Managing Innovation Complexity

About the Co-Existence of Innovation Types

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I hereby declare that:

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Maastricht, 01-06-2014

Philipp Adrian Pohlmann

"The enterprise that does not innovate inevitably ages and declines. And in a period of rapid change such as the present…the decline will be fast"

- Peter F. Drucker (1909 – 2005)

Abstract

The purpose of this study is to contribute to the changing innovation management literature by providing an overview of different innovation types and organizational complexity factors. Aiming at a better understanding of effective innovation management, innovation and complexity are related to the formulation of an innovation strategy and interaction between different innovation types is further explored. The chosen approach in this study is to review the existing literature on different innovation types and organizational complexity factors in order to design a survey which allows for statistical measurement of their interactions and relationships to innovation strategy formulation. The findings demonstrate interaction between individual innovation types. Additionally, organizational complexity factors and different innovation types are significantly related to innovation strategy formulation. In particular, more closed innovation and incremental innovation positively influence the likelihood of innovation strategy formulation. Organizational complexity factors have an overall negative influence on innovation strategy formulation. In order to define best practices for innovation management and to guide managerial decision making, organizations need to be aware of the co-existence of different innovation types and formulate an innovation strategy to more closely align their innovation objectives.

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Chapter 1: Introduction

Increasing economic liberalization and technological advances, such as the introduction of information and communication technologies, have introduced global competition to regional markets. These environmental factors have greatly influenced organizational complexities (Fløysand and Jakobsen, 2011). Nedopil et al. (2011) differentiate between four distinct components of organizational complexity: diversity, ambiguity, interdependency and flux. Due to their dynamic nature, organizational complexity as a whole has become increasingly difficult to manage (Steger et al., 2007). At the same time, competitive pressures force organizations to add further management complexity due to the need for continuous innovation (Gottfredson and Aspinall, 2005).

Over the past decades, different types of innovation have emerged in an evolutionary fashion (Ortt and Van der Duin, 2008). In particular, three antagonistic pairs of innovation approaches can be considered most relevant: closed versus open innovation, incremental versus radical innovation and product versus service innovation. The current literature measures these different innovation types on a continuum as if they were exclusive to each other (e.g. Almirall and Casadesus-Masanell, 2010; Chesbrough, 2003; Nijssen et al. 2006). However, organizations need to invest in different innovation types simultaneously in order to differentiate themselves from competitors. For instance, incremental innovation is imperative to a competitive survival. However, in order to differentiate organizations would also need to invest in radical innovation (Inauen and Schenker-Wicki, 2012).

In line with this observation, competitive pressures not only increase organizational complexity, but also foster the adoption of different co-existing innovation types within a single organization

(e.g. Ortt and Van der Duin, 2008; Van den Elst et al., 2006; Verloop, 2006). Acknowledging that individual innovation types have unique characteristics, modern organizations are faced with a large number of different processes.

Thus, organizational complexity factors and different innovation types have an influence on how effective organizations can manage their innovation. Although different approaches to measure innovation management have been considered in the past (e.g. Adams et al., 2006, Quinn, 1985) there is only limited research on the management of different innovation types within a single organization. Additionally, there is still little understanding about the relationship between different innovation types and organizational complexity factors (Tidd, 2001; Damanpour, 1996).

While Naji and Tuff (2012) focus on best practices for managing a portfolio of innovation types, Ortt and Van der Duin (2008) highlight the contextual nature of innovation management, arguing that innovation management needs to be adjusted to the individual situation. Considering innovation from a contextual standpoint, it becomes very difficult to provide tailored managerial advice. Therefore, this study builds on the attempt to find a common approach towards innovation management, keeping in mind that innovation management can be context specific. Going one step further, not only the degree of organizational innovativeness is considered, but also organizational openness, ranging from closed to open innovation. Thus, in order to explore innovation management the following research question is analyzed:

To what extent does the co-existence of different innovation types and organizational complexity factors within a single organization impact on an organization's innovation management?

For a comprehensive answer to this question the following investigative questions provide research guidance towards a meaningful outcome:

1. *What different types of innovation can be distinguished within organizations?*

2. *What different factors constitute organizational complexity?*
3. *How can organizations manage the co-existence of different innovation types and organizational complexity effectively?*

First, the theoretical background considers the portfolio view to innovation management and organizational complexity factors as well as the link between both, innovation and complexity. Second, the research design focuses on the methodology, data collection procedure and measurement. Third, the collected data is analyzed using linear and logistic regressions. Fourth, the discussion focuses on support and contradiction of these findings with regard to the current literature. Last the conclusion considers theoretical and managerial contributions as well as some associated limitations with this study.

Chapter 2: Theoretical Background

This section develops a theoretical understanding of the types of innovation that co-exist within a single organization and the complexity that innovating organizations face. In this research, the types of innovation are developed from a portfolio perspective suggesting that organizations need to manage a portfolio of different innovation types. This is based on the idea of Nagji and Tuff (2012), who define an innovation portfolio in terms of ambition to innovate. Concerning the management of organizational complexity, Nedopil et al. (2011) find that organizational complexity is composed of four main dimensions, namely, diversity, ambiguity, interdependence and flux. They are further refined to make them applicable to the context of this study.

2.1. Managing Co-Existing Innovation Types

"You cannot connect the dots looking forward; you can only connect them looking backwards. So you have to trust that the dots will somehow connect in your future."

- Steve Jobs (1955-2011)

David Brier (2013) recently published an article on the meaning of innovation. He takes Steve Job's commencement speech to the graduating class of Stanford University in 2005 as an opportunity to discuss the meaning of innovation. The above-mentioned quote taken from this speech reflects on the belief that true meaning of an action cannot be revealed in the process of acting, or figuratively it cannot be revealed during the stage of discovery. Instead it can only be revealed retrospectively after it already happened. Attempting to find a holistic approach towards innovation, Brier's idea is that life is made up of commonly known dots. They form a belief system on which decisions and solutions are based. Organizations are built on these commonly known dots and they reflect the *status quo* of modern business operations. At some point, new dots are discovered that change existing dots or replace them entirely. Brier identifies unexpected connections, notions, ideas, possibilities and imagination to be major sources of the identification of new dots. He concludes that most of today's commonly known dots were uncommon at some point in time and that each innovation represents one of these dots.

Formally, the literature on innovation management distinguishes different generations of innovation (e.g. Miller, 2001; Cooper, 1994; Rothwell, 1994). These different generations seem to emerge in an evolutionary fashion, with sometimes opposing beliefs about the time of emergence. Niosi (1999, p. 117) provides a concise definition:

"The first generation brought the corporate R&D laboratory. The second generation adapted project management methods to R&D. The third brought internal collaboration between different

functions in the firm. The fourth adds routines designed to make more flexible the conduct of the R&D function through the incorporation of the knowledge of users and competitors."

Following the ideas of Herzog (2011) and Chesbrough (2003) the first three generations of innovation represent closed innovation and the fourth generation represents open innovation. These types of innovation embody approaches towards managing the innovation process either in an open or closed environment (Van den Elst et al., 2006; Verloop, 2006). At the same time, innovation can be either incremental by altering existing products or radical by replacing them completely (e.g. Garriga et al., 2013; Norman and Verganti, 2012; Dewar and Dutton, 1986; Ettlie, et al., 1984). As a last distinction, innovation can be either for products or services (Nijssen et al., 2006). Empirical evidence suggests that service innovation has some unique characteristics that differentiate it from product innovation. Although service innovation can accompany product innovation and vice versa, both product and service innovation need to be considered independently (Chesbrough, 2010; Preissl, 2000).

There is strong reason to believe that different types of innovation can be adopted simultaneously within a single organization (Ortt and Van der Duin, 2008; Van den Elst et al., 2006; Verloop, 2006). This finding suggests the adoption of a portfolio view towards innovation as illustrated by Figure 1 below.

Figure 1 is an adopted model of the innovation portfolio by Naji and Tuff (2012). It shows three continuums of innovation: from closed to open, from incremental to radical and from product to service. Product innovation can be either incremental, or radical in a closed, or open environment. The same is true for service innovation. Traditionally, research has focused entirely on product innovation with closed research and development departments. More recently, and as a result of

increased economic activity in services, this focus has shifted towards service innovation, which is suggested to be more collaborative and open in nature (Chesbrough, 2010a). While most product innovation is of incremental nature and introduces new product features and designs to an existing offering, radical innovation represents a large share of service innovation (Chesbrough, 2010b). The arrangement of the different innovation types in Figure 1 follows this reasoning by relating product innovation to incremental and closed innovation in the lower left corner and service innovation to radical and open innovation in the upper right corner. It needs mentioning that this placement is not exclusive. Some products might very well be of radical nature, developed in an open environment. Similarly, some services might be of incremental nature and kept in a closed environment. This is why Figure 1 also depicts a transition where a product or service can be either closed and incremental, or open and radical.

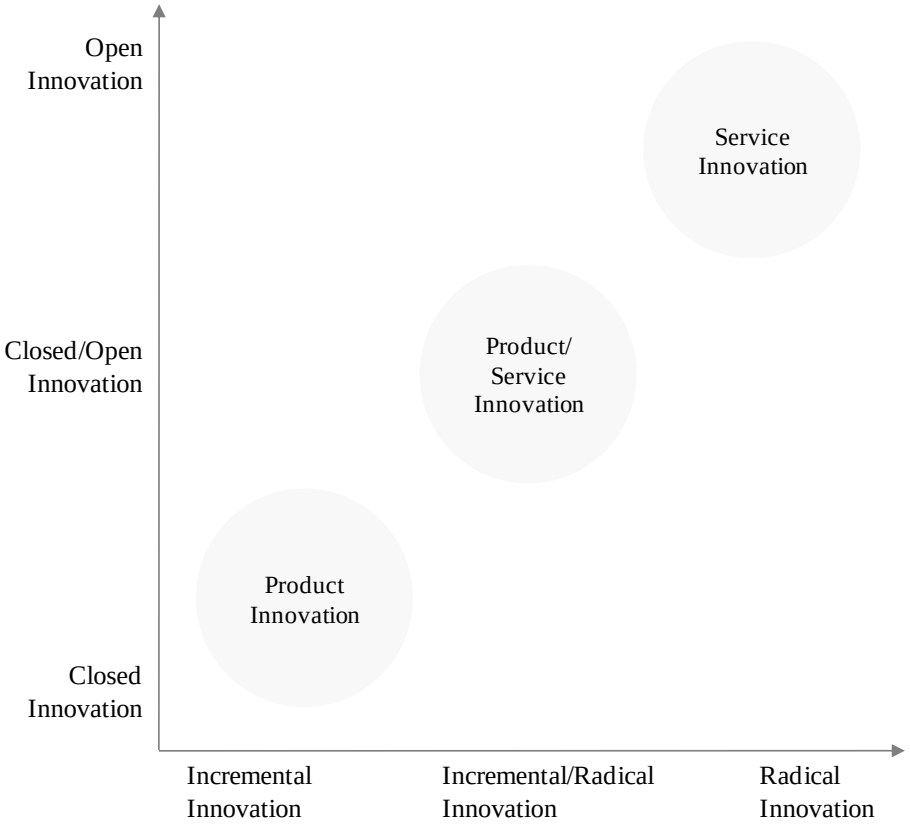


Figure 1: Innovation Portfolio Model[1]

2.1.1. Open Innovation versus Closed Innovation

The development of new products and services revokes an imperative question for organizations' innovation management: whether to take a closed approach to innovation by internalizing all research and development choices or to take an open approach to innovation by externalizing parts of its technology and incorporating parts developed by other parties (Almirall and Casadesus-Masanell, 2010).

Although academic literature has found convincing evidence of the added value through externalizing research and development processes of products and services, long time ago (e.g. Rothwell and Zegveld, 1985 Allen, 1969) the concept of open innovation was first formally introduced by Chesbrough in 2003. In his book on open innovation, Chesbrough creates a dichotomy that questions the old way of innovating, i.e. closed innovation, and agrees on reasons for organizations to foster collaboration with external parties, i.e. to engage in open innovation (Trott and Hartmann, 2009).

Since its introduction, the open innovation paradigm has gained strong momentum in academic research and applied practice (e.g. Boureau, 2006; von Hippel, 2005; Chesbrough, 2003; von Burg, 2001). The general idea is that organizations' resource constraints limit the amount of new innovation. Assuming that innovation costs rise, for example, through innovation protection and revenue streams decline, for example, through shortened product life cycles, Chesbrough (2003) suggests a new paradigm of innovation whereby organizations generate additional revenue streams

[1] Adopted from Naji and Tuff (2012)

through expanding to other markets, creating spin-off's and licensing off their innovation. As defined by Chesbrough et al. (2003; p.1):

"Open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market".

In contrast, Chesbrough (2003) associates closed innovation with complete control over the innovation process. The underlying rationale is that external parties might not be able to add value to the existing innovation process. This can be due to insufficient quality input or limited capabilities (Herzog, 2011).

Opening up product and service development processes has great potential compared to keeping all research and development in house. Openness promotes knowledge sharing by combining the efforts of a large group of diverse organizations. Thereby, organizations innovate products and services with a more accurate fit between consumer preferences and product specifications (Chesbrough, 2006). It is further suggested that external parties, such as independent suppliers and complementors, follow independent product and service development processes. Thus, they are likely to develop products and services in ways the incumbent organization would not have chosen. This allows for product and service features, which are not foreseen by the incumbent organization (Almirall and Casadesus-Masanell, 2010).

However, there are also unresolved drawbacks to sharing knowledge with external parties. Most importantly, openness means exposure to competing organizations (Dahlander and Gann, 2010). Internal research and development processes need to be externalized. Additionally, the incumbent organization loses partial control over the development process. This means that certain product

and service features become external ownership and cannot be reconfigured easily at a later stage (Almirall & Casadesus-Masanell, 2010).

To prevent any financial damage from knowledge expropriation, organizations usually take precautionary measures by carefully defining appropriate relationship governance structures and patenting their existing technology (Oxley and Sampson, 2004). As such, these measures drive capital expenditures, which monetize only for successful innovations. Additionally, to truly profit from open innovation patents would need to be tradable to external parties. However, patent valuation remains complicated due to their unique nature. Thus, open innovation certainly stimulates and widens research and development opportunities but does not find full application due to its inherent riskiness (Gassmann et al., 2010).

Considering both innovation approaches, open and closed, Almirall and Casadesus-Masanell, (2010) find a trade-off between divergence and discovery, meaning the cost of losing control over the development of products and services vis-à-vis the opportunity to aggregate and share knowledge for gaining an improved understanding of customer needs. However, this is not to say that both innovation approaches cannot co-exist within a single organization (Ortt and Van der Duin, 2008). Even Chesbrough (2003, p. xxvii) admits that there are limitations to open innovation applicability in all industries:

"This is not to argue that all industries now operate in an Open Innovation regime. Some industries [...] continue to operate in a Closed Innovation regime"

Thus, in line with researching the management of different co-existing innovation types, it is suggested that organizations need to manage both, open and closed innovation projects simultaneously.

2.1.2. Incremental Innovation versus Radical Innovation

Regardless of the various definitions of incremental and radical innovation, researchers have agreed on substantial differences between these innovation types (e.g. Clausen and Pohjola, 2013; Dewar and Dutton, 1986; Bridges and O'keefe, 1984). Due to the fact that there is limited consensus on a formal definition for incremental and radical innovation (Ehrnberg, 1995) this research takes a strategic perspective in line with McDermott and O'Connor (2002).

Raisch et al. (2009) find that innovating organizations need to balance short-term exploitation of profits and long-term exploration of arising opportunities. In the context of incremental and radical innovation, they should follow tactical or short-term objectives for incremental innovation and strategic or long-term objectives for radical innovation. Whereas most radical innovation projects require large upfront capital expenditure and last for several years, incremental innovations are continuously introduced to the market (Morone, 1993).

Following this logic, organizations need to manage both incremental and radical innovation in order to be competitive. In fact, incremental innovation may only be seen as a prerequisite for keeping competitive parity (Inauen and Schenker-Wicki, 2012; Bettis, and Hitt, 1995). In other words, a portfolio of products and services needs to be updated regularly in order to keep an organization attractive to its customers. However, simply sustaining existing products and services will not provide an organization with a competitive advantage. The opposite holds for radical innovation. This type of innovation often relates to rather complex technologies (Sood and Tellis, 2005). Once a market for these new products and services has emerged, it becomes difficult for any other organization to enter. The proprietary knowledge of the incumbent organization coupled

with strong patent protection creates an immediate first mover advantage (Stieglitz and Heine, 2007; Gopalakrishnan and Damanpour, 1997).

When considering radical innovation, the inherent riskiness of this type of innovation seems to prohibit large organizations to invest in it (Dougherty and Hardy, 1996). Failing to deliver truly radical products and services can have enormous negative financial and reputational consequences. Thus, most innovation from large organizations (such as those listed on the S&P 500) is of incremental nature. It takes place at the subsystem level, for example, the altering of product and service design, costs and features to extent their lifespan (Fuglsang and Sørensen, 2011; Toivonen and Tuominen, 2009; Pires et al., 2008).

Shane and Venkataraman (2000) argue that most radical innovation comes from entrepreneurial organizations. In fact, the authors suggest that innovation is one of the major drivers for entrepreneurial activity. Small and medium sized organizations are inclined to take on greater risks to enter new markets. This makes them more vulnerable on the one hand, but enables them to develop radical products and services in such markets on the other hand. The great success of entrepreneurial ventures in Silicon Valley seems to confirm this line of argumentation (Fairlie and Chatterji, 2013).

2.1.3. Product Innovation versus Service Innovation

While interest in service innovation is a more recent phenomenon, product innovation is a well-defined research field (e.g. Meyer and DeTore, 2001; Dougherty and Hardy, 1996). Interest in products originates from the introduction of a formal stage-gate model, which structures the product development process from an initial discovery stage to the product launch (Cooper, 1999).

Although there has been some progress on the dynamics of the stage gate process (Cooper, 2008), it remains rather static with limited applicability for service innovation (Coombs and Miles, 2000).

One of the major issues in formalizing the service innovation process is to distinguish characteristics that are unique for either products or services (Lovelock & Gummesson, 2004; Vargo and Lusch, 2004; Zeithaml, Parasuraman and Berry, 1985). In a quest for more clarification, current literature differentiates between two main approaches, an assimilation approach and a desecration approach (Nijssen et al., 2006; Drejer, 2004).

Proponents of the assimilation approach argue that concepts developed for the product context should be applicable to the service context (e.g. Hughes and Wood, 2000; Sirilli and Evangelista, 1998; Griffin, 1997). It is suggested that there are great similarities between organizations that do well in product innovation projects and those that do well in service innovation projects. First, those organizations tend to be strongly committed to innovation, which includes a well-structured, formalized innovation strategy. Second, their substantial investment in innovation pays off and is backed by key executives of the organization. As a last similarity, those organizations embrace an innovation culture and recruit the right human resources to put their research into action. (e.g. Ernst, 2002; Tidd and Bodley, 2002; De Brentani, 2001, Griffin, 1997; Brown and Eisenhardt, 1995).

In contrast, proponents of the desecration approach highlight the differences between products and services (e.g. Menor and Sampson, 2002; Djellal and Gallouj, 2001; Gallouj and Weinstein, 1997). Services are characterized by certain unique characteristics, such as intangibility, heterogeneity, simultaneity and co-production with customers (Fitzsimmons & Fitzsimmons, 2000). Whereas products are often tangible and intended for physical use, services are intangible and produced as a

prerequisite (Edvardsson, and Olsson, 1996). In other words, products are valuable to the customer as they are, but services become valuable to the customer due to the interaction with the service provider. Therefore, service innovation is not presumed to result in high research and development expenditures. Instead, true service success relies on the interaction between service development and service delivery (Nijssen et al., 2006).

Arguing that organizations need to manage different types of innovation simultaneously this research considers a summarized case study of an organization that successfully exploits both, product and service innovation.

In one of his recent studies, Chesbrough (2010) analyses the Smartphone industry. He finds that this industry has permanently changed with the introduction of the iPhone by Apple, Inc. Before the iPohne, organizations focused on the functional use of a Smartphone within the business context. However, in an early development stage of the iPhone Apple Inc. recognized a shift in the basis of the competition towards consumer services offered on mobile devices (West and Mace, 2010). Steve Jobs pointed out that Smartphones could become a gateway to multimedia usage. Agreeing on the importance of services, and in order to differentiate from its competitors Apple, Inc. made it their core business to provide a software platform on which third parties could build their service applications. While radical product innovation prevails to be the embodiment of what Apple Inc. stands for, the organization has successfully incorporated the applications service offering into the already existing iTunes Store in order to strengthen its overall business ecosystem. Having a look at Apple Inc.'s annual report of 2013, it becomes apparent that applications for the iPhone, and now also for the iPad, have turned the iTunes store into a powerhouse with net sales of more than USD 16.1 billion representing 9.4% of total net sales (Apple, 2013).

This example not only illustrates the potential opportunity for organizations to benefit from service innovation, but also highlights the increased necessity to do so. Although there might be organizations that do extremely well in one domain, either products or services, it can be argued that the majority of organizations will only be competitive when focusing on both, products and services in the long-term.

2.2. Managing Organizational Complexity

In order to have a basic understanding of how organizational complexity influences innovation management, its main components need to be considered. The term complexity originates in the natural sciences and is derived from the Latin word "*complexus*", which stands for connected or interweaved. This already points at the dynamic nature of the term. In modern society, complexity is often used subjectively in various contexts encompassing the academic and business world as well as everyday life (Niehaus, 2002). Thus, a variety of different definitions and perceptions have emerged leading to an increased difficulty of a specific application.

Derived from the natural sciences, complexity in its traditional sense cannot be directly applied to the business context. Nevertheless, there has been extensive research on coping mechanisms for managing organizational complexity (e.g. Bushman and Smith, 2004; House and Lirtzman, 1970; Lawrence and Lorsch, 1967). Given the stated need for a more precise definition of complexity in general (van Gigch, 1991), and for this paper in specific, this research focuses on the work of Ulrich and Probst (1988), who provided a broad definition of organizational complexity. Nedopil et al. (2011a) further advanced this definition by focusing on four main building blogs of organizational complexity: diversity, ambiguity, interdependence and flux. They are intertwined

and co-exist within a single organization. Following this approach, Figure 2 below is adopted from Nedopil et al. (2011b) and depicts the different complexity dimensions.

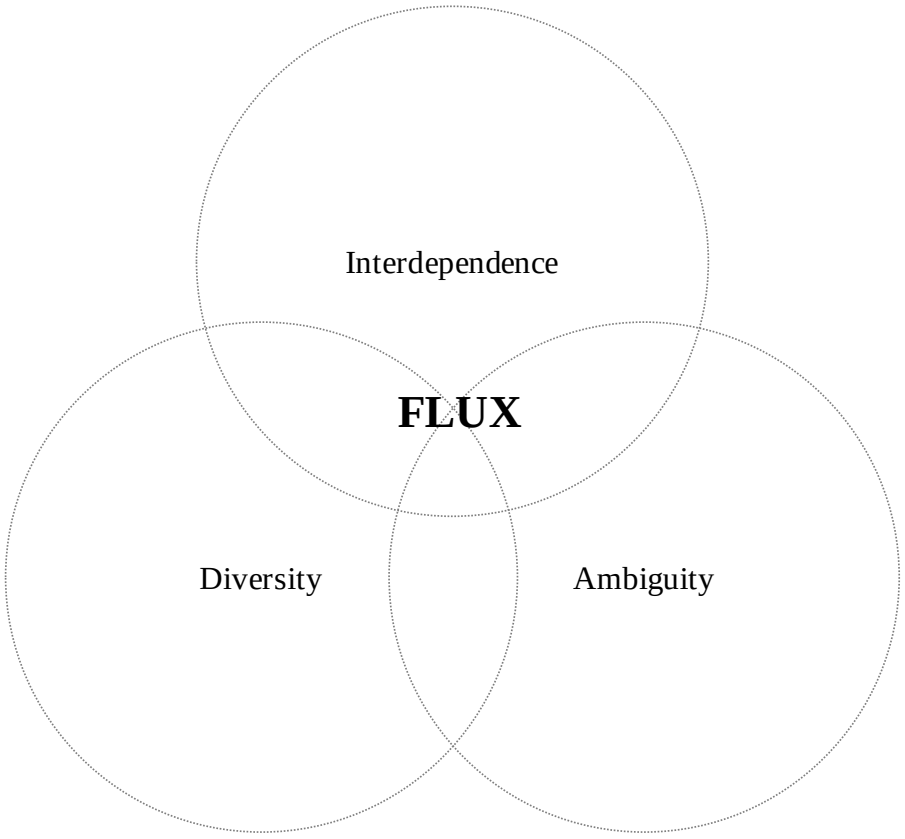


Figure 2: Organizational Complexity Factors[2]

2.2.1. Diversity

Formally, diversity provides a quantitative foundation for complexity referring to the number of elements in an organization as well as their dissimilarity. In general, diversity embodies the ability of an organization to take on different states over a given time span. As such, diversity illustrates

[2] Adopted from Nedopil et al. (2011)

the dynamic nature and continuity of organizational complexity (Malik, 2002; Ulrich and Probst, 1988).

In many ways, diversity represents the modern organization with its different structural and strategic challenges. Thereby, it encompasses internal and external organizational impact factors. Internally, diversity constitutes the management of human resources, the mind-sets of employees at different levels of the organizational hierarchy, their cultural and behavioral differences as well as different control systems for the management of products and services and strategic business model decisions. Externally, diversity reflects on different customer needs, the competitive environment, the regional and national political system as well as diverging demands from all stakeholders, in particular from shareholders (Maznevski, 2007).

To measure organizational diversity, two parameters are considered: geographical concentration and cultural concentration. A large number of branches worldwide highlight the potential for diverging mind-sets of employees due to regional differences in managerial and political systems. A large number of languages spoken at the office represent the cultural and behavioral diversity of employees (Damanpour, 1996).

2.2.2. Ambiguity

Another element of the organizational complexity construct is ambiguity. Broadly, ambiguity is concerned with information complexity prevalent in most organizations. More specifically, information in this context refers to availability, richness, predictability and accuracy. Increased uncertainty about information accuracy in the internal and external environment leads to information asymmetry (Woodward, 1993; Rizzo et al., 1970).

The causes of asymmetric information have had disastrous implications in the past. The global financial crisis of 2008 is one of the most prominent examples of increased asymmetric information within the economy. In particular, the speculation on financial products such as subprime mortgage securities almost collapsed the financial system. As a result, the phenomenon of external factors leading to ambiguity in the marketplace has been the object of extensive scientific research (e.g. Duchin et al., 2010; Ferraro, 2008).

In the context of this research, internal ambiguity, which comes from diverging attitudes towards organizational direction, goals and interpretation of market behavior, is assumed to be an important factor for organizational complexity (Maznevski, 2007).

In order to measure ambiguity, the size of an organization is considered. As an organization grows, so does the flow of information. Too much information stemming from various sources increases the difficulty of accurate interpretation leading to larger organizational ambiguity (Damanpour, 1996).

2.2.3. Interdependence

Interdependence is a crucial element for organizational complexity. It represents the intertwined, network like nature of the construct. Broadly, organizational complexity increases with increasing levels of organizational interconnectivity (Boyacigiller, 1990). Whereas internal interdependence refers to the organizational structure, external interdependence relates to the organizational interactions with its stakeholders, strategic alliances and outsourcing partnerships (Fiss, 2007).

As such, organizations can be scrutinized by considering interconnected structures and practices as a whole instead of evaluating the various elements individually. A growing number of

interconnected components naturally increase complexity due to the inability to determine the effects one variable has on the organization as a whole (Axelrod and Cohen, 2000). In general, as relationships inside and outside organizational boundaries increase, so does organizational complexity

However, an increase in complexity cannot always be presumed to entail negative effects in all instances. To the contrary, aggregated relationships as well as interconnectivity internal and external to an organization intensify the flow of information. This in turn leads to increased organizational ambiguity, but also enhances the depth of organizational learning. As a result, it further improves capabilities and facilitates the clear definition of goals and objectives that sustain competitive positioning within the marketplace (Ashmos et al., 2000).

To measure interdependence the level of hierarchy is considered as parameter. The hierarchy of an organization is associated with a certain level of control. An organization with a flat hierarchy is characterized by elasticity, which allows for interaction among all employees. In contrast, an organization with a steep hierarchy is inelastic and restricts the interaction of its employees by defining the locus of control that each employee has. As social interaction and, therefore, the flow of information is increased within a flat organization, it is suggested that this will boost potential interdependencies when compared to a steep organization (Broadbent and Weill, 1993).

2.2.4. Flux

The last component of organizational complexity is flux, or in other words, the organizational change taking place internally as well as externally. Flux relates to the dynamic nature of complexity and introduces aspects such as timing, duration, speed and frequency to the construct.

It applies to all levels of an organization ranging from individual change processes within organizational sub-units to regulatory ones that occur in the marketplace (Keuper, 2005).

Internally, change can be reflected by organizational reorientation and novelty of new processes for products and services. As change is reflected in all four components of organizational complexity, it is essential to effective management. Managing change means that an organization needs to allocate resources efficiently, thereby, balancing individual strengths and weaknesses (McKelvey, 2001).

The frequency of new product and service launch helps to measure organizational flux. Organizations that constantly innovate new products and services are assumed to encompass more complexity, when compared with their less innovative counterparts.

In sum, the four dimensions of complexity, namely, diversity, ambiguity, interdependence and flux drive complexity in an organizational setting. Both, the internal and external environment of an organization influence these components. Thus, managing complexity means evaluating potential costs and benefits that each individual component brings along.

2.3. Innovation and Complexity: the Missing Link

Economic liberalization and technological advances, such as the introduction of information and communication technologies, have introduced global competition to regional markets. As a response, to these developments organizations have commenced to expand their organizational boundaries. This is exemplified by their increased efforts to hire employees outside their home markets and to seek strategic partnerships in order to increase their market share (Fløysand and Jakobsen, 2011).

Those environmental factors not only have an impact on the amount of economic uncertainty, but also increase diversity, ambiguity, interdependence and flux within organizations. Thus, they influence organizational complexity. In order to ensure competitiveness organizations are forced to respond by continuously innovating new products and services (Merali and McKelvey, 2006; Ashby, 1958). However, recent events such as the global financial crisis of 2008 and data security issues have greatly increased the demand for transparency. As such, consumer preferences have shifted towards more simplicity in products and services (Etzioni, 2003). As a response, some organizations have reduced their product and service portfolio in order to enhance transparency (Gottfredson and Aspinall, 2005).

Consequently, the fundamental dilemma of growing environmental uncertainty is that it requires organizations to respond by either increasing the level of organizational complexity, for example, through innovating new products and services (Merali and McKelvey, 2006; Ashby, 1958) or by decreasing the level of complexity, for example, through reducing the product and service offering (Luhman and Boje, 2001). Gottfredson and Aspinall (2005, p. 2) describe this dilemma in the following way:

"As more products are added, the costs of the resulting complexity begin to outweigh the revenues, and profits start falling. From that point on, every new offering—however attractive in isolation—just thins margins further. The more aggressively the company innovates in product development, the weaker its results become. (It's not just manufacturers that suffer from profit-eroding complexity. It affects service firms and knowledge companies as well)."

From their observation it becomes clear that organizations need to innovate, bearing in mind that more innovation has an impact on organizational complexity and the organization as a whole. In

particular, in order to manage innovation effectively organizations need to find a shared understanding of the role that different innovation types play within the organization. A common agreement leads to aligned goals and objectives for innovation management (Naji and Tuff, 2012). As such, the formulation of an innovation strategy is of paramount importance (Adner, 2006).

Comparing the different pairs of innovation types, namely closed *versus* open innovation, incremental *versus* radical innovation and product *versus* service innovation, it is suggested that they influence the likelihood of a well-formulated innovation strategy differently. Therefore, the following three hypotheses argue for a relationship between the three pairs of innovation types, organizational complexity factors and the likelihood of a well-formulated innovation strategy:

H1: The amount of open and closed innovation and organizational complexity factors within an organization has an impact on the likelihood of a well-articulated innovation strategy.

H2: The amount of incremental and radical innovation and organizational complexity factors within an organization has an impact on the likelihood of a well-articulated innovation strategy.

H3: The amount of product and service innovation and organizational complexity factors within an organization has an impact on the likelihood of a well-articulated innovation strategy.

It needs mentioning that these three hypothesis incorporate six different manifestations relating to the six different innovation types. H1 can find an influence on innovation strategy formulation from either closed or open innovation. Similarly, H2 can find an influence on innovation strategy formulation from either incremental or radical innovation. Finally, H3 can find an influence on innovation strategy formulation from either product or service innovation.

2.3. Conceptual Framework

The applied conceptual model is composed of three building blogs representing major organizational complexities and innovations that influence the formulation of an innovation strategy. First, the innovation portfolio is composed of the six different innovation types: closed and open innovation, incremental and radical innovation and product and service innovation. It is proposed that these innovation types not only have an impact on complexity and innovation strategy formulation, but also interact with each other. Second, organizational complexity includes diversity, ambiguity, interdependence and flux, which are suggested to have an impact on innovation strategy formulation. Last, an innovation strategy is formulated in order to cope with the management of the different innovation types and organizational complexity factors.

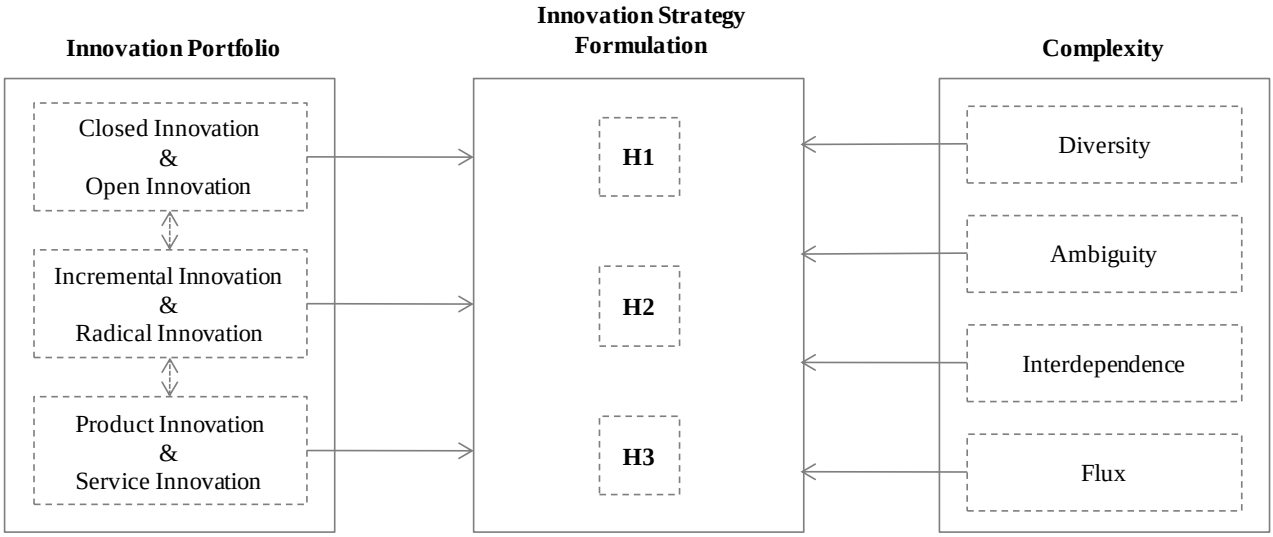


Figure 3: Conceptual Model[3]

Chapter 3: Research Design

[3] Own source

This section concerns the merits of the chosen research design as well as the resulting data collection process and measurement. First, this research provides a rationale for the chosen methodology. Second, it outlines the data collection process, which is followed by an illustration of the chosen approach to measure the collected data.

3.1. Methodology

This research has the primary objective to explain how organizational complexity factors and co-existing innovation types influence innovation management in general, and innovation strategy formulation specifically. To achieve this objective, the relationship between innovation, complexity and innovation strategy formulation is formally tested with the help of a logistic regression analysis. Additionally, correlations between different innovation types are tested with linear regressions. Attempting to gain new insights into management practice, questions with regard to constrains in reaching innovation targets are approached qualitatively. A cross-sectional online survey design seems an appropriate measurement instrument (Saunders et al., 2003).

In support for a cross-sectional online survey, Evans and Mathur (2005) emphasize its advantage of speed and flexibility of data collection and analysis for this research design. Additionally, researchers value the low costs, accessibility, ease of implantation and built-in features that facilitates the use of online surveys for research projects (Israel, 2011; Boyer et al., 2010; Dillman et al., 2009). Arguments against using online surveys emerge around the belief that online surveys will typically result in low response rates (Archer, 2008; Wiseman, 2003). This finding has empirical grounds with online survey's leading to an average response rate of 11% across different research areas (Petchenik and Watermolen, 2011).

3.2. Data Collection Process

In this research identifying the target population involves determining the degree of organizational innovativeness. Having reviewed the literature, it can be suggested that all organizations independent of their size and industry need to innovate (Cole, 2002). Therefore, a large sample of organizations from different countries could provide an indication of the overall population of organizations. A convenient sample technique was chosen in order to reach a large sample size in a short period of time. The online survey was sent out to 2000 business contacts with around 100 failed deliveries. Attached to the survey was some clarifying information on the research objectives, goals and anonymity of the respondents. A total of 447 responses were collected representing a response rate of 23.5% well above the findings of Petchenik and Watermolen, (2011).

The survey responses were recorded with the Qualtrics research software (www.qualtrics.com). To generate a high response rate the survey only included questions important for the measurement of the conceptual model as well as some controlling variables. As such it included 12 questions containing six questions that related to the measurement of complexity, four questions to the measurement of the different types of innovation and two questions controlling for potential limitations. The final data set was exported to MS Excel and IMB SPSS for further processing. The entire data collection process lasted for two weeks.

3.3. Measurement

The measurement focused on identifying the composition of a respondent's innovation portfolio and major organizational complexity factors, as well as their relation to innovation strategy formulation. The innovation portfolio construct was measured by identifying the types of

innovation that prevail within the organization. Respondents were able to indicate their most utilized innovation type on a scale from 1-10. The types of innovation were paired together in order to create three opposing innovation continuums, namely closed versus open, incremental versus radical and product versus service. The average of the responses for each pair provided an estimate of the overall composition of the innovation portfolio. The complexity construct, composed of the four dimensions, diversity, ambiguity, interdependence and flux, was measured by following the logic of Damanpour (1996), who suggested five main variables of organizational complexity, namely geographic diversity, cultural diversity, organization size, level of organizational hierarchy and freuquency of new innovation launch.

In order to measure the degree of organizational complexity the responses for each parameter correlating with the respective complexity dimension were coded on a scale from 1-5.

		Measurement				
		Geographic Diversity	Cultural Diversity	Organization Size	Innovation Rate	Level ofHierarchy
Diversity *Ambiguity* *Interdependence* *Flux*		x	x	x	x	x
Degree of complexity	5	7	>10	>10.000	≤1 Month	Far too Much
	4	6	8-9	5.001-10.000	< 1 Year	Too much
	3	5	6-7	1001-5000	1 Year	About Right
	2	3-4	4-5	201-1000	2-4 Years	Too Little
	1	1-2	1-3	1-200	≥5 Years	Far too Little

Table 1: Measurement of Organizational Complexity[4]

Interaction between different innovation types was measured with three linear regressions relating the different pairs of innovation types to each other. Next, the conceptual model in Figure 3 was

[4] Own source

measured by means of a logistic regression to test for a dichotomous dependent variable. The likelihood of an articulated innovation strategy was predicted by the identified independent variables that account for complexity and innovation within an organization.

To control for limitations, openness to innovate was explored and measured by organization's proactive involvement in collaborative projects. Additionally, reasons were listed that constrain an organization's achievement of innovation targets.

Chapter 4: Data Analysis

This section concerns the analysis of the data set. First, the overall sample structure is assessed by considering the percentage distribution of industries represented. Next, the questions relating to organizational complexity and innovation types are evaluated. Finally, limitations to appropriate innovation management are considered.

4.1. Sample Structure

Research in innovation management concerns organizations from all industries and at different size (Arthur D. Little, 2012). Therefore, an attempt has been made to compile a large sample across major industries. 447 respondents across 25 industries where recorded, however, with some industries being not representative as such. In order to create larger sub-samples, industries were combined into business sectors according to Financial Visualizations (2013) (Appendix). The sectors are services with 200 respondents (45%), financial with 73 respondents (16%), technology with 56 respondents (13%), health care with 27 respondents (6%), consumer goods with 16

respondents (4%), utilities with 10 respondents (2%) and industrial goods with 9 respondents (2%).

The top three sectors, services, financial and technology account for more than two third, or 74% of the sample. This reflects a strong overall representation of service related industries within the sample. Figure 4 shows the aggregated numbers and respective percentages for all sectors considered.

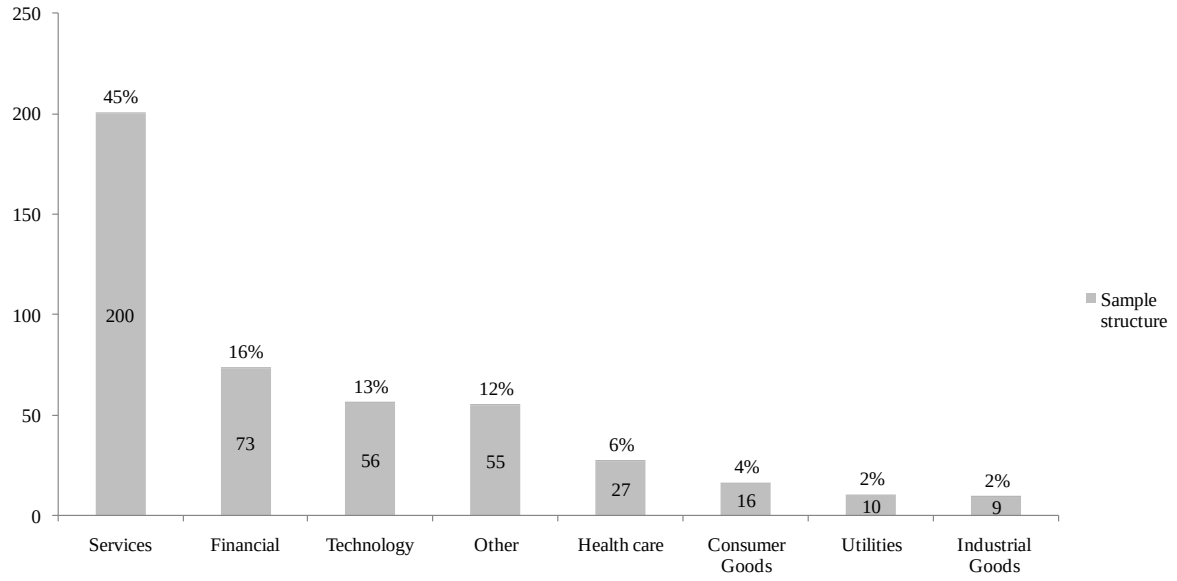


Figure 4: Sample Divided by Sector

4.2. Testing the Model

Considering effective innovation management, an appropriate, well-articulated innovation strategy is of paramount importance for achieving innovation objectives (Adner, 2006; Cooper et al., 1999; Griffin, 1997). Therefore, organizations were asked the following question: *Does your company have a strategy for managing innovation?* The result is depicted in Figure 5. Surprisingly, almost half the sample, or 191 respondents (43%) did not have an innovation strategy in place.

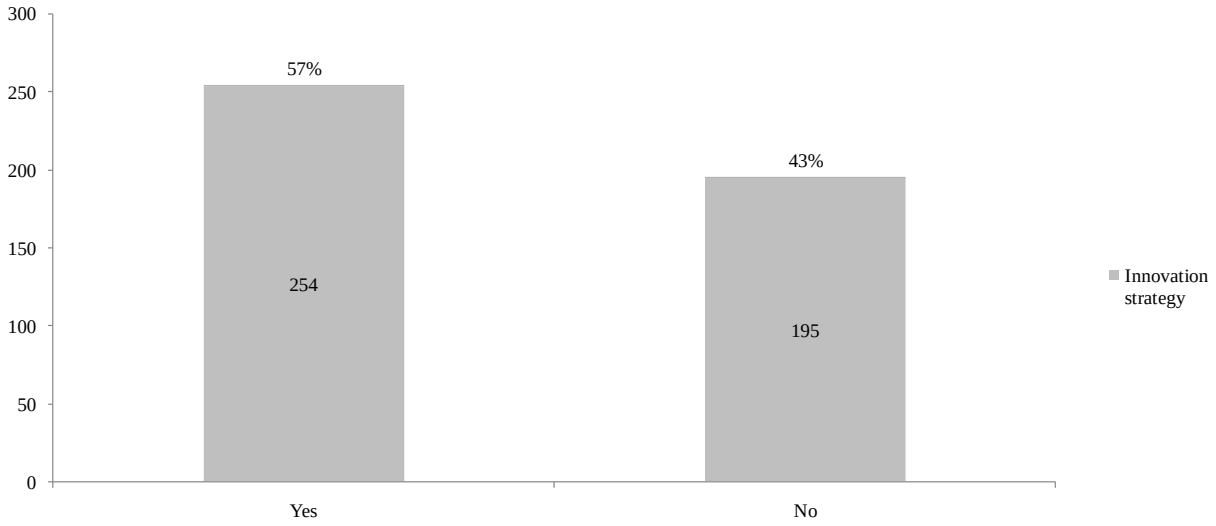


Figure 5: Does your Organization have an Innovation Strategy?

This finding already points at difficulties to cope with organizational complexity and issues regarding the management of co-existing innovation types. However, in this state, implications for theory and managerial practice are limited. Therefore the conceptual model was considered in more depth.

A logistic regression was performed to test the effects of geography, culture, size hierarchy launch, closed/open innovation, incremental/radical innovation and product/service innovation on the likelihood that respondents have an innovation strategy. To fulfill normality assumptions seven cases were excluded from the analysis due to studentized residual values greater than 2.5. To test for linearity the Box-Tidwell (1962) procedure was used. This procedure adds an interaction term for each continuous independent variable. The existing continuous variables were transformed into natural log transformations. The interaction term was then between the existing continuous

variables and their natural log transformations. All variables showed statistical insignificance (in this case a Bonferroni correction (2007) was applied, so statistical significance means $p < .017$ (.05/3)). This means that the independent variables were linearly related to the logistic function of the dependent variable, with no need for retransformation.

The logistic regression model was statistically significant, $\chi 2 = 74.190$, $p < .0005$. The model explained 21.8% (Nagelkerke R^2) of the variance in likelihood of having an innovation strategy and correctly classified 67.2% of cases. Sensitivity was recorded as 52.6% and specificity was recorded as 77.6%. The Positive predictive value was recorded as 62.58% (100*(92/(55+92)) and the negative predictive value was recorded as 69.7%. (100*(191/(191+83)). Of the eight predictor variables three were statistically insignificant ($p> 0.05$), namely geography, culture and product/service innovation (see Appendix 3).

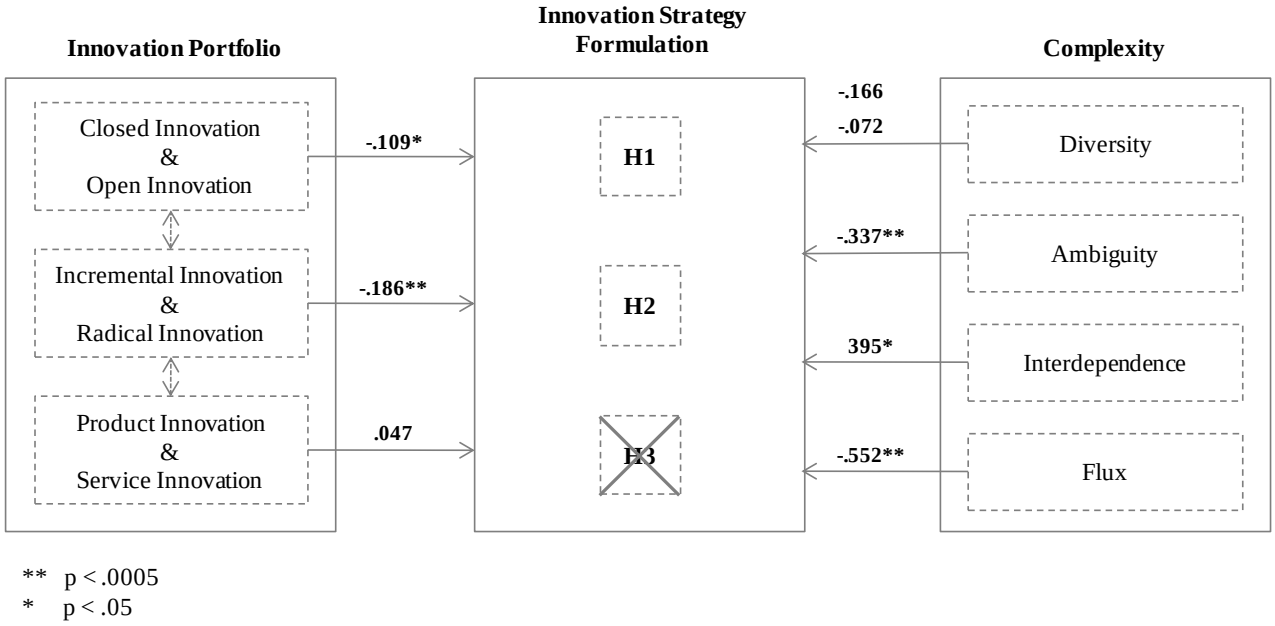


Figure 6: Conceptual Model (Tested)[5]

[5] Own source

More innovation closeness and continues improvement through incremental innovation was likely to result in the formulation of an innovation strategy. The launch of new products and services, the increase in organizational size, and the level of hierarchy were negatively associated with the likelihood of formulating an innovation strategy.

The results of the logistic regression have implications for the validity of the suggested innovation-complexity-innovation strategy relationship. According to the findings, H3 is rejected and H1 and H2 are accepted. This means closed and open innovation and incremental and radical innovation influence the formulation of an innovation strategy.

4.3. Interaction between different innovation types

Three linear regressions were performed in order to test the interaction between different innovation types. All associated relationships were tested for linearity and outliers. Nine cases were excluded from the analysis due to studentized residual values greater than three.

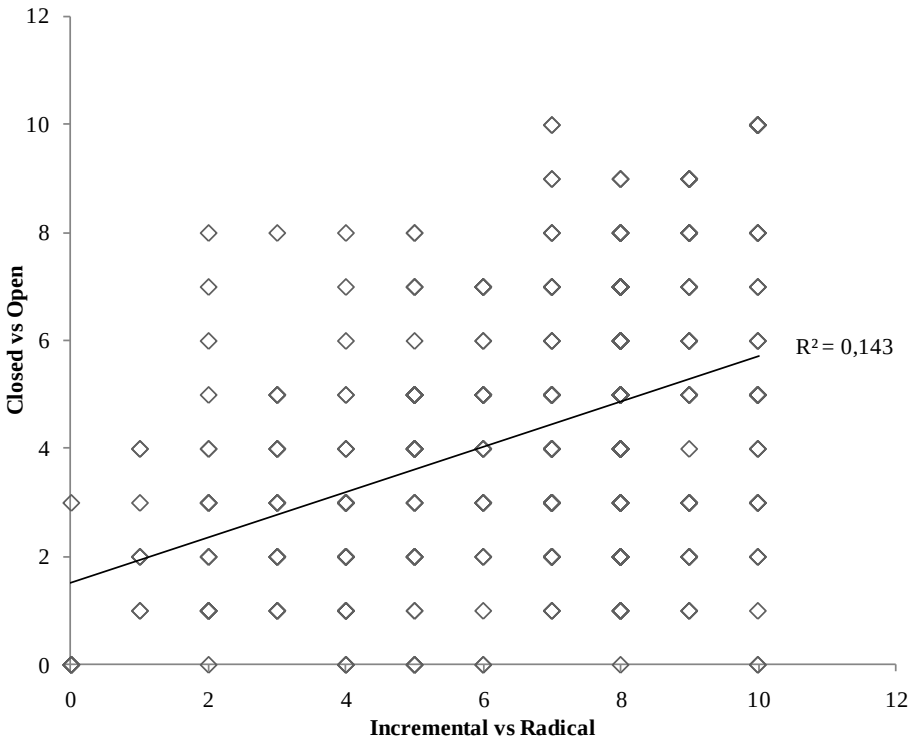


Figure 7: Incremental *versus* Radical and Closed *versus* Open[6]

The first linear regression shown in Figure 7 explains that incremental *versus* radical innovation significantly predicted closed *versus* open innovation within an organization F(1.97) = 70,810, p < .0005. Incremental *versus* radical innovation accounted for 14.3% explained variability in closed *versus* open innovation. The regression function was: incremental *versus* radical innovation = 5.113 + .371*(incremental *versus* radical innovation). This means, more closed innovation is positively associated with more incremental innovation. Similarly, more open innovation is positively associated with higher levels of radical innovation.

[6] Own source

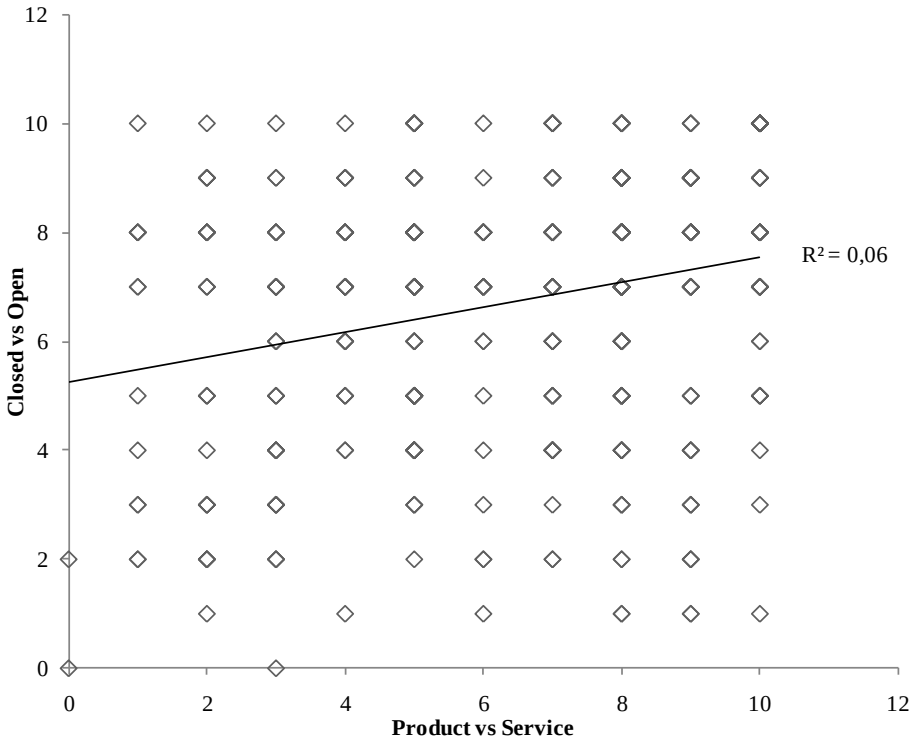


Figure 8: Product *versus* Service and Closed *versus* Open[7]

The second linear regression shown in Figure 8 established that product *versus* service innovation had a significant impact on closed *versus* open innovation F(1.97) = 27.385, p< .0005 and that closed *versus* open innovation accounted for 6% explained variability in product *versus* service innovation. The regression function was: product/services innovation = 5.266 + .0277*(closed *versus* open innovation). This mean, more product innovation is positively associated with more closed innovation. Similarly, more service innovation is positively associated with more open innovation.

[7] Own source

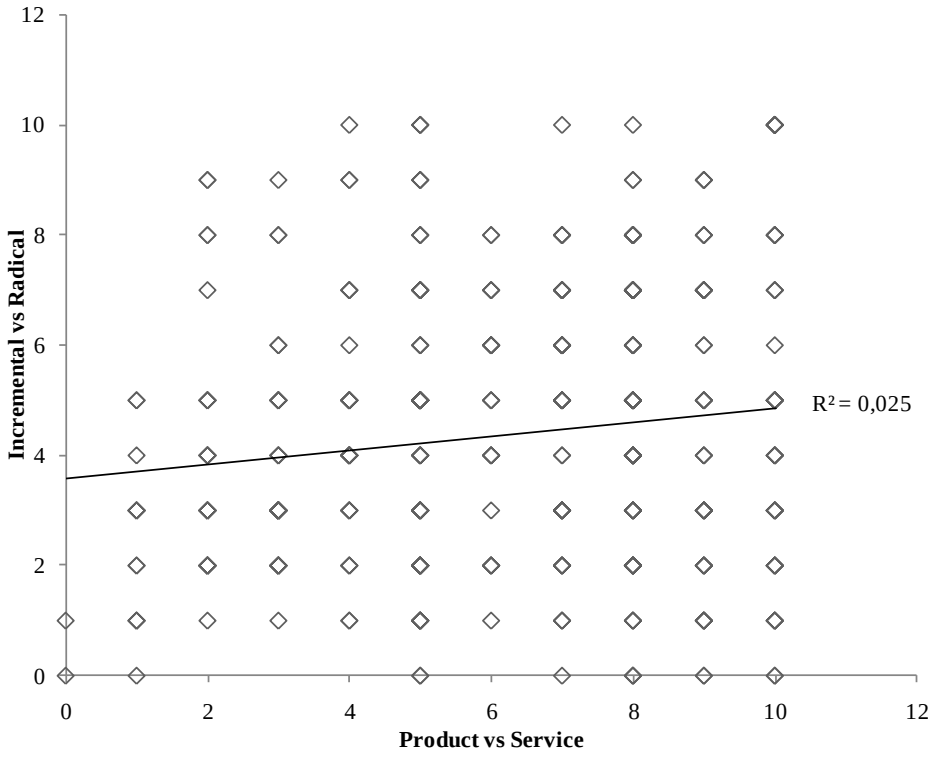


Figure 9: Product *versus* Service and incremental *versus* Radical[8]

The third linear regression shown in Figure 9 found that product *versus* service innovation had a significant influence on incremental *versus* radical innovation F(1.97) = 11,289, p< .0005 and that that incremental *versus* radical innovation accounted for 2.46% explained variability in product *versus* service innovation. The regression function was: product/service innovation = 3.481 + .151*(incremental *versus* radical innovation). This means, more product innovation is positively associated with more incremental innovation. Similarly, more service innovation is positively associated with more radical innovation.

4.4. Constraints to Achieving Innovation Objectives

[8] Own source

In order to control for limitations to effective innovation management other than not having a formulated innovation strategy, participants were asked the following question: *What constrains your organization from achieving its innovation objectives?* The findings are shown in Figure 6 below. Interestingly, the formulation of an innovation strategy was not suggested the main constrain towards achieving innovation objectives (27%). Much more prevailing was the lack of financial resources, or budget constraints that limit management flexibility and effectiveness (46%). Additionally, mangers lack skills in managing the co-existing innovation types (34%) and the conflicts that arise due to different innovation processes (10%). Finally, new innovations require top management buy-in. This is seen as another strong constrain towards achieving innovation objectives (30%).

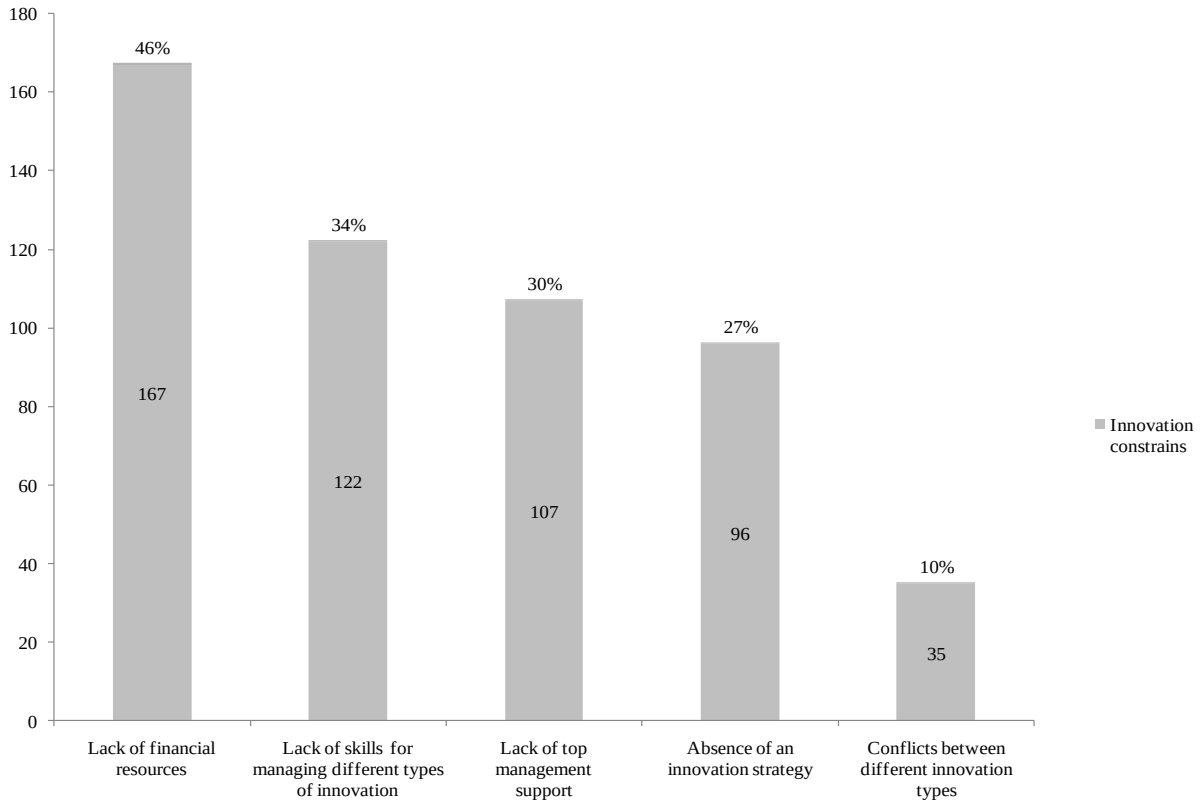


Figure 10: What constrains your Organization from achieving its Innovation Objectives?

Seeing as organizations differ in their desire to collaborate in open innovation projects, participants were asked to comment on their open innovation proactivity. The findings are shown in Figure 7 below. The sample distribution was strongly skewed towards proactive behavior with 261 (59%) of the participants claiming to take initiative when collaborating in an open innovation project. Only 36 (8%) of the participants credited other involved parties with taking initiative and 147 (33%) stated that the involvement was equal.

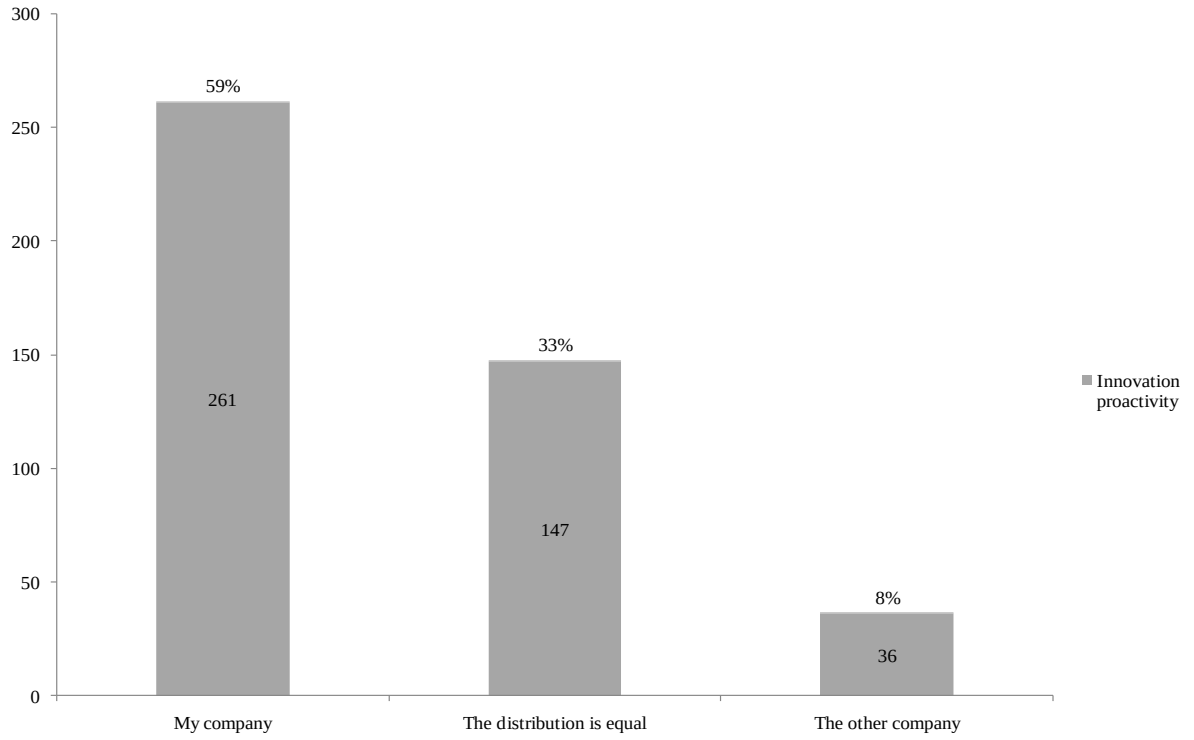


Figure 11: Who takes Initiative when collaborating in an Open Innovation Project?

Chapter 5: Discussion

This study demonstrates that different innovation types and organizational complexity factors have an impact on innovation management induced by the formulation of an innovation strategy. In particular, the likelihood of a well-formulated innovation strategy increases with the existence of

closed and incremental innovation and an increase in the level of organizational hierarchy. In contrast, the likelihood of a well-formulated innovation strategy decreases with open and radical innovation, and organizational size and innovation rate.

Organizations characterized by closed research and development departments have full control over their innovation processes. However, they might not be able to anticipate customer preferences correctly. Their innovation is bounded by the combined expertise of their employees. By opening up their innovation processes, organizations promote knowledge sharing given the combined efforts of internal and external parties (Chesbrough, 2006, 2003). Thus, openness promotes innovation success, but limits control. While Chesbrough (2003) suggests a paradigm towards open innovation, this study draws attention to the importance of closed innovation. In particular, control over innovation processes seems necessary for structuring the innovation process through the formulation of an innovation strategy.

As mentioned before, modern organizations are forced to respond to increased internal and external pressures by continually innovating new products and services (Merali and McKelvey, 2006; Ashby, 1958). Boer and Gertsen (2003) argue that this process is mainly focused on product and service line extensions as well as on the upgrading of existing offerings. Thus, it relates to incremental rather than radical innovation. To continually improve products and services, organizations need to follow a structured approach towards innovation and, therefore, should also have an innovation strategy in place. The findings of this study support this line of reasoning by revealing a positive relation between incremental innovation and innovation strategy formulation.

Additionally, organizations also have to cope with complexity factors, which influence their operations and render the adoption of a well-formulated innovation strategy more or less likely. On

the one hand, as organizations grow, it becomes more difficult to align innovation management objectives of the various departments. Not surprisingly, this is one reason why large organizations often do not have a well-formulated innovation strategy. Additionally, expanding the product and service portfolio at an ever faster rate not only has a negative influence on the management of different innovation types, but also increases overall management complexity and negatively influences the formulation of an innovation strategy. These findings support the research of Gottfredson and Aspinall (2005). On the other hand, strong top-down control caused by a steep hierarchy allows for smooth alignment of strategic objectives (Broadbent and Weill, 1993). Supporting this finding, a steep level of hierarchy increases the likelihood of innovation strategy formulation.

This study illustrates that a well formulated strategy does not represent the only requirement for an organization to achieve its innovation objectives. This finding contradicts Adner (2006), who emphasizes the need for an innovation strategy as the key element in order to reach innovation performance. Although an innovation strategy is important for achieving innovation objectives, other factors hold a dominant position, too. In particular, small to medium sized enterprises lack the financial resources to manage innovation effectively (Shane and Venkataraman, 2000). Furthermore, organizations often lack the skills required for managing the different innovation types. Traditionally, organizations were able to focus on only one paradigm leading to a limited number of different innovation types within their organizations. However, external market forces have introduced global competition to regional markets. In order to remain competitive, it is necessary that organizations utilize multiple approaches to innovate products and services. They cannot apply the traditional stage gate process to service innovation anymore due to the dynamic nature of specific innovation types (Coombs and Miles, 2000). Therefore, and as suggested by the

results of this study, organizations need to train and develop their management to meet the challenges of co-existing innovation types within their organization.

Chesbrough (2010) suggests that open innovation and service innovation are closely related. He proposes that due to the strong shift towards services, organizations should foster open innovation for new services. This study found some support for a closed *versus* open-product *versus* service-relationship. Additionally, associations between incremental *versus* radical innovation and product *versus* service innovation, as well as incremental *versus* radical innovation and closed *versus* open innovation showed significance and need to be further explored. Thus, as conceptualized, different innovation types seem to interact with each other.

Chapter 6: Conclusion

6.1. Theoretical Implications

This study contributes to the existing body of innovation management literature. In particular, while most research in this field focuses on the management of one specific innovation type, for example open innovation (e.g. von Hippel, 2005; Chesbrough, 2003; von Burg, 2001) this study seeks to evaluate different innovation types from a portfolio perspective in order to find best practices for effective innovation management. Contributing to research from Naji and Tuff (2012) innovation management also considers the management of closed and open innovation.

Considering different innovation types in isolation is too shallow. Therefore, this study also considers interaction between them. The findings have implications for literature that contrasts different types of innovation, such as closed *versus* open, or incremental *versus* radical (e.g. Almirall and Casadesus-Masanell, 2010; Ali et al., 1993). Further research is recommended to

explore the associated relationships in greater detail. In particular, and due to increasing research interest in service innovation (Nijssen et al., 2006) it should be explored in more depth whether service innovation relates to open and radical innovation.

In researching the link between co-existing innovation types and organizational complexity factors, this study not only considers the more general relationship between complexity and innovation, but also demonstrates how organizational complexity factors influence the management of different innovation types through the formulation of an innovation strategy. The findings suggest that many organizations still do not have a well-formulated innovation strategy. In this respect, incremental and closed innovations positively influence the adoption of an innovation strategy.

6.2. Managerial Implications

According to the findings, large organizations with continuous innovation often do not have an innovation strategy in place. This constrains them in achieving their innovation targets. In particular with growing size, managers need to align strategic objectives in order to limit associated risks and uncertainties stemming from the co-existence of different innovation types within their organization.

Considering the interaction between different innovation types within a single organization, it can be proposed that managers of organizations with a focus on open innovation should explore moving towards radical innovation. Similarly, more open innovation positively influences service innovation suggesting that organizations could foster open innovation in order to generate more service innovation.

Attempting to find additional constraints towards achieving innovation objectives, besides a well-defined innovation strategy, this study found that organizations often lack the skills for managing different types of innovation as well as conflicts between these co-existing innovation types. This calls for more training and development activities in innovation management practices in general, and for more detailed portfolio management including different innovation types in particular.

Managers need to be aware of and find a balance between increasing levels of organizational complexity and the amount of different innovation types they want to explore. A possible approach can be a reduction in the amount of innovation, thereby simplifying the product and service offering (Gottfredson and Aspinall, 2005). In contrast, organizations could also find mechanisms such as an appropriate innovation strategy in order to better cope with increasing amounts of different innovation types and organizational complexity.

6.3. Limitations

Research on innovation management is not exhaustive. This study focuses on overarching innovation concepts, such as incremental *versus* radical innovation. However, current literature on innovation management reflects a more narrow focus on individual innovation types. For example, Markides (2006) defines radical innovation as innovation that changes existing product and service, and breakthrough innovation as innovation that completely replaces existing products and services. Similarly, open innovation literature generally differentiates between outside-in and inside-out processes (Gassmann and Enkel, 2004). In order to gain a better understanding of the factors that influence the adoption of an innovation strategy, further research should refine individual innovation concepts leading to more conceptual richness.

As the formulation of an innovation strategy is influenced by different innovation types and organizational complexity factors, it can also be argued that this influence can be reversed after an innovation strategy has been formulated. This study found that more closed innovation and less open innovation results in innovation strategy formulation. However, once an organization has formulated an innovation strategy, part of this strategy might be to become more collaborative in the future by focusing on open innovation. This limits the applicability of the research findings to *ex ante* factors to an innovation strategy. Further research should also explore *ex post* factors influencing an innovation strategy in order to understand whether the formulation of an innovation strategy positively influences the adoption of radical and open innovation.

Another limitation of this study relates to the sample choice. As Figure 4 shows, more than two-thirds of the survey respondents come from service related sectors. This reflects a bias towards service rather than product innovation. Additionally, Figure 7 reveals that more than half of the respondents claim to take initiative when collaborating in an open innovation project. In line with these findings, Section 4.3 shows that increased levels of service innovation positively correlate with increased levels of open innovation. Thus, a strong tendency of sample respondents towards open innovation is observed and needs to be considered when evaluating the general validity of the results.

Finally, the findings show that there are more constraints towards reaching innovation targets besides the existence of a well-formulated innovation strategy. Major constraints constitute limited financial resources to support innovation processes and lacking capabilities for managing different innovation types. Thus, further research should explore whether innovation management can be improved by means of additional investment and training and development in managing different innovation types.

6.4. Final Remarks

This study provides an understanding of three major pairs of innovation paradigms: closed *versus* open innovation, incremental *versus* radical innovation and product *versus* service innovation. It is suggested that all of these innovation types can co-exist within a single organization (Ortt and Van der Duin, 2008). One contribution of this research constitutes the statistical measurement of the interaction between different innovation types. The findings showed that the adoption of open innovation can lead to more radical innovation. Likewise, more open innovation can also lead to more service innovation. In contrast, closed innovation positively influences incremental and product innovation. As a rationale step, it is suggested that effective innovation management requires organizations to balance their product and service portfolio by considering these different innovation types.

Besides an increase in innovation levels, organizations operations are also influenced by environmental factors, which drive organizational complexity. Diversity, ambiguity, interdependence and flux have been identified as major complexity drivers that influence an organization's innovation management. In order to manage innovation, organizations have to understand the relationship between these complexity drivers and the different innovation types. In this respect, organizations need to find a shared understanding of the role that different innovation types play within the organization (Naji and Tuff, 2012). As such, the formulation of an innovation strategy is of paramount importance (Adner, 2006). The findings showed that closed and incremental innovations, as well as a steep organizational hierarchy encourage organizations to formulate an innovation strategy. In contrast, open and radical innovations discourage the formulation of an innovation strategy. The same is true for the size of an organization and the frequency of new product and service innovation.

Limitations of this study concern the sample choice as well as additional constraints towards achieving innovation targets, other than a well-formulated innovation strategy. In particular, constraints constitute limited financial resources to support innovation processes and lacking capabilities for managing different innovation types.

Chapter 7: References

Adams, R., Bessant, J., & Phelps, R. (2006). Innovation management measurement: A review. International Journal of Management Reviews, 8(1), 21-47.

Adner, R. (2006). Match your innovation strategy to your innovation ecosystem. Harvard Business Review, 84(4), 98.

Ali, A., Kalwani, M. U., & Kovenock, D. (1993). Selecting product development projects: Pioneering versus incremental innovation strategies. Management Science, 39(3), 255-274.

Apple (2013). Annual Report 2013. Retrieved on December 13, 2013 from: http://files.shareholder.com/downloads/AAPL/2841397228x0x701402/a406ad58-6bde-4190-96a1-4cc2d0d67986/AAPL_FY13_10K_10.30.13.pdf

Arthur D. Little (2012). Innovation: measuring it to manage it. Retrieved on December 13, 2013 from: http://www.adlittle.com/downloads/tx_adlprism/Prism_01-12_Innovation.pdf

Archer, T. M. (2008). Response rates to expect from web-based surveys and what to do about it. Journal of extension, 46(3).

Ashby, W. R. (1958), Requiste Variety and its Implications for the Control of Complex Systems in: Cybernetica, 1, 2, 83-99.

Ashmos, D. P., Duchon, D. and McDaniel Jr., R. R. (2000), Organizational Responses to Complexity – The Effect on Organizational Performance, in: Journal of Organizational Change Management.

Axelrod, R. and Cohen, M. D. (2000), Harnessing Complexity: Organizational Implications of Scientific Frontier, Basic Books, New York, NY.

Bettis, R. A., & Hitt, M. A. (1995). The new competitive landscape. Strategic management journal, 16(S1), 7-19.

Boer, H., & Gertsen, F. (2003). From continuous improvement to continuous innovation: a retro-perspective. International Journal of Technology Management, 26(8), 805-827.

Box, G. E., & Tidwell, P. W. (1962). Transformation of the independent variables. Technometrics, 4(4), 531-550.

Boyacigiller, N. (1990). The role of expatriates in the management of interdependence, complexity and risk in multinational corporations. Journal of International Business Studies, 357-381.

Boudreau, K. J., & Lakhani, K. R. (2012). How to manage outside innovation. Image.

Broadbent, M., & Weill, P. (1993). Improving business and information strategy alignment: Learning from the banking industry. IBM systems Journal, 32(1), 162-179.

Bushman, R., Chen, Q., Engel, E., & Smith, A. (2004). Financial accounting information, organizational complexity and corporate governance systems. Journal of Accounting and Economics, 37(2), 167-201.

Chesbrough, H. (2011). Open Services Innovation: Rethinking You Business to Grow and Compete in a New Era. New York, NY Jossey Bass.

Chesbrough, H. (2006). Open Business Models. Cambridge, MA:Harvard Business School Press.

Chesbrough, H. (2004), "Managing Open Innovation: Chess and Poker," Research-Technology Management, 47, 1 (January): 23-26.

Chesbrough, H. (2003). Open Innovation: The New Imperative for Creating and Profiting from Technology. Cambridge, MA: Harvard Business School Press.

Clausen, T. H., & Pohjola, M. (2013). Persistence of product innovation: comparing breakthrough and incremental product innovation. Technology Analysis & Strategic Management, 25(4), 369-385.

Cole, R. E. (2002). From continuous improvement to continuous innovation. Total quality management, 13(8), 1051-1056.

Coombs, R., & Miles, I. (2000). Innovation, measurement and services: The new problematic. In J. S. Metcalfe, & I. Miles (Eds.), Innovation systems in the service economy; Measurement and case study analysis (pp. 85−103). Boston: Kluwer.

Cooper, R.G. (1994), "Perspective: third-generation new product processes", Journal of Product Innovation Management, Vol. 11 No. 1, pp. 3-14.

Cooper, R.G., Edgett, S. and Kleinschmidt, E.J. (1999), "New product portfolio management: practices and performance", Journal of Product Innovation Management, Vol. 16 No. 4, pp. 333-51.

Damanpour, F. (1996). Organizational complexity and innovation: developing and testing multiple contingency models. Management science, 42(5), 693-716.

Dewar, R. D., & Dutton, J. E. (1986). The adoption of radical and incremental innovations: an empirical analysis. Management science, 32(11), 1422-1433.

Dillman, D. A. (2011). Mail and Internet surveys: The tailored design method--2007 Update with new Internet, visual, and mixed-mode guide. Wiley.com.

Duchin, R., Ozbas, O., & Sensoy, B. A. (2010). Costly external finance, corporate investment, and the subprime mortgage credit crisis. Journal of Financial Economics, 97(3), 418-435.

Dougherty, D., & Hardy, C. (1996). Sustained product innovation in large, mature organizations: Overcoming innovation-to-organization problems. Academy of Management Journal, 39(5), 1120-1153.

Ehrnberg, E. (1995). On the definition and measurement of technological discontinuities. Technovation, 15(7), 437-452.

Ettlie, J. E., Bridges, W. P., & O'keefe, R. D. (1984). Organization strategy and structural differences for radical versus incremental innovation. Management science, 30(6), 682-695.

Etzioni, A. (Ed.). (2003). Voluntary simplicity: responding to consumer culture. Rowman & Littlefield.

Evans, J. and Mathur, A. (2005). The Value of Online Surveys, Internet Research, 15(2), pp. 195-219.

Ferraro, P. J. (2008). Asymmetric information and contract design for payments for environmental services. Ecological Economics, 65(4), 810-821.

Fiss, P. C. (2007), A Set-Theoretic Approach to Organizational Configurations, in: Academy of Management Review, 32, 4, 1180-1198.

Fløysand, A., & Jakobsen, S. E. (2011). The complexity of innovation: A relational turn. Progress in Human Geography, 35(3), 328-344.

Fuglsang, L., & Sørensen, F. (2011). The balance between bricolage and innovation: Management dilemmas in sustainable public innovation. The Service Industries Journal, 31(4), 581-595.

Gassmann, O., & Enkel, E. (2004). Towards a theory of open innovation: three core process archetypes. In R&D management conference (pp. 1-18).

Garriga, H., von Krogh, G., & Spaeth, S. (2013). How constraints and knowledge impact open innovation. Strategic Management Journal.

Gopalakrishnan, S., & Damanpour, F. (1997). A review of innovation research in economics, sociology and technology management. Omega, 25(1), 15-28.

Gottfredson, M., & Aspinall, K. (2005). Innovation versus complexity. Harvard Business Review, 62-71.

Griffin, A. (1997), "PDMA research on new product development practices: updating trends and benchmarking best practices", Journal of Product Innovation Management, Vol. 14, pp. 429-58.

Hertog, P. D. (2000). Knowledge-intensive business services as co-producers of innovation. International Journal of Innovation Management, 4(04), 491-528.

Herzog, P. (2011). Open and closed innovation. Springer.

Herzog, P. (2011). Innovation and the open innovation concept. In Open and Closed Innovation (pp. 9-57). Gabler.

Inauen, M., & Schenker-Wicki, A. (2012). Fostering radical innovations with open innovation. European Journal of Innovation Management, 15(2), 212-231.

Israel, G. D. (2011). Strategies for obtaining survey responses from extension clients: Exploring the role of e-mail requests. Journal of Extension, 49(3).

Jobs, S. (2005). Transcript of Commencement Speech at Stanford University. Retrieved on December 13, 2013from: http://www.acleareye.com/Transcript%20of%20Commencement%20Speech%20at%20Stanford%20given%20by%20Steve%20Jobs.pdf

Keuper, F. (2005), Gestaltung der Unternehmenskomplexität im Lichte von Ashby und Luhmann, in: Zeitschrift für Panung und Unternehmenssteuerung, 16, 2, 211-237.

Lane, D. A. (2011). Complexity and innovation dynamics. Handbook on the economic complexity of technological change, 63.

Lawrence, P. R., & Lorsch, J. W. (1967). Differentiation and integration in complex organizations. Administrative science quarterly, 1-47.

Lettl, C., Herstatt, C., & Gemuenden, H. G. (2006). Learning from users for radical innovation. International Journal of Technology Management, 33(1), 25-45.

Luhman, J. T. and Boje, D. M. (2001), What Is Complexity Science – A Possible Answer From Narrative Research, in: Emergence, 3, 1, 158-168.

Madhavaram, S., & Hunt, S. D. (2008). The service-dominant logic and a hierarchy of operant resources: developing masterful operant resources and implications for marketing strategy. Journal of the Academy of Marketing Science, 36(1), 67-82.

Malik, F. (2002), Strategie des Managements komplexer Systeme: Ein Beitrag zur Management Kybernetik evolutionärer Systeme. Haupt, Bern.

Markides, C. (2006). Disruptive Innovation: In Need of Better Theory*. Journal of product innovation management, 23(1), 19-25.

Maznevski, M., Steger, U. and Amann, W. (2007), Managing Complexity in Global Organizations as the Meta-challenge, in: Steger, U., Amann, W. and Maznewski, M., Managing Complexity in Global Organizations, Chichester, John Wiley & Sons Ltd, 3-14.

McDermott, C. M., & O'Connor, G. C. (2002). Managing radical innovation: an overview of emergent strategy issues. Journal of product innovation management, 19(6), 424-438.

McKelvey, B. (2001), What Is Complexity Science – It Is Really Order-Creation Science, in: Emergence, 3, 1, 137-157.

Meyer, M. H., & DeTore, A. (2001). Perspective: Creating a platform-based approach for developing new services. Journal of Product Innovation Management, 18(3), 188−204.

Miller, L. E., & Smith, K. L. (1983). Handling nonresponse issues. Journal of extension, 21(5), 45-50.

Miller, W.L. (2001), "Innovation for business growth", Research Technology Management, September-October, pp. 26-41.

Morone, J. (1993). Winning in high tech markets: the role of general management. Harvard Business School Press.

Nagji, B., & Tuff, G. (2012). Managing your innovation portfolio. Harvard Business Review, 90(5), 66-74.

Nedopil, C., Steger, U., & Amann, W. (2011). Managing Complexity in Organizations: Text and Cases. Palgrave Macmillan.

Niehaus, E. (2002). Information as a Basic Constituent of Human Existence. Informatica Didactica, 4.

Nijssen, E. J., Hillebrand, B., Vermeulen, P. A., & Kemp, R. G. (2006). Exploring product and service innovation similarities and differences. International Journal of Research in Marketing, 23(3), 241-251.

Niosi, J. (1999), "Fourth-generation R&D: from linear models to flexible innovation", Journal of Business Research, Vol. 45 No. 2, pp. 111-7.

Norman, D. A., & Verganti, R. (2012). Incremental and Radical Innovation: design research versus technology and meaning change.

Ortt, J. R., & van der Duin, P. A. (2008). The evolution of innovation management towards contextual innovation. European Journal of Innovation Management, 11(4), 522-538.

Pires, C. P., Sarkar, S., & Carvalho, L. (2008). Innovation in services–how different from manufacturing?. The Service Industries Journal, 28(10), 1339-1356.

Preissl, B. (2000). Service innovation: what makes it different? Empirical evidence from Germany. In Innovation systems in the service economy (pp. 125-148). Springer US.

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

Rizzo, J. R., House, R. J., & Lirtzman, S. I. (1970). Role conflict and ambiguity in complex organizations. Administrative science quarterly, 150-163.

Rothwell, R. (1994), "Towards the fifth-generation innovation process", International Marketing Review, Vol. 11 No. 1, pp. 7-31.

Saunders, M., Lewis, P., and Thornhill, A. (2003). Research Method for Business Students. Third Edition. New York, NY: Prentice Hall.

Shane, S., & Venkataraman, S. (2000). The promise of entrepreneurship as a field of research. Academy of management review, 25(1), 217-226.

Steger, U., Amann, W. and Maznewski, M. (2007), Managing Complexity in Global Organizations, John Wiley & Sons Ltd, Chichester.

Stieglitz, N., & Heine, K. (2007). Innovations and the role of complementarities in a strategic theory of the firm. Strategic Management Journal, 28(1), 1-15.

The Fast Company (2013). What is innovation? Retrieved on December 13, 2013 from: http://www.fastcompany.com/3020950/leadership-now/what-is-innovation

Tidd, J., & Bessant, J. (2011). Managing innovation: integrating technological, market and organizational change. Wiley. com.

Tidd, J. (2001). Innovation management in context: environment, organization and performance. International Journal of Management Reviews, 3(3), 169-183.

Toivonen, M., & Tuominen, T. (2009). Emergence of innovations in services. The Service Industries Journal, 29(7), 887-902.

Ulrich, H. and Probst, G. J. B. (1988), Anleitung zum ganzheitlichen Denken und Handeln, Haupt, Stuttgart.

van Gigch, J. P. (1991), System Design Modeling and Metamodeling, Plenum Press, New York.

Van den Elst, J., Tol, R. and Smits, R. (2006), "Innovation in practice – Philips Applied Technologies", International Journal of Technology Management, Vol. 34 Nos 3-4, pp. 217-31.

Vargo, S. L., & Lusch, R. F. (2004). The four service marketing myths remnants of a goods-based, manufacturing model. Journal of Service Research, 6(4), 324-335.

Verloop, J. (2006), "The Shell way to innovate", International Journal of Technology Management, Vol. 34 Nos 3-4, pp. 243-59.

West, J., & Mace, M. (2007). Entering a mature industry through innovation: Apple's iPhone strategy. In DRUID Summer Conference.

Wiseman, F. (2003). On the reporting of response rates in Extension research. Journal of Extension, 41(3), 1-5.

Woodward, D. (1993), Understanding Complexity- A Critique and Synthesis, Greenlands, Henley Management college.

Quinn, J. B. (1985). Managing innovation: controlled chaos. Harvard business review, 63(3), 73-84.

Appendices

Appendix A: Financial Visualization: Sector Overview

▼ Name	Stocks	Market Cap
Utilities	123	829.65B
Technology	870	5420.15B
Services	865	4435.39B
Industrial Goods	358	2026.35B
Healthcare	579	3172.01B
Financial	1059	6078.84B
Consumer Goods	375	3965.51B

Appendix B: Logistic Regression – Innovation Strategy Formulation

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	421	94,2
	Missing Cases	26	5,8
	Total	447	100,0
Unselected Cases		0	,0
Total		447	100,0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
Yes	1
No	0

Block 0: Beginning Block

Classification Table[a,b]

			Predicted		
			7. Does your company have a strategy for managing innovation?		Percentage Correct
	Observed		Yes	No	
Step 0	7. Does your company have a strategy for managing innovation?	Yes	246	0	100,0
		No	175	0	,0
	Overall Percentage				58,4

a. Constant is included in the model.

b. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-,341	,099	11,859	1	,001	,711

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	Q2_GEOGRAPHY	11,214	1	,001
		Q3_CULTURE	4,952	1	,026
		Q4_SIZE	13,678	1	,000
		Q5_HIERARCHY	,730	1	,393
		Q6_LAUNCH	30,681	1	,000
		Q8_CLOSED_OPEN	4,205	1	,040
		Q9_INCRE_RADIC	16,784	1	,000
		Q10_PROD_SERV	1,123	1	,289
	Overall Statistics		65,926	8	,000

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	74,190	8	,000
	Block	74,190	8	,000
	Model	74,190	8	,000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	497,409[a]	,162	,218

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than ,001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	4,831	8	,776

Contingency Table for Hosmer and Lemeshow Test

		7. Does your company have a strategy for managing innovation? = Yes		7. Does your company have a strategy for managing innovation? = No		
		Observed	Expected	Observed	Expected	Total
Step 1	1	41	38,105	1	3,895	42
	2	33	33,931	9	8,069	42
	3	30	31,217	12	10,783	42
	4	26	28,511	16	13,489	42
	5	25	26,609	18	16,391	43
	6	24	23,514	18	18,486	42
	7	21	21,017	21	20,983	42
	8	18	17,799	24	24,201	42
	9	18	14,716	24	27,284	42
	10	10	10,580	32	31,420	42

Classification Table[a]

	Observed		Predicted		
			7. Does your company have a strategy for managing innovation?		Percentage Correct
			Yes	No	
Step 1	7. Does your company have a strategy for managing innovation?	Yes	191	55	77,6
		No	83	92	52,6
	Overall Percentage				67,2

a. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Q2_GEOGRAPHY	-,166	,130	1,624	1	,203	,847	,656	1,094
	Q3_CULTURE	-,072	,110	,429	1	,512	,931	,751	1,154
	Q4_SIZE	-,337	,097	12,120	1	,000	,714	,591	,863
	Q5_HIERARCHY	,395	,176	5,022	1	,025	1,485	1,051	2,098
	Q6_LAUNCH	-,552	,146	14,299	1	,000	,576	,432	,766
	Q8_CLOSED_OPEN	-,109	,054	4,069	1	,044	,897	,807	,997
	Q9_INCRE_RADIC	-,186	,051	13,374	1	,000	,830	,751	,917
	Q10_PROD_SERV	,047	,044	1,127	1	,288	1,048	,961	1,142
	Constant	2,150	,796	7,296	1	,007	8,581		

a. Variable(s) entered on step 1: Q2_GEOGRAPHY, Q3_CULTURE, Q4_SIZE, Q5_HIERARCHY, Q6_LAUNCH, Q8_CLOSED_OPEN, Q9_INCRE_RADIC, Q10_PROD_SERV.

Casewise List[a]

a. The casewise plot is not produced because no outliers were found.

Box-Tidwell procedure

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Q2_GEOGRAPHY	-,156	,135	1,337	1	,248	,855	,656	1,115
	Q3_CULTURE	-,083	,118	,498	1	,481	,920	,730	1,160
	Q4_SIZE	-,299	,105	8,137	1	,004	,741	,604	,911
	Q5_HIERARCHY	,197	,226	,761	1	,383	1,218	,782	1,897
	Q6_LAUNCH	-,413	,200	4,253	1	,039	,662	,447	,980
	Q8_CLOSED_OPEN	-,094	,083	1,293	1	,256	,910	,774	1,071
	Q9_INCRE_RADIC	-,208	,071	8,657	1	,003	,812	,707	,933
	Q10_PROD_SERV	,049	,062	,616	1	,432	1,050	,930	1,185
	Ln_Q2_GEOGRAPHY by Q2_GEOGRAPHY	-,054	,160	,113	1	,737	,948	,692	1,297
	Ln_Q3_CULTURE by Q3_CULTURE	-,019	,132	,021	1	,884	,981	,757	1,270
	Ln_Q4_SIZE by Q4_SIZE	-,079	,079	1,006	1	,316	,924	,792	1,078
	Ln_Q5_HIERARCHY by Q5_HIERARCHY	,177	,129	1,902	1	,168	1,194	,928	1,536
	Ln_Q6_LAUNCH by Q6_LAUNCH	-,125	,130	,925	1	,336	,882	,683	1,139
	Ln_Q8_CLOSEDOPEN by Q8_CLOSED_OPEN	-,012	,034	,129	1	,719	,988	,923	1,057
	Ln_Q9_INCRERADIC by Q9_INCRE_RADIC	,015	,038	,151	1	,697	1,015	,943	1,092
	Ln_Q10_PRODSERV by Q10_PROD_SERV	-,005	,026	,034	1	,853	,995	,945	1,048
	Constant	2,244	,812	7,627	1	,006	9,428		

a. Variable(s) entered on step 1: Q2_GEOGRAPHY, Q3_CULTURE, Q4_SIZE, Q5_HIERARCHY, Q6_LAUNCH, Q8_CLOSED_OPEN, Q9_INCRE_RADIC, Q10_PROD_SERV, Ln_Q2_GEOGRAPHY * Q2_GEOGRAPHY , Ln_Q3_CULTURE * Q3_CULTURE , Ln_Q4_SIZE * Q4_SIZE , Ln_Q5_HIERARCHY * Q5_HIERARCHY , Ln_Q6_LAUNCH * Q6_LAUNCH , Ln_Q8_CLOSEDOPEN * Q8_CLOSED_OPEN , Ln_Q9_INCRERADIC * Q9_INCRE_RADIC , Ln_Q10_PRODSERV * Q10_PROD_SERV .

Appendix C: Linear Regression – Incremental vs Radical/Closed vs Open

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,378[a]	,143	,141	2,19481	2,009

a. Predictors: (Constant), 9. On a scale from 1-10 how much incremental and radical innovation does your company develop?

b. Dependent Variable: 8. On a scale from 1-10 how much closed and open innovation does your company develop?

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	341,109	1	341,109	70,810	,000[b]
	Residual	2052,132	426	4,817		
	Total	2393,241	427			

a. Dependent Variable: 8. On a scale from 1-10 how much closed and open innovation does your company develop?

b. Predictors: (Constant), 9. On a scale from 1-10 how much incremental and radical innovation does your company develop?

Coefficients[a]

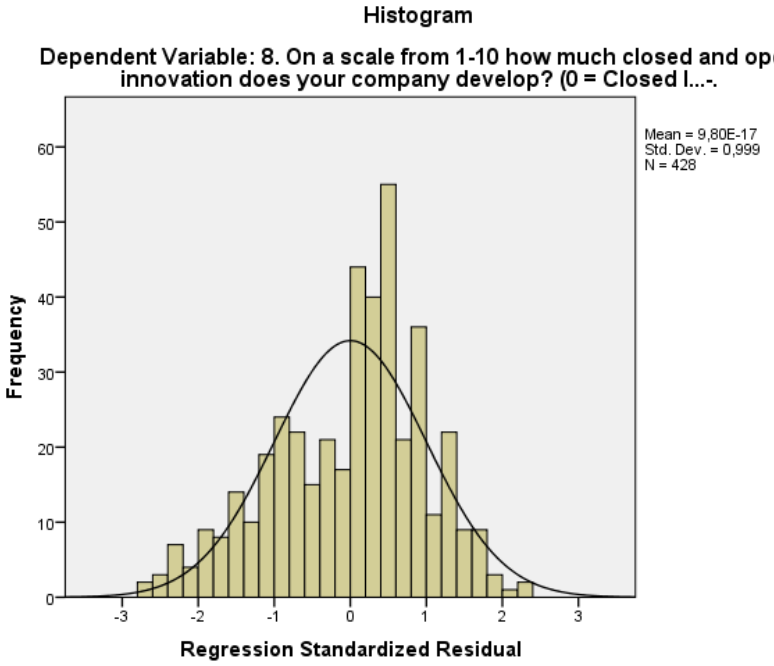
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	5,113	,222		23,022	,000	4,676	5,549
	9. On a scale from 1-10 how much incremental and radical innovation does your company develop?	,371	,044	,378	8,415	,000	,284	,457

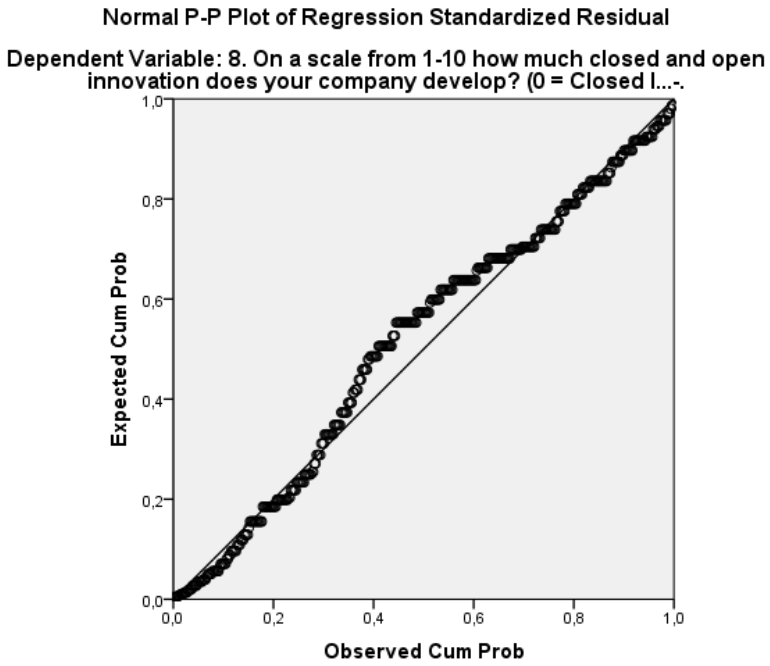
a. Dependent Variable: 8. On a scale from 1-10 how much closed and open innovation does your company develop?.

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	5,1129	8,8210	6,7547	,89378	428
Residual	-6,07937	4,88713	,00000	2,19224	428
Std. Predicted Value	-1,837	2,312	,000	1,000	428
Std. Residual	-2,770	2,227	,000	,999	428

a. Dependent Variable: 8. On a scale from 1-10 how much closed and open innovation does your company develop?




Normal P-P Plot of Regression Standardized Residual
Dependent Variable: 8. On a scale from 1-10 how much closed and open innovation does your company develop? (0 = Closed I...-.
Expected Cum Prob
Observed Cum Prob
0,0
0,2
0,4
0,6
0,8
1,0

Appendix D: Product vs Service/Closed vs Open

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,245[a]	,060	,058	2,30461	2,096

a. Predictors: (Constant), 10. On a scale from 1-10 how much product and service innovation does your company develop?

b. Dependent Variable: 8. On a scale from 1-10 how much closed and open innovation does your company develop?

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	145,450	1	145,450	27,385	,000[b]
	Residual	2273,213	428	5,311		
	Total	2418,663	429			

a. Dependent Variable: 8. On a scale from 1-10 how much closed and open innovation does your company develop?

b. Predictors: (Constant), 10. On a scale from 1-10 how much product and service innovation does your company develop?

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	5,266	,297		17,710	,000	4,682	5,850
	10. On a scale from 1-10 how much product and service innovation does your company develop?	,227	,043	,245	5,233	,000	,142	,312

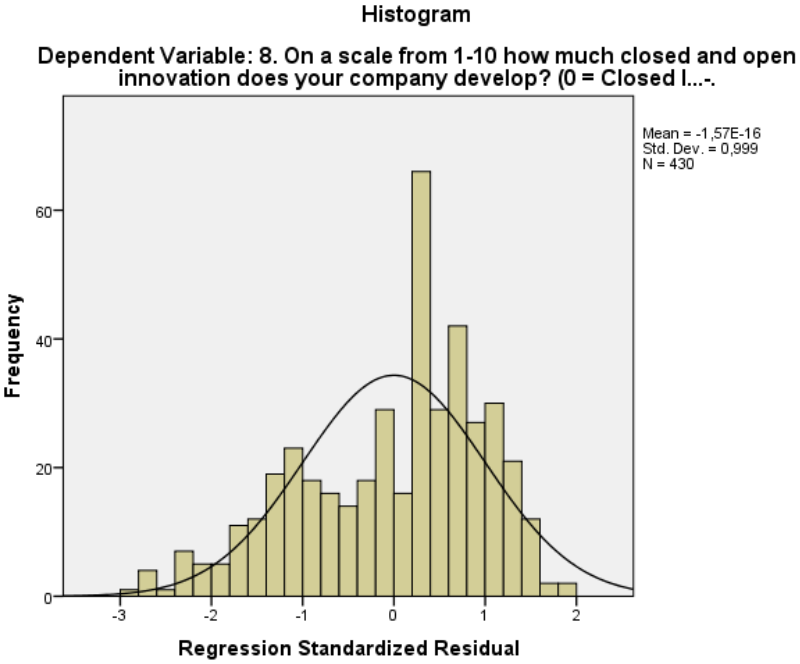
a. Dependent Variable: 8. On a scale from 1-10 how much closed and open innovation does your company develop?

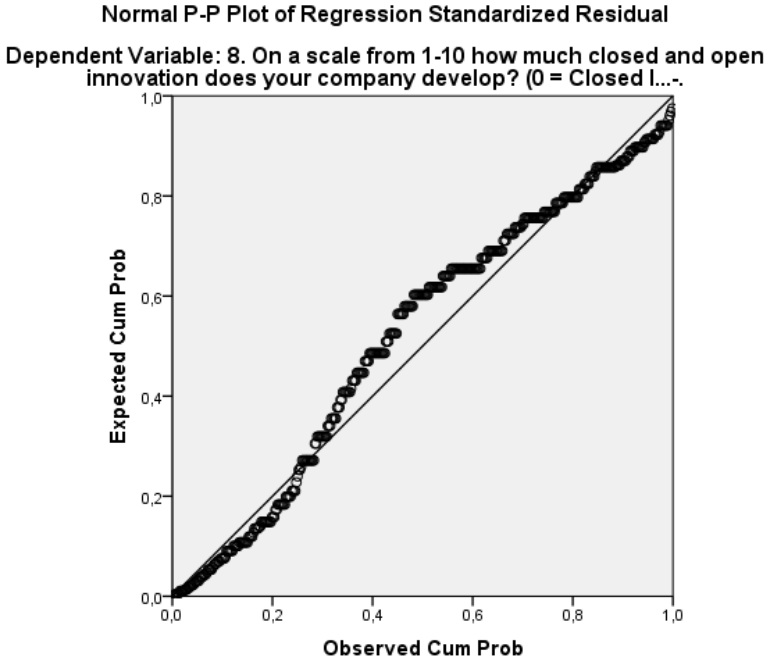
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	5,2660	7,5360	6,7093	,58228	430

Residual	-6,53598	4,50696	,00000	2,30193	430
Std. Predicted Value	-2,479	1,420	,000	1,000	430
Std. Residual	-2,836	1,956	,000	,999	430

a. Dependent Variable: 8. On a scale from 1-10 how much closed and open innovation does your company develop? (0 = Closed I...-.





Appendix E: Product vs Service/Incremental vs Radical

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,161[a]	,026	,024	2,38248	1,978

a. Predictors: (Constant), 10. On a scale from 1-10 how much product and service innovation does your company develop?

b. Dependent Variable: 9. On a scale from 1-10 how much incremental and radical innovation does your company develop?

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	64,077	1	64,077	11,289	,001[b]
	Residual	2406,711	424	5,676		
	Total	2470,789	425			

a. Dependent Variable: 9. On a scale from 1-10 how much incremental and radical innovation does your company develop?

b. Predictors: (Constant), 10. On a scale from 1-10 how much product and service innovation does your company develop?

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	3,481	,307		11,337	,000	2,877	4,084
	10. On a scale from 1-10 how much product and service innovation does your company develop? (0 = Pro...-.	,151	,045	,161	3,360	,001	,063	,240

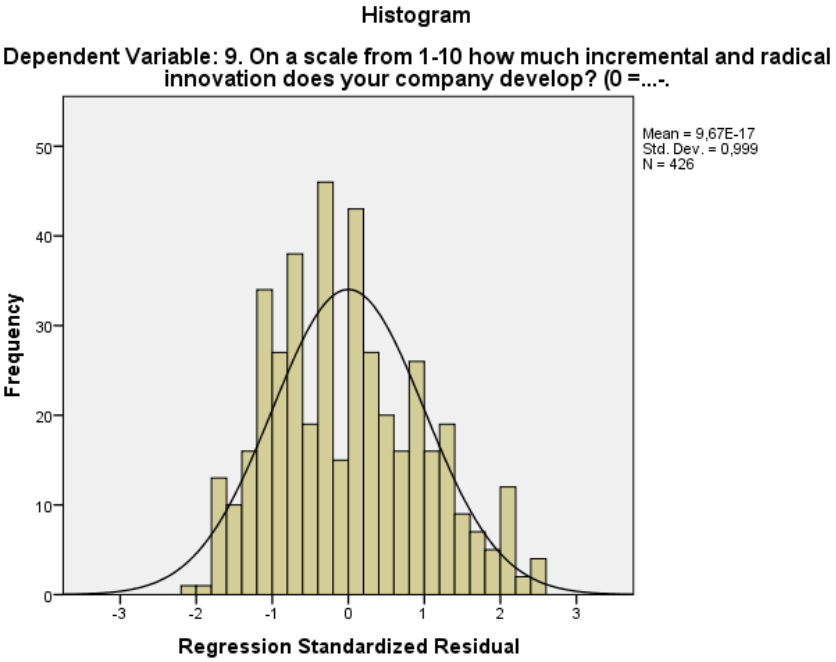
a. Dependent Variable: 9. On a scale from 1-10 how much incremental and radical innovation does your company develop?

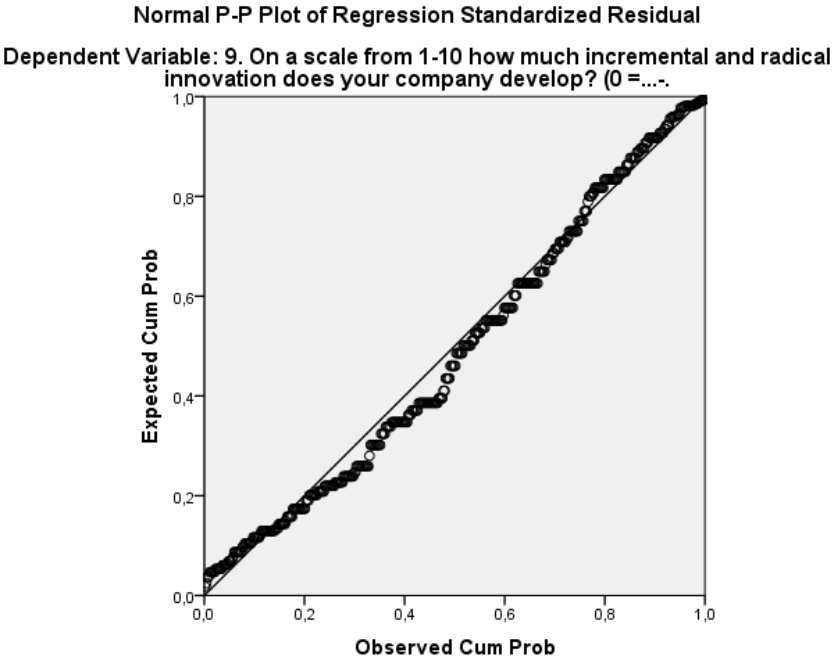
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N

Predicted Value	3,4808	4,9934	4,4366	,38829	426
Residual	-4,99337	5,91419	,00000	2,37967	426
Std. Predicted Value	-2,462	1,434	,000	1,000	426
Std. Residual	-2,096	2,482	,000	,999	426

a. Dependent Variable: 9. On a scale from 1-10 how much incremental and radical innovation does your company develop?





Appendix F: Online Survey Questions

1. In what industry does your company operate?

#	Answer	Response	%
1	Health Care	23	5%
2	Food, Beverage & Tobacco	2	0%
3	Manufacturing	7	2%
4	Publishing	9	2%
5	Pharmaceuticals	5	1%
6	Real Estate	9	2%
7	Service	27	6%
8	Software	12	3%
9	Sports	3	1%
10	Technology	30	7%
11	Telecommunications	8	2%
12	Transportation	5	1%
13	Financial Services	54	12%
14	Executive Search	2	0%
15	Entertainment & Leisure	8	2%
16	Energy	10	2%
17	Electronics	1	0%
18	Education	46	10%
19	Defense	2	0%
20	Cosmetics	0	0%
21	Consumer Products	7	2%
22	Consulting	91	20%
23	Computer	5	1%
24	Banking	21	5%
25	Automotive	3	1%
26	Advertising	3	1%
27	other	54	12%
	Total	447	100%

2. In which regions of the world does your company have branches?

#	Answer	Response	%
1	Africa	64	14%
4	Sub-Saharan Africa	42	9%
5	Northern America	114	26%
6	Asia	134	30%
7	Oceania	47	11%
8	Europe	419	95%
9	Latin America and the Caribbean	93	21%

3. How many languages are spoken in your office?

#	Answer		Response	%
1	1-3		321	72%
3	4-5		63	14%
4	6-7		13	3%
6	8-9		10	2%
7	10 or more		40	9%
	Total		447	100%

4. What is the size of your company?

#	Answer		Response	%
1	1 - 10		154	34%
2	11 - 50		66	15%
3	51 - 200		37	8%
4	201 - 500		27	6%
5	501 - 1000		12	3%
6	1001 - 5000		43	10%
7	5001 - 10000		18	4%
8	>10000		90	20%
	Total		447	100%

5. How hierarchical is your company?

#	Answer		Response	%
9	Far too Little		13	3%
10	Too Little		33	7%
11	About Right		309	69%
12	Too Much		71	16%
13	Far too Much		21	5%
	Total		447	100%

6. How often does your company launch new products or services?

#	Answer		Response	%
46	Several Times a Year		203	45%
45	Once a Year		92	21%
44	Every 2-4 Years		87	19%
48	2-3 Times a Month		22	5%
43	Once Every 5 Years or Less		21	5%
47	Once a Month		13	3%
49	Once a Week		9	2%
	Total		447	100%

7. Does your company have a strategy for managing innovation?

#	Answer		Response	%
1	Yes		252	57%
2	No		195	43%
	Total		447	100%

8. On a scale from 1-10 how much closed and open innovation does your company develop? (0 = Closed Innovation only, 10 = Open Innovation only) Definitions: Open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market. Closed innovation is a paradigm that assumes that firms should use only internal ideas and internal paths to market their technology.

#	Answer	Min Value	Max Value	Average Value	Standard Deviation	Responses
2	.	0.00	10.00	6.72	2.36	443

9. On a scale from 1-10 how much incremental and radical innovation does your company develop? (0 = Incremental Innovation only, 10 = Radical Innovation only) Definitions: Radical innovation is a new product, service, or technology, that completely replaces an existing one. Incremental innovation is a new product, service, or technology that modifies an existing one.

#	Answer	Min Value	Max Value	Average Value	Standard Deviation	Responses
4	.	0.00	10.00	4.43	2.40	437

10. On a scale from 1-10 how much product and service innovation does your company develop? (0 = Product Innovation only, 10 = Service Innovation only) Definitions: Product innovation is the development of a new product, changes in design of an established product, or use of new materials or components in the manufacture of an established product. Service innovation is the development of a new or significantly improved service concept that is taken into practice.

#	Answer	Min Value	Max Value	Average Value	Standard Deviation	Responses
3	.	0.00	10.00	6.34	2.57	439

11. Who takes initiative when collaborating in an open innovation project?

#	Answer		Response	%
1	My company		261	59%
2	The other company		36	8%
3	The distribution of who takes initiative when collaborating in an Open Innovation project is even		147	33%
	Total		444	100%

12. What most constraints your companies' ability to achieve its innovation targets?

#	Answer		Response	%
1	The absence of a well-articulated innovation strategy		96	27%
2	Conflicts between different innovation types		35	10%
3	Lack of skills for managing different types of innovation		122	34%
4	Lack of top management commitment to innovation		107	30%
5	Lack of financial resources		167	46%