MASTER THESIS

Towards an integrated innovation model

A study on the combined effects of innovation types on firm performance in the Dutch manufacturing industry

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Author:

Name: Sema Topaloglu

Student Number: s4415132

Radboud University Nijmegen

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Supervisor:

Dr. Peter Vaessen

Second and third reader:

Prof. dr. ir. Van der Heijden

Abstract

As once written by Wolfe (1994; p.405) "The most consistent theme found in organizational innovation literature is that its results have been inconsistent". The relation between innovation and firm performance has always been a very tricky, yet important one. This study sets out to understand this relation in more detail by looking at the different innovation types; product innovation, product-service innovation, organizational innovation and technological innovation, and their potential interactive effects on firm performance. The research question: To what extend do the different innovation types have a combined effect on firm performance in the Dutch manufacturing industry? Is explored through testing eight hypotheses with multiple hierarchical multiple linear regression analyses. The data used to test these hypotheses is obtained from the EMS survey dataset of 2018. The dataset consists out of 203 manufacturing firms in the Netherlands. The results show that there is a significant positive effect of product innovation and technological process capabilities on firm growth, especially employee growth. Product innovation and organizational capabilities had a significant negative effect on firm growth. Furthermore, the combination of organizational capabilities and product-service innovation had a significant positive effect on firm growth.

Keywords: Innovation types; firm growth; innovation capabilities

Preface

In front of you lies the product of my most challenging academic endeavor. The process of writing this thesis has made me feel proud but has also humbled me in many occasions. Writing this thesis made me realize how much I have learned as a student throughout the years, but it has also shown me that there is so much more for me to learn.

I would sincerely like to thank my supervisor, Peter Vaessen who has been everything a student could want in a supervisor. He has been nothing but helpful and has been invested in the projects of his students from the beginning. He has guided me with his years of experience and scientific knowledge and I have always appreciated his honest and professional feedback. I would also like to thank my second examiner Prof. dr. Van der Heijden in advance for taking the time out of his day to read and asses my master thesis.

I wish you a pleasant reading,

Kind regard,
Sema Topaloglu

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1. Introduction

1.1 Background and Problem indication

Besides its effect on societies (Dachs and Peters, 2014), economies (Grossman and Helpman, 1994; Hasan and Tucci, 2010; Hausman and Johnston, 2014; Romer, 1986) and even the environment (Nordhaus, 2007), innovation has also proven to greatly impact organizations. It is therefore of no surprise that the concept of innovation has enjoyed a lot of attention in organizational science. Innovation is defined as 'The generation of a new idea and its implementation into a new product, process or service, leading to dynamic growth of the national economy and the increase of employment as well as to a creation of pure profit for the innovative business enterprise' (Urabe, Child and Kagono, 1988, p. 3). One of the main reasons for innovation capturing the sustained attention of researchers is likely due to innovation often being associated with having positive effects on firm performance (Drucker, 1985; Hult et. al. 2003). Some researchers have even claimed that innovation is essential for the long-term survival of organizations (Cefis and Marsili, 2005; Freeman and Soete, 1997; Schumpeter, 1942) because of its positive effects on incumbent's ability to maintain their competitive position in the rise of novel disruptive technologies (Banbury and Mitchell, 1995; Christendsen, 1997). Innovation is also believed to be a facilitator for organizational growth (Freel and Robson, 2004; Sternberg, 2000; Kim, 2005) and sustainable competitive advantage (Bartel and Garud, 2009) and is therefore often used as a tool in growth strategies. This all suggest that innovation is a necessity, rather than a choice for many organizations that want to survive and thrive (Bell, 2005; Cho and Pucik, 2005**;** Fiol, 1996).

However, debate exists on whether innovation indeed leads to positive outcomes for organizations. Numerous researchers have discovered a positive relation between innovation and firm performance (Allocca and Kessler 2006; Choi, Park and Hong 2012**;** Hölzl and Friesenbichler**,** 2012; Santi and Santoleri, 2017; Wolff and Pett, 2006). Yet, some studies found no significant relation between innovation and firm performance (Hitt, Hoskisson and Kim, 1997; Gabriele and Corsino, 2010), while others have even discovered a negative correlation between these two variables (Balkin, Markman and Gomez-Mejia, 2000; Subramanian and Nilakanta, 1996). This inconsistency in innovation literature has been captured perfectly in a quote by Wolfe (1994; p405), who wrote: “The most consistent theme found in the organizational innovation literature is that its research results have been inconsistent”.

These ambiguous findings indicate that the relationship between innovation and firm performance is not conclusive and therefore complex and potentially risky. Innovation is already inherently risky due to it frequently involving initial large amounts of money being invested in R&D (Chan, Lakonishok and Sougiannis, 2001; Ghannajeh et al. 2015; Syed, Riaz and Waheed, 2016). This risk could be a barrier for organizations hesitating to pursue innovation in fear of detrimental results (Borgelt and Falk, 2007; Madrid-Guijarro, Garcia and Van Auken, 2009). An example of these detrimental results can be seen in what is referred to as the ‘valley of death’. The valley of death refers to the early stages of product innovation, more specifically to the phase between research and commercialization leading to successful innovation (Hudson and Khazragui, 2013). With innovation failure rates above 90% in the pharmaceutical and biochemistry industries, many innovation projects in these sectors do not manage to bridge this valley of death, resulting in big financial losses for the organization (Paul et al., 2010; Hay et al., 2014; Munos, 2009; Scannell et al., 2012**;** Thakor et. al., 2017). Thus, innovation being both crucial and risky puts organizations in a tough spot and creates the need to understand the relation between innovation and firm performance as completely as possible.

Accordingly, researchers have attempted to understand potential causes for these contradictions. The differences in results could partially be accounted for by the lack of consensus in the scientific literature on what firm performance is and how it is best measured (Taouab and Issor, 2019), leading to different metrics being used to measure firm performance. Firm performance is a broad concept that generally looks at the effectiveness and efficiency of an organization’s actions (Neely, Gregory and Platts, 2015) in order to evaluate whether the outcomes of these actions matches the organization’s corporate strategies and objectives (Carrie and McDevitt, 1997). Since these objectives and strategies can differ from organization to organization, the performance metrics used to measure the effectiveness and efficiency of these objectives can also vary greatly from one and other. It is easy to comprehend why an organization that aims for market growth would use metrics such as the Tobin’s Q in order to measure its performance, whereas an organization that wants to have a better reputation would look more into customer satisfaction metrics to measure its performance.

Even if the inconsistencies between studies could be partially explained by the different objectives of innovation projects and the variety of metrics used to measure their effectiveness, it does not explain the inconsistencies found in studies using the same metrics. Therefore it is important to note that there are different types of innovations that seem to have different effects on firm performance indicators as well. A well-studied typology for innovation types is one proposed by Schumpeter (1934) that roughly distinguishes between technological and non-technological innovation (Brouwer, 1991). Technological innovation types refer to technological process innovation and product innovation, whereas non-technological innovation types refer to organizational innovation and product-service innovation (Armbruster, Kirner and Lay, 2006).

Studies have shown that these different innovation types have different effects on various firm performance indicators. A great example is the study done by Gunday et al., 2011 in the Turkish manufacturing sector, in which four types of innovations and their individual effects on firm performance were studied. The results showed that organizational, marketing and product innovations had a positive effect on innovative performance (e.g. R&D expenditures, number of patents and new product announcements), but process innovation did not. Innovation performance then had a positive effect on market performance indicators (such as: total sales, market share and customer satisfaction) and production performance indicators (flexibility, production and delivery speed, production cost and quality) (Gunday et al., 2011). However, the effects of the different innovation types on these market performance and production performance indicators were indirect, and the researchers did not measure the direct and combined effects of these innovation types on the individual indicators. Similarly, two different studies conducted in the Ghanaian banking sector and The Sri Lankan Insurance sector both found that product innovation, market innovation and process innovation had a positive effect on innovative firm performance, however organizational innovation did not (Rajapathirana and Hui, 2018; YuSheng and Ibrahim, 2020). Whereas a study conducted in the Nigerian manufacturing industry found positive relations between process, product and organizational innovation (Abiodun, 2017). These studies show that there are in fact different effects of different innovation types on a variety of firm performance indicators.

Besides the innovation types having diverse effects on firm performance (Karabulut, 2015), numerous studies found that the innovation types also influenced each other in a multitude of ways (Gunday et al., 2011; Hassan et al., 2013). This interaction between the innovation types has been acknowledged by many researchers. For example, researchers have found that organizations that implemented organizational innovation are more likely to have both process and product innovation. Whereas organizations that did not have organizational innovation tended to focus on either process innovation or product innovation but not on both (Fonseca, 2014**).** These findings could mean that organizational innovation enables organizations to combine product and process innovation. Meanwhile**,** Mothe and Thuc Uyen (2012) found that non-technological innovation types such as organizational and marketing innovation is needed to increase the likelihood of technological innovation types such as product innovation. Suggesting that, non-technological innovation may encourage technological innovation or that non-technological innovation increased the need for technological innovation inside an organization. These findings show that innovation is complex and that innovation types are not autonomous, but influence each other and firm performance in different ways.

1.2 Research objective and Research question

Even though the effects of innovation types on each other and their indirect separate effects on firm performance have been studied in a multitude of different ways before, their combined effect on firm performance is often neglected and still poorly understood. Nevertheless, there have been conducted some studies in the service industry related to this phenomenon. An example of this is the study conducted by Damanpour, Avellaneda and Walker in the service industry of Hong Kong. This study looked at the combined effect of three types of innovations (namely: service innovation, technological process innovation and administrative/organizational innovation) on seven firm performance indicators in the service industry (Damanpour, Avellaneda and Walker, 2009). They analyzed over 400 organizations over a period of four years and found that focusing on a single type of innovation over a longer period of time, had a negative effect on firm performance, while a cumulative adoption of different innovation types had a positive effect on firm performance (Damanpour, Avellaneda and Walker, 2009). They came to the conclusion that focusing on one type of innovation could be detrimental to an organization, whereas focusing on multiple innovation types as a whole might be favorable. They even argue that innovation is often path-dependent and that the inconsistent finding between innovation and firm performance lies in the fact that most studies are cross-sectional and therefore miss the combinative effect of previously implemented innovation on firm performance (Damanpour, Avellaneda and Walker, 2009). A possible explanation for this is given by Roberts and Amit who argue that organizations can be seen as systems of strategic attributes that are all evolving and interact with each other (Levinthal, 1995; Rivkin, 2000; Roberts and Amit, 2003; Simon, 1962), which means that the change in one attribute eventually creates a need to change other attributes, since they are interconnected (Roberts and Amit, 2003).

Similarly, a longitudinal study of fourteen years conducted in the Australian banking sector, showed that an organization's success is more closely linked to its history of innovation, and the organization's overall innovativeness rather than its introduction of new products or processes (Robert and Amit, 2003). This line of thinking is supported by many others that link an organization's performance to the organization's overall innovative activity rather than a single innovation or innovation type (Geroski, Machin and Van Reenen, 1993). All these studies highlight that innovation types are part of an organization´s total innovativeness and that the introduction of one innovation type could enhance the value of another type suggesting synergetic effects between them (Robert and Amit, 2003; Damanpour, Avellaneda and Walker, 2009; Rosenberg, 1982). They demonstrate that innovation types are not independent phenomenon, but are interconnected and should therefore be researched in combination with each other instead of on their own.

Building on these previously mentioned studies, this paper recognizes that the integrated innovation approach could provide value for understanding the relation between innovation and firm performance in the manufacturing industry as well. This paper sets out to understand this relation from a more holistic perspective instead of a partial or separated innovation viewpoint in which different innovation types are not separate and do not merely influence firm performance indirectly or independently, but together form pieces of a complex puzzle and have the potential to create synergetic effects when combined and harmonized inside an organization. This perspective recognizes that a more holistic approach to innovation may help better understand the effect of innovation on firm performance (Damanpour, Avellaneda and Walker, 2009; Robert and Amit, 2003). The previously mentioned studies have all been conducted in the service industry; however a similar study has not yet been conducted in the manufacturing industry. Thus, this study sets out to examine the potential interaction effects of different types of previously implemented innovations on firm performance in the manufacturing industry, in order to add to the existing literature on the relation between innovation and firm performance by answering the following research question:

To what extend do the different innovation types have a combined effects on firm performance in the Dutch manufacturing industry?

The findings of this study could be useful for managers to better understand the relation between innovation and firm performance and help managers make better informed decisions regarding innovation. The earlier mentioned valley of death could be easier to bridge when innovation types and their effect on firm performance are better understood, helping to reduce the risk of losing invested resources. Even though the risk that comes with innovation cannot be entirely eliminated, the findings of this study could guide managers to better embrace and manage these risks. For example, it could be that new product innovations are not successful, simply because other innovation types are lagging behind inside the organization. This paper could furthermore expand the way managers look at innovation, and help them look at their organization's innovativeness as a combination of different types of innovation, rather than having a focus on a single innovation type. This could help them optimize their innovation projects in order to improve firm performance and learn to look at innovation processes as being interconnected. Finally, the findings could also serve as a reference point for managers who want to assess their overall organizational innovativeness. They could, for example, evaluate whether their technological process and organizational capabilities are sufficient to improve the financial success of their new product innovation projects.

1.3 Thesis outline

This research is divided into six chapters. The current chapter intended to introduce the subject of this paper and explain the research gap and its scientific and managerial relevance. In the next chapter the concepts; innovation types and firm performance are going to be expanded upon in order to better understand the theoretical background of the paper as well as use the Resource based view and dynamic capabilities to build the hypotheses that will be researched. This chapter also provides the conceptual model as a visual representation of the proposed hypotheses. The methodology chapter will cover the research method, research design and elaborate on the reliability and validity of the used dataset. Then, the fourth chapter sets out to provide the results of statistical analysis using SPSS in order to correctly answer the research question. These results will then be used in chapter five to answer the research question and interpret the outcomes. Last of all, the sixth and final chapter will contain the discussion as well as cover the limitations, managerial recommendations and potential future research directions.

2. Theoretical framework

This chapter aims to explain and define some key concepts, variables and relations mentioned in this research. Firstly firm performance and the different types of innovation that will be measured are explained and defined. Then the hypotheses that will be studied in order to correctly answer the research question are proposed. For this, the resource based view (RBV) and the dynamic capabilities theory is adopted as a theoretical lens. Finally, a conceptual model summarizing all the proposed hypotheses is presented.

2.1 Firm Performance

Firm performance has been a relevant topic in the strategic management literature for years, and is often used as a dependent variable (Taouab and Issor, 2019). However, as previously mentioned, there is a lack of consensus amongst researchers on how firm performance is best measured, and what metrics should be used. Throughout history researchers have proposed different ways in which firm performance should be evaluated; e.g. by measuring an organization's productivity and flexibility (Georgopoulos and Tannenbaum, 1957), its ability to exploit its environment (Seashore and Yuchtman, 1967), its ability to create value (Porter, 1986) or its ability to satisfy stakeholders (Harrison and Freeman, 1999). However, the efficiency and effectivity in which an organization is able to exploit its resources in order to reach its financial goals, is a point that is often agreed upon (Peterson, Gijsbers and Wilks, 2003; Taouab and Issor, 2019).

A main distinction for firm performance is made between hard/financial performance indicators e.g. ROA, ROE, ROS revenue, market share (Masa'deh et al., 2015) and soft/non-financial performance indicators such as customer satisfaction and quality (Gentry and Shen, 2010; Masa'deh et al., 2015; Subramanian and Nilakanta, 1996). These non-financial indicators often indirectly influence financial indicators (Bititci, Firat and Garengo, 2013). Financial firm performance indicators are generally further divided into market-based financial metrics e.g. revenue, Tobin's Q, price to earnings and market to book (Crook, Combs and Shook, 2005; Stickney, Brown and Wahlen, 2007; Alexander and Nobes, 2001) and accounting based financial metrics such as ROA, ROE and ROS (Tho, Dung and Huyen, 2021). Conventionally, most traditional metrics used to measure performance are financial in nature (Ghalayini and Noble, 1996; Taouab and Issor, 2019).

It is important to focus on how the performance of innovation is measured in the scope of this paper in order to select the correct metrics when measuring innovation. Overall, the main purpose of innovation is to increase an organization's financial performance by directly or indirectly increasing productivity and/or turnover (Arifeen et al., 2014) and thereby generate economic growth by increasing its competitive advantage (Onea, 2020). This goal is deeply imbedded in how organizations operate and survive. According to Porter (1985), the main purpose of an organization is to create value through capturing competitive advantage. This value needs to be created for both the customers as well as the shareholders/organization itself. Creating value for customers is often a means to an end for creating financial value for the shareholders/organization. Not creating this financial value will lead to the end of the organization's existence (Friedman, 1970). According to porter this competitive advantage can be achieved by increasing profitability in two different ways; 1) by entering new markets through differentiation, thus increasing sales and thereby making profit, or 2) by lowering the production costs of existing products in order to generally create more profit (Porter, 1985).

These two different strategies of gaining competitive advantage is sometimes reflected in the different innovation types like (technological) process innovation and product/product-service innovation. Product innovation is often aimed at entering new markets and introducing new products/services and is therefore in line with differentiation. (Technological) process innovation on the other hand, often targets the lowering of production costs in order to make more profit and is therefore more in line with the lowering costs strategy (Porter, 1985). However, this does not take into account the potential combined effect that these innovation types can have on firm performance. For example, technological process innovation has shown to significantly increase business growth when combined with product innovation (Goedhuys and Veugelers, 2008; Fonseca, 2014). In this example, this additional effect of technological process innovation on firm performance would be reflected in the growth indicators, instead of in the cost indicators that are generally associated with technological process innovation.

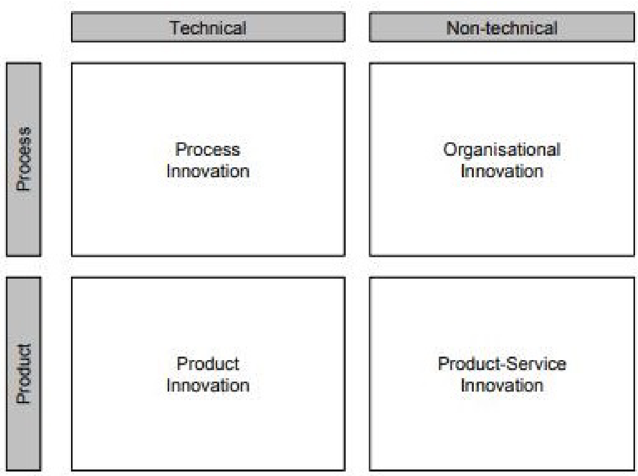
According to Bititci, Firat and Garengo (2013) the most useful indicators for comparing innovation performance amongst firms are the financial growth indicators. Some examples of these financial growth indicators are; growth in market share, growth in productivity and growth in revenue. This paper will measure firm performance by looking at growth in revenue and growth of the number of employees after the introduction of new products. These metrics have been used by an earlier study conducted in the Dutch manufacturing industry by Klomp and Leeuwen in 2001. It has been shown that both product and (technological) process innovation can lead to organizational growth in the form of an increased number of employees (Brouwer and Kleinknecht, 1994; Braunerhjelm and Thulin, 2022). Measuring the employee growth could furthermore be used as an indicator for firm size and overall firm growth, which is said to be driven by innovation (Liao and Rice, 2010). However, some have noted that the innovativeness of an organization did not significantly influence the number of employees in an organization, meaning that more innovation does not automatically lead to employee growth (Klomp and Leewen, 2001). This could potentially be explained by productivity. A smaller employee growth combined with an increase in product output and sales, leads to an increase in productivity, which is often still a desired outcome of innovation for organizations

2.2 Innovation types as innovation capabilities

The following section starts off with providing a general overview of the earlier mentioned innovation types. The next subparagraph introduced the resource based view. Then it describes dynamic capabilities, innovation capabilities and their relation. Finally, it proposes that previously implemented innovations could be considered innovation capabilities.

2.2.1 Innovation types

Innovation literature has divided innovation into several types mainly based on their different characteristics (Damanpour, Walker and Avellaneda, 2009). However, two of the best known and well-studied innovation typologies are the ones that distinguish between product and process innovation (Abernathy and Utterback, 1987; Damanpour, Walker and Avellaneda, 2009; Kotabe and Murray, 1990; Light, 1998) and between technological and non-technological innovation (Birkinshaw, Mol and Hamel, 2008; Damanpour, Walker and Avellaneda, 2009; Kimbery and Evanisko, 1981; Lam, 2005). Researchers have combined these two typologies



and proposed a taxonomy that divides product innovation in goods and services and divides process innovation in process innovation and organizational innovation (Edquist, Hommen, McKelvey, 2001; Meeus and Edquist, 2006). This paper will use a similar taxonomy that was later proposed by Lay and colleagues (Figure 1). This typology splits product innovation in product innovation and product-service innovation; and process innovation in technological process innovation and organizational innovation (Armbruster, Kirner and Lay, 2006; Kinkel, Lay and Wengel, 2005).

Process innovation can be technical, and is then referred to as technological process innovation, as well as non-technical which is then referred to as organizational innovation. Technological process innovation refers to finding and implementing new ways and technologies in order to produce more efficiently. The direct effects of this type of innovation often translate into lower costs, shorter lead times and higher quality products (Armbruster, Kirner and Lay, 2006). Organizational innovation on the other hand refers to the implementation of new organizational methods or practices that are new to the organization (Mothe, Thuc Uyen, 2012; OECD, 2005). Organizational innovation is referred to as managerial innovation or administrative innovation in the scientific literature as well (Camison and Villar-Lopez, 2014; Daft, 1978; Hamel, 2006; Birkinshaw, Mol and Hamel, 2008). The independent effect of this type of innovation on firm performance is often difficult to pinpoint and directly measure.

Product innovation refers to the development of new products, new services or new technologies (Armbruster, Kirner and Lay, 2006). A more elaborate definition given by Mothe and Thuc Uyen (2012) is “The introduction of goods or services that are new or significantly improved with respect to their specifications or intended use.” This definition expands the previous definition by also including products that are not necessarily novel but are improved significantly. Product innovation refers to the mentioned definition regarding products; whereas product-service innovation refers to new or improved services on their own or that go along with a physical product (Armbruster, Kirner and Lay, 2006). The effects of product/product-service innovation can often be measured with financial indicators such as the breakeven-point, return on sales (ROS), firm growth and revenues.

2.2.2 Innovation in the resource based view

The resource based view (RBV) of the firm is a well-established organizational framework that takes an internal approach to explain the difference in financial performance amongst organizations. It sets out to understand why some organizations are more successful than others. The core idea of the RBV is that organizations gain sustainable competitive advantage by exploiting their internal resources, such as their assets, competences and capabilities (Barney, 1991; Penrose, 1959). These resources should ideally be heterogeneous, immobile as well as valuable, rare, imperfectly imitable and not substitutable in order to create this sustainable competitive advantage. These resources could be either tangible (such as; materials, equipment or machinery) or intangible (e.g. knowledge, managerial skills or organizational processes/routines) (Barney, Wright and Ketchen, 2001).

The RBV has long been criticized for its optimism about the possibility to maintain sustainable competitive advantage. Some researchers claim that competitive advantage cannot be sustained for organizations that are in rapidly changing environments. It is not enough to have the correct resources but it is also important for organizations to be agile and be able to respond to their changing environment in a timely matter in order to survive and thrive in fast changing environments (Spender and Grant, 1996; Eisenhardt and Martin, 2000). The shift from the third industrial age; the age of expertise, when organizations gained advantage through having knowledge and expertise in a field, has been shifting towards the fourth industrial age; the age of agility, when organizations must learn the ability to respond to their environments in a timely matter. Having resources is not enough, but the ability to change these resources when necessary seems to gain importance.

This need for agility has been gaining a lot of scientific attention over the past years. The ability of an organization to be agile and change its resources is often referred to as dynamic capabilities (Fiol, 2001; Teece, Pisano and Shuen, 1997). Critics claim that the RBV is outdated because it does not acknowledging this organizational need for agility in dynamic environments. According to these critics, the RBV must be modified because sustained competitive advantage is not possible in fast changing environment unless the organization has dynamic capabilities and therefore the ability to change its internal resources (Eisenhardt and Martin, 2000; Fiol, 2001). And even if an organization would possess these capabilities that could lead to a competitive advantage, due to the fast changing environment this competitive advantage would not be sustainable for a long time. However the writers of RBV themselves argue that dynamic capabilities are simply capabilities that are dynamic and therefore perfectly fit in their RBV (Barney, Wright and Ketchen, 2001). They elaborate on this point by explaining that innovation can be costly for incumbents, and thus the ability of organization to change faster than its competitors could be interpreted as a source of sustainable competitive advantage (Barney, Wright and Ketchen, 2001). Therefore, organizations can create sustainable competitive advantage in fast changing environments as long as they hold these dynamic capabilities.

2.2.3 Dynamic capabilities and innovation capabilities

Dynamic capabilities point out the need for an organization's ability to change internally, to match the change that is taking place externally in order to sustain competitive advantage. As a result, dynamic capabilities do not merely look inwards like the RBV, but also emphasize the fitness between the organization's internal organization and its environment, by including the notions of innovation (Aas and Breunig, 2017; Porter, 1980; 1985). Dynamic capabilities refer to an organization's ability to change and adapt its internal resource base in order to keep up with its external environment (Teece, Pisano and Shuen 1997; Eisenhardt and Martin, 2000) and is defined by Teece et al., (1997, p516) as "The ability to integrate, build and reconfigure internal and external competencies to address rapidly changing environments". Dynamic capabilities can furthermore be seen as a higher order capability that aims to combine resources and processes to achieve competitive advantage (Barreto, 2010; Kor and Mesko, 2013). The value of dynamic capabilities therefore lies in its output rather than in its mere existence (Ambrosini and Bowman, 2009). Dynamic capabilities are closely related to innovation capabilities (Lawson and Samson, 2001). Instead of focusing on the environmental fitness of an organization, innovation capabilities put an emphasis on an organization's ability to successfully modify its offerings in the first place (Helfat et al. 2007).

According to Lawson and Samson, innovation capabilities refer to an organization's ability to constantly transform knowledge and concepts into new systems, processes and products (Lerro, Linzalone and Schiuma, 2009; Lawson and Samson, 2001). Organizations that have innovation capabilities therefore possess the ability to stimulate and implement successful innovation (Aas and Breunig, 2017). Success in this case, often refers to an improved financial performance for the organization. These innovation capabilities are embedded deep within the organization's strategies, systems and structures and cannot be seen separate from the organization as they are composed throughout the entirety of it (Gloet and Samson, 2016; Lawson and Samson, 2001; Guan and Ma, 2003). When correctly integrated, these innovation capabilities enable organizations to introduce new product more quickly and better adopt new systems (Rajapathirana and Hui, 2018), making them a critical tool for attaining advanced innovation performance (Cavusgil, Calantone and Zhao, 2003). Additionally, innovation capabilities encompasses the synthesis of different capabilities inside an organization to generate successful innovation (Parashar and Singh, 2005; Tidd, Bessant and Pavitt, 2009). Therefore innovation capabilities can be seen as a higher order integration capability that aims to shape and manage several other capabilities inside the organization to bring about successful internal change (Lawson and Samson, 2001; Breznik and Hisrich, 2014).

The exact relation between dynamic capabilities and innovation capabilities is not completely agreed upon in scientific literature (Breznik and Hisrich, 2014). Dynamic capabilities have been described as an outcome of innovation capabilities while others have theorized that dynamic capability is a precondition for innovation capabilities (Breznik and Hisrich, 2014). Arguing that; dynamic capabilities are essential for innovation (Rothaermel and Hess, 2007). Some researchers have also taken the stance that innovation capabilities are a build-in component of dynamic capabilities. For example Wang and Ahmed (2007) propose that dynamic capabilities can be split into three different components, namely; adaptive capability, absorptive capability and innovation capability. Claiming that, the innovation capability of an organization is an indispensable component of dynamic capabilities (Helfat et. al., 2007).

In contrast, some researchers have argued that dynamic capabilities and innovation capabilities are synonyms that essentially refer to the same thing (Breznik and Hisrich, 2014)**.** This is mainly based upon the notion that both dynamic capabilities and innovation capabilities are being described as a higher-order capability that both integrate and combine different capabilities inside the organization (Breznik and Hisrich, 2014). However, there is in fact a difference between the two capabilities. The aim of dynamic capability by combining these capabilities is to keep up with dynamic environments and has therefore an outward perspective. The effectiveness of dynamic capabilities depends on the organization’s environment and strategy (Karna, Richter and Riesenkampff, 2016; Schilke, 2014; Winter, 2003). Dynamic capabilities are generally more effective is dynamic environments, (Karna et al., 2016), they can be useful in stable environments (Ambrosini and Bowman, 2009; Wilden and Guderan, 2015), and may not be worth the costs in extremely dynamic environments (Schilke, 2014). On the contrary, innovation capability does not specify a goal or type of environment but simply aims to bring about successful innovation. This indicates that innovation capability does not aim to per se respond to its environment like dynamic capabilities do, but can also initiate innovation and internal change that ultimately will change its environment. Thus, innovation capabilities can initiate change in their environment, whereas dynamic capabilities aim to respond and react to external change when necessary. Innovation capabilities can therefore be useful for both inward as well as outward focused organizations.

Yet, most research leans towards the belief that innovation capability can be best described as a type of dynamic capability (Breznik and Hisrich, 2014). Dynamic capabilities first have to be able to identify change in the environment and then respond to it by changing the organization's internal resources in order to respond to this external change. Therefore, Teece splits dynamic capabilities in three main components; sensing, seizing and reconfiguring/transforming (2007). Sensing refers to organizations constantly observing their external environment in order to collect insights about potential opportunities and threats (Augier and Teece, 2009). Seizing entails the constant evaluation of the organization's internal capabilities and resources (Wilden et al., 2013). Reconfiguring/transforming is characterized by recombining and transforming the organization's resources and capabilities in order to match it with its external environment (Sirmon et al., 2011; Teece, 2012; Wilden and Gudergan, 2015). Reconfiguring is where innovation capabilities come into place. Innovation capabilities aim to change the organizations internal resources by combining and transforming resources and capabilities, which is in line with the reconfiguring/transformation component described in the dynamic capability theory. Thus innovation capabilities can be seen as a type of dynamic capability (Birchall and Tovstiga, 2005; Breznik and Hisrich, 2014). However, as mentioned earlier, on their own, innovation capabilities can also initiate internal change instead of merely responding to external change. Nonetheless, according to the dynamic capability theory, reconfiguring without first seizing and sensing may lack direction and therefore result in an undesirable mismatch with the environment (Drevich and Kriauciunas, 2011). However, it is important to note that sensing activities need outward-looking managerial attention and that constant sensing can be costly (Helfat and Peteraf, 2015; Wilden and Gudergan, 2015). Hence innovation capabilities may be more widely applicable than dynamic capabilities and will therefore be used in this paper from now on.

2.2.4 Innovation activity and innovation capabilities

Many researchers have found that the innovation capabilities of an organization (Rajapathirana and Hui, 2018), innovative performance (Gunday et al., 2011; Hassan et al., 2013) and the total number of innovations being done by an organization (Geroski, Machin and Van Reenen, 1993) influences the financial outcome of current innovation endeavors. This displays that the success of an innovation does not solely depend on the characteristics of the type of innovation, but also on the organization's overall innovativeness, innovation history and its firm-specific differences (Johnson et al, 2014**).** Some organizations just seem to be more successful when it comes to innovating. They possess the right innovation capabilities for innovation to successfully be implemented in the first place (Lafort, 2011).

As defined in the previous section, innovation capabilities are the ability of an organization to transform knowledge into systems, processes and products (Lerro, Linzalone and Schiuma, 2009). At the same time, these innovation capabilities, and thus this ability, are embedded in the strategy, systems and structures of the organization (Gloet and Samson, 2016; Lawson and Samson, 2001; Guan and Ma, 2003). This shows that innovation capabilities are made out of systems and processes, but at the same these systems and processes enable the organization to successfully transform and create systems, processes and products pointing to a reinforcing positive feedback loop (figure 2).

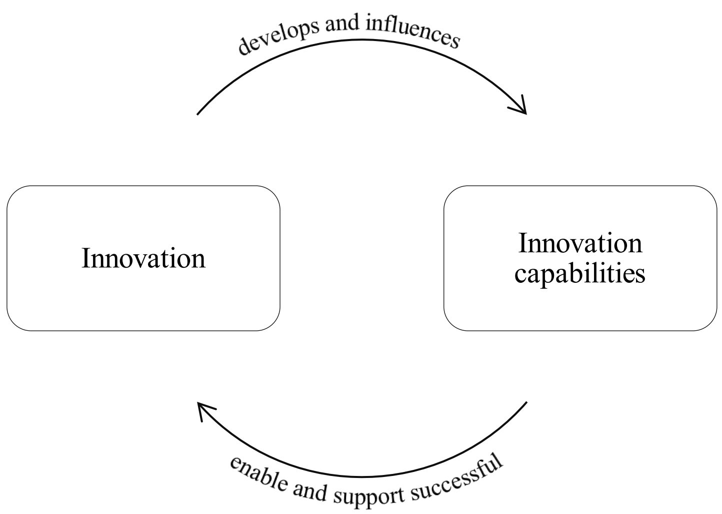


Figure 2: Reinforcing loop between innovation capabilities and innovation

This notion of; the more an organization innovates, the better it is able to develop capabilities in order to successfully innovate has been supported by others in scientific literature. For example, Geroski and colleagues (1993) researched whether it was the *product of the innovation process* that lead to improved firm performance or *the process of innovation* itself, and thus assess whether innovative organizations were more profitable compared to non-innovative organizations. The difference between these two views, tries to decode whether the financial results of an innovation are temporary and directly related to a specific innovation (product view), or are permanent and on the long term lead to fundamental and structural differences between innovating and non-innovating organizations (process view). This distinction is crucial, because it dictates whether organizations should focus on creating marketable products and processes to sell in the short-term, or rather develop and strengthen their internal capabilities for the long-term (Geroski, Machin and Van Reenen, 1993). According to their research, the process of innovation improves and develops an organization's capabilities, which makes the organization overall quicker, more flexible and more adaptive compared to non-innovating organizations (Geroski, Machin and Van Reenen, 1993). In their longitudinal study of 10 years, they found that in the first four years after introducing an innovation, there were no significant differences in profit between innovative and non-innovative organizations. However, after the initial four years, the innovative organizations started making significantly more profit compared to the non-innovative organizations. This suggests that there are some long-term effects of previous innovations on firm performance (Geroski, Machin and Van Reenen, 1993).

Since the innovation capabilities are deeply imbedded in an organization's strategy, systems, and processes, (Gloet and Samson, 2016) changes to any of these would influence the innovation capabilities of an organization. The processes and systems of an organization can be roughly split up into the 'technological core' or the 'technological system' and the 'managerial core' or the 'social system' of an organization (Daft, 1978; Damanpour and Evan, 1984; Meeus and Edquist, 2006). This distinction is based on the socio-technical systems theory (STS), that notes that the technological and social system of an organization are two sides of the same coin and must work together in order to accomplish tasks (Appelbaum, 1997). Technological process innovation refers to changes to the technological system of an organization, whereas organizational innovation refers to changes to the social system, resulting in different processes inside the organization. This paper suggests that since innovation capabilities are imbedded in these systems and processes, the technological and social system can be considered as the technological process capabilities and organizational of an organization. Any changes to these systems will therefore influence these technological process capabilities and organizational capabilities. Since the innovation capabilities of an organization consist out of these systems and processes (Gloet and Samson, 2016) and these capabilities influence the implementation of successful innovation (Lerro, Linzalone and Schiuma, 2009), this paper proposes that technological process capabilities and organizational capabilities could be considered innovation capabilities. And thus, any changes to these capabilities through the implantation of technological process innovation and/or organizational innovation will impact the ability of an organization to successfully innovate.

2.3 Innovation and business growth: construction of an explanatory framework

This section sets out to systematically construct a framework by developing hypotheses that will be tested in order to correctly answer the research question. This framework essentially sets out to research whether there are any interaction effects between the different innovation types that influence firm growth.

2.3.1 Aligning the types of product innovation with technological process capabilities and organizational capabilities individually

Technological capabilities are made up of an organization´s ability to execute technical tasks, including the development of new products and processes (Tsai, 2004). These types of capabilities are particularly important in high-tech environments e.g. in the pharmaceutical, chemical and electronic industries (Duysters and Hadgedoom, 2000; Ortega, 2010; Schoenecker and Swanson, 2002**;** Tsai, 2004; Wong, 2014). The accumulation of these capabilities can be referred to as the technological capital or the technological system of an organization, which refers to the technological infrastructure and equipment used to manufacture goods and services (Grigoriev et al., 2014). Any changes to this technological system will be referred to as technological process innovation from now on.

Product innovation is generally adopted more often than process innovation because the increased performance is usually more noticeable with the introduction of new products rather than the introduction of new processes (Myers and Marquis, 1969, Pisano and Wheelwright, 1995, Strebel, 1987). However, organizations that focus on product innovation alone miss out on the potential combined effect that product and process innovation can have on firm performance. Goedhuys and Veugelers (2008) found that product innovation combined with technological process innovation leads to higher sales growth rates in Brazilian manufacturing organizations. They set out to identify the effective drivers for firm growth and they found that process and product innovation particularly when combined improved firm growth. Technological process innovation was measured by the acquisition and development of new processes that changed the way the main products of the organization was produced, while product innovation was measured by looking at the number of new products that were introduced in the past three years (Goedhuys and Veugelers, 2008). They then divided the organizations in three different groups; only product innovation, only process innovation and both product and process innovation. The measurement used to determine growth was the average annual sale growth over a period of three years. The organizations that just introduced new products had a significant sales growth; this growth was higher when combined with process innovation, while process innovation alone was associated with a lower sales growth (Goedhuys and Veugelers, 2008). Their research found that 73% of the successful product introductions were done by companies that did a combination of both product and process innovation, even though that particular group made up merely 50% of the sample size.

The combination of product and process innovation has also shown to improve performance outside of the manufacturing industry, suggesting a synergetic effect between the two types of innovation in the service industries as well (Damanpour and Gopalakrishnan, 2001). Damanpour and Goplakrishan for example found that banks that adopted product and process innovation more evenly performed better than banks that did not (2001). Many others have found similar interaction effects between product and technological process innovation in different industries (e.g.; Capon et al., 1992; Martinez-Ros, 1999; Milgrom and Roberts, 1990; Pisano, 1996; Reichstein, 2006). For example, Miravete and Pernias found that there was a high collaborative correlation between technological process and product innovation in the Spanish tile industry (2006). In this industry specific, new technological process innovation enabled organizations to be able to produce higher quality tiles in different shapes and colors; this enabled the production of more unique products which resulted in higher sales (Miravete and Pernias, 2006). This was supported by others, who found that process innovation indeed enables organizations to create more unique products (Al-Sa'di, Abdallah and Dahiyat, 2017). Another possible contribution is that technological process innovation enabled organizations to produce in larger numbers, leading to the production of more products and therefore the opportunity for higher sales (Miraveta and Pernias, 2006). These mentioned findings indicate that the technological process innovativeness of an organization can improve the success of product/product-service innovations and therefore the following hypotheses are proposed:

H1: The more improved the technological process capabilities of an organization, the stronger the impact of product innovation on firm growth.

H2: The more improved the technological process capabilities of an organization, the stronger the impact of product-service innovation on firm growth.

Organizational capital is defined as “the set of non-technical means and processes devoted to the formal organization of an organization”, and is made up of the organizational capabilities of an organization (Martin-de Castro et al., 2006). It refers to things like organizational culture, structure, processes (Martin-de Castro et al., 2006), and management systems (Damanpour and Evan, 1984). Organizational innovation aims to improve these mentioned structures and processes. Any changes to this social system will be referred to as organizational innovation from now on.

Whereas technological process innovation only focusses on the technological part of the organization, organizational innovation tends to have a broader focus spanning different processes, units and sometimes the entire organization (Teece, 1980**;** Vaessen, Lighthart and Dankbaar, 2013). Organizational innovation is often assumed to improve firm performance through lowering costs such as administrative and transaction costs (Gunday et al., 2008). In addition, Vaessen, Lighthart and Dankbaar found that organizations that implemented organizational innovations were more likely to introduce new products and product related services and these product/product-service innovations were more likely to perform well and have higher sales (2013). They explained this relation by shedding light on the possibility that organizational innovation improved the non-technical activities that support product innovation (Vaessen, Lighthart and Dankbaar, 2013). This may be especially true for the broad boundary spanning activities of an organization such as marketing and HRM (Floyd and Wooldrige, 1997; Vaessen, Lighthart and Dankbaar, 2013). These activities are believed to influence the creation of knowledge (Henderson and Cockburn, 1994), the adoption of new ideas (Floyd and Wooldridge, 1997) and the introduction of new products (Reid and Brentani, 2004).

Additionally, organizational innovation is also believed to create a suitable environment for other types of innovation to successfully take place (Lin and Chen, 2007; Gunday et al., 2008). According to Gunday et al., organizational innovation improves intra-organizational coordination and cooperation which in turn contributes to a more suitable environment for product and process innovation to be implemented. They concluded that organizational innovation was the strongest driver for innovation performance (Gunday et al., 2008). In contrast, many others have noted that it is not organizational innovation that leads to higher sales, but mostly marketing innovation (Johne and Davies, 2000)

Furthermore, organizational innovation has proven to stimulate successful product innovation, resulting in improved firm performance (Schmidt and Rammer, 2007). It did this by reducing the respond time to customers and suppliers and improving the quality of the product and services, leading to higher sales. However, it is important to note that the same study found that organizations that only implemented technological process innovation had higher profit margins than organizations that implemented both technological process innovation and organizational innovation (Schmidt and Rammer, 2007). Indicating that the sales grew, but in turn there were extra costs involved that affected the overall profit margin. Based on these mentioned findings, the following two hypotheses are proposed:

H3: The more developed the organizational capabilities of an organization, the stronger the impact of product innovation on firm growth.
H4: The more developed the organizational capabilities of an organization, the stronger the impact of product-service innovation on firm growth.

2.3.2 Aligning the types of product innovation with technological process innovation and organizational capabilities combined

The relation between technological process innovation and organizational innovation has been studies extensively in innovation literature (Burns and Stalker, 1961; Kimberly and Evanisko, 1981). Research has shown multiple times that the combination of an organization's technological capabilities in combination with its organizational capabilities can positively affect firm performance (Camison and Villar Lopez, 2014). Many have mentioned that organizational and technological innovation types are complementary and are therefore better implemented in combination (Battisti and Stoneman, 2010; Piva, Santarelli and Vivarelli, 2005**).** This has been supported by research done by Vaessen, Lighthart and Dankbaar (2013), who set out to research the effect of technological innovation, organizational innovation and the combination of these two innovation types on ten different business performance indicators. They found that six out of the ten performance indicators were affected positively by the combination of technological and organization innovation endeavors (Vaessen, Lighthart and Dankbaar, 2013). Organizations that engage in both organizational and technical innovations in a balanced matter are better able to sustain or improve their performance level than organizations that choose to focus on one of those types of innovation (Damanpour and Evan, 1984; Trist, 1981).

Some researchers even argue that technical innovation and organization innovation are referring to different aspects of the same socio-technical system and should therefore be researched in a holistic matter (De Sitter, Den Hertog & Dankbaar, 1997)**.** According to a research conducted by Fonseca organizational innovation is a crucial component enabling organizations to successfully combine product and process innovation (2014). It is argued that to be able to use product and process innovation at the same time, different organizational structures and systems are needed, and that is where organizational capabilities comes into place (Fonseca, 2014). This has been supported by Camison and Villar-Lopez who found that the effect of organizational innovation and product innovation on firm performance is mediated by technological process innovation (2014). They indicated that only organizational innovation was not enough for successful product innovation, but that technological process innovation was needed in combination with organizational innovation (Camison and Villar-Lopez, 2014). This is line with the Schmidt and Rammer who claim that organizational innovation is closely linked to technological process innovation, because the introduction of new technological processes and new ways of distribution may call for a reorganization regarding business routines, business practices and organizational models (Schmidt and Rammer, 2007). In a similar logic, new product innovation may demand a re-organization of work flows, knowledge management and outside relations (Schmidt and Rammer 2007). They concluded that organizations that had both organizational and technological innovation had better new product successes and higher sales, than organizations that only implemented technological innovations (Schmidt and Rammer, 2007).

The importance of organizational innovation in combining product and technological process innovation has been supported by others as well (Polder et al, 2010). They found that organizations that have product, technological process and organizational innovations had an increased productivity rate. They also concluded that technological process innovation and organizational innovation specifically were complimentary (Polder et al., 2010). This view is supported by many others propose that the integration of product, technological process and organizational innovation is crucial for the market success of new products (Cozzarin and Perzival, 2006; Hauser, Tellis & Griffin, 2001; Tidd, Bessant and Pavitt, 2009). Organizations with high innovation scores for product, technological process and organizational innovation were also associated with higher totals sales and exports (Gunday et al., 2008).

These findings indicate that on their own the technological process and organizational capabilities may not always influence firm performance; however, when correctly synthesized inside the organization they can increase an organization's ability to successfully implement new product/product-service innovations. Therefore they can be considered innovation capabilities. Accordingly, organizations with these higher innovation capacities can respond to challenges more quickly and exploit new products and market opportunities better (Brown and Eisenhardt, 1995; Miles et al., 1978; Adler and Shenhar, 1990). It is therefore expected that the positive effect of product/product-service innovation on firm performance is stronger when combined with both the organizational capabilities and technological capabilities of an organization. Based on these mentioned findings, the following two hypotheses are proposed:

H5: The combination of technological and organizational capabilities exceeds their respective individual contribution to the growth effectiveness of product innovation.

H6: The combination of technological and organizational capabilities exceeds their respective individual contribution to the growth effectiveness of product-service innovation.

There is some research on the interaction effect of product and product-service innovations and firm growth. It is believed that is could possibly lead to a competitive advantage in the manufacturing industry (**Ferreira and Proenca, 2010**). For example, Kinkel, Lay and Wengel found that organizational that were able to realize advanced innovation breakthroughs by intelligent product and product-service mixtures were better when it came to employee growth (2005). Many organizations have designed complementary services on top of their products. They have chosen to add services that go along with products and give the opportunity to sell product-serviced that accompany the use of a product before, during or after the sale of the main product (Kinkel, Lay and Wengel, 2005). This enables organizations to increase their additional sales. They concluded that adding services related to the main product positively influences both firm growth as well as employee growth in the German manufacturing industry (Kinkel, Lay and Wengel, 2005). These types of findings have been supported by some (Antioco, et. al. 2008; Gebauer, 2007; Homburg, Fassnacht and Guenther, 2003), but disproven (Fang, Palmatier and Steenkamp, 2008). However, it is important to note that research has also shown that organizations that normally produce products, but decide to enter the service industry, often have a lower financial firm performance than their competitors (Eggert et. al., 2011). Some organizations even lose money by adding product-services next to their products (Stanley and Wojcik, 2005). According to Eggert and collogues, this negative interaction effect between product and product-service innovation can be explained by the two types often having to compete for managerial and marketing attention in the production organization (Eggert et al., 2011). Thus it's not their combination per se, rather their incorrect combination that can lead to a negative firm performance. They also argue that the combination of product and product-service innovation does lead to improved firm growth in the long-term (Eggert et. al., 2011). Based on these findings the following hypothesis is proposed:

H7: The combination of product innovation and product-service innovation exceeds their respective individual contribution to firm growth.

2.3.3 Aligning product and product-service innovation with coordinated and uncoordinated technological process and organizational capabilities

Finally, it is hypothesized that an integration and synthesis of all four types of innovation type will lead to greater firm growth than the innovation types separately. Multiple different studies have found that the success of innovations depends on the alignment of different innovation types (Battisti and Stoneman, 2010; Schmidt and Rammer, 2007). Organizations that do not have a narrow approach to innovation that focusses on just one innovation type, but chose to introduce more complex innovation strategies consisting out of different innovation types have a clear competitive advantage and therefore an increased firm performance (Evangelista and Vezzani, 2010). This is supported by Damanpour, Avellaneda and Walker who found that focusing on one type of innovation over a period of time, had a negative effect on firm performance, indicating that a more integrated and balanced approach to innovation may be more beneficial for organizations in the long run (2009). This could partly be explained by the earlier mentioned socio-technical system theory. According to the STS, the technical and social systems inside an organization influence each other (Scott, 1992). As a result, any change in one of the systems will therefore result in certain constrains or requirement in the other system in order to maintain positive outcomes (Cummings and Srivastva, 1977; Damanpour and Evan, 1984; Fritsch and Meschede, 2001; Kotabe and Murray, 1990). Similarly, firm performance is thought to be better when organizations adopt multiple different innovation that lead to a wide range change in the system (MacDuffie, 1995; Walker, 2004). Moreover, according to Rosenberg, innovation types are interdependent, and so the introduction of one type, can add value to the other (Rosenberg, 1982). Based on these findings, a final hypothesis was constructed:

H8: The impact of product innovation and product-service innovation on firm growth is stronger when it is combined with the organizational capabilities and technological capabilities of an organization.

2.4 Conceptual model

The above mentioned hypotheses together with their expected relations are illustrated in the conceptual model in figure 2. The conceptual model shows firm growth as the dependable variable and Technological product innovation and product-service innovation as the independent variables and Technological capabilities and Organizational capabilities as the moderating variables. The moderating variables are expected to strengthen the effects of product innovation and product-service innovation on firm growth and are therefore expected to interact with each other.

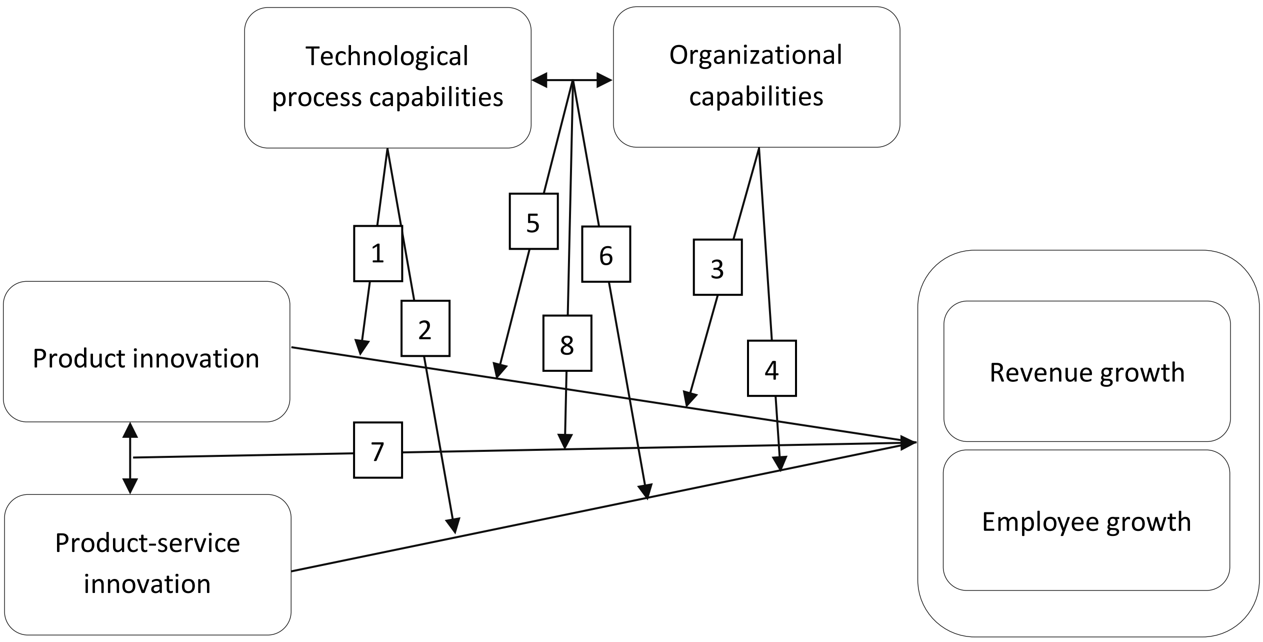


Figure 2: Conceptual model

3. Methodology

This chapter first repeats the research objective in order to correctly select a research method and design. Then the data collection method of the utilized dataset is described and justified. The validity and reliability are touched upon followed by an explanation of how the variables were measured and analyzed in the scope of this research. Lastly, the code of conduct that has been at the core of this study is elaborated upon.

3.1 Research objective

The objective of this paper is to research whether an integrated approach to innovation may be more beneficial for organizations that want to introduce new products/product-services. In order to do so, seven hypotheses were proposed that anticipate that organizations with higher technological and/or organizational capabilities are more successful when it comes to firm growth through the introduction of new products and product-services, than organizations with lower technological and/or organizational capabilities. Thus, this study sets out to examine whether the relation between product/product-service innovation and firm growth is moderated by an organization's technological and/or organizational capabilities. To satisfy the objective of this paper and correctly answer the research question; '*To what extend do the different innovation types have combined effects on firm performance in the Dutch manufacturing industry?*' a quantitative method was selected.

3.2 Research method

Quantitative research methods set out to understand (social) phenomena by collecting numerical data. This numerical data is then analyzed using mathematic-based methods such as statistics (Creswell, 1994). This research method is rooted in logical positivism, which assumes that an objective reality exists and that the only way to correctly measure this objective reality is through the use of objective research methods (Holton, 1993). According to this paradigm; truth exists independently from the observer (Clark, 1998), hence it is argued that opinions, experiences and perceptions are not objective enough to correctly measure and understand this reality (Dzurec, 1989; Greene, 1979). However, it must be noted that researchers are humans with perceptions and cannot fully detach themselves from the examined phenomenon. Consequently true objectivity could never be achieved. Post-positivism acknowledges this observer bias, and argues that even if the objective truth is out there but cannot be objectively measured and understood by the observer, researchers should still aim to get as close as possible to this objective truth (Sukamolson, 2007).

One of the main advantages of quantitative research is that it enables researchers to use larger randomized sample sizes and collect these large amounts of data in a relatively short amount of time (Connolly, 2007). This makes the results generally more representative of the research population (Carr, 1994; Martin and Bridgmon, 2012; Queros, Faria and Almeida, 2017). A larger sample size also reduces the risk that a false picture is painted due to some extreme outliers unwantedly skewing data leading to misleading results. In doing so, it helps to reach more accurate generalized results. The time limits for this study played a big part in the final decision to use a pre-existing data set that has been collected by using quantitative methods. With quantitative research methods, large amounts of data can be collected in a limited timeframe, which nonetheless are still representative of the population, and are therefore considered valuable for this study. In addition, quantitative research is generally easier to replicate than qualitative research, which makes the results more reliable and less prone to bias because they can be reproduced and checked if considered necessary.

However, just like any method, quantitative research also has its drawbacks. It can be too general, missing important details that can be significant to understand phenomenon in-depth. Hence it is not suited for research that aims to understand a phenomenon or a subject in more detail (Rahman, 2016**).** For these types of studies, qualitative research is generally recommended. Taking a qualitative approach to answer the research question of this study has been contemplated. However, considering the objective of this paper, quantitative research was found more appropriate. This study sets out to investigate specific relations between well-defined variables, instead of examining broad variables in more depth. Moreover, the research approach taken for the purpose of this research was deductive in nature. A deductive approach consists out of building hypotheses based on theories and previous studies, and then of testing the accuracy of these proposed hypotheses (Locke, 2007; Nola and Sankey, 2007). In order to correctly research these relations and produce representative results, a quantitative research method was deemed more suitable.

Another possible drawback of quantitative research methods is that is does not ask for the reasoning behind the answers given by participants. In contrast, qualitative research focusses more on perceptions, reasons and opinions of participants in order to understand the phenomenon in more detail (Vennix, 2012). However, considering the research objective of this study, researching the reasoning and perception of the participants does not fit in the scope of this study and does not add any significant value. This study sets out to examine the capabilities of an organization, and its effect on the relation between product innovation and firm growth. The reasoning behind these innovations choices of the organizations are out of the scope of this study. These variables are most accurately measured with numerical data and therefore a quantitative research method was decided to be more applicable.

3.3 Data collection

Several different study designs have been carefully considered, in particular; descriptive, experimental and correlational study designs. It should be noted however, that a perfect research design does not exists (Cook and Campbell, 1979; Maxwell, 2004; Newman et al., 2002). The best research design is the one that will most gracefully, sparingly, correctly and ethically support answering the research question (Johnson, 2009).

Descriptive research sets out to understand and describe a phenomenon. However, it is not suitable to identify or tests relations between variables and is therefore not suited for this research. Both the experimental and correlational designs are interested in the measurement of change between different variables affecting each other. However, they differ in one crucial aspect (Campbell and Stanley, 1963; Shadish, Cook and Campbell, 2002). With experiments, the researcher introduces change to one variable in order to measure how that change affect the other variable. This gives the researcher the ability to truly measure cause and effects between variables, and therefore determine true causation (Campbell and Stanley, 1963). Experiments are a unique type of study design that enables the researcher to have a high level of control by isolating specific variables (Shadish, Cook and Campbell, 2002). This helps the researcher to really understand the effect of specific variables and to find accurate results. However, a big drawback from experiments is the fact that it can create unrealistic situations, which makes the results not representative of/or useful to real life situations. In addition, experiments are often expensive, difficult and time consuming (Cook and Cook, 2008**).** In the scope of this study it would be incredibly difficult to control the variables of organizational and technological capabilities. Besides, organizations are in constant interaction with their environments, partially being formed by them, so isolating and controlling parts of the organization might lead to unrealistic research environments, deeming the results less representative of the research population in this study.

With correlational studies however, the researcher does not manipulate the variables but only observes them in order to discover correlations between them **(**Sherri, 2011; Robinson et al., 2007**).** These types of studies are also less, expensive and easier to conduct compared to experimental studies (Cresewell, 2011**).** Due to limited time and resources for this particular research, a correlation study was found more fitted. A correlation study is also useful in the context of this study because as mentioned before, manipulating the specific variables of this study may proof to be difficult and unrealistic. In addition, this research sets out to investigate the correlation between product/product-service innovation and firm growth, and the potential interaction effect of technological and organizational capabilities on this relation. It does not try to identify causation between these variables. For these mentioned reasons, a correlational research design was selected.

Furthermore, an existing dataset of a survey was decided most suitable for this research considering the research design, the time limits and the research objective. Surveys enable the researcher to gather a broad range of data in a short amount of time. Due to time limits and the scope of this study, the use of a large secondary dataset was decided upon. This dataset has been gathered by collecting data with a large survey. This survey was cross-sectional, meaning that the data was collected during a single period of time (Yee and Niemeier, 1996).

This survey mostly consisted out of close-ended questions, making it suitable for statistical analysis. A possible disadvantage of using close-end surveys is the fact that what is not asked for on the survey is not measured. Organizations could have some organizational or technological capabilities that are not asked about on the survey. To minimize this, a broad range of items are used to measure these variables. Another, potential drawback of using surveys is the fact that there is no way to determine whether the answers given by the participants are truthful. It could be that the questions are not correctly understood for example. To reduce this, several measurements regarding the internal validly of the survey have been taken. These are described in more detail in section 3.4.

3.4 Data set

As mentioned above, the data used to tests the hypotheses in this study are from a secondary dataset, more specifically; from the European Manufacturing Survey (EMS) taken in 2018. The EMS survey originated in 1993 at the Fraunhofer Institute for Systems and Innovation Research in Germany (then called the German Manufacturing Survey) and is currently managed by a consortium that consists out of research institutes and universities from 20 different European countries (Fraunhofer, 2022). Every three years this large scale survey is send out to manufacturing organizations across Europa in order to gather data about their innovation activities (Fraunhofer, 2022). The EMS is made out of several core indicators covering relevant innovation topics, to which every country can decide to add their own additional indicators to. These core indicators are translated from English to the dominant language in the targeted country. The survey of 2018 has been carried out in eleven countries and in doing so, has generated over 3.000 responses (Frauhofer, 2022). Since the research population of this study is organizations in the Dutch Manufacturing sector, only the data from the Dutch EMS will be used to answer the research question.

This Dutch survey is managed and sent out by the Institute for Management Research at the Radboud University in Nijmegen and is funded by the Rabobank amongst others (RU, 2022). The survey of 2018 has been sent out to all Dutch manufacturing organizations with more than 10 employees that are registered to the Kamer van Koophandel (KvK). The respondents span across 21 different sectors (SBI 10-31) that have been grouped together in the following seven industries; 1) Metal and metal products, 2) Food, Beverages and Tobacco, 3) Textile, Leather, Paper and Cardboard, 4) Construction and Furniture, 5) Chemical, 6) Machinery, equipment and Transportation, 7) Electronical and optical. The addresses of the organizations have been attained from the KvK and surveys have been sent to these addresses. The surveys have been sent to a total of 7172 organizations, which yielded a total of 416 respondents (5.8%). However, almost half of those respondents did not finish the survey and were therefore not part of the final dataset. A total of 203 were left, making the response rate of the survey 2.8%.

3.5 Validity and Reliability

To improve internal validity several measurements have been taken by the researchers at EMS and the Radboud University. Most questions on the survey are close-ended questions, making them easier to compare and analyze using statistical methods; however this can take away from the richness of information attained from these questions. In order to make the data comparable and rich, the researchers made sure to ask a lot of detailed questions. Consequently the survey measures a broad spectrum of different topics, across 22 questions consisting out of a total of 176 items. Asking more questions can also help the responded better understand what is meant by the question and therefore improve internal validity. In addition, some trial surveys were send out in order to make sure the questions were interpreted and understood correctly by the respondents, increasing internal validity as well. To construct the correct questions, multiple international gatherings were held with the involved countries. At these gathering, intensive discussions about the correct formulation and set-up of the survey took pace. Lastly, the English survey has been translated into Dutch and to ensure accuracy of this translation, a translation-check has been performed.

To improve external validity, efforts have been made to increase the response rate of the organizations. First of all, all organizations that did not reply to the first invitation were sent two follow-up reminders. Secondly, an incentive was offered in order to increase the willingness of organizations to participate in the survey (Church, 1993; Singer et al., 1999). The organizations were offered a free benchmark rapport that gave detailed information on seven different performance indicators of the organization compared to more than 1.300 organizations. The seven indicators included productivity, percent of on time delivery, scrap rate, manufacturing lead time, share of sales on product innovation and R&D investments (Fraunhofer, 2022). This type of information is hard to obtain, valuable and generally very expensive, making it a good motivation to participate in the survey. To ensure reliability, the researchers designed the questions on the survey in a way that does not ask for opinions. The survey questions are aimed at gathering objective data e.g. practices, facts, investments and performance figures. This makes the data more comparable, because it tries to exclude potential biases that can come about when asking questions related to opinions, perspectives and experiences.

3.6 Measurement development

In order to accurately answer the research question, e hypotheses spanning five different variables were developed and tested. The dependent variable ‘firm growth’ was measured using two different items; employee growth and revenue growth. Employee growth was measured by comparing the number of employees in 2015 with the number of employees in 2017. Revenue growth was measured in two different ways. First of all overall revenue growth was measured by comparing the revenue of 2015 with the revenue of 2017. Secondly, it was measured by looking at the revenue growth that resulted directly from the new product/product service innovation.

The independent variables product innovation and product-service innovation were measured by asking whether the organization had introduced new or significantly improved products or services between the years of 2015 and 2017. The moderating variables that represent the levels of technological and organizational capabilities of an organization were measured using multiple items. The level of technological capabilities of an organization was measured using 21 items covering different aspects of technological capabilities of an organization such as; digital processes, automatization and the use of robotics, energy saving systems, the use of technologies for processing novel materials, additive manufacturing technologies and digital factory/ IT network systems. The organizations were asked whether they currently use these technologies and if so, what year was this technology implemented. Based on how many of these systems are present in the organization, the level of technological capability of the organization will be determined. Similarly, the level of organizational capabilities of an organization was measured using 16 items covering multiple organizational concepts relating to; organization of work; management and human resource management.

Last of all, some control variables were added to the model. This improves the internal validity of the model by limiting the influence that these variables may have on the correlations that are being studied. The control variables included in the analysis are; firm size, firm age and dominant industry. Firm size and age (Dooley, Kenny and Cronin 2016; Kijkasiwat and Phuensane, 2020; Mabenge, Ngorora-Madzimure and Makanyeza, 2020), as well as industry (Dosi, 1988; Ting, Wang and Wang, 2012) have often been found to influence the relationship between innovation and firm growth and are therefore included in the analysis. For the industry variable, dummy variables were created in order to correctly add them to the linear regression model. More details about all the variables can be found it table 3.1. The number between the brackets after the item corresponds with the questions in the questionnaire (appendix I).

Type variable	Variable name	Item	Min	Max	Measurement level
Dependent Variables	Firm Growth	Compare number of employees in 2015 with number of employees in 2017. (Q21.2 (3+4)) - Employee growth in %	-∞	∞	Ratio
		Compare revenue 2015 with revenue 2017. (Q21.2 (1+2)) - Revenue growth in %	-∞	∞	Ratio
Independent Variables	New product innovation since 2015	Has your organisation introduced new or significantly improved products since 2015 that are new to your organisation? (Q14.1)	0	1	Nominal
	New product-service innovation since 2015	Has your organisation introduced new or significantly improved product-services since 2015 that are new to your organisation?(Q17.5)	0	1	Nominal
Moderating Variables	Organizational capabilities	Which of the following organizational concepts are currently being used in your organization? (Q8)	0	16	Interval
	Technological capabilities	Which of the following technologies are currently being used in your organization? (Q10.1, Q10.2,Q12.1, Q21)	0	21	Interval
Control variables	Industry	In what industry is your organization mostly operating? (Q2)	0	7	Nominal
	Firm size	Number of employees in 2017 (Q21.1)	0	∞	Ratio
	Firm age	2017 minus the year of registering to KvK (Q21.1 (13))	0	∞	Ratio

Table 3.1 Operationalization of variables

3.7 Analysis method

The gathered data was analyzed using a multiple linear regression analysis on SPSS. The dependent variable firm growth is measured with two different variables that are both on an interval measurement level. The independent variables; product and product/service innovation are both measured on a nominal level. This means that an organization either did or did not introduce a new product on service during the time period of 2015 and 2017. The moderating variables organizational capabilities and technological capabilities are both on an interval measurement level.

The decision on what analysis method to use was based on the dataset and the conceptual model. If the dependent variable firm growth were to be measured by two different dependent variables, a decision had to be made between a MANCOVA or multiple different regression analyses. However, combining employee growth and revenue growth would create a decision between an ANCOVA or a multiple linear regression analysis. For both these analysis methods the assumptions were assessed with the data in the dataset. ANCOVA has more assumptions compared to multiple regression analysis (Field, 2018). The data showed that multiple assumptions of ANCOVA were violated, namely; linearity between all pairs of the dependent variables within each group of the independent variables, linearity between the covariates and the dependent variables within each group of the independent variable and correlation between covariates and dependent variables. Therefore the multiple linear regression analysis was considered more fitting. The assumptions of multiple linear regression are explained in more detail in the analysis chapter.

The the eight hypotheses were tested using a hierarchical linear regression analysis. This means that the linear regression model was built by adding variables to the model. The condition for significance is a p value of <0.05 (Field, 2018). The first four hypotheses were tested together with three different models, followed by the fifth and sixth hypothesis using two different models. The final two hypotheses were measured using another three models.

3.8 Research ethics

The American psychological association (APA) has put together an ethics code for psychologist consisting out of five general principles (APA, 2017). These principles set ethical standards that need to be lived up to in order to ethically conduct research. The five general principles proposed by the APA are as followed; 1) Beneficence and non-maleficence; 2: Fidelity and responsibility; 3) Integrity; 4) Justice; 5) Respect for people's rights and dignity (APA, 2017). The mentioned principles were designed for psychologists specifically, and do not all apply to this study. A more general version that applies to researchers in all disciplines is the code of conduct for scientific integrity that has been created by the Dutch research council together with the Koninklijke Nederlandse Akademie van Wetenschappen and others (Netherlands Code of Conduct for Research Integrity, 2018). This code of conduct describes five principles that are at the base of integrity in research, and apply to all types of researchers, students, supervisors and research directors. The five principles are: 1) Honesty; 2) Scrupulousness; 3) Transparency; 4) Independence; 5) Responsibility (Netherlands Code of Conduct for Research Integrity, 2018).

The first principle is honored by making sure the reporting process of this research has been done accurately. The drawbacks and uncertainties that the researcher is aware of have been discussed and reported openly. In no way has this research falsified or fabricated data in order to generate more favorable results. The principle of scrupulousness has been lived up to by using solely scientific methods, and carefully selecting and using the most suitable research design in order to accurately conduct the research. Transparency has been maintained by sharing willingly what sources were used and how the data was collected. All information known to the researcher about the dataset has been openly shared in the methodology chapter. Every step taken to conduct this research has been laid out in order to add to the replicability of this research. The fourth principle of independence refers to the impartiality of the researcher.

This research has not been guided or influenced by any non-scientific parties of e.g. political or commercial interest. The researcher has made every decision staying true to scientific interest. As a final point, the principle of responsibility has been honored by conducting a research that is above all of scientific relevance.

Last but not least, it is worth noting that the EMS dataset used for this study has been made available by the researchers who gathered the data. They made sure that no personal information of any kind was shared with the researcher. The survey contains no identifiable data, meaning that the respondents are completely anonymous to the researcher. There is no data about the names, brands, locations or products offered by any of the organizations that participated in the survey. The identities of the participants are kept private, and therefore this study respects the participant's right of privacy, confidentiality and self-determination (APA, 2017).

4. Analysis

This chapter sets out to correctly analyze the data in order to test the hypothesis and answer the research question. The first section provides some descriptive statistics in order to identify some key features; such as size, age and industry of the sample set. The next section explains the variable construction of the predictor variables and the dependent variable by conducting some univariate analyses. This section is followed by the bivariate analysis where correlations are investigated in order to assess potential multicollinearity issues. The final part is the multivariate analysis where the model assumptions are tested and the regression analyses are performed in order to test the hypotheses.

4.1 Descriptive statistics

As mentioned before, the dataset consisted originally out of 203 respondents; however 44 of those respondents did not provide enough information on their number of employees or their revenue in order to determine employee growth or revenue growth and therefore were excluded from the dataset since they did not meet the necessary criteria to determine a value for the dependent variable. There were also many cases that only reported their number of employees in 2015 and 2017 or who only reported their revenue of 2015 and 2017. For those cases either an employee growth or a revenue growth could be determined. Therefore, those cases had some missing data, however, since multilevel models do not require the deletion of an entire case with partially missing data (Field, 2018), those cases were included in the dataset resulting in a total of N=159.

In order to minimalize bias, outliers were identified and deleted. Outliers are scores that are very different from the rest of the scores which could lead to skewed and incorrect results (Field, 2018). The outliers were detected by constructing Z –scores after transforming the variables with high kurtosis and skewness. Cases with Z-scores outside of the norm range of -3.29 and 3.29 were deleted from the dataset (Field, 2018). This in turn had a positive effect on several indicators such as the skewness and kurtosis of the variables, making them more of a normal distribution. This is important, since normality of the variables is one of the assumptions of the linear regression model that is used for the analysis later on in this chapter. After the deletion of the cases with too much missing data and the two extreme outliers, the dataset has a total of N=155.

The following section aims to provide some descriptive statistics on the used dataset such as the number of respondent, the firm size, firm age and dominant industry. Descriptive statistics help summarize and categorize the sample that represents the research population. To help better visualize these statistics, they are summarized in multiple tables below. The SPSS output for the descriptive statistics can be found in appendix II.

Firm Size

The firm size in this research is measured by the total number of employees in 2017. The number of employees of an organization is a frequently used metric to represent the size of an organization. The mean of the firm size was 61.21. The smallest organization had 10 employees, while the largest organization had a total of 320 employees. The skewness of 2.089 and the kurtosis of 4.265 are just out of the normal distribution range of +/-2 (Field, 2018). The positive skewness indicates that the dataset consists more out of smaller organizations. This can be seen in the frequency table 4.1 in which more than 80% of the organizations have between the 20 and 99 employees. In order to correct the skewness and kurtosis the variable was put through a logistic transformation (Field, 2018). The original and improved skewness and kurtosis are summarized in table 4.2.

	Frequency	Percentage	Cumulative percentage

< 20 employees	33	21.3	21.3
20 to 49 employees	59	38.1	59.4
50 to 99 employees	36	23.2	82.6
100 to 249 employees	23	14.8	97.4
> 250 employees	4	2.6	100
Total	**155**	**100**	

Table 4.1 Firm size

	N	Mean	Min	Max	Standard deviation	Skewness	Kurtosis
Original firm size	155	61.21	10	320	62.212	2.089	4.265
Transformed firm size	155	3.72	2.3	5.77	0.855	.409	-.557

Table 4.2 Firm size transformation

Firm Age

The age of the firm is measured by the difference between the year that the organization was registered in the KvK and the year of the data collection, thus 2017. Out of the 155 respondents, there were 6 missing items. For the 149 valid respondents, the mean firm age is 44 years, with the oldest organization being 205 years old and the youngest 3 years old in 2017. The skewness of 1.562 falls in the normal distribution range but shows a slight lean towards the left. This means that dataset consists more out of younger organizations, which can also be seen in the frequency table with more than 67% of the organizations being under 50 years old. The kurtosis of 3.043 falls outside the normal distribution range of +/-2. In order to correct this, a logistic transformation was performed on this variable. The original and the improved kurtosis and skewness can be seen in table 4.4.

Table 4.3 Firm age

Established	**Age in years**	**Frequency**	**Percentage (%)**	**Valid percentage**	**Cumulative Percentage**
Between 2007-2017	< 10	10	6.5	6.7	6.7
Between 1992-2000	10-25	50	32.3	33.6	40.3
Between 1967-1991	26-50	40	25.8	26.8	67.1
Between 1942-1966	51-75	27	17.4	18.1	85.2
Between 1917-1941	76-100	7	4.5	4.7	89.9
Before 1916	> 100	15	9.7	10.1	100
Missing		6	3.9		
Total		**155**	**100**		

	N	Mean	Min	Max	Standard deviation	Skewness	Kurtosis
Original firm age	149	44.42	3	205	34.019	1.562	3.043
Transformed firm age	149	3.50	1.1	5.32	0.810	-.559	.814

Table 4.4 Firm age after transformation

Industry

The survey was send to organizations over 21 different industries (SBI 10-31) in the Netherlands. These industries have been roughly grouped together in seven different groups, namely; 1) Metal and metal products, 2) Food, beverages and tobacco, 3) Textile, leather, paper and cardboard, 4) Construction and furniture, 5) Chemical, 6) Machinery, equipment and transportation, 7) Electronical and optical equipment. Table 4.5 shows that the groups; metal and metal products and the group electronical and optical equipment are the largest groups. The smallest group is the construction and furniture industries with just 3 organizations, followed by the food, beverages and tobacco industry with just 13 organizations. The chemical industry seems to be the biggest industry on its own, since that industry alone has 21 respondents, meaning that more than 13% of the organizations of the dataset are predominately active in the chemical industry.

	Frequency	**Percentage (%)**	**Percentage cumulative**
Metal and metal products	32	20.6	20.6
Food, beverages and tobacco	13	8.4	29.0
Textile, leather, paper and cardboard	22	14.2	43.2
Construction and furniture/other	3	1.9	45.2
Chemical	21	13.5	58.7
Machinery, equipment and transportation	25	16.1	74.8
Electronical and optical equipment	39	25.2	100
Total	**155**	**100**	

Table 4.5 Industry

4.2 Variable construction

4.2.1 Technological process capabilities and organizational capabilities

The technological capabilities and organizational capabilities of an organization are hard to directly observe and measure. These types of difficult to measure variables are called latent variables (Borsboom, Mellenbergh and van Heerden, 2003). Instead of measuring this latent variable directly, indicators that either reflect or form the construct variable are measured. A latent variable in that case can be made up out of a formative construct or a reflective construct (Stadler, Sailer and Fischer, 2021). In a reflective model, the change in the latent variable would result in changes in the indicators (Standler, Sailer and Fischer, 2021). In the context of this study, it would mean that a change in organizational capabilities would results in a change of the technological systems they used. However, in formative models, changes in the indicators will lead to a change in the latent variable. This is because the latent variable is made up out of these indicators (Standler, Sailer and Fischer, 2021). This would mean that, the technological advancements the organization has implemented would result in an organization having higher technological capabilities. The second logic is adopted in this paper, resulting in the variable technological capabilities and organizational capabilities being interpreted and analyzed as latent formative variables.

The construct reliability and validity of reflective latent variables are measured using Chronbach's alpha and discriminant validity of convergent validity. Formative latent variables however, are examined using the weights and VIF, which stands for Variance Inflation Factor. However, a VIF cannot be used for categorical or binary variables, which is the case for the indictors that form the two capabilities constructs.

The organizational capabilities of an organization are assessed using 16 items, whereas technological capabilities of an organization are measured using 21 items. These items can be seen in more detail in tables 4.6 and 4.9. Adding the number of innovations together forms the score that reflects the organizational and technological capabilities of the organization. In this case, the more advancements an organization has, the higher their capabilities are, and therefore the total number of technological and organizational innovations are added up together to score the organization's capabilities.

4.2.2 Product innovation and product-service innovation

Both product innovation and product-service innovation consists out of a single item. The item measures whether the organization has introduced a new product or product-service since 2015. This means that the dataset can be split into two different groups per independent variable. Namely; organizations that have not introduced a new product since 2015 and organization that have, and organizations that have not introduced a new product-service since 2015 and organizations that have.

4.2.3 Firm growth

Firm growth is measured with two indicators; 1) employee growth and 2) revenue growth. Employee growth is measured by calculated the growth in the number of employees from 2015 to 2017 in percentages. This means that an organization that has 100 employees in 2015 and 120 employees in 2017 will have an employee growth of 20%. In the same logic, revenue growth is determined by calculating the difference between total revenue in 2015 and 2017. This means that an organization that had a revenue of 55 million in 2015 and 50 million in 2017, will have a revenue growth of -10%. Since not all participants have all provided data on both their number of employees and their revenue, there was a lot of missing data. This was especially the case for revenue growth. In order to combine employee growth and revenue growth, the variables were first centered. The missing values for revenue growth were replaced by the centered z-scores of employee growth and vice versa. These scores were then added and divided by two to create the value for firm growth. This resulted in a usable firm growth values for all 155 cases. .

4.2.4 Firm size, Firm age and industry

The control variables firm size, firm age and industry have all been measured using a single item in the questionnaire. Firm size was measured by the number of employees of an organization in 2017. The firm age in 2017 was calculated using the year the organization was registered in the KvK. This would mean that an organization that has been registered to the Kvk in 1995 would be 22 years old in 2017. The dominant industry of the organization was measured by simply asking it in the questionnaire. Then they were grouped together to form 7 main industry groups as mentioned in the previous section. In order to correctly add this variable to the analysis, there were 7 different dummy variables created for each industry.

4.3 Univariate analyses

4.3.1 Organizational capabilities

Table 4.6 below shows the indicators for the variable organizational capabilities. It shows the 16 different indicators in a frequency table gives insight into the number of organizations that have implanted these organizational concepts. The three most implemented organizational concepts are instruments to promote staff loyalty (61.3%), certified quality standards (55.2%) and training on the job (55.8%). On the other hands, the three least implemented organizational concepts are certified energy management systems (5.2%), methods of operation management for mathematical analysis of production (8.4%) and fixed process flows to reduce setup time (19.0%).

Organizational concepts	YES	NO	Missing	YES %	NO %
Standardized and detailed work instructions	62	92	1	40.3	59.7
Measured to improve internal logistics	56	99	0	36.1	63.9
Fixed process flows to reduce setup time	29	125	2	19.0	81.0
Integration of tasks	64	91	0	41.3	58.7
Production controlling following the pull principle	55	99	1	35.7	64.3
Display boards in production	51	103	1	33.1	66.9
Methods of assuring quality in production	83	70	2	54.2	45.8
Certified quality standards	85	69	1	55.2	44.8
Certified energy management system	8	146	1	5.2	94.8
Methods of operation management for mathematical analysis of production	13	141	1	8.4	91.6
Certified environmental management system	38	115	2	24.8	75.2
Instruments to promote staff loyalty	95	60	0	61.3	38.7
Training on the job	86	68	1	55.8	44.2
Experimentation for employees in the production	59	96	0	38.1	61.9
Instruments to maintain elderly employees	58	97	0	37.4	62.6
Broad-based employee financial participation schemes	30	125	0	19.4	80.6

Table 4.6 Frequency table for organizational concepts

Table 4.7 shows how the organizations score on all of these 16 indicators. The table shows that the average number of organizational concepts implemented by the organization is 5.60. The number of implemented organizational concepts range between 0 and 15. The skewness of 0.285 and the kurtosis of -.0355 fall in the normal distribution range of +/=2 (Field, 2018).

	N	Min	Max	Mean	Standard deviation	Skewness	Kurtosis
Number of total organizational concepts	155	0	15	5.60	3.476	0.285	-0.355

Table 4.7 Organizational capabilities

The frequency table 4.8 shows that 80% of the organizations have 8 or less implemented organizational concepts. Furthermore, the two largest groups of 20 are the ones that have either implemented 6 or 8 organizational concepts in total.

Number of organizational concepts	**Frequency**	**Percentage**	**Cumulative percentage**		**Number of organizational concepts cont.**	**Frequency**	**Percentage**	**Cumulative percentage**
0	10	6.5	6.5		**9**	10	6.5	87.7
1	14	9.0	15.5		**10**	9	5.8	93.5
2	11	7.1	22.6		**11**	2	1.3	94.8
3	14	9.0	31.6		**12**	3	1.9	96.8
4	9	5.8	37.4		**13**	0	0	96.8
5	15	9.7	47.1		**14**	4	2.6	99.4
6	20	12.9	60.0		**15**	1	0.6	100
7	13	8.4	68.4		**16**	0	0	100
8	20	12.9	81.3		**Total**	**155**	**100**	

Table 4.8 frequency table of total number of implemented organizational concepts

4.3.2 Technological process capabilities

Table 4.9 shows the 21 indicators for the variable technological process capabilities. Just as with table 4.6 for the organizational capabilities, this table gives some insights into the frequency of organizations that have implemented each different technology in their organization over the past years. The table shows that the three most implemented technological developments are software for production planning/scheduling (62.3%), digital solutions to provide drawings, work schedules or work instruction on the shop floor (39.2%) and use machines or systems that automatically store operating data (42.6%). Whereas the three least implemented technological developments are energy technologies for transition from fossil to non-fossil carriers (9.0%), use web-based platforms for distribution of products (8.8%) and 3D printing technologies for manufacturing products, components and tools (7.7%).

Technological developments	YES	NO	Missing	YES %	NO %
Mobile/wireless devices for programming and controlling facilities and machinery	36	118	1	23.4	76.1
Digital solutions to provide drawings, work schedules or work instruction on the shop floor	60	93	2	39.2	60.8
Software for production planning/scheduling	96	58	1	62.3	37.7
Digital exchange of product/process data with suppliers or customers	41	114	0	26.5	73.5
Near real-time production control systems	27	127	1	17.5	82.5
Systems for automation and management of internal logistics	18	136	1	11.7	88.3
Product-lifecycle-management-systems or product/process data management	14	140	1	9.1	90.9
Virtual reality or simulation for product design or product development	20	135	0	12.9	87.1
Industrial robots for manufacturing processes	43	109	3	28.3	71.7
Industrial robots for handling processes	33	120	2	21.6	78.4
3D printing technologies for prototyping	22	133	0	14.2	85.8
3D printing technologies for manufacturing	12	143	0	7.7	92.3
Technologies for recycling and re-using water	26	128	1	16.9	83.1
Technologies to recuperate kinetic and process energy	26	128	1	16.9	83.1
Energy technologies for transition from fossil to non-fossil energy carriers	14	141	0	9.0	91.0
To generate own energy, heat using solar, wind, water, bio-mass or geothermal energy	32	123	0	20.6	79.4
Switching off components, machinery or equipment during periods of non-use	55	100	0	35.5	64.5
Upgrading existing machinery or equipment	31	124	0	20.0	80.0
Use of industrial robots	57	98	0	36.8	63.2
Use web-based platforms for distribution of products	13	135	7	8.8	91.2
Use machines or systems that automatically store operating data	66	89	0	42.6	57.4

Table 4.9 Frequency table for organizational concepts

Table 4.10 shows how the organizations score on all of these 21 indicators combined. The table shows that the average number of organizational concepts implemented by the organization is 5.6. The number of implemented organizational concepts range between 0 and 15 just like with the organizational capabilities. The skewness of 0.598 and the kurtosis of -.0306 fall in the normal distribution range of +/=2 (Field, 2018).

	N	Min	Max	Mean	Standard deviation	Skewness	Kurtosis
Number of total technological developments	155	0	15	5.55	3.253	0.598	-0.306

Table 4.10 Technological capabilities

The frequency table 4.11 shows that just over 81% of the organizations have 8 or less implemented organizational concepts which are almost identical to the total number of organizational concepts. It is also interesting to note that no organization has more than 15 technological developments or organizational concepts. Furthermore, the two largest groups are the ones that have implemented either 3 or 7 technological developments in total. In addition, only one organization has zero technological developments.

Number of technological developments	**Frequency**	**Percentage**	**Cumulative percentage**		**Number of technological developments cont.**	**Frequency**	**Percentage**	**Cumulative percentage**
0	1	0.6	0.6		**11**	5	3.2	94.2
1	11	7.1	7.7		**12**	5	3.2	97.4
2	16	10.3	18.1		**13**	2	1.3	98.7
3	25	16.1	34.2		**14**	1	0.6	99.4
4	15	9.7	43.9		**15**	1	0.6	100
5	19	12.3	56.1		**16**	0	0	100
6	7	4.5	60.6		**17**	0	0	100
7	21	13.5	74.2		**18**	0	0	100
8	11	7.1	81.3		**19**	**0**	**0**	100
9	9	5.8	87.1		**20**	**0**	**0**	100
10	6	3.9	91.0		**21**	**0**	**0**	100
					Total	**155**	**100**	

Table 4.11 frequency table of total number of implemented organizational concepts

4.3.3 Product innovation and product-service innovation

Table 4.12 shows the frequencies of the organizations that have introduced a new product or product-service innovation since 2015. The table shows that just over 47% of the organizations have introduced a new product or have significantly improved an existing product since 2015. This shows that the two groups are pretty well balanced. On the other hand, only 18.1% of the organizations have introduced or significantly improved a new product-service since 2015. This group is less biased, by almost 80% to 20%.

	YES	**NO**	**Missing**	**YES %**	**NO %**
Introduced new product since 2015	73	82	0	47.1	52.9
Introduced new product-service since 2015	27	122	6	18.1	81.9

Table 4.12 frequency table for product and product-service innovation

The analysis later will analyze whether there is an interaction effect between product and product-service innovation. Therefore, it may be useful to divide the organizations in four different groups; 1) organizations that have not introduced new products or product-services since 2015; 2) organizations that have only introduced or significantly improved a new product since 2015; 3) organizations that have only introduced or significantly improved a new product-service since 2015; 4) organizations that have introduced or significantly improved both products and product-services since 2015. The frequency table 4.13 shows that; 49% of the organizations have not introduced or significantly improved a product or product-service since 2015. Furthermore, it shows that the other innovative 51% of the organizations have almost all introduced a new product since 2015. Out of that 51% approximately one third has also introduced or significantly improved a product-service during the same period. Only 6 organizations have only introduced or significantly improved a product-service in 2015, making it the smallest group of the dataset.

	Frequency	Percentage	Cumulative percentage
No innovation	76	49.0	49.0
Only product innovation	53	33.5	82.6
Only product-service innovation	6	3.9	86.5
Both innovation types	21	13.5	100
Total	**155**	**100**	

Table 4.13 Frequency table for innovative organizations

4.3.4 Firm growth

Firm growth is measured by the combination of employee growth and revenue growth between the years of 2015 and 2017. As mentioned before, not all organizations have provided enough data to calculate both their revenue growth, as well as their employee growth. In some cases, a participant has provided enough to calculate one of the two, but not both. As mentioned at the beginning of this chapter, the extreme outliers were deleted by first transforming the variable and then detecting the extreme outliers. However, since revenue growth and employee growth can both have a 0 or negative numbers, a constant was added to all cases. After making sure there were not any zero's or negative values for employee growth or revenue growth, z-scores were created in order to spot outliers. The z-scores were then added together and divided by two in order to determine the value for firm growth. The statistics of the employee growth and revenue growth before and after transformation can be seen in table 4.14. This table also contains the statistics for the new variable firm growth. The skewness of 0.147 and the kurtosis of 1.920 fall just inside of the normal distribution range (Field, 2018). Furthermore, the 155 organizations have increased their revenue with an average of 22.56% and have grown their number of employees with an average of 13.84% since 2015.

	N	Missing	Min	Max	Mean	Standard deviation	Skewness	Kurtosis
Revenue growth %	155	28	-33.33	150	22.56	27.35	2.011	6.951
Revenue growth centered and Transformed	155	28	3.60	5.39	4.49	0.267	0.279	2.575
Employee growth %	155	3	-30.00	100	13.84	20.245	1.368	3.879
Employee growth centered and transformed	155	3	3.81	5.16	4.46	0.215	0.242	1.534
Firm Growth	155	0	-3.19	3.25	0.016	0.909	0.147	1.920

Table 4.14 Revenue growth and Employee growth

The SPSS output for all the univariate analyses can be found in appendix III.

4.4 Bivariate analysis

This section sets out to determine whether there is any multicollinearity between the variables. Multicollinearity means that variables are highly correlated which can be a problem for determining a variables unique contribution or explaining power (Field, 2018). Multicollinearity exists when the correlation between two variables is R>0.8 (Field, 2018). In the scope of this study it is important to determine whether there is any multicollinearity since it is one of the assumptions for multiple linear regression models. Multicollinearity will be assessed using two different methods; 1) Pearson correlation matrix. 2) Variance Inflation Factor (VIF) with tolerance values. Appendix IV shows a summary of the Pearson correlation matrix with * meaning a significance of p>0.05 and ** meaning significance of p<0.01.

There are no correlation between any of the variables with a significant R>0.8 showing that there is no multicollinearity. According to Field (2018), an R value, between +/-0.1 and +/-0.3 indicates a small effect, values between +/- 0.3 and +/- 0.5 indicate a medium effect and bigger than +0.5 indicates a large effect.

The correlation table shows some interesting significant correlations between some variables. For example the positive effect between technological process capabilities and organizational capabilities of R(153)=.517,p<.001 shows that the two capabilities are highly correlated. There is also a small and medium positive effect between firm size and both organizational and technological process capabilities of R(153)=.294, p=<.001 and R(153)=.433,p<.001. This could indicate that the bigger the organization, the more capabilities they have. This effect seems to be stronger on technological process capabilities than on organizational capabilities. Furthermore, firm size is also positively correlated to firm age R(147)=.171, p=.037.

Product innovation correlates significantly with both technological process capabilities R(153)=.225, p=.005, as well as with organizational capabilities R(153)=193, p=.016. In addition, product innovation also significantly correlates with product-service innovation R(147)=284, p=<.001. It is however interesting to see that none of the variables are significantly correlated to the dependent variables firm growth.

The second way to test if there is multicollinearity between the predictor variables is by checking the variance inflation factor (VIF) and the tolerance value. Generally, a VIF of >10 and a tolerance of <0.1 indicated that there is multicollinearity (Field, 2018). The correlation table, together with the VIF and tolerance values will be evaluated for every model in the analysis. It is important that the variables do not show multicollinearity in any of the models used to test the hypotheses.

4.5 Multivariate analyses

4.5.1 Multiple linear regression model assumptions

In order to use the multiple linear regression model, the data has to meet some of the model assumptions. Linear regression has a total of six main assumptions that will be evaluated in the following section. These assumptions are: 1) all variables must be on a continuous scale and have a normal distribution 2) Linearity between the independent and dependent variables 3) No multicollinearity between the independent variables 4) Normal distribution of the residuals. 5) Homoscedasticity, meaning that the residuals have a constant variance at every level of the independent variable. 6) Independence of the errors. (Field, 2018).

The first assumption is met because the variables firm growth, organizational capabilities, technological process capabilities; firm age and firm size are all on a continuous scale. The variables product innovation and process innovation are both dichotomous variables. For these two variables dummy variables are created where 0= no and 1= yes, so it would fit the assumption. The control variable industry is a categorical variable and therefore multiple dummy variables are created in order to include it in the analysis. As shown earlier in the univariate analysis section, all variables have a normal distribution. The second assumption of linearity is assessed by creating scatter plots between the dependent variable and all independent variables (Field, 2018). These plots can be seen in appendix V and show that there is a slight linear relation between the dependent variable and all the independent variables. The third assumption of no multicollinearity between the independent variables has been met and can be seen by the correlation table in the previous section. For every model that is used to test the hypothesis, the tolerance values and VIF will be assessed in order to meet this assumption. As mentioned before, the tolerance value should be >0.1 and the VIF should be <10 in order for there not to be any multicollinearity (Field, 2018).

The assumptions of normal distribution of the residuals, homoscedasticity and independence of residuals will be assessed for each model. The normal distribution of residuals is assessed by interpreting the P-P plots in order to see whether the residuals follow the normal distribution line. Homoscedasticity is assessed by plotting the regression standardized predicted value against the regression standardized residuals and determining whether there is a pattern that could indicate heteroscedasticity (Field, 2018). The independence of errors is measured with the Durbin-Watson test in which a number around 2 is good, and a number below 1 and above 3 can be problematic and point to autocorrelation (Field, 2018). This could mean that the values are inflated which could lead to insignificant results being found significant and should therefore be kept in mind when interpreting the results.

4.5.2 Hypotheses testing

In order to correctly answer the eight hypotheses, multiple regression analyses are done. Since there are missing values for the variables product-service innovation and firm age, the missing values were replaced by the mean in SPSS regression analysis for all models. The interaction effects were created by centering the variables of organizational capabilities and technological capabilities and multiplying these centered variables with the interaction variable.

H1, H2, H3 and H4

In order to answer the first four hypotheses a hierarchical multiple linear regression with three models was constructed. The first model includes the dependent variable firm growth and the control variables firm age, firm size and the dummy variables for industry. In the second model, the independent variables product and process innovation and the moderators; organizational capabilities and technological process capabilities are added. In the last model the four interaction effects are added. The four interaction effects are: 1) product innovation with technological process capabilities. 2) Product-service innovation with technological process capabilities 3) Product innovation with organizational capabilities. 4) Product-service innovation with organizational capabilities.

First the four assumptions of normally distributed residuals, homoscedasticity, independence of errors and the lack of multicollinearity are assessed. The SPSS output in appendix VI shows that the residuals follow the normal distribution line in the P-P plots and therefore meet the fourth assumption. The tolerance values are >0.1 and the VIF values are <10 for all values, indicating that there is no multicollinearity between the independent variables and therefore assumption three is also met. The scatterplot of the regression standardized predicted value against the regression standardized residuals show no patter which means that there is homoscedasticity and assumption five is met. The Durbin-Watson value is 0.806 which means it is < 1 and therefore there is a positive autocorrelation (Field, 2018). Assumption six is therefore not met and should be kept in mind when interpreting the results.

All three models are not significant and do not explain a significant proportion of the variance in the dependent variable. The second model has the least explanatory power (adjusted R^2=.020; F (4,142) = 1.257; p =.251), followed by the first model (adjusted R^2 = 0.23; F (8,146) = 1.448, p =.181), with the third model having the highest adjusted R^2 (adjusted R^2 = 0.60; F (16,138) = 1.629, p = .071). This means that product innovation, product service innovation, technological capabilities and organizational capabilities when added separately to the model, actually decrease the explaining power of the model. However, adding the four interaction effects increases it and accounts for some of the variance in the dependent variable firm growth. The F change is significant F = (4,138) 2.544, p=.042 for the third model. All variables combined only explain 15.8% the variance in the dependent variable firm growth, however according to the adjusted R^2 the model only explains 6% of the variance. Furthermore the R square change shows that adding the interaction effects results in the biggest (adjusted) R^2.

Table 4.15 summarizes the results of the three models in the hierarchical multiple regression analysis. It shows that none of the variables are significant in the first two models. However, when the four interaction effects are added in the third model, three out of the four interaction effects are significant. In the following section the results of the model will be used to test the first four hypotheses.

	Model I	Model II	Model III
	B (β)	B (β)	B (β)
Firm age	-.004 (-.144)	-.004 (-.144)	-.004 (-.156)
Firm size	.001 (.063)	.001 (.054)	.001 (.050)
Metal industry	.044 (.019)	.054 (.024)	.049 (.022)
Food industry	.059 (.018)	.033 (.010)	.021 (.007)
Textile industry	-.155 (-.060)	-.125 (-.048)	-.136 (-.052)
Chemical industry	-.114 (-.043)	-.094 (-0.35)	-.124 (-.047)
Machinery industry	.395 (.160)	.368 (.149)	.267 (.109)
Construction industry	.784 (.119)	.801 (.122)	.783 (.119)
Product innovation		.023 (.012)	.063 (.035)
Product-service innovation		.234 (.097)	.069 (.029)
Organizational capabilities		-.029 (-.110)	.016 (.061)
Technological process capabilities		.033 (.117)	-.021 (-.074)
Product*Technological			**.431 (.332)***
Product*Organizational			**-.503 (-.392)***
Product-service*Technological			-.073 (-.039)
Product-service*Organizational			**.556 (.218)***
Model Statistics			
R^2 (adjusted R^2)	.074 (.023)	.096 (.020)	.158 (.060)
F (degrees of freedom)	1.448 (8, 146)	1.257 (12, 142)	1.620 (16, 138)
p-value	.181	.251	.071

Table 4.15: Model summary - N = 155; **p<.01; *p<.05

The first hypothesis is that the more improved the technological process capabilities of an organizational, the stronger the impact of product innovation on firm growth. The second model shows that product innovation predicted firm growth with β =.012; p =.887 which increases to β =.035; p =.688 in the third model. However, these effects are both not significant. According to the first hypothesis, the effect on firm growth of product innovation combined with technological process capabilities is stronger than the effect of product innovation alone. This is supported by the significant interaction effect of product innovation and technological process capabilities in the third model β = .332; p = .022. Therefore the first hypothesis is accepted.

The second hypothesis is that the more improved the technological process capabilities of an organization, the stronger the impact of product-service innovation on firm growth is. The second model shows that product-service innovation predicted frim growth with β =.079; p =.258 which decreased to β =.029; p =.753 in the third model. According to the second hypothesis, the effect of product-service innovation combined with technological process capabilities on firm growth is stronger than the effect of product-service innovation alone. The third model shows that the interaction effect of product-service innovation and technological process capabilities is β =-.039; p =.726. This effect is stronger than the individual effect of product-service innovation of firm growth; however the effect is not significant. Therefore the second hypothesis is rejected.

The third hypothesis is that the more developed the organizational capabilities of an organization, the stronger the impact of product innovation on firm growth is. The third model shows that the effect of product innovation combined with organizational capabilities has a stronger significant effect on firm growth β = -.392; p =.008, than product innovation alone β =.035; p =.688. Therefore the third hypothesis is accepted. However, it is important to note that the effect is negative, meaning that the more organizational capabilities an organization has, the less firm growth they will experience after introducing a new product.

The fourth hypothesis is that the more developed the organizational capabilities of an organization, the stronger the impact of product-service innovation will be on firm growth. The third model shows that the effect of product-service innovation combined with organizational capabilities has a stronger significant effect on firm growth β = .218; p =.047, than product-service innovation alone β =.029; p =.753. Therefore the fourth hypothesis is also accepted.

H5 and H6

In order to answer the fifth and the sixth hypothesis a hierarchical multiple linear regression with two models was constructed. The first model includes the dependent variable firm growth, the control variables firm age, firm size, the industries, product innovation, product-service innovation, technological process capabilities and organizational capabilities. In the second model the two additional interaction effects are added; 1) Product innovation with technological process capabilities and organizational capabilities. 2) Product-service innovation with technological process capabilities and organizational capabilities.

The four assumptions have been assessed for these models as well. The data met the assumption of normally distributed residuals, homoscedasticity, and lack of multicollinearity. However, the Durbin-Watson test value was 0.750 and is therefore too low. Therefore this assumption was not met again. The scatterplots and tables used to assess the assumptions can be found in appendix VII.

Both of the models are not significant and explain a very small and insignificant proportion of the variance in the dependent variable. The second model with the interaction effects has a smaller explanatory power (adjusted $R^2 = .015$; $F(14,140) = 1.167$, $p = .308$) than the first model without interaction effects (adjusted $R^2 = .020$; $F(12,142) = 1.257$; $p = .251$). This indicates that, adding the interaction effects actually makes the model have less explanatory power. The second model explains 10.4% of the variance. However, when adjusting the R^2 it only predicts 1.5%. Yet, the F changes are not significant, and thus the added interaction effects do not significantly influence the R^2.

Table 4.16 summarizes the results of the three models. In the following section the results of the model will be used to test the fifth and sixth hypotheses.

	Model I	**Model II**
	B (β)	B (β)
Firm age	-.004 (-.144)	-.004 (-.144)
Firm size	.001 (.054)	.001 (.035)
Metal industry	.054 (.024)	.053 (.024)
Food industry	.033 (.010)	-.018 (-.006)
Textile industry	-.125 (-.048)	-.155 (-.060)
Chemical industry	-.094 (-0.35)	-.107 (-.040)
Machinery industry	.368 (.149)	.343 (.139)
Construction industry	.801 (.122)	.800 (.122)
Product innovation	.023 (.012)	-.003 (-.002)
Product-service innovation	.234 (.097)	.247 (.103)
Organizational capabilities	-.029 (-.110)	-.037 (-.141)
Technological process capabilities	.033 (.117)	.026 (.094)
Product*Tech*Organ		.097 (.100)
Product-service*Tech*Organ		.081 (.045)
Model Statistics		
R^2 (adjusted R^2)	.096 (.020)	.104 (.015)
F (degrees of freedom)	1.257 (12, 142)	1.167 (14,1440)
p-value	.251	.308

Table 4.16: Model summary - N = 155; $^{**}p<.01$; $^{*}p<.05$

The fifth hypothesis is that the combination of technological process capabilities and organizational capabilities exceeds their respective individual contribution to the growth effectiveness of product innovation. When looking at product innovation on its own, It barely has a direct effect on firm growth $\beta = -.012$; $p = .887$ in the first model. It actually has a negative effect on firm growth in the second model with β -.002; $p = .987$ when the interaction effects are added to the model, however it is still not a significant effect. It is interesting to see that in the first model, there is a positive effect and in the second model a negative effect. Organizational capabilities has an insignificant negative effect on firm growth in both models β =-.110; p =.267 and β =-.141; p =.173, technological process capabilities has an insignificant positive effect in both models with β =.117; p =.241 and β =.094; p =.363. However, their combination has a larger positive effect on firm growth β =.100; p =.319. Yet, this effect is insignificant and therefore the fifth hypothesis is rejected.

The sixth hypothesis is that the combination of technological process capabilities and organizational capabilities exceeds their respective individual contribution to the growth effectiveness of product innovation. When looking at product-service on its own in the second model, it has an insignificant positive effect on firm growth β =.103; p =.281. The interaction effect between technological process capabilities, organizational capabilities and product-service innovation is smaller β =.045; p =.629, than the negative individual effect of organizational capabilities β =-.141; p =.173. In addition, none of these relations are significant and therefore the sixth hypothesis is rejected.

H7 and H8

In order to answer the last two hypotheses a hierarchical multiple linear regression with three models was constructed again. The first model includes the dependent variable the three control variables, product/product-service innovation, technological process capabilities and organizational capabilities. The interaction effect between product and product-service innovation is added to the second model. The third model includes the interaction effect between all four variables.

Firstly, thee four assumptions have been evaluated for all three models. The data met the assumption of homoscedasticity, normally distributed residuals, and the lack of multicollinearity. Still, The Durbin-Watson test value was 0.748 and is therefore too low again. Therefore the assumption of independence of errors was not met. The scatterplot and SPSS output used to evaluate the assumptions can be found in appendix VIII.

None of the three models are significant or explain a decent amount of the variance in the dependent variable. It is interesting to see that adding the interaction effect between product and product-service innovation brings the adjusted R^2 down (adjusted R^2=.016; F (13,141) = 1.190; p =.292). And adding the last interaction effect between all four variables is also bringing it down (adjusted R^2=.014; F (14,140) = 1.156; p =.316). This means that adding these two interaction effects, actually help to explain the firm growth of an organization less. The first model has the largest explanatory power, however, it is still very small adjusted R^2=.020; F (12,142) = 1.257; p =.251. The model explains 10.4% of the variance, however, when the R^2 is adjusted it only predicts 1.4%. The F changes are not significant; therefore the added interaction effects do not have a significant enough effect on the R^2. Table 4.17 summarizes the findings in the three models. In the next section the outcomes of the model will be used to test the last two hypotheses.

	Model I	**Model II**	**Model III**
	B (β)	B (β)	B (β)
Firm age	-.004 (-.144)	-.004 (-.143)	-.004 (-.146)
Firm size	.001 (.054)	.001 (.052)	.001 (.049)
Metal industry	.054 (.024)	.024 (.011)	.011 (.005)
Food industry	.033 (.010)	-.026 (-.008)	-.042 (-.013)
Textile industry	-.125 (-.048)	-.146 (-.056)	-.152 (-.058)
Chemical industry	-.094 (-0.35)	-.111 (-.042)	-.138 (-.052)
Machinery industry	.368 (.149)	.344 (.140)	.309 (.125)
Construction industry	.801 (.122)	.785 (.119)	.765 (.116)
Product innovation	.023 (.012)	.073 (.040)	.083 (.046)
Product-service innovation	.234 (.097)	.463 (.193)	.475 (.198)
Organizational capabilities	-.029 (-.110)	-.030 (-.115)	-.034 (-.130)
Technological process capabilities	.033 (.117)	.032 (.115)	.033 (.116)
Product*Product-service		-.319 (-.120)	-.380 (-.144)
Product*product-service*Organ*Tech			.276 (.073)
Model Statistics			
R^2 (adjusted R^2)	.096 (.020)	.099 (.016)	.104 (.014)
F (degrees of freedom)	1.257 (12, 142)	1.190 (13, 141)	1.156 (14, 140)
p-value	.251	.292	.316

Table 4.17: Model summary - N = 155; **p<.01; *p<.05

The seventh hypothesis is that the combination of product innovation and product-service innovation exceeds their respective individual contribution to firm growth. When looking at the second model, the individual effect of product-service innovation on firm growth (β =.193; p =.248) is bigger than the combinative effect of product innovation and product-service innovation in the same model β =-.120; p =.503. It is interesting to see that the separate effects of product innovation and product-service innovation on firm growth are both positive, while the combinative effect is negative. However, none of these relations are statistically significant and therefore the seventh hypothesis is rejected.

The final hypothesis is that the impact of product innovation and product-service innovation on firm growth is stronger when it is combined with the organizational capabilities and technological process capabilities of an organization. As mentioned in the section above, the combination of product and product-service innovation has a negative effect on firm growth. This effect is also still there in the third model β =-.144; p =.430. However when combining it with organizational capabilities and technological process capabilities the effect on firm growth turns positive again β =.073; p =.391. Still, this effect is smaller than the individual effect of product-service innovation on firm growth (β =.198; p =.236). Besides, the effects are all statistically insignificant and therefore the eighth hypothesis is rejected.

Figure 3 summarizes the findings and shows which hypothesis are accepted and rejected with the adjusted R^2. It shows that H1, H3 and H4 are accepted, while H2, H5, H6, H7 and H8 are rejected.

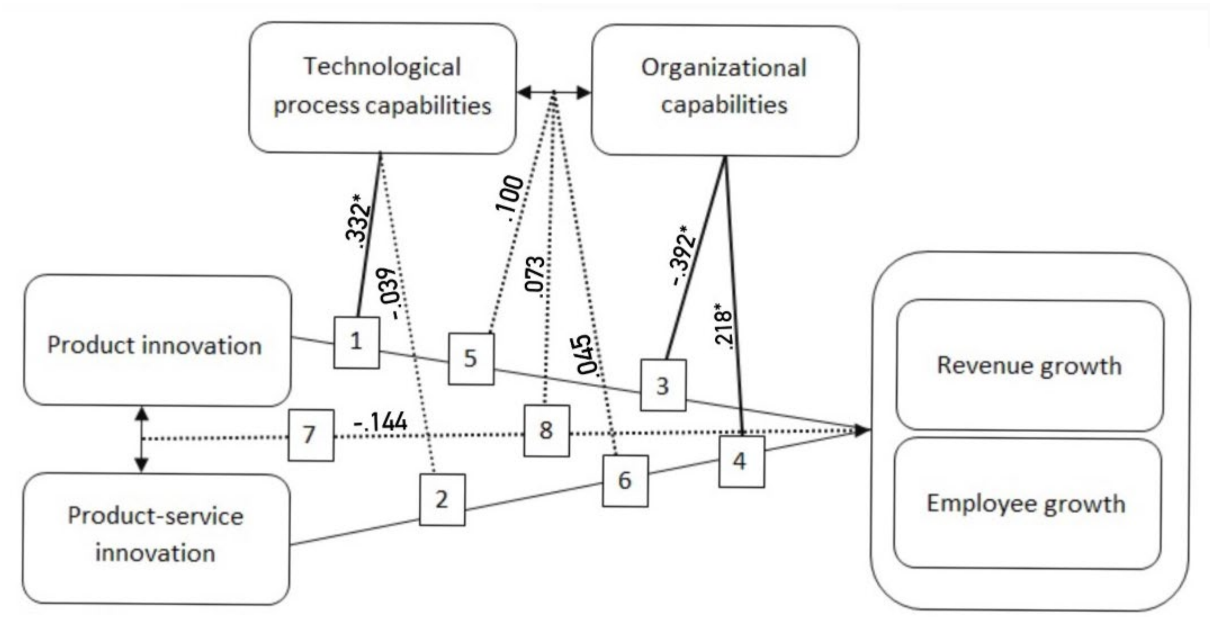


Figure 3: Summary of findings *N = 155, **p <.01; *p <.05*

4.5.3 Post-hoc analyses

In order to further investigate the significant relationships between; product innovation-technological process capabilities, product innovation-organizational capabilities and product-service innovation-organizational capabilities, some additional regression analysis were done that are out of the scope of this research. The purpose of these analyses was to determine whether there was a difference of these interaction effects on employee growth and revenue growth separately. The results of these analyses indicate that the Durbin-Watson statistic is 1.353 for employee growth but only .290 for revenue growth. Since the Durbin-Watson statistic for employee growth is >1 and higher than the Durbin-Watson value of .806 for firm growth, there is less autocorrelation and the results may be more reliable (Field, 2018).

The results show that all three interaction effects disappeared for revenue growth. However, firm age has an unexpected significant negative effect on revenue growth with β =-.179; p =.040 indicating that older organizations were generally less profitable. Additionally, the interaction effect between product-service innovation and organizational innovation disappeared for employee growth as well β =.180; p =.102. However, the interaction effect between product innovation and technological process capabilities β =.362; p =.013 and between product innovation and organizational capabilities β =-.349; p =.018 are still significant for employee growth. These results indicate that the interaction effects between these two variables are the strongest on the employee growth of the organization. The findings indicate that the combination of product innovation with technological process capabilities results in an increase in employee growth, which is in line with the findings of Braunerhjelm, P. & Thulin, P. (2022). In contrast, the combination or product innovation and organizational capabilities results in a decreased number of employees. All the other analyses did not show any significant interaction effects for employee growth or revenue growth. If interested in the SPSS output for these additional analyses, the output can be requested from the student.

5. Conclusion and Discussion

This chapter aims to bring together the findings of this study and synthesis them in order to answer the research question. It does this by simultaneously placing the findings in the context of existing scientific literature. Lastly, it answers the research question and elaborates on some managerial implications that arise from the empirical findings.

This research aimed to examine the potential interaction effects of different types of innovation on firm performance, in order to add to the exiting literature on the complex relation between innovation and firm performance. Similar studies have been conducted mainly in the service industry, however to the knowledge of the researcher similar studies have not yet been conducted in the manufacturing sector in the Netherlands. The research aimed to provide some insight by exploring the following research question: "To what extend do the different innovation types have a combined effect on firm performance in the Dutch manufacturing industry?"

In order to properly answer this research question, eight hypothesis were constructed that aimed to explore the relationship between four different innovation types, namely; product innovation, product-service innovation, organizational innovation and technological process innovation, and firm growth. These hypotheses were tested for 155 organizations in the Dutch manufacturing sector. The data was provided by the EMS survey and was analyzed by performing multiple hierarchical linear regression analyses. The results showed that three out of the eight hypotheses were accepted. The findings of this study and their relation to existing literature will be discussed in the following section.

This study has provided some interesting insights into the complex relation between innovation types and their effects on firm growth, by testing the proposed hypotheses as well as though findings that emerged from the analysis. In the context of this study, the findings that were out of the scope of this study were that none of the analysis showed that product innovation or product-service innovation individually had a direct significant effect on firm growth in the short term. These findings are in line with the findings of several researchers that found no significant direct effect of product innovation on firm growth (Bottazzi et al., 2001; Gabriele and Corsino, 2010; Geroski, Machin and Walters, 1997; Geroski and Mazzucato, 2002). This seems to indicate that simply introducing new products does not significantly affect firm growth. In addition, none of the analyses showed a significant direct effect of technological process innovation or organizational innovation on firm growth. These findings are in line with some studies that also failed to find significant relations between organization innovation and performance (Rajapathirana and Hui, 2018; YuSeng and Ibrahim, 2020) and between technological process innovation and firm growth (Ali-Yrkko and Martikainen, 2008). These findings indicate that organizations that simply innovating do not have a significant increase in firm growth.

However, this study hypothesized that some combinations of innovation types would have a significant effect on firm growth because some innovation types could be considered capabilities. This notion is partially supported. The combination of product innovation and technological process capabilities was found to significantly and positively affect firm growth, in particular employee growth. Organizations that had more developed technological capabilities were found to be more successful when introducing new products. These findings are in line with the findings of multiple researchers who found that the combination of product innovation and technological process innovation lead to improves performance in the manufacturing sector (Goedhuys and Veuegelers, 2008; Mirvate and Pernias, 2006). Additionally, the findings also seem to support the view that technological capabilities could be considered innovation capabilities that improve the success of product innovations. A similar moderating relationship between technological capabilities and product innovation was found by Agustia et al. (2022). However, it is important to note that they found that technological capabilities of an organization had a negative effect on firm performance when combines with product innovation. Furthermore, the combination of product-service innovation and technological process capabilities did not significantly affect firm growth in the scope of this study. This indicates that the effect of technological capabilities is different on product and product-service innovations.

Another finding of this study was the negative combined effect of product innovation and organizational capabilities on firm growth. According to the analysis, organizations that had developed organizational capabilities, shrunk when they introduced a new product. This affected employee growth in particular. These findings are in contrast with a large scientific body that argues that the combination of organizational innovation and product innovation will improve firm performance (Lin and Chen, 2007; Gunday et al., 2008). However, some have noted that these effects are not due to organizational innovation, but due to marketing (Johne and Davies, 2000). In addition, the results of this study showed that organizational capabilities did have a significant positive effect on firm growth when combined with product-service innovation. This indicated that the organizational capabilities may be more beneficial for organizations that offer product-services instead of products.

Paradoxically, the combination of product innovation, organizational capabilities and technological process capabilities were not found to significantly affect firm growth, even though their separate combination did have a significant effect. The effect was also not found to be significant for product-service innovation. These findings are in stark contrast with the findings of Damanpour and Evan (1984), who found organizations that focused on both innovation types to be more successful than organizations that chose to focus on one. The findings also diverge from many researchers who found that the combination of technological and organizational innovation is crucial for the market success of new products (Cozzarin and Perzival, 2006; Hauser, Tellis & Griffin, 2001; Tidd, Bessant and Pavitt, 2009).

Similarity, the combination of product innovation and product-service innovation showed a negative effect on firm growth. This is line with the findings of Eggert et al. (2011) and others, who have found that combining the two types of innovation could lead to a decrease in firm performance (Standley and Wojcik, 2005; Fang, Palmatier and Steenkamp, 2008). But, it is important to note that the findings of this negative effect were not significant. Even though, the correlation table showed that there was a significant correlation between product innovation and product-service innovation, further research is needed to identify the exact nature of this relation.

The findings of the analysis did not support the final hypothesis that the combination of all four innovation types will lead to a significant firm growth. This is not surprising considering the previously explained interactions. The mixed effects between the innovations types could explain why combining all four innovations did not have a significant effect on firm growth. Based on the findings of this study, the following research question is answered and some managerial implications that arise from the empirical findings are elaborated upon:

"To what extend do the different innovation types have a combined effect on firm performance in the Dutch manufacturing industry?"

The findings of this study indicate that different innovation types have a combined effect on firm performance in the Dutch industry. These combined effects are often stronger and more significant than the separate direct effect of these same innovation types on firm growth. However, these effects are not consistent between the different types. For example, organizational innovation has a positive effect on firm growth when combined with product-service innovation, but a negative effect when combined with product innovation. Similarity, technological process capabilities have a positive effect on firm growth when combined with product innovation, but a negative effect when combined with product-service innovation. These relations show that organizations are better off when focusing on a combination of either technological (product and technological process innovation) or non- technological innovation types (product-service and organizational innovation) in order to improve their growth strategy.

Based on the empirical findings of this study, organizations that want to optimize their growth strategy by product and product-service innovations could benefit from sticking to improving either their technological or non-technological capabilities depending on their offered products. If an organization wants to introduce a new product, it would be recommended to make sure their technological process capabilities are developed, since according to the findings, product-innovation on its own does not lead to significant firm growth. Additionally, these organizations seemed to be negatively affected by organizational capabilities and could be better of sticking to developing their technological process capabilities instead. In contrast, organizations that want to introduce a product-service innovation, should considering evaluating their organizational capabilities, since product-service innovation on its own does not lead to a significant firm growth either. These organizations seemed to be negatively affected by technological process capabilities and should therefore consider elevating their organizational capabilities, rather than their technological process capabilities. These findings could therefore help guide organizations in their innovation decisions, based on whether they are planning on introducing new products or new product-services.

On the other hand, the findings could help managers decide whether their organization could be more successful in introducing new products or products-services. If an organization has highly developed technological process capabilities, it may be more successful focusing on products innovation rather than product-service innovation. In contrast, organizations that have better developed organizational capabilities could benefit in focusing on product-service innovations. Lastly, organizations that engage in both product innovation and product-service innovation could assess their capabilities in order to decide which type of innovation would be more suited for their organization. They should also keep in mind, that if they engage in all four types of innovations, these innovation types could have a combined positive effect with some innovations, while simultaneously having a negative effect with other innovation types.

6. Limitations and recommendations

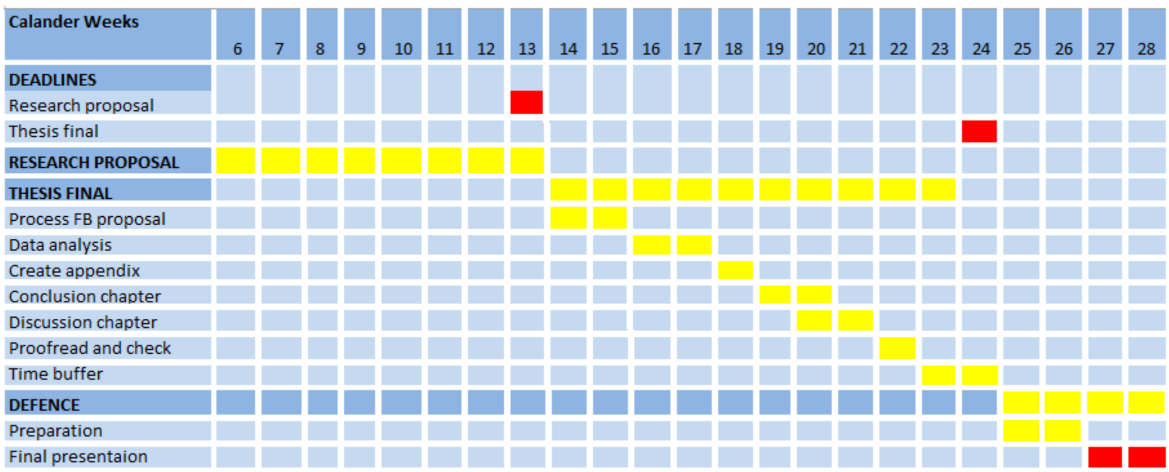
As is always the case with any research, this study had some limitations. The most relevant limitations of this study can be divided into three main issues, namely, time constrains, representativeness and methodological/design issues. These limitations will be discussed in this chapter, and will serve as inspiration for potential future research projects.

The limitation of time and methodological/design issue are somewhat overlapping in the context of this study. While researching innovation, it was evident that the relationship between innovation and firm performance is often subject to time lag issues. This simply means that in order to correctly measure the effect of innovation, it is best to observe the organization and its performance over a longer period of time (Mai et al., 2019; Zahra and Sidhartha, 1993; West, 1992). Therefore, longitudinal studies might be more appropriate, but were not possible due to time constraints. In order to somewhat include a variable that measures change over a period of time, the employee growth and revenue growth between the years of 2015 and 2017 was decided upon. However, more complex research could have been designed with the data that was available in the dataset. For example, this research did not take into account the year the different technological and organizational concepts were implemented. Thus, an organization that has been using 3D printing for 8 years is considered just as technologically developed as an organization that has just started using 3D printers half a year ago. However, due to time constraints this type of complex methodologic design was not used. Yet, future research could include a time aspect to these types of researches and use more detailed indictors to determine organizational and technological capabilities.

Another limitation is the representativeness of the research findings and the dataset. The survey was send to all organizations in the Dutch manufacturing industry that are registered in the KvK. From the total of 7172 organizations, 155 were included in the final analysis which means that the dataset was 2.16% of all the organizations. For example, the sector construction only had three organizations, which should be kept in mind when interpreting the results. Future research could try to focus on one or two subsectors instead of a broad industry.

Furthermore, the study suffered from some methodological/design issues. First of all, the determination of organizational and technological process capabilities was restricted due to the close-ended nature of the survey. The questionnaire asked for a couple specific organizational and technological concepts and left no space for organizations to included organizational and technological concepts that they may have implemented. This could lead to organizations scoring low on capabilities, even if they were to have a lot of other implemented concepts that were not measured by the questionnaire. Future research could try to avoid this problem by constructing surveys in a different way or measuring organizational and technological capabilities differently.

Lastly, there were two main issues with the analysis that should be mentioned. These are the violation of the independence of errors assumption in linear regression and the low R^2 scores. Due to a lack of experience and advanced statistical knowledge, the problem of independence of errors was determined, however not resolved. A low Durbin-Watson score points to a positive autocorrelation. This could inflate some results and show insignificant results to be significant. Therefore this should be kept in mind when interpreting the results. Nevertheless, it is important to note that thee Durbin-Watson score was higher while conducting the post-hoc analysis for employee growth. These post-hoc analyses did find some significant interaction effects which could be more reliable. Furthermore, a low R^2 score could indicate that the model fit is not correct for the data. This could mean that the relationship between innovation types and firm growth is not linear. If this is the case, other analysis methods could be better fitted to explore and understand the relationship between innovation and firm growth more accurately.



Gantt-chart of the MT process

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Appendices

Overview appendices

Appendix I: EMS Survey 2018

Digitalisering in de Maakindustrie 2018

(versie 7April20; edited & coded using DataEntry_EMS_2018_Core_final (21Sept19)
Radboud University, Nijmegen\ IMR ©

Notes:
- Variable labels k01a – nlk26 (variables with prefix nl are included in the NL questionnaire only)
- CORE questions are included by all countries, non-core only by some countries

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Start of Block: Default Question Block

Frontpage
Modernisering en verduurzaming van de productie
Enquête 2020

Deze vragenlijst heeft als doel inzicht te krijgen in de inspanningen van industriële bedrijven in Nederland om hun productie en bedrijfsprocessen te moderniseren en te verduurzamen. In de vragenlijst worden gegevens verzameld over het gebruik van nieuwe technologieën, organisatieconcepten en over indicatoren zoals productiviteit, flexibiliteit en kwaliteit.

Het onderzoek richt zich op productiebedrijven met een omvang van tenminste 10 werknemers. Bij ondernemingen met meerdere vestigingen hebben de vragen betrekking op de aangeschreven vestiging en niet op de totale onderneming.

Voor het onderzoek is beantwoording van alle vragen van belang. Ook als niet alle genoemde technologieën of organisatieconcepten van toepassing zijn op uw bedrijfsvestiging, verzoeken wij u vriendelijk de vragenlijst toch volledig in te vullen. De vragenlijst heeft 26 thema's en vraagt ongeveer 30 tot 40 minuten van uw tijd.

Voor een representatief overzicht van de gehele maaksector, is het van groot belang dat elk aangeschreven bedrijf deelneemt.

We danken u vriendelijk voor uw deelname waarmee u ons helpt in het onderzoek naar innovatie en duurzaamheid. Na afloop krijgt u als dank direct een gratis benchmark waarin uw score vergeleken wordt met andere bedrijven in uw bedrijfstak of van uw grootte.

Voor vragen kunt u terecht bij:
Radboud Universiteit \ Centre of Innovation Studies
dr. Paul E.M. Ligthart dr. Peter Vaessen
Tel.: 024 361 1835

Let op: deze enquête werkt het beste wanneer u javascript inschakelt in uw browser. Zonder javascript is het NIET mogelijk een benchmark te ontvangen.

[INT: Q CORE k01a] / {NL non core}
1.1 **Maakt uw bedrijfsvestiging deel uit van een onderneming met meerdere vestigingen?**

- ◯ Ja (1)
- ◯ Nee (0)

/ {NL non core} nlk01q2
Notice
LET OP: Bij ondernemingen met meerdere vestigingen hebben de vragen betrekking op de aangeschreven vestiging en niet op de totale onderneming.

1.2 **Is uw bedrijfsvestiging :**

- ◯ Het hoofdkantoor van een onderneming/groep met ook buitenlandse vestigingen (1)
- ◯ Een dochter/divisie van een buitenlandse onderneming/groep (2)
- ◯ Het hoofdkantoor van een onderneming/groep met alleen binnenlandse vestigingen (3)
- ◯ Een dochter/divisie van een onderneming/groep met alleen binnenlandse vestigingen (4)
- ◯ Een zelfstandige onderneming (5)

[INT: Q CORE] k02ax k02bx k02c

2 **In welke bedrijfstak is uw bedrijfsvestiging voornamelijk actief en met welk hoofdproduct(groep)?**

- ◯ Hoofdproduct(groep): (2) ____
- ◯ Aandeel van hoofdproduct(groep) in omzet, ca. ...% (3) ________________________________

[INT: Q CORE] NACErev2
2_industry **In welke bedrijfstak is uw bedrijf actief?**

- ... kies uw sector uit de onderstaande lijst... (0)
- Vervaardiging van voedingsmiddelen (10)
- Vervaardiging van dranken (11)
- Vervaardiging van tabaksproducten (12)
- Vervaardiging van textiel (13)
- Vervaardiging van kleding (14)
- Vervaardiging van leer en van producten van leer (15)
- Houtindustrie en vervaardiging van artikelen van hout en van kurk, exclusief meubelen; vervaardiging van artikelen van riet en van vlechtwerk (16)
- Vervaardiging van papier en papierwaren (17)
- Drukkerijen, reproductie van opgenomen media (18)
- Vervaardiging van cokes en van geraffineerde aardolieproducten (19)
- Vervaardiging van chemische producten (20)
- Vervaardiging van farmaceutische grondstoffen en producten (21)
- Vervaardiging van producten van rubber of kunststof (22)
- Vervaardiging van andere niet-metaalhoudende minerale producten (23)
- Vervaardiging van metalen in primaire vorm (24)
- Vervaardiging van producten van metaal, exclusief machines en apparaten (25)
- Vervaardiging van informaticaproducten en van elektronische en optische producten (26)
- Vervaardiging van elektrische apparatuur (27)
- Vervaardiging van machines, apparaten en werktuigen, n.e.g. (28)

○ Vervaardiging van auto's, aanhangwagens en opleggers (29)

○ Vervaardiging van andere transportmiddelen (30)

○ Vervaardiging van meubelen (31)

○ Overige maakindustrie (32)

○ Reparatie en installatie van machines en apparaten (33)

○ Overige sectoren niet maakindustrie (34)

[INT: Q CORE] nlk03a_6c1 k03a1 k03a2 k03a3 k03a4 k03a5 k03a6
3.1 **Is uw bedrijfsvestiging gelet op uw hoofdproduct(groep) hoofdzakelijk een leverancier van eindfabrikaten of een toeleverancier van systemen, onderdelen of bewerkingen?**

○ Producent van eindfabrikaten voor consumenten (1)

○ Producent van eindfabrikaten voor bedrijven: kapitaalgoederen, apparatuur etc. (2)

○ Producent van eindfabrikaten voor bedrijven: verbruiksmiddelen, andere producten (3)

○ Toeleverancier van systemen/installaties (4)

○ Toeleverancier van halffabrikaten/onderdelen (5)

○ Aanbieder van bewerkingen (zoals draaien, coaten, lassen, vermalen etc.) (6)

[INT: Q CORE] nlk03b_8c1 k03b1 k03b2 k03b3 k03b4 k03b5 k03b6 k03b7 k03b8 k03b9x

3.2 **Als u uw hoofdproduct(groep) levert aan andere bedrijven (als eindfabrikant of toeleverancier), aan welke bedrijfstak levert u dan hoofdzakelijk?**

- ◯ Machinebouw (1)
- ◯ Chemische industrie (2)
- ◯ Automotive (3)
- ◯ Technisch / Onderzoek & Ontwikkeling (O&O)-dienstverlening (4)
- ◯ Informatie- en communicatietechnologie (ICT) (5)
- ◯ Energiesector (6)
- ◯ Logistiek (7)
- ◯ Andere bedrijfstak, namelijk... (8) ____

] / {NL non core; oostnl }

3.3 In welke provincie is uw bedrijfsvestiging gevestigd?

- ◯ ... Kies uw provincie uit de onderstaande lijst ... (0)
- ◯ Groningen (1)
- ◯ Friesland (2)
- ◯ Drenthe (3)
- ◯ Overijssel (4)
- ◯ Flevoland (5)
- ◯ Gelderland (6)
- ◯ Utrecht (7)
- ◯ Noord-Holland (8)
- ◯ Zuid-Holland (9)
- ◯ Zeeland (10)

◯ Noord-Brabant (11)

◯ Limburg (12)

/ {NL non core} nlk04a_4c: nlk04b_4c nlk04c_4c nlk04d_4c nlk04e_4c nlk04f_4c
4 **Welke van de volgende activiteiten van de waardeketen worden door uw bedrijfsvestiging uitgevoerd?**

	Grotendeels intern (>85%) (1)	Relevant deel intern (25%-85%) (2)	Klein deel intern (	Niet nodig voor vervaardiging van hoofdproduct (4)
Onderzoek & Ontwikkeling (O&O) (4_1)	◯	◯	◯	◯
Ontwerp/ Vormgeving (4_2)	◯	◯	◯	◯
Productie/Verwerking/Recycling (4_3)	◯	◯	◯	◯
Assemblage (4_4)	◯	◯	◯	◯
Onderhoud/Dienstverlening (4_5)	◯	◯	◯	◯
Verpakken/Distributie (4_6)	◯	◯	◯	◯

[INT: Q CORE] nlk05a_4c: k05a1 k05a2 k05a3 k05a4
5.1 **Welke van de volgende kenmerken is het meest van toepassing op de *productontwikkeling* van uw hoofdproduct(groep)?**

◯ Op specificatie van de klant (1)

◯ Voor een standaardprogramma waarbinnen klantspecifieke wensen gerealiseerd kunnen worden (2)

◯ Voor een standaardprogramma waaruit de klant kan kiezen (3)

◯ Niet aanwezig in deze bedrijfsvestiging (4)

[INT: Q CORE]] / {NL non core} nlk05b_4c: k05b1 k05b2 k05b3 k05b4
5.2 **Welke van de volgende kenmerken is het meest van toepassing op de *seriegrootte* van uw hoofdproduct(groep)?**

- ◯ Enkelstuksproductie (1)
- ◯ Kleine of middelgrote series (2)
- ◯ Grote series (3)
- ◯ Geen discrete productie (procesindustrie) (4)

[INT: Q CORE] nlk05c_4c: k05c1 k05c2 k05c3 k05c4
5.3 **Welke van de volgende kenmerken is het meest van toepassing op de *fabricage/montage* van uw hoofdproduct(groep)?**

- ◯ Na binnenkomst klantorder (make to order) (1)
- ◯ Eindmontage van het product wordt uitgevoerd na binnenkomst klantorder (assemble to order) (2)
- ◯ Op voorraad (make to stock) (3)
- ◯ Niet aanwezig in deze bedrijfsvestiging (4)

[INT: Q CORE] nlk05d_3c: k05d1 k05d2 k05d3
5.4 **Welke van de volgende kenmerken is het meest van toepassing op de *productcomplexiteit* van uw hoofdproduct(groep)?**

- ◯ Eenvoudige producten (1)
- ◯ Producten van middelgrote complexiteit (2)
- ◯ Complexe producten (3)

[INT: Q CORE] k06a1 k06a2 k06a3 k06a4 k06a5 k06a6
6 **Hoe belangrijk zijn de volgende concurrentiefactoren om uw bedrijfsvestiging positief te onderscheiden van uw concurrenten?**
(geef de volgorde van belangrijkheid aan door met de muis belangrijke factoren hoger te rangschikken)
______ Innovatieve producten (3)
______ Productprijs (1)
______ Productkwaliteit (2)
______ Aanpassing producten aan klantwensen (4)
______ Tijdige levering / korte levertijden (5)
______ Dienstverlening/service (6)

[INT: Q CORE]] / {NL non core}
k07a k07b k07c k07d k07e k07f k07g
nlk07a_3c nlk07b_3c nlk07c_3c nlk07d_3c nlk07e_3c nlk07f_3c nlk07g_3c
nlk07a_freq_3c nlk07b_freq_3c nlk07c_freq_3c nlk07d_freq_3c nlk07e_freq_3c nlk07f_freq_3c nlk07g_freq_3c

7 **Werkt uw bedrijfsvestiging samen met andere bedrijven op de volgende terreinen?**
(samenwerking is vrijwillige relatie tussen bedrijven die verder gaat dan alleen in- en verkoop transacties)

	Werkt u samen?			Hoe frequent werkt u samen op de volgende terreinen? *(op jaarbasis)*		
	Nee (1)	Ja, nationaal (2)	Ja, internationaal (3)	Eenmalig (1)	Meermaals (2)	Continu (3)
Samenwerking in inkoop (7_1)	◯	◯	◯	◯	◯	◯
Samenwerking in de productie (voor capaciteitsuitbreiding of gezamenlijke gebruik van machines) (7_2)	◯	◯	◯	◯	◯	◯
Samenwerking in verkoop/ distributie (7_3)	◯	◯	◯	◯	◯	◯
Samenwerking in service (7_4)	◯	◯	◯	◯	◯	◯
Samenwerking in onderzoek & ontwikkeling (O&O) met afnemers of leveranciers (7_5)	◯	◯	◯	◯	◯	◯
Samenwerking in O&O met andere bedrijven (uitgezonderd afnemers en leveranciers) (7_6)	◯	◯	◯	◯	◯	◯
Samenwerking in O&O met onderzoeksinstituten (bijv. universiteiten, TNO) (7_7)	◯	◯	◯	◯	◯	◯

/ {NL non core; oostnl }

7.1 Werkt uw bedrijfsvestiging samen met bedrijven in Duitsland?

Nee (0)

ja, (1)

/ {NL non core; oostnl }

7.2 [indien ja] Vinden deze Duitse samenwerking plaats binnen en/of buiten het Europese interregionale samenwerkingsprogramma Interreg?

via het Europese interregionale samenwerkingsprogramma Interreg programma (1)

zakelijke samenwerking(en) buiten het Interreg programma (opdrachtgever, opdrachtnemer) (2)

innovatie samenwerking(en) buiten het Interreg programma (3)

/ {NL non core; oostnl }

7.3 Bevinden deze bedrijven zich binnen en/of buiten de aangrenzende Bundesländer Nordrhein-Westfalen en NiederSachsen?

Alleen binnen de aangrenzende Bundesländer Nordrhein-Westfalen en Niedersachsen (1)

Alleen buiten deze aangrenzende Bundesländer (2)

Zowel binnen en buiten deze aangrenzende Bundesländer (3)

[INT: Q CORE]] / {NL non core}

[nlk08a_3c:	k08a1	k08a2]	k08a3	k08a4
[nlk08b_3c:	k08b1	k08b2]	k08b3	k08b4
[nlk08c_3c:	k08c1	k08c2]	k08c3	k08c4
[nlk08d_3c:	k08d1	k08d2]	k08d3	k08d4
[nlk08e_3c:	k08e1	k08e2]	k08e3	k08e4
[nlk08f_3c:	k08f1	k08f2]	k08f3	k08f4
[nlk08g_3c:	k08g1	k08g2]	k08g3	k08g4
[nlk08h_3c:	k08h1	k08h2]	k08h3	k08h4
[nlk08i_3c:	k08i1	k08i2]	k08i3	k08i4
[nlk08k_3c:	k08k1	k08k2]	k08k3	k08k4
[nlk08l_3c:	k08l1	k08l2]	k08l3	k08l4
[nlk08m_3c:	k08m1	k08m2]	k08m3	k08m4
[nlk08n_3c:	k08n1	k08n2]	k08n3	k08n4
[nlk08o_3c	nlk08o1	nlk08o2]	nlk08o3	nlk08o4
[nlk08p_3c	nlk08p1	nlk08p2]	nlk08p3	nlk08p4
[nlk08q_3c	nlk08q1	nlk08q2]	nlk08q3	nlk08q4

8 **Welke van de volgende organisatieconcepten en werkwijzen worden momenteel in uw bedrijfsvestiging toegepast?**

	Momenteel toegepast?			Voor het eerst toegepast in	Omvang van het toegepaste potentieel		
	Nee (0)	Nee, maar toepassing gepland voor 2021 (1)	Ja (3)	(jaar) (1)	Gering (1)	Midden (2)	Hoog (3)
Organisatie van de productie Gestandaardiseerde en gedetailleerde werkinstructies, bijv. Standard Operation Procedures (SOP), Media-Oriented Systems Transport (MOST) (8_1)							
Maatregelen ter verbetering van de interne logistiek (Value Stream Mapping/ Design, ruimtelijke inrichting van productiestappen) (8_2)							
Taakverrijking productiemedewerker (integratie van planning, uitvoering of controle) (8_4)							

Vaststaande methoden voor het verkorten van omstel- en aanlooptijden bij productwisseling (bijv. Single Minute Exchange of Die (SMED); Quick Change Over (QCO)) (8_3)

Vraaggestuurde productie (bijv. KANBAN, afschaffen van tussenvoorraden) (8_5)

Management/beheersing
Grafische weergave werkprocessen en-status (Visual Management; dashboard) (8_6)

Kwaliteitsmanagement (bijv. continue verbeteren, total quality management (TQM), Six Sigma, preventief onderhoud (8_7)

Gecertificeerde kwaliteitsstandaarden (zoals ISO 900xx) (8_8)

Gecertificeerde energie-management systeem (bijv. ISO 50001) (8_9)

Methoden voor operation management o.b.v. wiskundige analyse van productie (bijv. regressieanalyse, wachtrij-analyse) (8_10)

Gecertificeerde milieu-management systeem (bijv. ISO 14001) (8_11)

Human resource management/personeelszaken
Instrumenten ter bevordering van werknemersbetrokkenheid (bijv. mogelijkheden voor studie/ cursussen, flexibele werktijden, ondersteuning kinderopvang) (8_12)

Training on the job door bijv. taakroulatie, georganiseerde kennisuitwisseling onder collega's, Training-within-industry (TWI) (8_13)

Maatregelen om werknemers in de productie te laten experimenteren met nieuwe ideeën door beschikbaar stellen van bijv. werktijd, locatie, machines. (8_14)

Maatregelen voor het behoud van oudere werknemers of hun kennis voor uw bedrijfsvestiging (bijv. teams met verschilllende leeftijdsgroepen, begeleidingsprogramma's, senior-junior tandems) (8_15)

Financiële participatie toegankelijk voor alle werknemersgroepen (bijv. winstdelingsregelingen, aandelen(optie)plannen) (8_16)

[INT: Q CORE] k09a1 k09a2 k09a3 k09a4 k09a5
9.1 **Wat is het opleidingsniveau van het personeel van uw bedrijfsvestiging?**
(ca. percentage van het totale personeel; totaal moet 100 zijn)
Hoger onderwijs (WO+HBO) : ________ (1)
MBO technische opleiding : ________ (2)
MBO commerciële of administratieve opleiding : ________ (3)
LBO of ongeschoold : ________ (4)
Technisch of commercieel personeel in opleiding (leerlingen) : ________ (5)
Total : ________

[INT: Q CORE] k09b1 k09b2 k09b3 k09b4 k09b5
9.2 **Hoe is het personeel in uw bedrijfsvestiging verdeeld over de volgende werkterreinen:**
(ca. percentage van het totale personeel; totaal moet 100 zijn)
Onderzoek en ontwikkeling (O&O) : ________ (1)
Constructie, ontwerp en vormgeving : ________ (2)
Fabricage en montage : ________ (3)
Klantenservice : ________ (4)
Overige (administratie, inkoop, logistiek/distributie, onderhoud, productieplanning enz.) : ________ (5)
Total : ________

[INT: Q CORE]] / {NL non core}

[nlk10a_3c:	k10a1	k10a2]	k10a3	k10a4	k10a5
[nlk10b_3c:	k10b1	k10b2]	k10b3	k10b4	k10b5
[nlk10c_3c:	k10c1	k10c2]	k10c3	k10c4	k10c5
[nlk10d_3c:	k10d1	k10d2]	k10d3	k10d4	k10d5
[nlk10e_3c:	k10e1	k10e2]	k10e3	k10e4	k10e5
[nlk10f_3c:	k10f1	k10f2]	k10f3	k10f4	k10f5
[nlk10g_3c:	k10g1	k10g2]	k10g3	k10g4	k10g5
[nlk10h_3c:	k10h1	k10h2]	k10h3	k10h4	k10h5
[nlk10i_3c:	k10i1	k10i2]	k10i3	k10i4	k10i5
[nlk10k_3c:	k10k1	k10k2]	k10k3	k10k4	k10k5
[nlk10l_3c:	k10l1	k10l2]	k10l3	k10l4	k10l5
[nlk10m_3c:	k10m1	k10m2]	k10m3	k10m4	k10m5
[nlk10n_3c:	k10n1	k10n2]	k10n3	k10n4	k10n5
[nlk10o_3c:	k10o1	k10o2]	k10o3	k10o4	k10o5
[nlk10q_3c	nlk10q1	nlk10q2]	nlk10q3	nlk10q4	nlk10q5
[nlk10r_3c	nlk10r1	nlk10r2]	nlk10r3	nlk10r4	nlk10r5
[nlk10s_3c	nlk10s1	nlk10s2]	nlk10s3	nlk10s4	nlk10s5
[nlk10t_3c	nlk10t1	nlk10t2]	nlk10t3	nlk10t4	nlk10t5

10.1 **Welke van de volgende technologieën worden momenteel in uw bedrijfsvestiging toegepast?**

	Voor het eerst toegepast in	Omvang van het toegepaste potentieel			Nieuwe investering sinds 2015		Momenteel toegepast?		
	(jaar) (1)	Gering (1)	Midden (2)	Hoog (3)	Nee (0)	Ja (1)	Nee (0)	Nee, maar toepassing gepland voor 2021 (1)	Ja (2)
Productiebeheersing Mobiele/ draadloze apparaten voor programmering en bediening van installaties en machines (bijv. tablets) (10.1_1)									
Digitale oplossingen voor het direct beschikbaar maken van tekeningen, werkschemas en -instructies op de werkvloer (10.1_2)									
Digitale productieplanning en roostering (bijv. ERP-systeem) (10.1_3)									

Digitale uitwisseling van productieplanningsgegevens met toeleveranciers en/of klanten (elektronische data-uitwisseling (EDI)) (10.1_4)
Bijna real-time productiemanagementsystemen (bijv. systemen voor gecentraliseerde besturing en machinemonitoring) (10.1_5)
Systemen voor geautomatiseerd management van interne logistiek en orderverzameling (e.g. RFID, warehouse management system) (10.1_6)
Product Lifecycle Management (PLM) systemen of product- of productieproces-datamanagement (10.1_7)
Virtual Reality of simulatie voor productontwerp of productontwikkeling (bijv. Finite Element Method (FEM), digitale prototypes, computermodellen) (10.1_8)
Automatisering en robotisering Industriële robots voor bewerking en fabricage (bijv. lassen, coaten, snijden) (10.1_9)
Industriële robots voor hanteren van gereedschap en werkstukken in productie (bijv. verplaatsen, assemblage, sorteren, verpakken, automatic guided vehicle (AVG)) (10.1_10)
Additive manufacturing technologieën 3D printertechnologie voor prototypes, demonstratiemodellen, 0-series (10.1_11)
3D printertechnologie voor de vervaardiging van producten, onderdelen, mallen, instrumenten, e.d. (10.1_12)

Energie en grondstoffenbesparing
Technologieën voor recycling and hergebruik van water (bijv. water recirculatie systemen) (10.1_13)

Systemen voor terugwinning van kinetische en procesenergie (bijv. terugwinnen afvalwarmte, energie opslag) (10.1_14)

Installaties voor omschakeling van fossiele brandstoffen (olie, aardgas) naar andere energiebronnen (electriciteit, waterstof) (10.1_15)

Technologieën voor eigen energie- en/of warmteopwekking door middel van zon-, wind-, waterkracht, biomassa of geothermische energie (bijv. zonnepanelen, windmolen, warmtepomp, etc) (10.1_16)

Afschakelsystemen voor onderdelen, machines of installaties indien niet in gebruik (bijv. afschakeling luchttoevoer, aangepaste verlichtingssensoren) (10.1_17)

Verbeteren van bestaande machines of installaties (bijv. hoog efficiënte motoren (IE3), aanbrengen isolatie, warmtewisseleraar) (10.1_18)

[INT: Q CORE] k10p1 k10p2 k10p3 k10p4
10.2 **Op welke manier worden industriële robots ingezet?**
(meerdere opties mogelijk)

- ☐ Mobiele industriële robots (1)
- ☐ Industriële samenwerkingsrobots (bijv. hand gestuurde popnagelrobot) (2)
- ☐ Zelfstandige robots (3)
- ☐ Geen van deze drie oplossingen wordt gebruikt in de fabriek (4)

[INT: Q CORE] k11a
11 **Worden gerecyclede metalen en kunststoffen gebruikt in het hoofdproduct van uw fabriek?**

- ◯ Nee (0)
- ◯ Ja (1)

[INT: Q CORE] k11b
11_Nee **Bent u van plan gerecyclede metalen en kunststoffen te gebruiken binnen de komende drie jaar?**

- ◯ Nee (0)
- ◯ Ja (1)

[INT: Q CORE] k11c
11_Ja **Heeft u voor het gebruik van gerecyclede metalen en kunststoffen specifieke technologieën in het vervaardigingsproces toegepast?**

- ◯ Nee (0)
- ◯ Ja (1)

[INT: Q CORE] k12a
12.1 **Gebruikt u machines of systemen in uw productieproces die automatisch [zonder menselijke tussenkomst] gegevens opslaan?**

- ◯ Nee (0)
- ◯ Ja (1)

[INT: Q CORE] k12b1 k12b2 k12b3 k12b4 k12b5 k12b6
12.1a **Waar worden de gegevens die uw productiemachines of -systemen opslaan voor gebruikt?**
(meerdere opties mogelijk)

- Optimaliseren van productieprocessen (1)
- Plannen van middelengebruik en toepassing (2)
- Plannen van onderhoud en reparaties (3)
- Voorbereiden productiviteits- of prestatieindicatoren (4)
- Ander gebruik (5)
- Geen gebruik (6)

[INT: Q CORE] k12c
12.1b **Zijn verzamelde gegevens uit het productieproces ook gebruikt voor risicoanalyse?**
(identificeren, analyseren, evalueren)

- Nee (0)
- Ja (1)

[INT: Q CORE] k12d1 k12d2 k12d3 k12d4

12.2 **Welke van de volgende databeveiligingsmaatregelen worden gebruikt om de data uit het productieproces veilig te stellen?**
(meerdere opties mogelijk)

- Activiteiten die werknemersbewustzijn over gegevensbescherming vergroot (1)
- Gebruik van specifieke software (datacontrole: cijfers over toegang, gebruik, volume etc.) (2)
- Gebruik van specifieke hardwareoplossingen (gescheiden (sub)netwerken, gescheiden van internet, etc.) (3)
- Gebruik van specifieke organisatie-maatregelen (verhinderen van wifi/ internet, radio ontvangst, toegangsbeperking etc.) (4)

[INT: Q CORE] k13b k13c: k13d
13 **Geef alstublieft antwoord op de volgende vragen over de productie van uw hoofdproduct(lijn).**

○ Hoeveel procent van de orders wordt op tijd afgeleverd? (in ca. ...%) (5) ____

○ Hoeveel procent van uw producten of halfproducten moet na kwaliteitscontrole nabewerking ondergaan of geheel worden afgekeurd? (in ca. ...%) (6) ____

○ Welk percentage van de geleverde bestellingen heeft klachten opgeleverd vanwege kwaliteitsproblemen? (in ca. ...%) (7) ____

[INT: Q CORE] k13a2 k13a1
13prodtijd **Wat is de gemiddelde productietijd van uw hoofdproduct(groep)?**
(doorlooptijd vanaf moment dat opdracht binnenkomt bij productie tot product klaar voor levering)

○ In uren: (1) ____

○ In dagen: (2) ____

End of Block: Default Question Block

Start of Block: Block 3

[INT: Q CORE] k14a
14.1 **Heeft uw bedrijf sinds 2015 nieuwe producten geïntroduceerd of producten die ingrijpend technisch verbeterd zijn? (bijv. door nieuwe grondstoffen of materialen te gebruiken, veranderingen in productfuncties of werking etc.)**

○ Nee (0)

○ Ja (1)

[INT: Q CORE] k14b k14c
14.1a

○ Wat was het aandeel van deze nieuwe/verbeterde producten in de omzet van 2017? (in ca. ...%) (1) ____

○ Hoe lang duurde gemiddeld de ontwikkeling van zo'n product? (van productidee tot aan het moment van marktintroductie) (in maanden) (2) ____

[INT: Q CORE] k14d
14.1b **Zijn deze veranderingen (mede) gebaseerd op introductie van digitale mogelijkheden aan het product of een grote verandering in bestaande digitale productelementen?**

- ◯ Nee (0)
- ◯ Ja (1)

[INT: Q CORE] k14e
14.2 **Hebben deze productvernieuwingen ook geleid tot betere milieueffecten bij gebruik of verwijderen van deze nieuwe producten?**

- ◯ Nee (0)
- ◯ Ja (1)

[INT: Q CORE] k14f1 k14f3 k14f5 k14f2 k14f4 k14f6
14.2welke **Welke verbeteringen in de milieueffecten zijn met deze producten bereikt?**
(meerdere opties mogelijk)

- ☐ Vermindering van gezondheidsrisico's bij gebruik (1)
- ☐ Verlenging product levensduur (2)
- ☐ Vermindering van energieverbruik bij gebruik (3)
- ☐ Vermindering van milieuvervuiling bij gebruik (van grond, water, lucht, of geluid) (4)
- ☐ Vereenvoudiging van onderhoud of herstel (5)
- ☐ Verbeterde recycling, terugwinning of verwijderingseigenschappen (6)

[INT: Q CORE] k14g k14h
14.3 **Bevonden zich bij deze nieuwe producten (nieuw sinds 2015) ook producten die nieuw-voor-de-markt waren en die uw bedrijfsvestiging als eerste op de markt introduceerde?**

- ◯ Nee (1)
- ◯ Ja, deze hadden een aandeel in de omzet van ca. ...%: (2)
____

] / {NL non core} nlk14i_4c
14.3_klantmarkt **Waarvoor zijn uw *nieuw-voor-de-markt*producten vooral ontwikkeld?**

◯ Bestaande klanten binnen huidige markt (1)

◯ Aantrekken van nieuwe klanten binnen huidige markt (2)

◯ Toetreding tot nieuwe markt voor uw bedrijfsvestiging (3)

◯ Ontwikkelen van geheel nieuwe markten (4)

[INT: Q CORE] k15a k15b

15.1 **Heeft uw bedrijfsvestiging producten in het programma die u al langer dan 10 jaar aanbiedt?**

◯ Nee (1)

◯ Ja. Deze producten hebben een aandeel in de omzet van ca. ...%: (2)
____

[INT: Q CORE] k04a k04b k04c k04d k04e k04fx

15.2 **Bevat uw hoofdproduct (lijn van producten) de volgende digitale elementen?**

	Nee (1)	Ja (2)
Interactieve besturing (stemcommando's, databrillen, Virtual en Augmented Reality) (1)	◯	◯
Internet/netwerkverbinding voor geautomatiseerde datauitwisseling (real time) (2)	◯	◯
Sensortechnologie / controle-elementen voor digitale productfuncties (3)	◯	◯
Identificatie-tags (zoals RFID, QR of barcodes) (4)	◯	◯
Andere digitale elementen: (5)	◯	◯

[INT: Q CORE] k16a1 k16a2 k16b1 k16b2

16 **Maak alstublieft een schatting waar uw bedrijf zijn bedrijfsmiddelen in 2017 kocht en producten verkocht.**

Invoer bestaat uit verkregen onderdelen, materialen, grondstoffen, middelen of diensten. Uw antwoord heeft betrekking op uw bedrijfsvestiging.

(in ca. ...% van de omzet in 2017; totaal moet 100% zijn)

	Thuisland (1)	Buitenland (2)
Invoer verkregen uit (16_1)		
Producten verkocht aan (16_2)		

Start of Block: Block 2

[INT: Q CORE] k17a1 k17a2 k17a3 k17a4 k17a5 k17a6 k17a7 k17a8

17.1 **Welke van de volgende productgerelateerde diensten biedt u uw klanten aan?**

	Nee (0)	Ja (1)
Installatie, inbedrijfstelling (17.1_1)	○	○
Onderhoud en reparatie (17.1_2)	○	○
Training (17.1_3)	○	○
Ontwerp, technisch advies (incl. O&O voor klanten) (17.1_4)	○	○
Software-ontwikkeling (bijv. software aanpassing) (17.1_5)	○	○
Klantondersteuning op afstand (helpdesk, service hotline, website) (17.1_6)	○	○
Reviseren, vernieuwen (incl. functie opwaardering of software uitbreidingen) (17.1_7)	○	○
Terugname dienstverlening (bijv. recycling, opheffen, terugname) (17.1_8)	○	○

[INT: Q CORE] nlk17b_3c1 k17b k17d
17.2 **Biedt u productondersteuning ook aan via web-based platformen?**
(web-based platformen zijn digitale marktplaatsen om in contact te komen met leveranciers en afnemers)

- Nee (1)
- Nee, maar wij plannen web-based productondersteuning voor 2021 (2)
- Ja (3)

[INT: Q CORE] nlk17c1_2c: k17c1 k17c2
17.2_Ja **Hoe biedt u productondersteuning via web-based platformen aan?**

- Via een eigen platform (1)
- Via een platform van derde partijen (2)

[INT: Q CORE] k17e1 k17e2 k17e3 k17e4 k17e5 k17e6 k17ex
17.3 **Welke van de volgende digitale oplossingen biedt u aan als onderdeel van uw dienstenportfolio?**

	Nee (0)	Ja (1)
Webgebaseerde aanbiedingen voor productgebruik (training, documentatie, foutbeschrijving) (17.3_1)		
Webgebaseerde diensten voor aangepaste productspecificaties of productontwerp (17.3_2)		
Digitale monitoring van de werkzame status op afstand (17.3_3)		
Mobiele apparaten voor diagnose, reparatie of advies (bijv. digitale camera, smartphone, tablet) (17.3_4)		
Diensten gebaseerd op de analyse van grote databestanden (big data) (17.3_5)		
Andere digitale diensten, nl. (17.3_6)		

[INT: Q CORE]
17.4 **Indien u productgerelateerde diensten aanbiedt, hoe hoog schat u het aandeel daarvan in de totale omzet van 2017?**
(in geval van geen omzet, vul in 0)

◯ Aandeel in totale omzet van diensten die u in 2017 direct, d.w.z. apart, in rekening heeft gebracht (ca. ...%) (1)

◯ Aandeel van diensten die u in 2017 indirect in rekening heeft gebracht (via de productprijs) (ca. ...%) (2)

[INT: Q CORE]
17.5 **Heeft uw bedrijfsvestiging vanaf 2015 nieuwe productgerelateerde diensten aangeboden die geheel nieuw zijn voor uw bedrijfsvestiging of belangrijke verbeteringen bevatten?**

◯ Nee (1)

◯ Ja. Het aandeel in de omzet van 2017 van deze nieuwe productgerelateerde diensten die mijn bedrijf direct of indirect in rekening bracht zijn ca. ...%: (2)

[INT: Q CORE]

nlk18a_3c:	k18a1	k18a2	k18a3
nlk18b_3c:	k18b1	k18b2	k18b3
nlk18c_3c:	k18c1	k18c2	k18c3
nlk18d_3c:	k18d1	k18d2	k18d3
nlk18e_3c:	k18e1	k18e2	k18e3
nlk18f_3c:	k18f1	k18f2	k18f3

18.1 **Welke van de volgende commerciële diensten biedt uw bedrijfsvestiging uw klanten aan?**

	Momenteel toegepast?			Voor het eerst toegepast in
	Nee (1)	Nee, maar toepassinggepland voor 2021 (2)	Ja (3)	(jaar) (1)
Verhuur producten, machines of installaties (18.1_1)				
Full-service contracten met omschreven onderhoudsbepalingen voor uw producten (18.1_2)				
Bediening van de eigen product(en) of installaties voor/bij de klant (bijv. pay on production) (18.1_3)				
Overname van onderhoudsbeheer van de klant voor inzetbaarheids- of kostengarantie (18.1_4)				
Aanbestedingen (levering van middelen zoals samengeperste lucht, licht, warmte, kou, elektriciteit of chemische stoffen) (18.1_5)				
Andere service concepten met prestatie-gebaseerde prijsstelling afhankelijk van gebruik, inzetbaarheid of volume. (18.1_6)				

[INT: Q CORE] k18g
18.2 **Als u een van bovenstaande diensten aanbiedt, geef dan aan welk aandeel deze diensten hadden in uw omzet over 2017.**
(als er geen omzet is gegenereerd, vul dan 0 in)
Aandeel in omzet van 2017 gegenereerd door bovenstaande diensten:

- ◯ ca. ...% van omzet in 2017 (1) ____

[INT: Q CORE] nlk19a_4c: k19a k19b1 k19b2 k19d
19 **Heeft uw bedrijfsvestiging onderzoek en ontwikkelingsactiviteiten (O&O) uitgevoerd of laten uitvoeren door externe partners in 2017?**

- ◯ Nee, wij doen geen O&O (1)
- ◯ Nee, niet in 2017, maar sporadisch doen wij wel O&O (2)
- ◯ Ja, wij hebben in 2017 O&O gedaan of laten doen, maar doen dit niet continu (3)
- ◯ Ja, we doen de laatste drie jaar onafgebroken O&O of laten dit onafgebroken uitvoeren door partners (4)

[INT: Q CORE] k19c
19_omzetpct O&O vertegenwoordigt ca. ...% van de omzet in 2017:

nlk20a1	nlk20a2	nlk20a3	nlk20a4
nlk20b1	nlk20b2	nlk20b3	nlk20b4
nlk20c1	nlk20c2	nlk20c3	nlk20c4
nlk20d1	nlk20d2	nlk20d3	nlk20d4
nlk24e1	nlk24e2	nlk24e3	nlk24e4
nlk28f1	nlk28f2	nlk28f3	nlk28f4
nlk32g1	nlk32g2	nlk32g3	nlk32g4
nlk36h1	nlk36h2	nlk36h3	nlk36h4

/ {NL non core}
20 **Welke van de onderstaande informatiebronnen zijn het meest relevant voor ideeën voor vernieuwing op de vier volgende terreinen?**
(kruis maximaal drie informatiebronnen aan per kolom)

	Nieuwe producten (1)	Nieuwe procestechnologieën (2)	Nieuwe diensten (3)	Nieuwe organisatieconcepten (4)
Intern: Onderzoek & Ontwerp / Engineering (20_1)	☐	☐	☐	☐
Productieafdeling(en) (20_2)	☐	☐	☐	☐
Serviceafdeling(en) (20_3)	☐	☐	☐	☐
Leiding bedrijfsvestiging (20_4)	☐	☐	☐	☐
Extern: Klant/gebruiker (20_5)	☐	☐	☐	☐
Leverancier (20_6)	☐	☐	☐	☐
Onderzoeksinstellingen, universiteiten (20_7)	☐	☐	☐	☐
Conferenties/beurzen (20_8)	☐	☐	☐	☐

End of Block: Block 2

Start of Block: Block 1

[INT: Q CORE] k20b1 k20b2 k20c1 k20c2 k20j

21.1
Hier worden enkele algemene gegevens over uw bedrijfsvestiging gevraagd:

Aantallen

◯ Aantal werknemers (excl. uitzendkrachten) in 2017 (3)
____

◯ Aantal werknemers (excl. uitzendkrachten) in 2015 (4)
____

◯ Uitzendkrachten in 2017 bij uw vestiging (nee, ja)

◯ Gemiddeld aantal uitzendkrachten in 2017 bij uw vestiging (5)
____

Jaartal

◯ Jaar van oprichting, c.q. inschrijving bij de Kamer van Koophandel (13)
____

[INT: Q CORE] k20a1 k20a2 k20d k20e k20f k20g
21.2
Hier worden enkele gegevens over uw bedrijfsvestiging gevraagd:

Geldbedragen (in miljoen €)

◯ Jaaromzet 2017 (in miljoen €) (1) ____

◯ Jaaromzet 2015 (in miljoen €) (2) ____

◯ Inkoop 2017 (ingekochte onderdelen, materialen en diensten) (in miljoen €) (6)
____

◯ Afschrijvingen op machines en installaties in 2017 (zonder grond en gebouwen) (in miljoen €) (7)
____

◯ Investeringen in machines en installaties 2017 (in miljoen €) (10)
____

[INT: Q CORE]] / {NL non core} k20g k20h nlk21a nlk21b
21.3
Hier worden enkele percentages over uw bedrijfsvestiging gevraagd:

Percentages

○ Personeelskosten als percentage van de omzet in 2017 (incl. loonnevenkosten) (ca. %) (9)
____

○ Graad van capaciteitsbenutting (gemiddeld in 2017) (ca. %) (11)
____

○ Totale energiekosten als percentage omzet 2017 (ca. %) (12)
____

○ Aandeel van groene stroom in totale stroomverbruik in 2017 (ca. %) (14)
____

] / {NL non core} nlk20l_7c nlk20m_7c
20Sust **Hoe heeft het stroom-, olie- en gasverbruik van uw bedrijfsvestiging zich ontwikkeld in 2017?**

	Gedaald met 10% of meer (1)	Gedaald met 5-10% (2)	Gedaald met 0-5% (3)	Gelijk gebleven (4)	Gestegen met 0-5% (5)	Gestegen met 5-10% (6)	Gestegen met 10% of meer (7)
Stroomverbruik (20Sust_Stroom)	○	○	○	○	○	○	○
Olie- en gasverbruik (20Sust_OilGas)	○	○	○	○	○	○	○

[INT: Q CORE] nlk20k_2c: k20k1 k20k2 (0= yes)
21webbased **Gebruikt u een web-based platform om uw producten te distribueren? (bijv. digitale marktplaats voor Business-to-Business)**

○ Nee (1)

○ Nee, maar ingebruikname gepland voor 2021 (2)

○ Ja (3)

[INT: Q CORE] nlk20i_5c: k20i1 k20i2 k20i3 k20i4 k20i5
21rendementomzet **Wat is het rendement op de omzet (vóór belasting in 2017)?**

- negatief (1)
- 0 tot 2% (2)
- 2 tot 5% (3)
- 5 tot 10% (4)
- meer dan 10% (5)

[INT: Q CORE] k21a k21c
22 **Heeft uw bedrijf productie of O&O-activiteiten (Onderzoek en Ontwikkeling, R&D) in het buitenland?**

	Nee (1)	Ja (2)
Productie in het buitenland (22_1)	○	○
O&O in het buitenland (22_2)	○	○

[INT: Q CORE] k21b1 k21b2 k21b3
22_1Prod **Hoe zijn de productieactiviteiten verdeeld over de volgende regio's?**
Thuisland : _______ (1)
EU : _______ (2)
Elders : _______ (3)
Total : ________

[INT: Q CORE] k21d1 k21d2 k21d3
22_2R&D **Hoe zijn de O&O-activiteiten verdeeld over de volgende regio's?**
(totaal moet 100% zijn)
Thuisland : _______ (1)
EU : _______ (2)
Elders : _______ (3)
Total : ________

[INT: Q CORE] k22a1 k22a2x k22a3x k22b1 k22b2x k22b3x k22c1 k22c2x k22c3x

23 **Heeft uw bedrijfsvestiging sinds 2016 delen van de productie of delen van Onderzoek en Ontwikkeling (O&O) overgeheveld naar andere bedrijven (uitbesteding) of eigen vestigingen in het buitenland (verplaatsing)?**
(neem alle landen in overweging, indien uw bedrijfsvestiging hierin actief is in meerdere landen)

	Heeft dit plaatsgevonden?			
	Nee (0)	Ja (1)	Naar welk(e) land(en)? (1)	Belangrijkste reden(en) voor verplaatsing (2)
Overheveling naar buitenland sinds 2016 Overhevelen delen van productie (23_offprod)	○	○		
Overhevelen delen van Onderzoek & Ontwikkeling (23_offr&d)	○	○		
Terughalen naar thuisland vanaf buitenland sinds 2016 Terughalen delen van productie (23_backprod)	○	○		

] / {NL non core} nlk24a_5c

24 **Wie is in meerderheid of exclusief eigenaar van het bedrijf waartoe uw bedrijfsvestiging behoort?**

- ○ Directeur eigenaar/familie (1)
- ○ Financiële investeerders (bijv. durfkapitaal) (2)
- ○ Stichting (3)
- ○ Overige eigenaren (4)
- ○ Geen meerderheidseigenaar (5)

] / {NL non core}   nlk24b
24fam **Is de familie actief in het management?**

○ Nee (0)

○ Ja (1)

] / {NL non core; oostnl } nlk25

25 Op welke terreinen ervaart u belangrijke knelpunten bij digitalisering in uw bedrijfsvestiging zelf?
Selecteer de drie belangrijkste INTERNE knelpunten

☐ Eigen kennis over nieuwe digitaliseringstechnologieën (1)

☐ Ontwikkelen van eigen digitaliseringsstrategie (visie, doelstellingen) (2)

☐ Ontwikkelen van nieuwe verdienmodellen \ businesmodellen (3)

☐ Interne onderzoek en ontwikkelingsmogelijkheden (R&D) (4)

☐ Opleiding en vaardigheden eigen personeel (5)

☐ Interne ontwikkeling van digitale productvernieuwingen (6)

☐ Interne ontwikkelen van digitale diensten (7)

☐ Interne mogelijkheden van financiering van digitaliseringen (8)

☐ Doorvoeren van aanpassingen in het productieproces (9)

☐ Overige interne knelpunten, nl. (10) ____

] / {NL non core; oostnl} nlk25

26 Op welke terreinen ervaart u belangrijke knelpunten bij digitalisering in uw omgeving? Selecteer de drie belangrijkste EXTERNE knelpunten

- ▢ Ondersteuning vanuit ICT-bedrijven (1)
- ▢ Ondersteuning vanuit organisaties als KvK, Oost NL, Rijksdienst voor Ondernemend Nederland (RVO) (2)
- ▢ Werving en selectie personeel met kennis van digitalisering (3)
- ▢ Externe financiering van digitaliseringen in de productie (machines, installaties, gereedschappen) (4)
- ▢ Samenwerkingsmogelijkheden met partners in de waardeketen (toeleveranciers, afnemers) (5)
- ▢ Afzetmogelijkheden van digitale productvernieuwingen (6)
- ▢ Afzetmogelijkheden van betaalde digitale diensten (7)
- ▢ Overige externe knelpunten, nl. (8) ____

End of Block: Block 1

Appendix II: SPSS output descriptive statistics

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	< 20 employees	33	21,3	21,3	21,3
	20 to 49 employees	59	38,1	38,1	59,4
	50 to 99 employees	36	23,2	23,2	82,6
	100 to 249 employees	23	14,8	14,8	97,4
	> 250 employees	4	2,6	2,6	100,0
	Total	155	100,0	100,0	

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Firm size	155	10,00	320,00	61,2129	62,25492	2,089	,195	4,265	,387
Firm size LOG	155	2,30	5,77	3,7270	,85535	,409	,195	-,557	,387
Valid N (listwise)	155								

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	< 10 years (2007-2017)	10	6,5	6,7	6,7
	between 10 and 25 years (1992-2006)	50	32,3	33,6	40,3
	between 25 and 50 years (1967-1991)	40	25,8	26,8	67,1
	between 50 and 75 years (1942-1966)	27	17,4	18,1	85,2
	between 75 and 100 years (1917-1941)	7	4,5	4,7	89,9
	> 100 years (before 1916)	15	9,7	10,1	100,0
	Total	149	96,1	100,0	
Missing	System	6	3,9		
Total		155	100,0		

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
FIRM_AGE	149	3,00	205,00	44,4228	34,01911	1,562	,199	3,043	,395
Firm age LOG	149	1,10	5,32	3,5063	,81008	-,559	,199	,814	,395
Valid N (listwise)	149								

industry

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	metal	32	20,6	20,6	20,6
	Food	13	8,4	8,4	29,0
	textile	22	14,2	14,2	43,2
	construction	3	1,9	1,9	45,2
	chemical	21	13,5	13,5	58,7
	machinery	25	16,1	16,1	74,8
	electronic	39	25,2	25,2	100,0
	Total	155	100,0	100,0	

Appendix III: SPSS output univariate analysis

Organizational concepts - Standardized and detailed work instructions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	92	59,4	59,7	59,7
	yes	62	40,0	40,3	100,0
	Total	154	99,4	100,0	
Missing	System	1	,6		
Total		155	100,0		

Organizational concepts - Measures to improve internal logistics

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	99	63,9	63,9	63,9
	yes	56	36,1	36,1	100,0
	Total	155	100,0	100,0	

Organizational concepts - Fixed process flows to reduce setup time or optimize change-over time

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	124	80,0	81,0	81,0
	yes	29	18,7	19,0	100,0
	Total	153	98,7	100,0	
Missing	System	2	1,3		
Total		155	100,0		

Organizational concepts - Integration of tasks

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	91	58,7	58,7	58,7
	yes	64	41,3	41,3	100,0
	Total	155	100,0	100,0	

Organizational concepts - Production controlling following the Pull principle

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	99	63,9	64,3	64,3
	yes	55	35,5	35,7	100,0
	Total	154	99,4	100,0	
Missing	System	1	,6		
Total		155	100,0		

Organizational concepts - Display boards in production to illustrate work processes and work status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	103	66,5	66,9	66,9
	yes	51	32,9	33,1	100,0
	Total	154	99,4	100,0	
Missing	System	1	,6		
Total		155	100,0		

Organizational concepts - Methods of assuring quality in production

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	70	45,2	45,8	45,8
	yes	83	53,5	54,2	100,0
	Total	153	98,7	100,0	
Missing	System	2	1,3		
Total		155	100,0		

Organizational concepts - Certified quality standards

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	69	44,5	44,8	44,8
	yes	85	54,8	55,2	100,0
	Total	154	99,4	100,0	
Missing	System	1	,6		
Total		155	100,0		

Organizational concepts - Certified energy management system

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	146	94,2	94,8	94,8
	yes	8	5,2	5,2	100,0
	Total	154	99,4	100,0	
Missing	System	1	,6		
Total		155	100,0		

Organizational concepts - Methods of operation management for mathematical analyses of production

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	141	91,0	91,6	91,6
	yes	13	8,4	8,4	100,0
	Total	154	99,4	100,0	
Missing	System	1	,6		
Total		155	100,0		

Organizational concepts - Certified environmental management system

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	115	74,2	75,2	75,2
	yes	38	24,5	24,8	100,0
	Total	153	98,7	100,0	
Missing	System	2	1,3		
Total		155	100,0		

Organizational concepts - Instruments to promote staff loyalty

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	60	38,7	38,7	38,7
	yes	95	61,3	61,3	100,0
	Total	155	100,0	100,0	

Organizational concepts - Training on the job

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	68	43,9	44,2	44,2
	yes	86	55,5	55,8	100,0
	Total	154	99,4	100,0	
Missing	System	1	,6		
Total		155	100,0		

Organizational concepts - Experimentation for employees in the production

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	96	61,9	61,9	61,9
	yes	59	38,1	38,1	100,0
	Total	155	100,0	100,0	

Organizational concepts - Instruments to maintain elderly employees

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	97	62,6	62,6	62,6
	yes	58	37,4	37,4	100,0
	Total	155	100,0	100,0	

Organizational concepts - Broad-based employee financial participation schemes

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	125	80,6	80,6	80,6
	yes	30	19,4	19,4	100,0
	Total	155	100,0	100,0	

Organizational capabilities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	,00	10	6,5	6,5	6,5
	1,00	14	9,0	9,0	15,5
	2,00	11	7,1	7,1	22,6
	3,00	14	9,0	9,0	31,6
	4,00	9	5,8	5,8	37,4
	5,00	15	9,7	9,7	47,1
	6,00	20	12,9	12,9	60,0
	7,00	13	8,4	8,4	68,4
	8,00	20	12,9	12,9	81,3
	9,00	10	6,5	6,5	87,7
	10,00	9	5,8	5,8	93,5
	11,00	2	1,3	1,3	94,8
	12,00	3	1,9	1,9	96,8
	14,00	4	2,6	2,6	99,4
	15,00	1	,6	,6	100,0
	Total	155	100,0	100,0	

Technological process capabiliies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	,00	1	,6	,6	,6
	1,00	11	7,1	7,1	7,7
	2,00	16	10,3	10,3	18,1
	3,00	25	16,1	16,1	34,2
	4,00	15	9,7	9,7	43,9
	5,00	19	12,3	12,3	56,1
	6,00	7	4,5	4,5	60,6
	7,00	21	13,5	13,5	74,2
	8,00	11	7,1	7,1	81,3
	9,00	9	5,8	5,8	87,1
	10,00	6	3,9	3,9	91,0
	11,00	5	3,2	3,2	94,2
	12,00	5	3,2	3,2	97,4
	13,00	2	1,3	1,3	98,7
	14,00	1	,6	,6	99,4
	15,00	1	,6	,6	100,0
	Total	155	100,0	100,0	

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Organizational capabilities	155	,00	15,00	5,6065	3,47626	,285	,195	-,355	,387
Technological process capabiliies	155	,00	15,00	5,5548	3,25365	,598	,195	-,306	,387
Valid N (listwise)	155								

Technologies - Mobile/wireless devices for programming and controlling facilities and machinery

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	118	76,1	76,6	76,6
	yes	36	23,2	23,4	100,0
	Total	154	99,4	100,0	
Missing	System	1	,6		
Total		155	100,0		

Technologies - Digital solutions to provide drawings, work schedules or work instructions directly on the shop floor

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	93	60,0	60,8	60,8
	yes	60	38,7	39,2	100,0
	Total	153	98,7	100,0	
Missing	System	2	1,3		
Total		155	100,0		

Technologies - Software for production planning and scheduling

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	58	37,4	37,7	37,7
	yes	96	61,9	62,3	100,0
	Total	154	99,4	100,0	
Missing	System	1	,6		
Total		155	100,0		

Technologies - Product-Lifecycle-Management-Systems or Product/Process Data Management

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	140	90,3	90,9	90,9
	yes	14	9,0	9,1	100,0
	Total	154	99,4	100,0	
Missing	System	1	,6		
Total		155	100,0		

Technologies - Digital Exchange of product/process data with suplliers/ customers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	114	73,5	73,5	73,5
	yes	41	26,5	26,5	100,0
	Total	155	100,0	100,0	

Technologies - Near real-time production control system

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	127	81,9	82,5	82,5
	yes	27	17,4	17,5	100,0
	Total	154	99,4	100,0	
Missing	System	1	,6		
Total		155	100,0		

Technologies - Systems for automation and management of internal logistics

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	136	87,7	88,3	88,3
	yes	18	11,6	11,7	100,0
	Total	154	99,4	100,0	
Missing	System	1	,6		
Total		155	100,0		

Technologies - Virtual Reality or simulation for product design or product development

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	135	87,1	87,1	87,1
	yes	20	12,9	12,9	100,0
	Total	155	100,0	100,0	

Technologies - Industrial robots for manufacturing processes

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	109	70,3	71,7	71,7
	yes	43	27,7	28,3	100,0
	Total	152	98,1	100,0	
Missing	System	3	1,9		
Total		155	100,0		

Technologies - Industrial robots for handling processes

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	120	77,4	78,4	78,4
	yes	33	21,3	21,6	100,0
	Total	153	98,7	100,0	
Missing	System	2	1,3		
Total		155	100,0		

Technologies - 3D printing technologies for prototyping

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	133	85,8	85,8	85,8
	yes	22	14,2	14,2	100,0
	Total	155	100,0	100,0	

Technologies - 3D printing technologies for manufacturing of products, components and forms, tools, etc

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	143	92,3	92,3	92,3
	yes	12	7,7	7,7	100,0
	Total	155	100,0	100,0	

Technologies - Technologies for recycling and re-use of water

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	128	82,6	83,1	83,1
	yes	26	16,8	16,9	100,0
	Total	154	99,4	100,0	
Missing	System	1	,6		
Total		155	100,0		

Technologies - Technologies to recuperate kinetic and process energy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	128	82,6	83,1	83,1
	yes	26	16,8	16,9	100,0
	Total	154	99,4	100,0	
Missing	System	1	,6		
Total		155	100,0		

Technologies - Energy technologies for transition from fosile to non-fosile energy carriers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	141	91,0	91,0	91,0
	yes	14	9,0	9,0	100,0
	Total	155	100,0	100,0	

Technologies - to generate one' s own energy, heat using solar, wind, water, bio-mass or geothermal energy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	123	79,4	79,4	79,4
	yes	32	20,6	20,6	100,0
	Total	155	100,0	100,0	

Technologies - Switching off components, machinery or equipment during periods of non-use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	100	64,5	64,5	64,5
	yes	55	35,5	35,5	100,0
	Total	155	100,0	100,0	

Technologies - Upgrading existing machinery or equipment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	124	80,0	80,0	80,0
	yes	31	20,0	20,0	100,0
	Total	155	100,0	100,0	

Tech, use industrial robots

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	98	63,2	63,2	63,2
	yes	57	36,8	36,8	100,0
	Total	155	100,0	100,0	

use machines or systems in your production that automatically store operating data

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	89	57,4	57,4	57,4
	yes	66	42,6	42,6	100,0
	Total	155	100,0	100,0	

Use web-based platform for distribution of your products

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	135	87,1	91,2	91,2
	yes	13	8,4	8,8	100,0
	Total	148	95,5	100,0	
Missing	System	7	4,5		
Total		155	100,0		

Product-service innovation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	122	78,7	81,9	81,9
	yes	27	17,4	18,1	100,0
	Total	149	96,1	100,0	
Missing	System	6	3,9		
Total		155	100,0		

Product innovation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	82	52,9	52,9	52,9
	yes	73	47,1	47,1	100,0
	Total	155	100,0	100,0	

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No innovation	76	49,0	49,0	49,0
	Only product innovation	52	33,5	33,5	82,6
	Only product-service innovation	6	3,9	3,9	86,5
	Both innovation types	21	13,5	13,5	100,0
	Total	155	100,0	100,0	

Descriptive Statistics

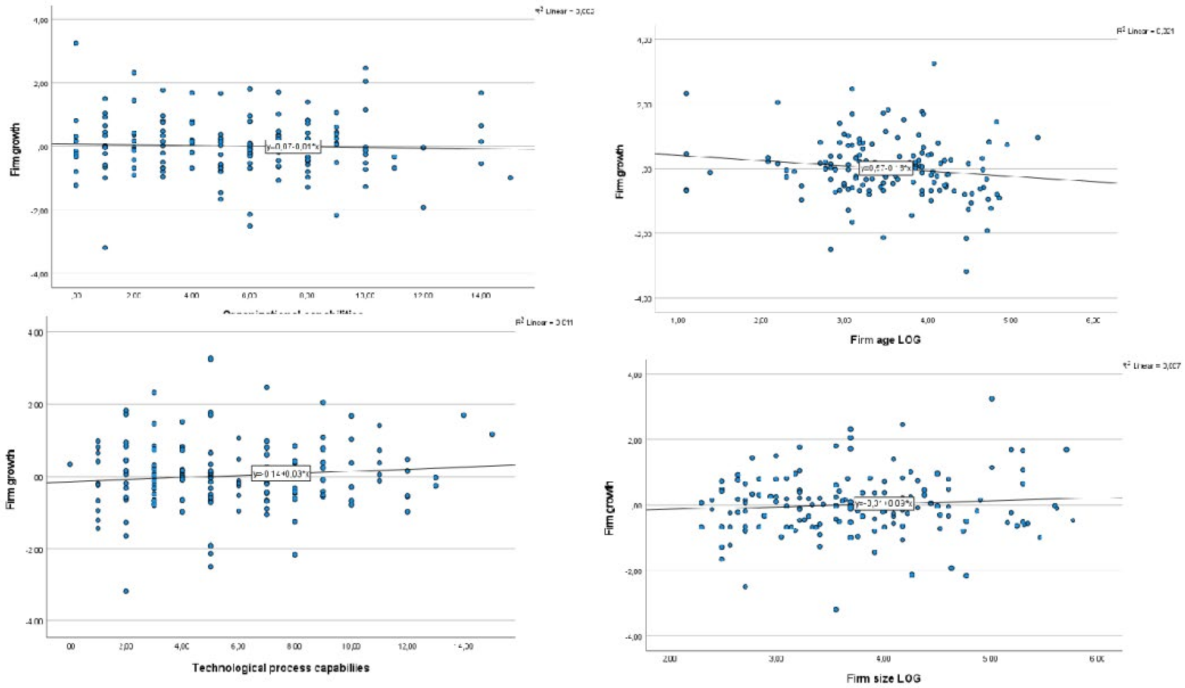
	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Revenue_growth	127	-33,33	150,00	22,5615	27,35072	2,011	,215	6,951	,427
ln_RGnew	127	3,60	5,39	4,4911	,26727	,279	,215	2,575	,427
Employee_growth	152	-30,00	100,00	13,8438	20,24556	1,368	,197	3,879	,391
ln_Eg	152	3,81	5,16	4,4633	,21553	,242	,197	1,534	,391
Firm growth	155	-3,19	3,25	,0163	,90920	,147	,195	1,920	,387
Valid N (listwise)	124								

Appendix IV: Correlation table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Organizational capabilities	1													
2. Technological capabilities	**.517****	1												
3. Firm Growth	-.040	.103	1											
4. Product innovation	**.193***	**.225****	.068	1										
5. Product-service innovation	.161	.160	.095	**.284****	1									
6. Firm age	-.039	.029	-.145	-.036	-.042	1								
7. Firm size	**.294****	**.433****	.083	.135	-.073	**.171***	1							
8. Metal industry	-.002	.065	-.032	.098	-.119	**.197***	-.027	1						
9. Food industry	.075	.113	.006	.134	.053	.060	.140	-.154	1					
10. Textile industry	.025	-.081	-.111	-.013	.001	.041	-.089	**-.207****	-.123	1				
11. Construction industry	-.038	.005	.124	-.039	-.067	-.134	.035	-.072	-.043	-.057	1			
12. Chemical industry	.094	.008	-.052	-.071	.019	**-.162***	-.091	-.202*	-.120	**-.161***	-.056	1		
13. Machinery industry	**-.224****	-.053	.164*	.113	-.048	-063	-.099	**-.224****	-.133	**-.178***	-.062	**-.174***	1	
14. Electronic industry	.062	-.030	-.022	-.011	.124	-.032	-.017	**-.296****	**-.175***	**-.236****	-.081	**-.230****	**-.254****	1

*Pearson correlation table; **p<0.01, *p<0.05*

Appendix V: Linearity between independent variables



Appendix VI: SPSS Output first analysis

Model Summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	,271[a]	,074	,023	,89880	,074	1,448	8	146	,181	
2	,310[b]	,096	,020	,90024	,022	,883	4	142	,476	
3	,398[c]	,158	,060	,88128	,062	2,544	4	138	,042	,806

Residuals Statistics[a]

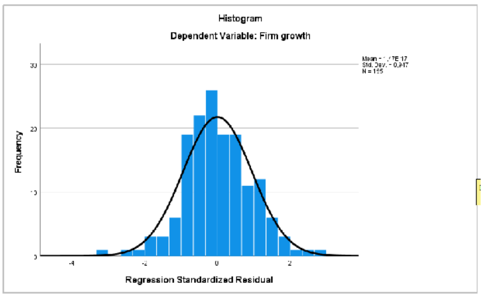
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-1,1218	,9677	,0163	,36150	155
Residual	-2,89546	2,35215	,00000	,83424	155
Std. Predicted Value	-3,148	2,632	,000	1,000	155
Std. Residual	-3,286	2,669	,000	,947	155

a. Dependent Variable: Firm growth

ANOVA[a]

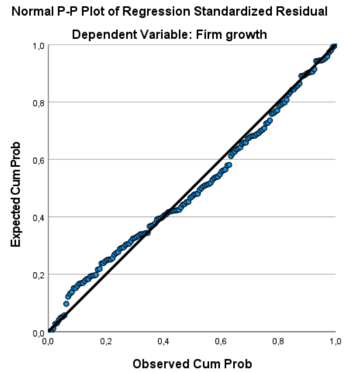
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9,359	8	1,170	1,448	,181[b]
	Residual	117,944	146	,808		
	Total	127,304	154			
2	Regression	12,222	12	1,019	1,257	,251[c]
	Residual	115,082	142	,810		
	Total	127,304	154			
3	Regression	20,125	16	1,258	1,620	,071[d]
	Residual	107,179	138	,777		
	Total	127,304	154			

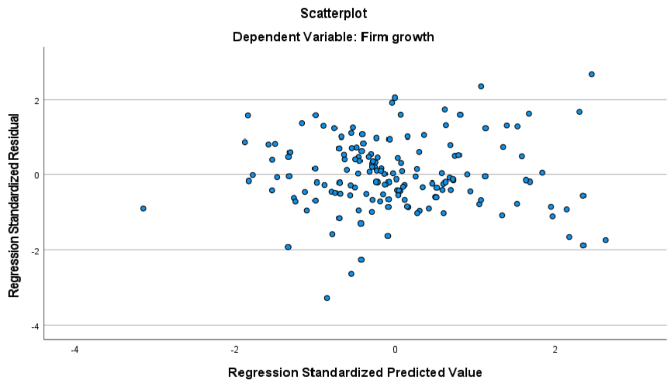
a. Dependent Variable: Firm growth



Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	VIF
1	(Constant)	,079	,179		,444	,658		
	FIRM_AGE	-,004	,002	-,144	-1,734	,085	,914	1,094
	Firm size	,001	,001	,063	,764	,446	,929	1,077
	Metal industry	,044	,218	,019	,200	,842	,671	1,489
	Food industry	,059	,296	,018	,201	,841	,776	1,288
	Textile industry	-,155	,242	-,060	-,640	,523	,732	1,366
	Chemical industry	-,114	,245	-,043	-,466	,642	,743	1,345
	Machinery industry	,395	,232	,160	1,700	,091	,714	1,400
	Construction industry	,784	,539	,119	1,454	,148	,944	1,059
2	(Constant)	,011	,231		,049	,961		
	FIRM_AGE	-,004	,002	-,144	-1,707	,090	,892	1,121
	Firm size	,001	,001	,054	,596	,552	,768	1,303
	Metal industry	,054	,222	,024	,245	,807	,649	1,540
	Food industry	,033	,298	,010	,112	,911	,768	1,303
	Textile industry	-,125	,243	-,048	-,516	,606	,729	1,373
	Chemical industry	-,094	,246	-,035	-,380	,704	,737	1,357
	Machinery industry	,368	,242	,149	1,522	,130	,663	1,509
	Construction industry	,801	,544	,122	1,472	,143	,930	1,075
	Product innovation	,023	,158	,012	,142	,887	,837	1,194
	Product-service innovation	,234	,206	,097	1,136	,258	,866	1,154
	Organizational capabilities	-,029	,026	-,110	-1,114	,267	,648	1,543
	Technological process capabiliies	,033	,028	,117	1,177	,241	,644	1,554
3	(Constant)	,080	,270		,295	,769		
	FIRM_AGE	-,004	,002	-,156	-1,883	,062	,884	1,132
	Firm size	,001	,001	,050	,553	,581	,736	1,359
	Metal industry	,049	,218	,022	,222	,824	,643	1,555
	Food industry	,021	,296	,007	,073	,942	,743	1,346
	Textile industry	-,136	,241	-,052	-,564	,574	,706	1,416
	Chemical industry	-,124	,246	-,047	-,504	,615	,705	1,419
	Machinery industry	,267	,239	,109	1,118	,266	,647	1,546
	Construction industry	,783	,534	,119	1,467	,145	,926	1,080
	Product innovation	,063	,157	,035	,402	,688	,821	1,218
	Product-service innovation	,069	,218	,029	,315	,753	,741	1,350
	Organizational capabilities	,016	,034	,061	,466	,642	,359	2,786
	Technological process capabiliies	-,021	,038	-,074	-,543	,588	,328	3,049
	Product innovation*Technological process capabilities	,431	,186	,332	2,316	,022	,296	3,373
	Product innovation* Organizational capabilities	-,503	,187	-,392	-2,694	,008	,287	3,478
	Product-service innovation * Technological process capablities	-,073	,209	-,039	-,351	,726	,494	2,023
	Product-service innovation * Organizational capabilities	,556	,278	,218	2,001	,047	,515	1,943

a. Dependent Variable: Firm growth





Appendix VII: SPSS Output second analysis

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	,310[a]	,096	,020	,90024	,096	1,257	12	142	,251	
2	,323[b]	,104	,015	,90240	,008	,661	2	140	,518	,750

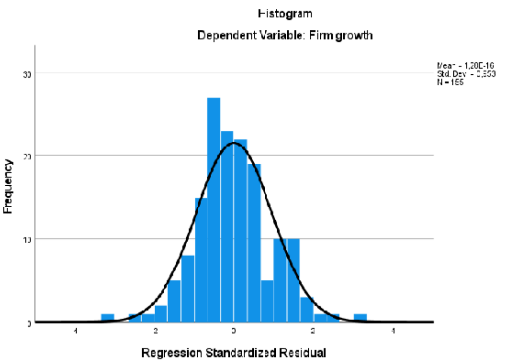
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-,6126	,9137	,0163	,29386	155
Residual	-2,97753	2,81283	,00000	,86040	155
Std. Predicted Value	-2,140	3,054	,000	1,000	155
Std. Residual	-3,300	3,117	,000	,953	155

a. Dependent Variable: Firm growth

ANOVA[a]

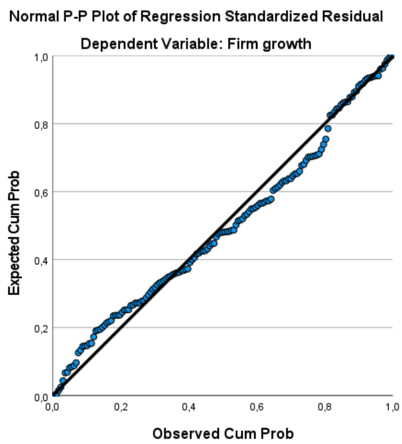
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	12,222	12	1,019	1,257	,251[b]
	Residual	115,082	142	,810		
	Total	127,304	154			
2	Regression	13,299	14	,950	1,167	,308[c]
	Residual	114,005	140	,814		
	Total	127,304	154			

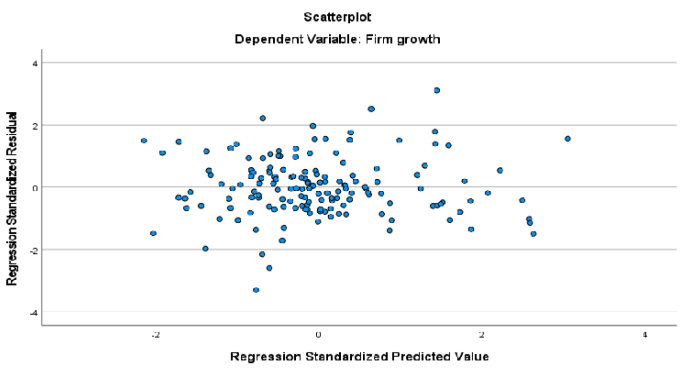


Coefficients[a]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	VIF
1	(Constant)	,011	,231		,049	,961		
	FIRM_AGE	-,004	,002	-,144	-1,707	,090	,892	1,121
	Firm size	,001	,001	,054	,596	,552	,768	1,303
	Metal industry	,054	,222	,024	,245	,807	,649	1,540
	Food industry	,033	,298	,010	,112	,911	,768	1,303
	Textile industry	-,125	,243	-,048	-,516	,606	,729	1,373
	Chemical industry	-,094	,246	-,035	-,380	,704	,737	1,357
	Machinery industry	,368	,242	,149	1,522	,130	,663	1,509
	Construction industry	,801	,544	,122	1,472	,143	,930	1,075
	Product innovation	,023	,158	,012	,142	,887	,837	1,194
	Product-service innovation	,234	,206	,097	1,136	,258	,866	1,154
	Organizational capabilities	-,029	,026	-,110	-1,114	,267	,648	1,543
	Technological process capabiliies	,033	,028	,117	1,177	,241	,644	1,554
2	(Constant)	,100	,245		,409	,683		
	FIRM_AGE	-,004	,002	-,144	-1,705	,090	,892	1,121
	Firm size	,001	,001	,035	,373	,710	,741	1,349
	Metal industry	,053	,225	,024	,238	,812	,635	1,575
	Food industry	-,018	,303	-,006	-,060	,952	,746	1,340
	Textile industry	-,155	,245	-,060	-,635	,527	,720	1,389
	Chemical industry	-,107	,252	-,040	-,423	,673	,708	1,412
	Machinery industry	,343	,244	,139	1,405	,162	,650	1,539
	Construction industry	,800	,546	,122	1,466	,145	,929	1,077
	Product innovation	-,003	,170	-,002	-,016	,987	,729	1,372
	Product-service innovation	,247	,228	,103	1,083	,281	,706	1,417
	Organizational capabilities	-,037	,027	-,141	-1,370	,173	,605	1,654
	Technological process capabiliies	,026	,029	,094	,912	,363	,608	1,643
	Product innovation*technological process capabilites*organizational capabilities	,097	,097	,100	1,000	,319	,641	1,560
	Product-service innovation*technological process capabilites*organizational capabilities	,081	,168	,045	,484	,629	,727	1,376

a. Dependent Variable: Firm growth





Appendix VIII: SPSS Output third analysis

Model Summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	,310[a]	,096	,020	,90024	,096	1,257	12	142	,251	
2	,314[b]	,099	,016	,90199	,003	,450	1	141	,503	
3	,322[c]	,104	,014	,90282	,005	,739	1	140	,391	,748

Residuals Statistics[a]

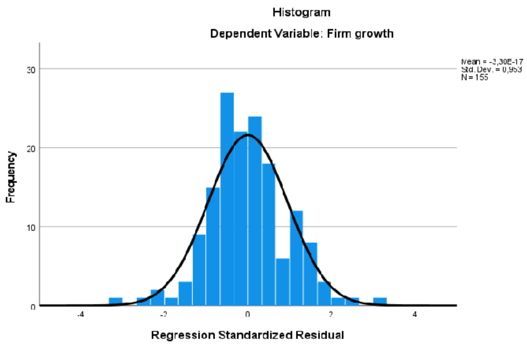
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-,5623	,9180	,0163	,29267	155
Residual	-2,95359	2,76996	,00000	,86081	155
Std. Predicted Value	-1,977	3,081	,000	1,000	155
Std. Residual	-3,271	3,068	,000	,953	155

a. Dependent Variable: Firm growth

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	12,222	12	1,019	1,257	,251[b]
	Residual	115,082	142	,810		
	Total	127,304	154			
2	Regression	12,588	13	,968	1,190	,292[c]
	Residual	114,716	141	,814		
	Total	127,304	154			
3	Regression	13,191	14	,942	1,156	,316[d]
	Residual	114,113	140	,815		
	Total	127,304	154			

a. Dependent Variable: Firm growth



Coefficients[a]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	VIF
1	(Constant)	,011	,231		,049	,961		
	FIRM_AGE	-,004	,002	-,144	-1,707	,090	,892	1,121
	Firm size	,001	,001	,054	,596	,552	,768	1,303
	Metal industry	,054	,222	,024	,245	,807	,649	1,540
	Food industry	,033	,298	,010	,112	,911	,768	1,303
	Textile industry	-,125	,243	-,048	-,516	,606	,729	1,373
	Chemical industry	-,094	,246	-,035	-,380	,704	,737	1,357
	Machinery industry	,368	,242	,149	1,522	,130	,663	1,509
	Construction industry	,801	,544	,122	1,472	,143	,930	1,075
	Product innovation	,023	,158	,012	,142	,887	,837	1,194
	Product-service innovation	,234	,206	,097	1,136	,258	,866	1,154
	Organizational capabilities	-,029	,026	-,110	-1,114	,267	,648	1,543
	Technological process capabiliies	,033	,028	,117	1,177	,241	,644	1,554
2	(Constant)	,020	,232		,087	,931		
	FIRM_AGE	-,004	,002	-,143	-1,683	,095	,891	1,122
	Firm size	,001	,001	,052	,566	,572	,766	1,305
	Metal industry	,024	,227	,011	,108	,914	,624	1,602
	Food industry	-,026	,311	-,008	-,083	,934	,706	1,416
	Textile industry	-,146	,245	-,056	-,597	,552	,717	1,395
	Chemical industry	-,111	,248	-,042	-,447	,656	,729	1,371
	Machinery industry	,344	,245	,140	1,407	,162	,649	1,541
	Construction industry	,785	,546	,119	1,438	,153	,928	1,077
	Product innovation	,073	,176	,040	,416	,678	,683	1,464
	Product-service innovation	,463	,399	,193	1,160	,248	,231	4,321
	Organizational capabilities	-,030	,026	-,115	-1,153	,251	,645	1,549
	Technological process capabiliies	,032	,028	,115	1,153	,251	,643	1,555
	Product innovation* Product-service innovation	-,319	,475	-,120	-,671	,503	,199	5,022
3	(Constant)	,058	,236		,246	,806		
	FIRM_AGE	-,004	,002	-,146	-1,724	,087	,889	1,125
	Firm size	,001	,001	,049	,534	,594	,765	1,307
	Metal industry	,011	,227	,005	,050	,960	,622	1,609
	Food industry	-,042	,312	-,013	-,134	,894	,704	1,421
	Textile industry	-,152	,246	-,058	-,619	,537	,716	1,396
	Chemical industry	-,138	,250	-,052	-,553	,581	,717	1,394
	Machinery industry	,309	,248	,125	1,246	,215	,631	1,584
	Construction industry	,765	,547	,116	1,399	,164	,927	1,079
	Product innovation	,083	,176	,046	,472	,637	,680	1,471
	Product-service innovation	,475	,399	,198	1,190	,236	,231	4,327
	Organizational capabilities	-,034	,026	-,130	-1,288	,200	,625	1,601
	Technological process capabiliies	,033	,028	,116	1,167	,245	,643	1,556
	Product innovation* Product-service innovation	-,380	,481	-,144	-,791	,430	,195	5,137
	Product*product-service*organizational capabilities*technological process capabilities	,276	,321	,073	,860	,391	,884	1,132

a. Dependent Variable: Firm growth