. Once goodness-of-fit criteria for the basic structural model indicated that the model adequately reflected the data, several alternative models were developed and used to test the research hypotheses. For reference, a similar approach was chosen by Bell and Kozlowski (2008), using a moderated structural equation model to test active learning.

The process of testing alternative models started with a basic hybrid structural model. Six independent latent variables explain 33.9% of the variation in service performance. The basic model shows good model fit: Chi-square/df = 2.159; CFI = 0.959; TLI = 0.978; RSMEA = 0.017 and SRMR = 0.029. The second step in the two-step process suggested by Anderson and Gerbing (1988) involves testing of alternate models. Three of the four success factors included in the model revealed a significant positive impact on service performance. *Development Culture* was highly significant at the $P<0.001$ level. Development Culture was measured as a composite score including elements relating to senior management support, organisational culture, and transfer of development knowledge and experience. In the order of success factors, it takes the lead position with an unstandardized regression coefficient of 0.464. The result suggests that a single unit increase (1.0) in in development culture as the predictor variable is associated with a 0.5 increase in service performance. *Project Leadership* and *Timing Plans* were also significant at

the *P*<0.01 and *P*<0.05 level respectively. The strength of the relationship is far below development culture at an unstandardized estimate of 0.06 and 0.05. *Process Formality* was the only latent variable that does not significantly related to service performance. This confirms some of the earlier findings in literature, stating that structure and formality in NSD does not lead to better results (Edvardsson & Olsson, 1996; Martin & Horne, 1993). The findings regarding the four measured antecedents of service performance were regarded as the basis for further analysis. It was also expected that the introduction of product scores for interaction effects would not change the basic results of the initial un-moderated model.

In order to test the theory of moderation through complexity, eight further variables and constraining interaction paths were added. The resulting model is a fully-moderated hybrid structural model. Factor scores increased both the chi-square ratio and the degree of freedom, but model fit indicators overall showed a small improvement in goodness-of-fit: Chi-square/df = 2.024; CFI = 0.982; TLI = 0.948; RSMEA = 0.016 and SRMR = 0.027. This was in line with suggestions in the SEM literature, that model fit generally improves with the addition of paths (Kline, 2011; Williams et al., 2009). The addition of components is different from the addition of paths between extant model components. Yet, as product scores are based on information that was already included in the model, worse model fit from the addition of interaction terms is considered unlikely and therefore the addition of interaction terms seen as similar to the addition of paths.

The model with all moderation terms (Model 3) explained 37.8% of the variation of the dependent variable. An increment in the squared multiple correlations (ΔR^2) which is significantly different from zero indicates that the moderated model is significantly different from the basic model (Whisman & McClelland, 2005). The increase in R-squared of 3.8% can be seen as evidence of interaction effects within the model. Furthermore, a chi-square difference test for the two models was highly significant ($\Delta\chi^2$=609.02; df=352; *P*<0.001), confirming the better model fit of the moderated model. The basic hybrid structural model (Model 2) is nested in the fully moderated hybrid structural model. This is a necessary condition in order to derive confirmation of positive interaction based on a significant chi-square test (Garson, 2012; Mathieu, Tannenbaum, & Salas, 1992). Moderator effects have been found to be elusive and hard to detect (McClelland & Judd, 1993). Thus, model re-specification was done by constraining non-significant moderator paths in the model and by setting them equal to zero. Garson (2012) describes that in a re-specification approach, the researcher starts with a saturated model and sets individual

constraints to non-significant paths in an attempt to generate a more parsimonious model, which still reveals good fit to the data. This approach was followed in order to test hypotheses. Ullman (2006) describes that model modification can be done to improve model fit and test hypotheses. Whereas the improvement of model fit falls into the category of exploratory work, testing of hypotheses serves theoretical purposes and should be done on the basis of underlying theory. Several examples of research following a similar approach can be found in psychological and social studies (Ahearne, Mathieu, & Rapp, 2005; Bell & Kozlowski, 2008; Farmer, Tierney, & Kung-McIntyre, 2003; Perdue & Summers, 1991).

The evaluation of interaction effects revealed that no significant paths exist between moderating product terms relating to organisational complexity. All paths involving moderator terms relating to organisational complexity were subsequently constrained to zero but variables kept in the model. In a next step of the model re-specification process, paths between development culture and project leadership moderated by process complexity were constrained, due to a non-significant impact on service performance. The resulting final model is named constrained moderated hybrid structural model (Model 4). Fit statistics of the models used in the analysis phase are shown in Table 5-13.

Table 5-13: Model Fit Statistics for Alternate Structural Models

Model	χ^2	df	χ^2 / df	CFI	TLI	RMSEA	SRMR
1 Measurement Model	279.14	200	1.40	0.96	0.94	0.044	0.055
2 Basic Hybrid Structural Model	688.75	319	2.16	0.98	0.96	0.017	0.029
3 Fully Moderated Hybrid Structural Model	1357.77	671	2.02	0.98	0.95	0.016	0.027
4 Constrained Moderated Hybrid Structural Model	897.51	407	2.21	0.98	0.96	0.017	0.032

Note . CFI = Comparative Fit Index; TLI = Tucker-Lewis Index ; RMSEA = Root Mean Squared Error of Approximation; SRMR = Standardised Root Mean Square Residual

The final model reveals high goodness-of-fit indices, indicating that the model reflects the empirical data well: Chi-square/df = 2.205; CFI = 0.981; TLI = 0.961; RSMEA = 0.017 and SRMR = 0.032. The final model (Model 4) was a constrained structural model. Constraining of paths relating to interaction terms is considered part of the testing process and thus seen as a modification that is theoretically supported. It therefore meets the criteria that are frequently cited in respect of model re-specifications (Anderson & Gerbing, 1988; MacCallum, 1986).

The control variables described in section 4.2.1.2 were subsequently added to the model in order to test for an eventual presence of spurious relationships within the structural model. The addition of the three previously described controls (degree of innovativeness, development experience, availability of dedicated development facilities) resulted in a deterioration of the overall model fit. Furthermore, the relationships between independent variables, the interaction terms and the dependent variable remained directionally stable and did not reveal significant change as a result of the addition of controls to the model. This led to the conclusion that the relationships explicitly tested for are of non-spurious nature and controls were not required in the model, due to a lack of additional information with regards to the explanation of the overall variance of the dependent variable (ΔR^2=0.002) or an effect on the explored causal relationships of the model. Control variables were therefore excluded from the model for further analysis.

5.4.2.4. Results

As a consequence of the absence of significant paths between moderating product scores relating to organisational complexity, no evidence was found in support of hypotheses $H1_a$ – $H4_a$. The initially hypothesised organisational complexity construct represents a novel measurement construct. Whereas the composition of the scale was made in dependence on general findings within the theory of organisations related complexity, EFA resulted in a lack of coherence between measurement indicators. As a consequence, the construct that reflected an anticipated composition of factors relating to organisational size, hierarchies, and infrastructural conditions was reduced to a construct predominantly based on organisational size. Thus, the lack of support for hypotheses related to organisational complexity can be related to measurement difficulties of the construct.

$H1_b$ asserts that *Process Formality* is more positively related to *Service Performance* in an environment of high *Process Complexity*. This hypothesis was supported through SEM analysis using the constrained theoretical model (Model 4). Whereas *Process Formality* is non-significant as a performance driver, the interaction terms is highly significant at the *P*<0.001 level (β=0.141). In order to visualise the interaction effect, a procedure suggested by Aiken and West (1991) has been adopted for standardised estimates as described by Cortina et al. (2001). The plot for the interaction of *Process Complexity* on the relationship between *Process Formality* and *Service Performance* is shown in Figure 5-3.

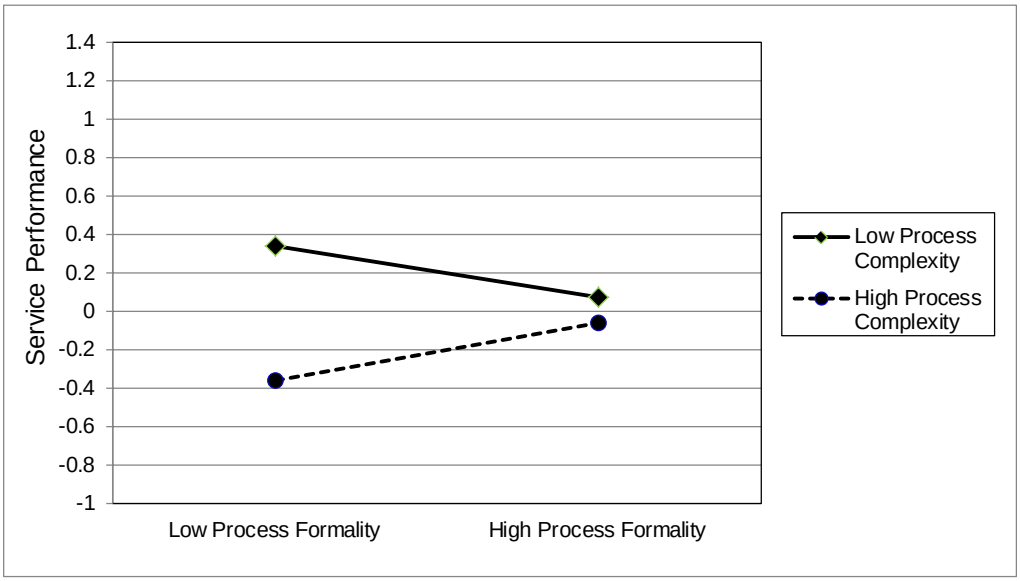


Figure 5-3: Moderating effect of Process Complexity on Process Formality

Whereas the level of process formality in the development process reveals a negative slope for low levels of process complexity, services of high process complexity show a positive relationship between the degree of inherent process formality and the service performance outcome, supporting the research hypothesis. The use of *Timing Plans* as a success factor turned out to be significant at $P<0.01$ ($\beta=0.068$). As the interaction term relating to Process Complexity was itself non-significant, the path was constrained to zero in the final model and no evidence found in support of $H2_b$.

Development Culture was identified as the strongest success factor in terms of new service development performance for $P<0.001$ ($\beta=0.553$). Given the strong impact on service performance, the interaction term fell short in terms of significance and was constrained to zero in the final structural model. Hence, no support can be reported for $H3_b$, asserting a stronger performance impact of *Development Culture* for NSD projects in an environment of high *Process Complexity*.

A positive moderating impact of *Process Complexity* on the relationship between *Project Leadership* and *Service performance* is hypothesised in $H4_b$. Whereas *Project Leadership* is significant at $P<0.001$, a significant interaction term (also at $P<0.001$) shows a moderating impact of *Process Complexity*. $H4_b$ is supported through the positive direction of the interaction impact.

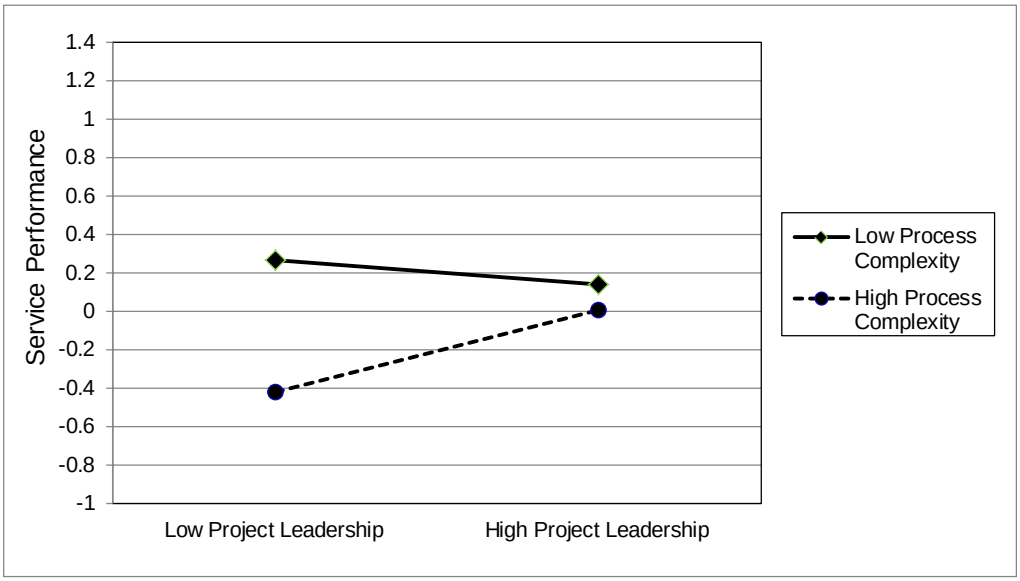


Figure 5-4: Moderating effect of Process Complexity on Project Leadership

The standardised coefficient of the interaction term (β=0.138) exceeds the un-moderated standardised coefficient of *Project Leadership* (β=0.075), which provides support for $H4_b$. The interaction plot shown in Figure 5-4 shows a similar moderation impact of *Process Complexity* as in the interaction of *Process Formality*. The figure indicates that services at low levels of process complexity do not benefit from increases in project leadership, whereas a significant enhancement is achieved for services at higher levels of process complexity.

The existence of evidence supporting the hypothesis of a moderating impact of some of the reported antecedents of new service success and service performance confirms the expectation that complex services behave differently to simple services. H0 asserts that highly complex services are more positively correlated to the antecedents of service performance than services with lower degrees of complexity. As previously outlined, only $H0_b$ could be supported related to difficulties in the measurement of *Organisational Complexity*. Yet, the implications of the general findings are far-reaching and require further discussion. First, positive correlations between service performance and all of the assumed service performance drivers apart from *Process Formality* create a case supporting the mixed findings in the service innovation literature. Second, reported evidence showing a positive interaction effect of *Process Complexity* on the aforementioned relationship provide support for the general thesis that complexity is a factor that should be considered in

the development of new services. The findings are relevant both from a theoretical and practical perspective and indicate directions for new avenues in future NSD research.

Chapter 5 provided a detailed overview of how the empirical dataset of this thesis was prepared for quantitative testing. The key hypotheses of this research were tested through a moderated structural model using SEM. Data analysis followed a rigorous research methodology by following established testing procedures and embracing guidance on statistical methods e.g. by Hair et al. (2009). The research results provide support for a moderating impact of *Process Complexity* on both *Process Formality* and *Project Leadership* as determinants of NSD success. The use and adherence to *Timing Plans* as well as *Development Culture* were found to be significant and highly significant as NSD success factor, notwithstanding of interaction through complexity. Outcomes and results are discussed in more depth in following section.

6. Evaluation of Research Results

The analysis of the empirical dataset used in this thesis delivered a number of both interesting and surprising results. Chapter 6 focuses on an in-depth evaluation and discussion of research results both from a theoretical and applied perspective. The finding that *Development Culture* as a NSD success factor is unrelated to the degree of inherent service complexity shows that organisations who dedicate resources such as senior management attention to innovation activities and create a corporate culture that is prone to innovation generally do better at NSD, is of high relevance to service innovation professionals, who strive to improve the success rate of new service development projects. *Process Formality*, in contrast, is a factor that increasingly benefits the development of services with higher degrees of complexity. Whereas this research finding is helpful to explain why previous test results documented in the service innovation literature show mixed results for *Process Formality* as a success factor, the finding can help service development practitioners for both simple and highly complex services improve NSD success rates. The key objective of the chapter is to evaluate the outcomes of the data analysis in light of anticipated outcomes and the core objectives of the dissertation.

6.1. Discussion

Data used in this research thesis was obtained from a cross-sectional and multinational sample of service professionals using a self-administered survey questionnaire approach. The survey questionnaire was sent to a research sample consisting of service innovation professionals, which were identified following a multi-stage cluster sampling approach, and yielded an overall response rate of 10%. The research findings are based on a moderated model of factors contributing to service performance and NSD success. The structural model was theoretically developed and tested using SEM. The theoretical grounding of this research represents an advantage over a number of purely exploratory research studies within the body of service innovation research, which have been criticised for being descriptive and not theory driven (Menor & Roth, 2008).

The research results provide evidence for a relationship between recognised NPD success factors and service innovation performance, contingent upon process complexity. Furthermore, confirmation of a number of success factors is provided through the model. In the conceptual framework of this dissertation new services are

classified according to the inherent degree of complexity. Complexity is defined as a moderating variable with strong influence on the appropriate development approach that is to be taken. Evidence is presented supporting the hypothesis that NSD projects in services with low degrees of complexity can do with a lighter development approach in terms of structure and formality, or even benefit from reduced levels of formality, potentially yielding positive effects on creativity. On the other hand, services classified as highly complex benefit from formal and structured development approaches, similar to common NPD projects.

De Brentani (1995a, p. 219) postulates that "*…the importance of an open and innovative NSD culture within the service organization cannot be overstated*". This statement can be fully supported by the findings of this research. *Development Culture* was found to be the key indicator behind successful introduction of new services, notwithstanding of the degree of inherent complexity (Storey & Hughes, 2013). Whereas this result is of high relevance in terms of the academic debate surrounding efficient NSD process organisation, the practical implication of this finding results in a conundrum. NSD performance can be defined by using a number of indicators ex-ante to the start of a service innovation project. The enhancement of organisational *Development Culture*, however, is similar to the achievement of ex-post service performance, as it is by itself a complex process, which cannot be achieved through the implementation of a short-term agenda. Besides openness to innovation from sides of senior management, a culture supportive to communication and cross-functional exchange need to be build up over time in order to pay tribute to the tacit and human element of innovation processes. This requires a substantial effort of senior managers within a firm, who need to dedicate scarce time and resources to service innovation, encourage team and cross-functional work and show openness to new processes and technologies (De Brentani & Ragot, 1996). Facing the challenge of creating such an environment can be considered a large step toward successful new service development.

The second key finding of this research is linked to the discussion surrounding the required degree of formality of NSD processes. Advocates of formalised development processes underline their importance with regards to the success rate of the NSD process outcome (De Brentani, 2001; Edgett, 1994; Scheuing & Johnson, 1989b). Taking the example of an organisation in the education sector, a newly developed and introduced course (e.g a new international Master's programme offered by a university), researchers who support formalised development

approaches argue that coordinated planning activities and a structured approach including development phases, project management responsibilities etc. leads to a more successful new service. On the other hand, some researchers see higher efficiency in loosely coupled NSD processes and argue that highly formalised processes create rigid structures and bureaucracy thereby imposing barriers to innovation (Menor & Roth, 2008, p. 278). The research findings of this thesis are located in-between these two contrary points of view. Similar to other research on formality of NSD processes (De Brentani & Ragot, 1996), the factor *Process Formality* turned out highly non-significant (P = 0.765). This does not necessarily indicate that service firms use a haphazard or unpredictable approach to NSD, as some studies suggest (Chae, 2012; Edvardsson et al., 1995), but rather that formality as a process factor during the development of new services is no panacea that will guarantee superior new service performance. Put in a different way, formality of service innovation processes might lead to improved NSD processes for some service firms, but not all. De Brentani and Ragot (1996) suggest that a reason for formality not being a success factor in service innovation is that not all firms apply such processes, despite their potential benefits for the performance outcome. This argument appears to be of speculative nature, as it does not address the reason why some firms do not use formal development processes and still manage to be successful in introducing new services – a situation which is explored through the hypotheses of this dissertation.

Evidence for a non-significant relationship between *Process Formality* and *Service Performance* becomes a more substantiated finding when put into the context of moderation through complexity. This thesis presents evidence for a moderating influence of *Process Complexity* on the relationship between *Process Formality* and the success rate of new service introductions. Process Complexity is defined as a multi-dimensional, composite measure including functional differentiation and process scope. Damanpour (1996) uses a similar construct to test for contingency effects in the relationship between structural complexity and innovation. The research results show that *Process Formality* is a factor which significantly contributes to performance when the relationship is tested under the interacting influence of complexity. Whereas services with low levels of *Process Complexity* reveal a weak correlation between formality and new service performance, the relationship is stronger for services with high levels of *Process Complexity*. This could be visualised by taking two extreme examples from within the restaurant industry. Setting up a new hotdog stand is a business that is likely to produce only marginal improvement from a

formalized planning approach. The right location for the stand will beat other factors such as an innovative concept or a steam-lined service process, as it is unlikely that customers go out of their way for simple convenience food. In order to successfully set-up a high quality restaurant that aims for one or several Michelin stars, an ad-hoc development approach is likely to result in failure. Complexity in the latter example is significantly higher, driving the need for structure and formalized development activities. The ramifications of this finding are far-reaching. Whereas difficulties to categorise services, related to the high level of diversity and heterogeneity between different service types (Hollenstein, 2003), have been frequently reported in the literature, different conditions facilitating the introduction of new services depending on service complexity suggest that a classification of services by complexity can create higher levels of consistency in service research. Furthermore, the findings provide directional evidence towards a synthesised or convergence approach of new product and new service development (Chae, 2012; Sundbo & Gallouj, 2000). The literature on NPD performance indicators reveals a higher degree of homogeneity and consistency of research results compared to the body of literature on service innovation (Nijssen et al., 2006). Given the research results of this thesis, it can be assumed that products and services are not substantially different and therefore do not require different organisational approaches to innovation processes. Rather, diversity between services is considerably larger compared to manufacturing or industrial organisations and service complexity needs to be considered as a means of gaging diversity and categorising different service types. As a result, service firms operating at *Process Complexity* levels similar to those of organisations producing physical goods are likely to reveal higher correlations between factors facilitating innovation than service firms with lower levels of *Process Complexity*. Whereas this research makes a valuable contribution by providing empirical evidence for a moderation effect of *Process Complexity* on the relation between service performance factors and service success, it is assumed that additional research on organisational complexity covering both domains relating to size and external/environmental factors will overcome the difficulties in measuring complexity and lead to further insights on moderating effects of complexity covering all facets and dimensions.

In addition to the moderation effect described above, the research results of this thesis demonstrate that also the relationship between *Project Leadership* and *Service Performance* is contingent upon *Process Complexity*. Whereas Ulrich and Ellison (1999) argue that activities associated with project leadership such as

development capabilities and specialisation improves NPD performance for complex products, evidence of the empirical analysis of this study provides support that the same relationship holds for services. A fundamental difference to *Process Formality* is that *Project Leadership* itself turned out to be significant as a performance driver of NSD ($P<0.001$). The interaction effect reinforces the predictor effect on the dependent variable. This result confirms research findings which have demonstrated that the availability of a project leader who champions NSD activities is associated with superior NSD performance (Edvardsson et al., 1995; Storey & Easingwood, 1999). At the same time, it shows that project leadership becomes increasingly important when organisational processes are complex. Again, this finding reemphasises the notion that complexity is a factor which should not be ignored when approaching service innovation. Firms with strong NSD experience are more likely to have structures in place, which provide task ownership and assign clear responsibilities during the service development project. Yet, the research results imply that the nomination of a project leader should be considered even for firms without development routines, especially when service processes reveal high degrees of complexity.

6.2. Implications

As outlined in chapter 3, the starting point of this research thesis was marked by a professional interest in product innovation which motivated the study of organisational innovation processes and eventually resulted in the theoretical framework that provides the foundation of this research. Given this background, it was always considered important to work on a robust theoretical basis and apply rigorous research methods without ignoring practical relevance of research findings. Ganz et al. (2011) criticise that most service innovation research entails deficits in terms of practical relevance and applicability of research findings.

6.2.1. Theoretical Implications

Academics have long deplored the smaller volume of research on NSD in comparison to NPD (Bretthauer, 2004; Easingwood, 1986; Tatikonda & Zeithaml, 2002). Despite their paramount importance in today's economy, services are found to be insufficiently explored and poorly understood (Metters & Marucheck, 2007).

This dissertation makes several contributions to organisational research in general and the body of service innovation research in particular. First, the research findings

contribute to the service innovation literature in that service performance factors are tested and confirmed to contribute to service performance in a cross-sectional and multi-national research design. The majority of present NSD research studies concentrated on a particular service industry sector such as financial or business services. It has thus been criticised to be lacking generalisability (Ordanini & Parasuraman, 2011; Song et al., 2009) as well as practical applicability (Ganz et al., 2011). The theoretical contribution is further extended through a successfully tested moderated service innovation model. Whereas no evidence was found supporting '*Planning and Formality*' as a contextual variable increasing the performance of service development processes, the model revealed that the relationship is contingent upon process complexity of the service. For services with high levels of service complexity the relationship between '*Planning and Formality*' is significantly stronger than for services with low levels of process complexity. A similar finding was made in the context of project leadership. In comparison to the performance factor '*Planning and Formality*', '*Project Leadership*' was already identified as a significant performance driver. Yet, its relationship to service performance was also better explained through the moderated model by process complexity. The empirical findings provide a direct contribution to the service innovation literature and establish a basis for further research on the moderating impact of complexity in innovation processes and projects as well as measurement of complexity in organisational contexts. Menor at al. (2002, p. 135) call for additional research to either validate or discredit the "*…belief that new services happen as a result of intuition, flair, and luck.*" This thesis delivers a contribution to this debate by demonstrating that whereas services with low levels of process complexity benefit from a lesser degree of development formality and process organisation, the development of highly complex services reveals similarities to innovation processes applied for developing physical products. Thus, the finding that services with high levels of process complexity benefit from formalised and planned process organisation as well as project leadership clearly indicate that success in their development is not a matter of chance and intuition.

6.2.2. Practical Implications

Service innovation is a crucial success factor for many organisations. Given the importance of new service introduction for organisational sustainability, practitioners are under high pressures to deliver successful outcomes of NSD projects. In order to enhance chances of success, service development managers rely on past

experience, intuition, and theoretical knowledge. Applied research strives to deliver answers and solutions to specific practical problems. This thesis repeatedly stresses the strategic organisational importance of service innovation. Managers, partners, and corporate decision makers in general are frequently confronted with the challenging task to rethink their corporate offerings, make adjustments to products and services, meet customer expectations, reflect technological advancement, or introduce a new - at times disruptive idea. Practitioners who are engaged in NSD activities would benefit from a clear brief as to how set parameters within their organisations in order to achieve a best possible success rate for newly developed services. Whereas it is all but impossible to achieve this sublime objective in a single study, this dissertation has delivered a number of findings with direct practical relevance and implications for practitioners in the service industry and thereby contributes to applied management practice.

The key contribution of this thesis from an applied perspective relates to the identification and interpretation of complexity and within service organisations and its implications for NSD professionals. This thesis outlines the different dimensions of complexity within service organisations and stresses that it is a crucial factor for innovation processes and needs to be considered when planning and organising the development of new services. Highly complex new services were found to benefit from formalized structural processes. These processes, however, can be too rigid for service with low levels of complexity, limiting creativity or causing demotivation through overreliance on structure. When introducing a new service, a service development manager is advised to assess the complexity of the new service and find benchmark projects for orientation. These do not necessarily have to be based in the same industry, but reveal similar patterns in terms of service inherent complexity.

The practical contribution of this dissertation can be subdivided into three distinct categories. The first category relates to success factors in NSD decision making and the setting of structural factors that promote the chances of a successful outcome of new service development projects. The second category entails the notion of complexity within both new and established services and provides service practitioners with an enhanced understanding of the differences between the wide varieties of services that can be found in modern economies. The last category explores similarities and differences between the development of new products and new services and provides practical guidance towards the application of best practise.

a) Settings of structural factors for NSD success

The development of new services is a critical activity a large number of organizations that can significantly influence and determine future success and organizational sustainability. The survey results described in section 5.3.3 reveal that this does not necessarily relate to the frequency of new service introduction as other factors such as *service quality* or *CRM*. All these factors share the communality of their foundations being established and anchored into the service model during NSD activities. Thus, failure to adequately address important sustainability factors as part of service innovation activities can have negative long-term implication for the respective service organisation.

This dissertation takes a new look at a number of established success factors without limiting the scope of the evaluation n to a specific industry segment. From an applied perspective, this creates the advantage of delivering relevant findings to a wider group of service development professionals. A question of paramount importance for all individuals involved in NSD is how to structure service innovation activities in order to derive optimal results in terms of service performance and success. Previous research has resulted in a degree of confusion regarding the role of structure and formality in service innovation. As a result, a project manager involved in NSD could opt for loose and informal project structures in order to avoid a loss of creativity amongst the project team, but risk costly errors for activities being inappropriately carried out at the appropriate project phase. A practical example would be the opening of a new restaurant. Whereas creativity that goes into the concept planning plays an important role in the future business success and is important in order to separate the organisation from competitors and carve a niche within the respective target market, a number of risks can be created by taking a haphazard approach to NSD, as found by a number of service development researchers (Chae, 2012; Edvardsson & Olsson, 1996). Inadequate planning can lead in an underestimation of required kitchen facilities and set limits to what can be achieved by a team of chefs both in terms of output volumes and quality. Similarly, a missing or shortened test phase increases risks of failures within the service concept surfacing during the opening of the restaurant. Good publicity or test results, which spur the popularity of a restaurant during such a crucial phase can easily be overshadowed by shortcomings, which are due improper execution of NSD activities.

The findings of this research provide service innovation professionals with new perspective for the interpretation of previous research results. Whereas planning and testing can prove to be critical for the opening of a restaurant, the situation would be

different if a fast food stand was planned for a specific event, taking place at a short timeline. If service planners found themselves getting tied up in detailed planning and testing, chances are that the stand would not be ready for the event, resulting in the ultimate failure for this particular service example.

Discussions with various service development practitioners which took place as part of this research project resulted in the finding that effective organisation of NSD activities is a main priority. The research results indicate that '*Development Culture*' as a NSD success factor is the most important antecedent of NSD performance. '*Development Culture*' is a composite measure including variables such as senior management support, organisational openness toward innovation, and knowledge transfer. The finding is not only of interest to managers involved in the service development process but also an important strategic determinant which addressed top management. Service innovation is recognised as a vital factor contributing long-term sustainability of service firms. A half-hearted approach to service innovation which is not reflected in the strategic agenda of a firm and supported by senior management action is likely to not deliver the desired outcome. With regards to other factors that have been identified as performance drivers in the innovation literature, the main contribution of this dissertation relates to the introduction of service complexity as a contingency factor. Practitioners are advised to view and interpret research results both in the context of the type of services that make up the research sample but also the specific complexity of the service and service organisation which is planning the new service introduction.

b) Understanding of complexity-driven differences between services

Whereas the measurement of service complexity is related to a number of challenges, which this dissertation has not fully resolved, a number of concepts are outlined which assist service practitioners to better understand the factors that are driving complexity within their organisation. Complexity within a service organisation is a multi-faceted construct. This dissertation has defined two complexity constructs, namely *Organisational Complexity* and *Process Complexity.* The measurement scales that were used can be easily replicated by service practitioners to measure and compare the level of complexity of their particular service organisation or the process complexity of the newly introduced service. *Organisational Complexity* entails measures related to the total number of employees, the number of countries with organisational presence, and the number of hierarchical levels within the organisation. *Process Complexity* is composed of the number of sub-processes

making up the new service, as well as the number of functions involved in the service process. Different functions result in interfaces between service delivery agents and drive service inherent complexity. Knowing what drives complexity can help service professionals to control complexity, but only to a certain extent. Complexity is inherent to organisations and processes and cannot be entirely avoided or controlled. Yet, understanding what level of complexity an organisation operates at is helpful to service development professionals for two reasons. First, structural settings for the development approach are linked to the level of complexity. Evidence for a moderating impact of service complexity on structural factors such as *Process Formality* and *Project Leadership* shows that highly complex new services and simple new services require a different development approach. The opening a gourmet restaurant needs to be differently approached to the opening of a pizza stand, medical care differently to child care. Second, the anticipated level of service complexity can be assessed in the context of the service strategy and adjustments made prior to the introduction of the service. An international service firm can decide whether a national roll-out of a new service is preferable in order to reduce complexity. Or going back to the previous example, a management team can assess if the complexity of a gourmet restaurant is aligned to strategic factors such as pricing or positioning prior to the introduction of the new service. Managers cannot fully control complexity of the service they wish to introduce, but make strategic decisions to change the service concept in order to alter inherent complexity.

c) Exploration of similarities and differences between product and service development

Whereas the dichotomy between products and services can be widely considered a theoretical debate, the exploration of similarities and differences between NPD and NSD also entails relevance from an applied perspective. The discovery of interaction effects of complexity upon the relationship between contextual NPD/NSD variables and service performance can be considered a practical contribution, as it provides practitioners with a enlarged perspective regarding benchmarking of best practise. Whereas service firms are often considered to be substantially different from organisations producing physical goods, therefore requiring specialised NSD processes, the research findings of this dissertation suggest that differences in process complexity between organisations result in a requirement for a tailored service innovation process and differences in contextual settings. The standalone fact that an intangible product is offered is therefore not the only and most important consideration. For the service innovation practitioner this indicates that benchmarking

and comparison of NSD best practice is not only limited to firms within the same industry sector, but organisations operating at similar levels of process complexity. In order to operationalize this empirical finding, further applied research of complexity in an organisational context and a reliable and practical complexity measurement tool is called for.

The research findings support the view that the boundaries between products and services are becoming increasingly blurry over time. Services have become a major component of modern production processes, which is described by the term ‘servuction’. Service and production processes have become increasingly interdependent and intertwined (Miles, 1993, p. 653). Practitioners may ask themselves whether or not the distinction between new product and new service development matters in terms of designing a development approach that lays the foundations for innovation success. Based on the findings of this research, the answer is no – what matters is the complexity of the product or service to be developed.

The advice to service operation professional based on the results if this research thesis can be summarized as follows. First, service development professionals should be aware of the impact of service inherent complexity on the success rate of the introduction. This dissertation presents a framework for measuring complexity or the service organisation and the service process. In scenarios where service operations professionals deal with highly innovative new service (discontinuous innovations) and benchmarking of development formality is not possible, the measurement of complexity allows to extend the benchmarking activity to organisations producing physical products. Second, knowledge of the drivers of complexity in terms of organisational and process complexity allows service innovation professionals to attain a certain level of control over service complexity. This can be useful if, for specific reasons, an overly formalised development approach is not desired. A multi-national service firm may choose to create a separate organisational entity for the introduction of a new service in order to reduce organisational complexity driven by size and the number of locations where the new service is introduced. Lastly, service operations professionals are advised to conduct a cultural due diligence focussed on innovation conditions within their service organisation, based on the scales suggested in this dissertation. Having a corporate culture that is open to innovation is a key success factor for new services independent of the level of inherent complexity. Hence, an assessment of how well

an organisation's culture is aligned to innovation will help service development practitioners to implement changes that ultimately improve the performance on service innovation projects.

6.3. Ethical Considerations

The study of literature on NPD and NSD has so far not given any indication of ethical problems or considerations that researchers have been confronted with during their research. This also counts for health, legal or safety concerns, which impact the design of a research study. Despite being mindful of ethical considerations throughout the research process, no issues came to light that demanded special attention.

Ethical considerations and awareness of potential issues should always to be part of a research process, especially when field research is conducted and individuals involved are unfamiliar with the research objective. Potential issues with regards to this research project could arise during the empirical investigation fall into the following categories:

a) *Disclosure of managerial failures during a product or service development project that become evident during the investigation.*
b) *Creation of tension or anxiety through the negative predictions made as part of the research.*
c) *Handling of confidential information received during the research.*

In their research study on NPD in engineering environments, Pillai et al. (2002, p. 166) state that "*…due to inherent complexity and uncertainty R&D projects are not easily amendable for performance measures.*" This finding can be confirmed by the survey results of Pawar and Driva (1999), who state that 80% of their respondents saw benefits in further R&D performance measurement in their companies. However, performance measurement can be perceived as a threat to managers, who might fear negative personal consequences from the disclosure of inefficiencies or failure [*category a)*]. This can result in potential bias in terms of the information collected but is also important in terms of the researcher's responsibility to handle results in an ethical manor. The issue has been addressed during the research design phase of this thesis. Whereas prospect respondents were directly approached and asked to participate in the research study, full confidentiality was assured, despite comprising a relinquishment to the opportunity to issue individualised reminders and follow-ups in case of participant nonresponse. Whereas this approach was considered an

important and necessary step towards assuring participant confidentiality and obviate a source of response bias, consequences of the renouncement of reminders directly implicated survey response rates. Knowledge about a particular response, especially in the context of electronic or online surveys can be considered an equivalent of the possibility to identify individual answer and thus link specific information about innovation projects to organisations. Thus, efforts were made to reflect high research ethics in this respect.

Negative predictions with regard to a project or a business model [*category b*)] are likely to have negative impacts on moral and motivation of the workforce and therefore should be handled with sensitivity or avoided. All interviews conducted during the pilot phase involved service managers and senior managers, who were briefed on the research agenda and who disposed of general were experience in being interviewed. Furthermore, due to the structured or semi-structured interview format, the majority of information was received rather than shared with interview partners and the risks of creating anxiety (e.g. through revealing potential NSD project failures) were considered negligible.

Informed consent was the basis of all conducted interviews and a clear outline of the research objective was provided as part of the survey invitation. As strict confidentiality in handling sensitive information [*category c)*] was assured throughout the research process, no ethical concerns remain after the completion of the research project.

Chapter 6 focussed on the analysis of empirical data collected for this thesis. The results delivered support for some of the hypotheses and provide evidence for a moderating impact of complexity on the relationship between structural factors relating to the organisation of NSD projects and service performance. Results were discussed from both a theoretical and practical perspective. From a theoretical perspective, this dissertation helps to explain why research results on NSD are in disarray, especially when compared to NPD. Services offered in the market place reveal a high degree of diversity. One aspect of this diversity is the fact that services can substantially vary in terms of their inherent degree of complexity, both from an organisational and process point of view. The assessment of service complexity, as proposed in this thesis, is considered a promising alley towards a higher degree of coherence and consistency in NSD research. From an applied perspective, the suggested approach for complexity measurement can be adopted by service operations professionals, working within the field of service innovation. In doing so,

service practitioners can compare the complexity of their particular service with other organisations, which can assist to find an appropriate level of development process formality. Given the combination of both theoretical and practical relevance, this research thesis stresses the importance of applied research in an innovation context.

7. Summary

Chapter 7 concludes the dissertation by reviewing the main findings and contributions of this study. A key contribution of this research dissertation is to provide evidence that complexity is a factor that matters in service innovation and helps to explain why the literature on NSD success factors is in disarray. Yet, in order to provide a rigorous review of the research undertaken, this chapter also focuses on a number of potential limitations of this study. These limitations are related to the applied sampling technique, as well as a number of methodological and conceptual restrictions that form part of the research approach. Section 7.2 further includes a discussion of implications of the limitations on the applicability of research results in a applied context. The chapter concludes the dissertation with several recommendations for future research opportunities.

7.1. Research Review

By looking at product and service innovation from a new angle, this research tries to bridge the widely accepted dichotomy between the two. As services are explored from a broad perspective in which they encompass added value activities that are carried out with the purpose of meeting customer demand, it becomes evident that products and services are closely interlinked, even more so in today's technologically advanced economy. Labour as a primary factor of production can be defined as a service delivered to an internal client. Despite not being substantially challenged from an economics point of view, the traditional demarcation between manufacturing and services is frequently questioned in organisations' related research, suggesting that the boundaries have over time become more and more fluent (Miles, 2007; Nijssen et al., 2006; Vandermerwe & Rada, 1988). A manufacturing company could, for instance, outsource development, production work, or marketing to external service providers, all of which included in the traditional view of key competencies. If a product is considered the outcome of a service driven transformation of commodities assisted by capital goods, the development of a new product also requires the creation of a new service as a necessary condition. Hence, looking at NPD fully independently of NSD nowadays seem less possible than a few decades ago (Kandampully, 2002).

A key objective behind this dissertation was to shed additional light on organisational factors around the organisation of service innovation and understand the limitations and impact of applying formalised NPD processes and procedures to services. As a starting point, the frequently expressed notion that NPD is generally better understood than NSD was considered an indication of conceptual difficulties within the study of service innovation. Very high levels of diversity amongst services were found to be a main reason for both the difference in volume of respective literature and the heterogeneity of research findings. However, as outlined above, the assumption that the development of a new product requires a new service suggests that NPD findings should be applicable to new services at least to some extent. The theoretical service framework presented in this dissertation represents an attempt to explain NSD behaviour as a function of inherent complexity. The framework serves as basis for hypotheses regarding structural criteria, which promote efficient NSD activities. Evidence is presented supporting the hypothesis of a moderating impact of complexity in service innovation. Complexity affects both the direction and strength of the relationship between independent and dependent variables (Baron & Kenny, 1986) and explains when the anticipated effects hold, without itself accounting for changes in the predictor variable or being a function hereof. An implication with both theoretical and practical relevance of the moderating impact of complexity in NSD is that whereas a rather simple service might just come about through putting an idea into practice, a highly complex service substantially benefits from the standardised development processes and procedures found in NPD such as *Process Formality*, *Timing Plans*, and *Project Leadership*. This finding helps to reduce the theoretical dichotomy between products and services and marks a step towards and integrated innovation approach.

7.2. Limitations

Despite its valuable contribution to the body of service innovation literature, a number of limitations of this research are worth noting. The first limitation revolves around the chosen sampling approach. This thesis strived to overcome the limitation of a large number of NSD studies only focussing on a narrow segment of the service industry. The cross-sectional and multinational design of the study served the primary objective of facilitating a broad and generic analysis and evaluation of NSD processes across a highly diverse sample of service firms. Responses collected cover a wide range of different business sectors. Whereas the cross-sectional research design allows to capture information encompassing many different service

types and thus has advantages regarding generalizability of research findings across service sectors, Song et al. (2009) point out that causal conclusions from such research need to be critically evaluated. Further qualification through additional research focussing on selected industries, longitudinal measures, and multiple informants would strengthen the line of enquiry of this research (Baker & Sinkula, 2007). Especially the number of small service organisations seems to be underrepresented in the sample, compared to the prevalent industry distribution. Whereas NSD success factors used in this thesis have been established in prior research, the introduction of the concept of complexity provides this research with an exploratory character and contributes to this limitation. For clarification, the reference to exploratory research does not relate to the independent constructs tested in the research model but the combination of testing for contingency effects resulting from inherent service complexity across a diverse cross-sectional service sample.

Data was collected by applying a multi-stage cluster sampling approach using a large professional online network with service innovation related interest groups to identify target respondents. A large advantage of this approach can be seen in the availability of background information of respondents, which allowed target-oriented selection of professionals with an appropriate level of seniority and a services background. Whereas this approach allows to capture a wider range of possible responses than the a pre-selection of professionals with specific job titles (e.g. CEO, Project Leader, Head of R&D)[45] and thereby may capture possible differences in views between professionals, the focus on the organisational level of the research design only allows to capture a single informant NSD project response within an entity and therefore has limitations in terms of an objective new service performance assessment. Whereas a project leader may consider a new service a success and rate the financial performance above expectation, a finance manager could arrive at a different, often more conservative or critical assessment. The applied sampling approach mitigates the single informant bias, as the selected respondents are relatively homogeneous in terms of job titles and functions during a NSD project, thereby reducing the variability of assessments.

Second, a number of methodological and conceptual limitations which are common to organisational research studies need to be discussed in the context of this study. The analysis of causal relationships assumes that measurement of variables is done

[45] Song et al. (2009) point out that relevant innovation literature suggests that project leaders have been found to be the best informants for service development project information.

without error (Froehle et al., 2000). This represents a constraint which needs to be taken into consideration when applying findings outside a theoretical context. Furthermore, the commonly used research practice of collecting responses on both dependent and independent variables from the same informant can represent a source of common variance bias (Gatignon et al., 2002) which needs to be considered.

A further limitation of the applied research concept is a potential for biases around the specification of NSD performance and success. The hypotheses are based on the assumptions that NSD professionals participating in the survey utilise a similar scale of rating development performance and new service success. Despite the importance of adequate NSD evaluation in order to justify NSD expenditures (Johne & Storey, 1998), accurate performance measurement often deals with a number of biases and is also difficult to operationalise across different industry sectors. Performance measurement based on inherent complexity is seen as a viable research opportunity, subject to the delivery of evidence supporting the service complexity model, outlined in this paper.

Some of the research results were unexpected. First, the outcome of the exploratory factor analysis revealed a lower than expected consistency between variables that were assumed to deliver latent constructs relating to NSD performance as independent variables. Factor retention decisions are of high importance in order to derive a parsimonious number of validated and robust constructs that adequately represent the data as well as underlying correlations (Hayton et al., 2004). Implications of the reduced number of factors supporting higher order constructs are assumed to be related to a combination of procedural factors linked to the research design rather than a reflection of theoretical issues around the research framework. Whereas the NSD performance factors and related scales were attained from a synopsis of results from both NSD and NPD literature, most studies were focussing on narrower samples of industries within the same sector and/or geographic region. By taking a cross-section sample of service firms across national boundaries, variation and variability of research findings exceeded the scale of those studies, which tested and validated the scales used. The sample size used in this research was considered adequate in terms of the methodology. Yet, a larger sample size

could have resulted in stronger coherence of performance constructs with high factor loadings, as suggested in the relevant literature (Hair et al., 2009).[46]

Second, the measurement of complexity was related to significantly higher challenges than anticipated. Whereas a number researchers has also strived to use complexity measures in previous organisational research studies (Bozarth et al., 2009; Damanpour, 1996; Danaher & Mattsson, 1996), the use of simplification, approximation, and specification generally results in restrictions to complexity which can produce measures that only rudimentarily gage complexity. Ulrich and Ellison (1999) report difficulties around the abstractness of functional complexity and replace the concept by 'difficulty of predicting' as a close surrogate. Vesterby (2008) argues that "*… quantitative analysis is rendered inadequate by the very nature of complexity*" (p. 90), and therefore does not reflect its intrinsic magnitude. Thus, it is assumed that improved measures of organisational complexity or an aggregate measure of complexity in organisational innovation processes would be able to provide further insights and support for the initially assumed theoretical framework.

7.3. Conclusion

With a share of over 70% of the global GDP in 2011 (World Bank, 2012), the preeminent importance of the service sector is blatant. Some researchers speak of explosive growth of the services sector during the past decades, both domestically and globally (Metters & Marucheck, 2007). The economic importance of services, however, is not reflected by the amount of academic service research, especially with regards to innovation. The body of literature remains dominated by research on manufacturing and physical products and a strong divide between research on NPD and NSD is still pervasive in innovation research. This thesis provides a dual contribution to academia and practice. The theoretical framework presented in this dissertation applies extant knowledge of NPD success factors in a service context. Whereas the factors have been tested in prior studies, resulting in mixed findings regarding their contribution to successful service innovation, both sample selection and composition of the theoretical framework address specific points which were not sufficiently explored in the literature. The conducted empirical study tests NPD success factors by using a cross-section and multinational sample of new service development projects. The sample is characterised by a high degree of diversity,

[46] Hair et al. (2009) propose that a minimum sample size should be at least five times the amount of observations – a more acceptable size being a ten-to-one ratio.

which is considered to have caused a significant barrier to the study of services in organisational sciences in general and innovation research in particular. The sample selection as such is considered a distinct contribution of this thesis, as it addressed shortcoming of some prior studies, which have been criticised for being insufficiently encompassing. Furthermore, organisational complexity is introduced as a contingency to the service innovation process. Organisational complexity has manifold facets. A newspaper and magazine publisher can have an organisation that varies in terms of total staff, staff locations, depth of research, commentatorship and coverage, distribution channels, to name only a few. Hence, an organisation within the same industry can rank low or high in terms of organisational complexity and a chosen approach for NSD needs to take these differences into account. Whereas the terms 'complexity' can be found in numerous articles and is frequently confused with diversity or complicatedness, the definition of service complexity as a construct used to create a classification of services represents a novel concept in innovation research.

Research findings presented in this thesis deliver a valuable contribution by addressing the role of complexity in service innovation. As noted by other researchers, the assessment of complexity is subject to a number of challenges. Robust measurement scales that manage to gage the full multidimensionality of the construct provide fertile grounds for further research. Yet, the empirical results of this study demonstrate that *i)* services benefit from a number of factors with positive influence on performance that are similar to those identified in NPD research (*Development Culture* and *Timing Plans*), *ii)* moderation through *Process Complexity* amplifies the causal relationship of *Process Formality* (non-significant performance factor) and *Project Leadership* (significant performance factor) on NSD performance, and *iii)* services with high degrees of process complexity reveal higher similarities to products in terms of the conditional factors that facilitate high performance and success of the development outcome. Whereas these findings would benefit from further research and validation, the insights contribute to the synthesis approach of NPD and NSD. The assimilation approach assumes that SI is related to similar structural variables as NPD, eventually differing in their relative importance or potency (Atuahene-Gima, 1996). Thus, research results presented in this dissertation create an argument supporting the assimilation approach for the evaluation of complex services and products and the demarcation approach for innovation of services with low levels of complexity.

The conceptual framework further delivers useful implications to service development practitioners, senior management and corporate decision makers dealing with service innovation topics. First, the strong correlation between *Development Culture* and NSD performance indicates that service innovation is not a topic that should be addressed by only few dedicated individuals within a service firm. Given the strategic importance of NSD and its link to long-term organisational sustainability, corporate leaders need to create structures that enable cross-functional exchange, communication, creativity, and openness towards change. Furthermore, they need to take an active role in NSD and anchor service innovation activities within the strategic agendas of their organisations. Factors such as *Development Culture* cannot be created over night. Hence, recognition of a need to innovate combined with long-term efforts to create a corporate culture open to innovation processes are two factors which can assist service firms to achieve improved NSD performance.
A second learning point relates to the awareness of different levels of organisational complexity and an understanding of its practical implications. Service managers who are aware of the drivers of complexity and who can prescind complexity from organisational contexts such as market or industry sector have advantages in finding adequate setting of structural factors supporting service innovation. This can be done through benchmarking activities with high performing firms operating at similar complexity levels or assessing changes of complexity caused through innovation and adapting NSD structures accordingly. An understanding of organisational complexity and its dimensions can therefore contribute to an enhanced success rate of service innovation activities.

This thesis followed the general objective of delivering a generic framework that helps to better understand service innovation and reduce the polarity between research dealing with product and service innovation. The introduction of complexity to organisational research represents a new concept that can facilitate the study of service innovation and enhance the homogeneity of NSD research results. Yet, complexity is a difficult field of study and some scholars question its merits (Manson, 2001).

Irrespective of the point of view someone may wish to take, the evidence presented in this thesis provides grounds to further explore contingency effects resulting from various dimensions of complexity on organisational innovation. A justified view that complexity is an ephemeral concept or a mere reflection of the zeitgeist of innovation research would equally require further investigation and justification as would the

further development of the theoretical concept outlined in this thesis. The empirical work undertaken as part of this dissertation is adds to the extant body of applied research dealing with complexity and represents a basis for further empirical work in this area.

7.4. Recommendations for Future Research

Whereas it would be desirable to see further research on the moderating impact of complexity in a service innovation context to provide additional confirmation of the research findings suggested in this paper, there are a number of research opportunities which are recommended to be explored with precedence.

A viable research opportunity presents itself in the exploration of improved measurement procedures for complexity as a multi-item construct. Research in this area would have merit in addressing a limitation identified in this thesis. Vesterby (2008) attests that none of the proposed measurement techniques found in the literature can live up to the challenges of complexity. While this thesis has taken an initial step towards a proposed multi-dimensional complexity scale, the creation of validated complexity measures that capture the various facets of complexity in an organisational context would be of high value to organisational research.

A promising venue for future research would also be to classify NSD processes as creative systems and use the theory behind complex adaptive systems (CAS) to analyse learning effects in NSD activities that take place over time. Brown and Eisenhardt (1997, p. 32) propose to define continuously changing organisations as CAS, whose semi-structures poise them on the edge of order and chaos. Whereas CAS methodology has been applied in the context of NPD (McCarthy et al., 2006), service specific findings could serve as descriptive tool for the emergence of new services and explain adaptive behaviours that take place within organisations during NSD projects. Research in form of longitudinal case studies would have the potential to shed light on how service organisations deal with issues during various stages of the development of a new service. Depending on the degree of innovativeness, the creative system can turn into an evolutionary system (Page, 2010), in case service components are modified or adapted through either learning or external influences. This type of research would have a significantly different focus to the research documented in this thesis, in that it adds time and learning as additional components to the analysis of NSD. Best practice in the development of new services is understood as a combination of using the appropriate development approach for the

respective service type and knowing how the organisational particularities or resources can be best geared up to achieving effective NSD outcomes. Whereas this thesis has made an attempt to explain the former, NSD literature would benefit from the integration of CAS principles and methodologies in NSD research.

Several other research avenues revolve around testing the research findings of this dissertation in the context of varying research samples. Tests of specific service industries or comparisons between service industries could be used to create a better understanding of complexity drivers across service sectors. Furthermore, differences relating to national particularities could be addressed by defining service samples within pre-defined geographic areas or countries.

Whereas this thesis has controlled for the influence of the degree of innovativeness, the high level of new service introductions being classified as ‘new to the world services’ suggests that practitioners struggle to adequately gage different degrees of innovation. Not enough focus has been given to the distinction of the perceived type of service innovation as seen by survey participants and an objectively measured degree of innovativeness in NSD. The amount of ground-breaking or disruptive innovations in the development of new products can be considered rather low. The vast majority of service innovation is also highly likely to be continuous or incremental. If service innovation is perceived as a complex process (Edvardsson et al., 1995), a clear conceptual approach to measurement of innovation as outlined by Adams et al. (2006) combined with an assessment of organisational complexity would certainly entail both high theoretical and practical relevance. Gatignon et al. (2002) bemoan the perceived conceptual confusion within innovation research relating to a lack of demarcation between units of analysis, innovation concepts and measures. Further research in service innovation would therefore benefit from a distinct conceptual framework that incorporates yet separates service competences, service concepts and measures.

Appendix 1 - Ethics Clearance Flow Chart

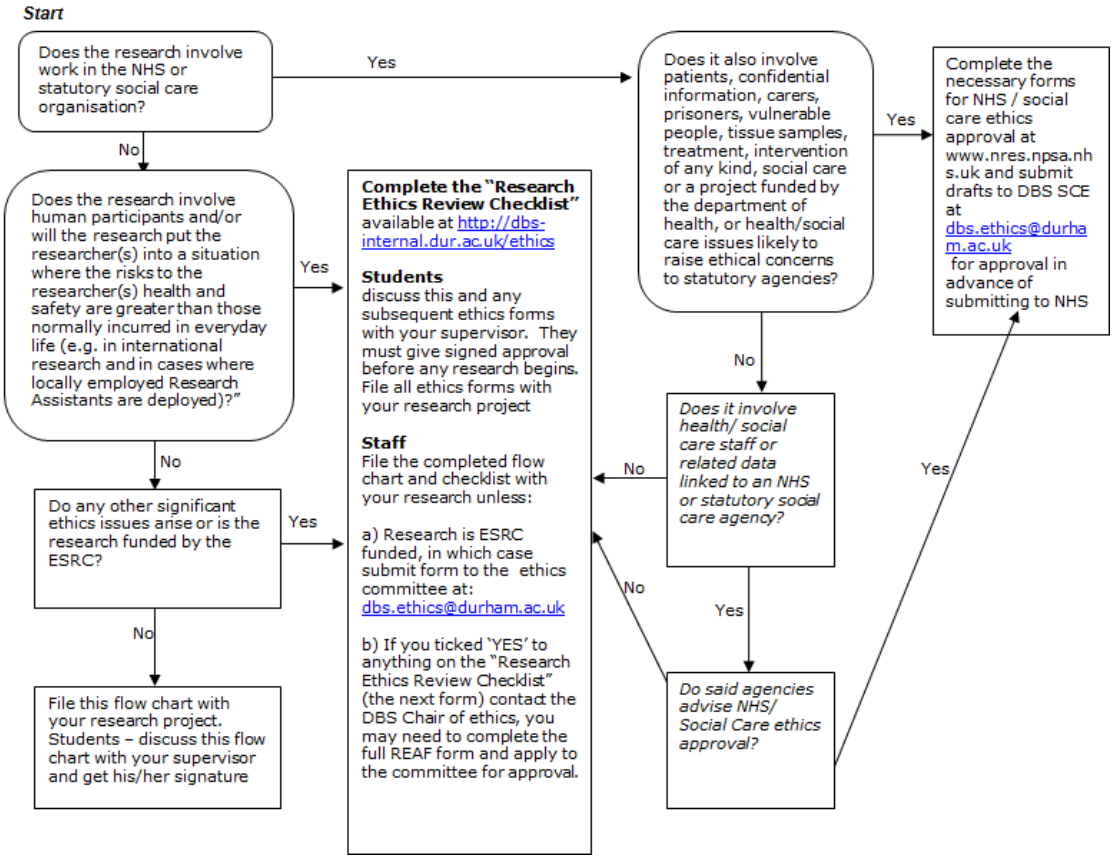
Ethics in Research

Process flow chart for students and staff undertaking research

Please complete the details as requested below and highlight either 'YES' or 'NO' after each box to show your route through the flow chart. "DBS SCE" refers to Durham Business School's Sub-Committee for Ethics throughout.

Title of Project: …*The Impact of Service Complexity on New Service Development – A Contingency Approach*……..……

Name of Principal Researcher: ...*Christian G. Schaefer*…….....



Signature of Principal Researcher or Supervisor:

Signed: …*Christos Tsinopoulos…04/10/2013*…….....

Appendix 2 – Research Questionnaire

A) Solicitation Letter

Dear Respondent,

This questionnaire is part of an empirical innovation research study at Durham University. The main objective of this research is to better understand the process of creating new services and attempt to explain why some services introductions are more successful than others. By addressing you, I intend to reach out to a broad array of service professionals and gain insight into service innovation in practice.

Why should you complete this questionnaire?
This questionnaire is part an academic research study on service innovation. By completing the questionnaire you help to create a better understanding of the development of new services and generate new knowledge. This questionnaire will not be used for commercial purposes. It is solely of academic interest.

Prize Draw
After completing this survey questionnaire you can chose to participate in an optional prize draw for a brand new Samsung Google Nexus 10. Participation is optional and email addresses submitted will not be used in relation to your responses.

What will be done with the information provided?
All complete answers will be evaluated and used as empirical research part in a doctoral thesis on new service development. As such, the information will be published, but without allowing inferences or identification of individual answers. Therefore, full confidentiality in handling information obtained through this questionnaire is assured.

If you have any questions or concerns about completing the questionnaire or about participating in this study, please do not hesitate to contact me email (c.g.schaefer@durham.ac.uk). If you have any questions about the background of this research, you can also contact the doctoral office at University of Durham Business School for enquiries.

This study was collated in accordance with the university research standards.
Thank you for your support.

Sincerely,

Christian Schaefer
Dipl. Kfm
DBA Research Student
Durham University Business School

B) Service Innovation Experience

Please provide an overview of your personal experience with the development and market introduction of new services.

In your professional career, have you had direct experience with service innovation?

Service innovation hereby comprises the following:

- Worked on the introduction of a new service
- Been involved in changing a service
- Improved an existing service

☐ Yes ☐ No

In how many New Service Development (NSD) projects have you been involved?

☐ Over the past 5 years ☐

☐ Over the past 2 years ☐

☐ During the past 12 months ☐

What secures long-term sustainability of a service firm? (Scale: 1-Not important; 2-Somewhat important; 3-Important; 4-Very important; 5-Essential; NA)

- Frequent new services introductions
- Service quality
- Competitive pricing
- Brand image / awareness
- Customer relationship management
- Client events
- Marketing activities
- Industry referrals
- After-sales services

C) Planning and Formality

From the generation of the new service idea to market introduction, how long did it take?

☐ Months

This question is optional, please leave blank if you don't know.

What about the service was new?

If several categories apply, please tick all relevant boxes.

☐ New to the world service (entirely new service)
☐ New service to the firm
☐ Modified service process
☐ Modified service outcome / service experience
☐ Other (please explain) Click here to enter text.

For the example you have chosen, how formal was the development process? (Scale: 1-Strongly disagree; 2-Disagree; 3-Neutral; 4-Agree; 5-Strongly agree; NA)

- The process to develop the new service was thoroughly planned.
- It comprised formal stages of development activities (e.g. concept phase, planning phase, test phase, etc.).
- We followed a standard development approach and routines, which are repeatedly employed in our firm.
- A timing plan reaching to the market introduction of the new service was used.
- Adhering to a timing plan was a priority throughout the development process.
- The service development included key events and / or milestones.
- Processes were documented.
- A fixed sequence of development activities was followed.

- The development process was not structured or planned. The new service mostly is a result of improvisation.
- The new service was mainly a result of intuition and experience of the employees involved in the development.
- A formalised development approach was never considered.
- Process documentation was created after the introduction of the new service.
- Milestones and development stages were irrelevant.
- Processes were not documented.
- Too many things happened at once. It wasn't possible to plan the new service in detail.
- All that mattered in the process was the idea for the new service.
- The go-ahead for the new service project required a formal decision of the management based on a project plan.

D) Management and Staffing

How was the project managed and how did staff work together? (Scale: 1-Strongly disagree; 2-Disagree; 3-Neutral; 4-Agree; 5-Strongly agree; NA)

- The project had a clear project leader.
- All people involved in the development had a clearly defined role.
- The project team was composed of staff from various departments.
- The project team had the authority to make important project decisions.
- Employees delivering the service had a key role in the development process.
- All people involved in the development were equal in status.
- The project was supported by Senior Management of the firm.
- Cross-functional teams were put in place.
- The direction given by the project leader needed to be followed.
- Development staff all came from the same area of the business.
- Senior Management had an active role throughout the development process.
- A project leader emerged during the development process but was not formally selected / put in place.
- There were different project leaders in place, depending on the stage of development.
- The development project received insufficient attention from Senior Management.

E) Organisational Factors

Please rate the following statements on a scale from 1 to 5. (Scale: 1-Strongly disagree; 2-Disagree; 3-Neutral; 4-Agree; 5-Strongly agree; NA)

- We could build on NSD experience in our organisation.
- The organisation had dedicated development staff and facilities in place.
- Introducing the new service was easy. It did not require major resources.
- Organisational hurdles that needed to be overcome in order to introduce a new service were significant.
- Funding for the new service was easily available.
- We had strong routines for developing new services.
- The organisation could not afford dedicated development personnel.
- During the development, the majority of the organisation worked as usual.
- The organisation invested in pre-testing the service in order to avoid risks.
- Specialised skills of dedicated development staff were not important.
- The new service secured the organisation's future.
- Introducing a new service represented a considerable risk to the existing business.
- Our company culture made the development of the new service a lot easier.

F) New Service Performance

Compared to the objectives and expectations your firm had prior to the new service introduction, how did the new service perform? (Scale: 1-Significant below objectives; 2-Below objectives; 3-Meeting objectives; 4-Above objectives; 5-Significantly exceeding objectives)

- How successful was the new service in terms of generating revenues?
- How successful was the new service in terms of delivering profits?
- How successful was the new service in terms of contributing to sales growth?
- How successful was the new service in terms of achieving market share?
- How successful was the new service in terms of attracting new customers?
- How successful was the new service in terms of giving the company a competitive edge?

G) Service Organisation Details

Organisational size.

In order to assess the organisational size of the service firm you work for, please state the approximated number of:

a. ☐ Total employees (world-wide)

b. ☐ Total employees (your local office / service unit)

c. ☐ Affiliates / offices locations

d. ☐ Countries, your organisation operates in

R&D Facilities.

Does the service firm you work for have a dedicated service development department / R&D department?

☐ Yes ☐ No ☐ Number of employees, if yes

Organisational structure.

Please state the number of:

e. ☐ Number of hierarchical levels (from entry level job to executive management)

f. ☐ Functional departments

g. ☐ Sales divisions within your organisation

Infrastructural requirements.

Please give an approximated investment value, required for the delivery of the service you described before. The value should be equal to the approximated

amount that is required to set-up a service of this kind, also accounting for existing infrastructure within your organisation.

Costs for recruitment and training should be excluded.

☐ [EUR] (Leave blank, if you cannot estimate the amount)

Specialised equipment and tools.

On a scale from one to five, how would you rate the importance of specialised equipment / tools for delivering the service? (Scale: 1-Unimportant; 2-Rather unimportant; 3-Indifferent; 4-Important; 5-Essential)

Process structure.

Please name the approximated number of:

☐ Sub-processes (processes, delivered by different employees)

☐ Process steps (one employee can do several process steps)

☐ Functional departments, involved in service delivery

☐ Employees, involved in service delivery

☐ Average length [hours] of the entire service process (process duration)

Knowledge Intensity.

Please name training and educational requirements, for the delivery of the service

☐ On the job training (up to 6-months)
☐ On the job training (more than 6-months)
☐ University degree (Bachelor)
☐ University degree (Masters or MBA)

☐ Specialised workshop
☐ Post-graduate education
☐ Apprenticeship
☐ Doctorate
☐ Secondary education (Diploma/certificate)
☐ Professional designation

Education.

Please provide the percentage of employees within your service firm, who have a minimum of 4 years of secondary education

[ ] %-age of employees with 4 or more years of mandatory education

Regulation.

Please name the type of regulation the service industry you work in is governed by.

☐ Governmental requirements
☐ Industry specific regulatory body
☐ Industry standards / code of conduct
☐ Regular monitoring and external supervision
☐ Other (please specify) [ ]

On a scale from 1 to 5, how do you rate the level of customer involvement during the delivery of the service? (Scale: 1-Not involved; 2-Little involvement; 3-Some involvement; 4-Strong involvement; 5-Fully involved; NA)

Please rate the level of customisation of the services offered by your firm. (Scale: 1-No customisation; 2-Standard service with minor customisation; 3-Regular customisation; 4-High levels of customisation; 5-Full customisation/individualised service; NA)

H) Service Sector and Sub-sector

	BUSINESS SERVICES
	Professional Services
☐	Legal Services
☐	Accounting, auditing and bookkeeping services
☐	Taxation Services
☐	Architectural services
☐	Engineering services
☐	Computer and Related Services
☐	Research and Development Services
☐	Real Estate Services
	Other Business Services
☐	Advertising services
☐	Management consulting service
☐	Services incidental to mining
☐	Services incidental to energy distribution
☐	Placement and supply services of Personnel
☐	Printing, publishing
	COMMUNICATION SERVICES
☐	Postal services
☐	Courier services
☐	Telecommunication services
☐	Audio-visual services
☐	Other
	CONSTRUCTION AND RELATED ENGINEERING SERVICES
☐	Construction work for buildings
☐	Construction work for civil engineering
☐	Installation and assembly work
☐	Other
	DISTRIBUTION SERVICES
☐	Commission agents' services
☐	Wholesale trade services
☐	Retailing services
☐	Franchising
☐	Other

	EDUCATIONAL SERVICES
☐	Primary education services
☐	Secondary education services
☐	Higher education services
☐	Adult education
☐	Other education services
	ENVIRONMENTAL SERVICES
☐	Environmental services
	FINANCIAL SERVICES
☐	All insurance and insurance-related services
☐	Banking and other financial services (excl. insurance)
☐	Other
	HEALTH RELATED AND SOCIAL SERVICES
☐	Hospital services
☐	Other Human Health Services
☐	Social Services
☐	Other
	TOURISM AND TRAVEL RELATED SERVICES
☐	Hotels and restaurants (incl. catering)
☐	Travel agencies and tour operators services
☐	Tourist guides services
☐	Other
	RECREATIONAL, CULTURAL OR SPORTING SERVICES
☐	Entertainment services (including theatre, live bands and circus services)
☐	News agency services
☐	Libraries, archives, museums and other cultural services
☐	Sporting and other recreational services
☐	Other recreational, cultural or sporting services
	TRANSPORT SERVICES
☐	Transport services
	OTHER SERVICES NOT INCLUDED ELSEWHERE
☐	Other services

Appendix 3 – Means, Standard Deviations, and Intercorrelation Matix

		Mean	Std. Deviation	N	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	SF Planning1	3.73	1.056	208	1.000													
2	SF Planning2	3.77	1.110	208	.417**	1.000												
3	SF Planning3	3.41	1.147	208	.303**	.651**	1.000											
4	SF Planning4	3.40	1.289	208	.384**	.382**	.190**	1.000										
5	SF Planning5	3.35	1.284	208	.361**	.239**	.166*	.518**	1.000									
6	SF Planning6	2.68	1.262	208	.337**	.333**	.245**	.222**	.293**	1.000								
7	SF Structure1	3.67	1.262	208	.600**	.508**	.353**	.467**	.452**	.355**	1.000							
8	SF Structure2	4.06	.971	208	.448**	.505**	.399**	.248**	.364**	.248**	.480**	1.000						
9	SF Structure3	3.43	1.119	208	.438**	.443**	.441**	.379**	.343**	.216**	.504**	.497**	1.000					
10	SF Structure4	3.48	1.503	208	.507**	.399**	.287**	.438**	.475**	.389**	.523**	.421**	.385**	1.000				
11	SF Structure5	3.76	1.145	208	.395**	.330**	.243**	.319**	.378**	.362**	.384**	.486**	.314**	.495**	1.000			
12	SF Structure6	3.85	1.027	208	.422**	.330**	.191**	.468**	.530**	.395**	.551**	.512**	.426**	.509**	.652**	1.000		
13	SF Structure7	3.33	1.204	208	.431**	.430**	.346**	.288**	.294**	.252**	.494**	.434**	.424**	.294**	.334**	.325**	1.000	
14	SF Structure8	3.68	1.310	208	.280**	.308**	.283**	.236**	.258**	.224**	.405**	.398**	.289**	.374**	.275**	.335**	.352**	1.000
15	SF Documentation1	3.55	1.158	208	.382**	.287**	.314**	.397**	.398**	.138*	.490**	.487**	.491**	.368**	.298**	.398**	.451**	.361**
16	SF Documentation2	3.50	1.188	208	.357**	.252**	.156*	.284**	.302**	.255**	.334**	.344**	.234**	.381**	.377**	.453**	.172*	.167*
17	SF Documentation3	3.77	1.181	208	.387**	.283**	.230**	.473**	.512**	.229**	.461**	.487**	.445**	.508**	.524**	.620**	.299**	.377**
18	MS Project Team1	4.01	.978	208	.073	.073	-.085	.135	-.033	-.088	.077	.137*	.067	-.046	.101	.122	.112	-.024
19	MS Project Team2	2.03	.983	208	-.118	-.047	-.071	-.223**	-.134	.062	-.035	-.240**	-.060	-.052	-.110	-.096	-.102	.015
20	MS Project Team3	3.60	1.040	208	.292**	.316**	.188**	.413**	.301**	.176*	.414**	.277**	.292**	.253**	.248**	.319**	.289**	.139*
21	MS Project Leader1	4.39	.867	208	.184**	.280**	.267**	.241**	.208**	.062	.276**	.312**	.229**	.109	.181**	.217**	.186**	.203**
22	MS Project Leader2	3.76	.899	208	.197**	.284**	.262**	.181**	.130	.022	.157*	.215**	.246**	.162*	.124	.025	.171*	.129
23	MS Project Leader3	3.63	1.165	208	.243**	.153*	.083	.251**	.291**	.289**	.212**	.280**	.184**	.290**	.444**	.454**	.206**	.203**
24	MS Project Leader4	3.44	1.218	208	.018	-.031	-.054	.164*	.139*	.112	-.015	-.001	-.017	.037	.162*	.188**	-.071	-.154*
25	MS Project Leader5	3.58	1.185	208	.051	.109	.110	.092	.103	.206**	.133	.030	-.025	.165*	.186**	.146*	.079	.094
26	MS Cross-functionality1	4.23	.985	208	.176*	.235**	.126	.197**	.074	.068	.255**	.203**	.194**	.079	.241**	.139*	.249**	.113
27	MS Cross-functionality2	4.17	.947	208	.269**	.185**	.081	.149*	.141*	.059	.290**	.330**	.157*	.139*	.189**	.260**	.263**	.150*
28	MS Cross-functionality3	3.88	1.196	208	.177*	.179**	.068	.147*	.273**	.118	.230**	.172*	-.004	.234**	.258**	.276**	.132	.121
29	MS Management Support1	4.49	.810	208	.176*	.104	.051	.128	.000	-.007	.080	.154*	.039	-.056	.119	-.005	.290**	.018
30	MS Management Support2	3.84	1.063	208	.164*	.092	.053	.198**	.072	.113	.120	.131	.009	.032	.076	.018	.106	-.012
31	MS Management Support3	4.11	1.081	208	.135	.105	.055	.219**	.074	.036	.043	.072	.050	.008	.137*	.084	.051	-.123
32	OF Frequency1	3.89	1.013	208	.252**	.218**	.135	.223**	.111	.014	.247**	.291**	.166*	.089	.115	.142*	.379**	.126
33	OF Frequency2	2.77	1.194	208	.452**	.383**	.306**	.330**	.289**	.146*	.482**	.312**	.397**	.336**	.324**	.366**	.504**	.342**
34	OF Frequency3xx	3.33	1.188	208	-.144*	.014	-.004	.150*	.007	-.080	-.059	-.059	.001	-.024	-.074	-.054	.031	-.075
35	OF NSD Facilities1	3.88	1.002	208	.238**	.201**	.182**	.149*	.231**	.210**	.213**	.325**	.098	.179**	.295**	.381**	.157*	.114
36	OF NSD Facilities2	3.22	1.254	208	.343**	.199**	.237**	.191**	.208**	.157*	.384**	.263**	.274**	.163*	.234**	.262**	.333**	.280**
37	OF NSD Facilities3	3.26	1.180	208	.046	.036	-.020	.146*	.124	-.056	.068	.054	.176*	.040	.057	.029	.132	.005
38	OF Resources1	4.01	1.021	208	.083	.228**	.178*	.037	.233**	.186**	.081	.262**	.017	.299**	.283**	.268**	.096	.320**
39	OF Resources2	2.84	1.107	208	-.028	-.065	.063	-.003	-.121	-.075	-.068	-.131	.017	-.184**	-.113	-.119	-.026	-.225**
40	OF Resources3	3.35	1.186	208	.257**	.256**	.246**	.202**	.155*	.176*	.171*	.221**	.191**	.136*	.342**	.269**	.206**	.028
41	OF Culture1	2.38	1.230	208	-.162*	-.023	-.078	.028	-.076	-.119	-.202**	-.104	-.055	-.180**	-.172*	-.218**	-.064	-.299**
42	OF Culture2	3.60	1.090	208	.127	.102	.021	.167*	.004	.067	.149*	.209**	.029	.021	.043	.067	.202**	-.090
43	OF Culture3	3.44	1.234	208	.198**	.233**	.238**	.090	.145*	.103	.368**	.346**	.212**	.150*	.186**	.212**	.243**	.194**
44	OF Culture4	3.8269	1.0536	208.0000	.114	.131	.067	.090	.041	.067	.092	.218**	-.067	.052	.178**	.101	.133	-.005

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Means, Standard Deviations, and Intercorrelation Matrix *(cont. 1)*

		Mean	Std. Deviation	N	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1	SF Planning1	3.73	1.056	208														
2	SF Planning2	3.77	1.110	208														
3	SF Planning3	3.41	1.147	208														
4	SF Planning4	3.40	1.289	208														
5	SF Planning5	3.35	1.284	208														
6	SF Planning6	2.68	1.262	208														
7	SF Structure1	3.67	1.262	208														
8	SF Structure2	4.06	.971	208														
9	SF Structure3	3.43	1.119	208														
10	SF Structure4	3.48	1.503	208														
11	SF Structure5	3.76	1.145	208														
12	SF Structure6	3.85	1.027	208														
13	SF Structure7	3.33	1.204	208														
14	SF Structure8	3.68	1.310	208														
15	SF Documentation1	3.55	1.158	208	1.000													
16	SF Documentation2	3.50	1.188	208	.195**	1.000												
17	SF Documentation3	3.77	1.181	208	.616**	.343**	1.000											
18	MS Project Team1	4.01	.978	208	.093	.096	.090	1.000										
19	MS Project Team2	2.03	.983	208	-.141*	-.199**	-.165*	-.282**	1.000									
20	MS Project Team3	3.60	1.040	208	.281**	.229**	.219**	.317**	-.329**	1.000								
21	MS Project Leader1	4.39	.867	208	.167*	.267**	.178*	.258**	-.274**	.363**	1.000							
22	MS Project Leader2	3.76	.899	208	.245**	.114	.158*	.173*	-.205**	.254**	.230**	1.000						
23	MS Project Leader3	3.63	1.165	208	.157*	.243**	.270**	.143*	-.113	.114	.203**	.081	1.000					
24	MS Project Leader4	3.44	1.218	208	-.080	.072	-.013	.150*	-.233**	.111	.216**	.091	.417**	1.000				
25	MS Project Leader5	3.58	1.185	208	.018	.163*	.058	-.213**	.077	.029	.128	-.080	.280**	.093	1.000			
26	MS Cross-functionality1	4.23	.985	208	.138*	.067	.237**	.178*	-.102	.214**	.081	.122	.088	-.146*	.121	1.000		
27	MS Cross-functionality2	4.17	.947	208	.217**	.138*	.226**	.280**	-.338**	.233**	.194**	.105	.195**	.017	.091	.532**	1.000	
28	MS Cross-functionality3	3.88	1.196	208	.079	.222**	.247**	-.028	-.026	.038	.097	-.026	.203**	.023	.291**	.401**	.338**	1.000
29	MS Management Support1	4.49	.810	208	.070	.005	.017	.238**	-.236**	.217**	.073	.144*	.122	.109	-.047	.246**	.280**	.095
30	MS Management Support2	3.84	1.063	208	.161*	.089	.102	.122	-.139*	.204**	.067	.148*	-.005	.043	-.111	.169*	.186**	.042
31	MS Management Support3	4.11	1.081	208	.023	.121	.091	.196**	-.139*	.137*	.142*	.006	.216**	.122	.145*	.186**	.105	.227**
32	OF Frequency1	3.89	1.013	208	.221**	.110	.136	.196**	-.162*	.347**	.198**	.109	.010	-.054	-.011	.287**	.302**	.200**
33	OF Frequency2	2.77	1.194	208	.354**	.224**	.363**	.122	-.060	.279**	.167*	.179**	.132	.021	-.018	.165*	.159*	.190**
34	OF Frequency3xx	3.33	1.188	208	.011	.109	-.014	.051	-.083	.078	.033	.101	.076	.148*	-.010	-.045	-.090	-.091
35	OF NSD Facilities1	3.88	1.002	208	.107	.249**	.286**	.119	-.139*	.194**	.199**	-.058	.292**	.115	.144*	.160*	.190**	.206**
36	OF NSD Facilities2	3.22	1.254	208	.234**	.223**	.220**	.120	-.099	.249**	.180**	.187**	.168*	-.034	-.062	.202**	.233**	.066
37	OF NSD Facilities3	3.26	1.180	208	.127	.030	.047	.153*	-.157*	.272**	.078	.164*	.076	.140*	-.013	.072	.110	-.025
38	OF Resources1	4.01	1.021	208	-.029	.231**	.218**	-.034	-.024	.035	.138*	-.061	.157*	-.089	.239**	.171*	.228**	.385**
39	OF Resources2	2.84	1.107	208	.046	-.142*	-.168*	.059	.018	.036	-.031	-.043	-.031	.084	.077	-.015	-.066	-.109
40	OF Resources3	3.35	1.186	208	.081	.219**	.165*	.097	-.063	.127	.045	.078	.295**	.099	.065	.112	.105	.064
41	OF Culture1	2.38	1.230	208	-.016	-.141*	-.108	.037	-.077	.031	.045	-.023	-.081	.076	-.054	-.173*	-.124	-.113
42	OF Culture2	3.60	1.090	208	.226**	.051	.096	.244**	-.169*	.303**	.111	.050	-.032	-.025	-.017	.195**	.246**	.007
43	OF Culture3	3.44	1.234	208	.268**	.135	.275**	.061	-.118	.142*	.206**	.058	.195**	-.033	.071	.207**	.199**	.141*
44	OF Culture4	3.8269	1.0536	208.0000	.074	.042	.131	.203**	-.172*	.117	.143*	.084	.112	.101	-.012	.150*	.214**	.233**

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Means, Standard Deviations, and Intercorrelation Matrix *(cont. 2)*

		Mean	Std. Deviation	N	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
1	SF Planning1	3.73	1.056	208																
2	SF Planning2	3.77	1.110	208																
3	SF Planning3	3.41	1.147	208																
4	SF Planning4	3.40	1.289	208																
5	SF Planning5	3.35	1.284	208																
6	SF Planning6	2.68	1.262	208																
7	SF Structure1	3.67	1.262	208																
8	SF Structure2	4.06	.971	208																
9	SF Structure3	3.43	1.119	208																
10	SF Structure4	3.48	1.503	208																
11	SF Structure5	3.76	1.145	208																
12	SF Structure6	3.85	1.027	208																
13	SF Structure7	3.33	1.204	208																
14	SF Structure8	3.68	1.310	208																
15	SF Documentation1	3.55	1.158	208																
16	SF Documentation2	3.50	1.188	208																
17	SF Documentation3	3.77	1.181	208																
18	MS Project Team1	4.01	.978	208																
19	MS Project Team2	2.03	.983	208																
20	MS Project Team3	3.60	1.040	208																
21	MS Project Leader1	4.39	.867	208																
22	MS Project Leader2	3.76	.899	208																
23	MS Project Leader3	3.63	1.165	208																
24	MS Project Leader4	3.44	1.218	208																
25	MS Project Leader5	3.58	1.185	208																
26	MS Cross-functionality1	4.23	.985	208																
27	MS Cross-functionality2	4.17	.947	208																
28	MS Cross-functionality3	3.88	1.196	208																
29	MS Management Support1	4.49	.810	208	1.000															
30	MS Management Support2	3.84	1.063	208	.410**	1.000														
31	MS Management Support3	4.11	1.081	208	.421**	.238**	1.000													
32	OF Frequency1	3.89	1.013	208	.336**	.293**	.152*	1.000												
33	OF Frequency2	2.77	1.194	208	.086	.085	.012	.358**	1.000											
34	OF Frequency3xx	3.33	1.188	208	-.003	-.073	.089	-.046	-.062	1.000										
35	OF NSD Facilities1	3.88	1.002	208	.132	.095	.230**	.201**	.195**	-.060	1.000									
36	OF NSD Facilities2	3.22	1.254	208	.101	.102	-.028	.300**	.311**	.081	.240**	1.000								
37	OF NSD Facilities3	3.26	1.180	208	.148*	.064	.137*	.117	-.022	.178**	-.030	.036	1.000							
38	OF Resources1	4.01	1.021	208	.070	.015	.078	.104	.133	-.245**	.298**	.002	-.146*	1.000						
39	OF Resources2	2.84	1.107	208	.086	-.042	.050	.019	-.101	.161*	.035	-.059	.151*	-.242**	1.000					
40	OF Resources3	3.35	1.186	208	.083	.033	.133	.137*	.208**	.051	.235**	.462**	.096	.153*	.057	1.000				
41	OF Culture1	2.38	1.230	208	.059	-.023	.176*	.015	-.153*	.233**	-.064	-.252**	.146*	-.287**	.290**	-.060	1.000			
42	OF Culture2	3.60	1.090	208	.310**	.366**	.303**	.410**	.128	-.008	.132	.114	.132	-.031	.071	.013	.116	1.000		
43	OF Culture3	3.44	1.234	208	.072	.127	.081	.193**	.164*	-.109	.109	.182**	-.023	.085	.012	.142*	-.156*	.207**	1.000	
44	OF Culture4	3.8269	1.0536	208.0000	.184**	.126	.110	.073	.133	-.035	.159*	.065	-.091	.168*	.018	.145*	-.127	.115	.166*	1.000

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Research Variables and Measures

	Variable	Question or Statement
1	SF Planning1	The process to develop the new service was thoroughly planned
2	SF Planning2	A timing plan up to the point of market introduction of the new service was used.
3	SF Planning3	Adhering to a timing plan was a priority throughout the development process.
4	SF Planning4	Too many things happened at once. It wasn't possible to plan the new service in detail.
5	SF Planning5	All that mattered in the process was the idea on which the new service was based.
6	SF Planning6	The new service was mainly a result of intuition and experience of the employees involved in the process.
7	SF Structure1	The development process was structured into formal phases (e.g. concept phase, planning phase, test phase, etc.).
8	SF Structure2	The service development included milestones and/or interim targets.
9	SF Structure3	A fixed sequence of development activities was adhered to.
10	SF Structure4	The development process was not structured or planned. The new service was arrived at mainly by improvisation.
11	SF Structure5	At no point did a formal development process come into play.
12	SF Structure6	Milestones and development stages were not relevant.
13	SF Structure7	The development approach followed standards and routines, which are regularly used by our firm.
14	SF Structure8	The go-ahead for the new service project required a formal decision of the management based on a project plan.
15	SF Documentation1	Processes were well documented.
16	SF Documentation2	Process documentation was issued after the introduction to the market.
17	SF Documentation3	Processes were not documented.
18	MS Project Team1	The project team had the authority to make important project decisions.
19	MS Project Team2	Employees who later carried out the service had a key role in the development.
20	MS Project Team3	Every project participant had a clearly defined role.
21	MS Project Leader1	There was a definite project leader.
22	MS Project Leader2	The direction given by the project leader needed to be followed.
23	MS Project Leader3	A project leader emerged during the development process but was not formally selected / put in place.
24	MS Project Leader4	There were various project leaders, depending on the stage of development.
25	MS Project Leader5	All people involved in the development had the same hierarchical status.
26	MS Cross-functionality1	The project team was composed of staff from various departments.
27	MS Cross-functionality2	Cross-functional teams were put in place.
28	MS Cross-functionality3	All development staff came from the same department within the business.
29	MS Management Support1	The project was supported by senior management of the firm.
30	MS Management Support2	Senior Management had an active role throughout the development process.
31	MS Management Support3	The development project received a lack of support from senior management.
32	OF Frequency1	We managed to profit from the service development experience of our firm.
33	OF Frequency2	There are strict routines for developing new services.
34	OF Frequency3	Introducing a new service represented a considerable risk to the existing business.
35	OF NSD Facilities1	Special skills of dedicated development staff were not important.
36	OF NSD Facilities2	The organisation had dedicated development staff and facilities in place.
37	OF NSD Facilities3	During the development, the majority of the organisation worked without interference.
38	OF Resources1	Introducing the new service was simple and did not require resources worth mentioning.
39	OF Resources2	Funding for the new service was easy to come by.
40	OF Resources3	The organisation could not afford dedicated development personnel.
41	OF Culture1	There were significant organisational hurdles that needed to be overcome in order to introduce the new service.
42	OF Culture2	Our company culture has supported the development of the new service significantly.
43	OF Culture3	To reduce risk, the organisation invested in pre-testing the service.
44	OF Culture4	The new service contributed to securing the organisation's future.

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