“Going for gold by going green?”

A study about the relation between energy and material saving activities and the financial performance of organizations.

Radboud Universiteit Nijmegen

Master Thesis 2019-2020
Master: Innovation & Entrepreneurship
Iris van Marle – 4559649
Supervisor: dr. Peter Vaessen
Examiner: dr. Robert Kok
15-06-2020

Abstract

This study researches the relation between energy and material saving activities and business performance. The theory of Hart and Dowell (2011) regarding pollution prevention strategies forms the theoretical background for this study. Literature does not agree upon the nature of the relation between sustainable activities and business performance, some studies outline a neutral relation, whether other studies state that a negative relation is present. This study aims to address this inconsistency by researching the influence of energy and material saving activities on the revenue outcomes and production costs of manufacturing firms in the Netherlands. Additionally, this study aims to understand how the moderating effects of organisational capabilities and searching for sustainable practices influence the relation between energy and material saving activities and revenue/production cost changes. The regression analysis and several post-hoc analyses show that autonomously investing in energy and material saving activities does not result in revenue growth or reductions in production costs. The possession of organisational capabilities does not have an influence on this relation. However, a search for energy and material saving activities that is motivated by laws and regulations results in production cost savings or revenue growth. Prerequisites for this relation are that regulatory forces highly motivate companies to search, are effective enough to overcome organisational inertia, and customers should be aware of the sustainable activities of companies. Contrary, voluntary searching for energy and material saving activities results in production cost increasements in situations with high searching costs.

Table of Contents

1. Introduction

The effects of global warming are starting to become visible in the world. The temperature of the earth is rising which results in several problems such as heatwaves and drought (Masson-Delmotte et al., 2018). The recent bushfire crisis in Australia is a concrete example of the effects of climate change, and scientists expect such a crisis to occur more frequently in the future (BBC NEWS, 2019). Many manufacturing organizations contribute to these environmental problems with their business processes (Dummett, 2006). Companies can decrease the negative impact on the environment by implementing sustainable activities (Sindhi & Kumar, 2012). However, many companies do not implement sustainable activities, as managers associate sustainable activities with higher costs (Epstein & Buhovac, 2010). A manner to convince companies to put in place sustainable activities is by explaining what underlying factors cause these higher costs, or by showing them that these activities result in higher financial performance. Consequently, this study focuses on the relation between sustainable activities and the financial performance of organizations.

This study is in line with the personal interests of the researcher. The researcher is convinced that everybody needs to contribute to the solution of global warming. A proven positive relation between implementing sustainable activities and financial performance might stimulate companies to invest in these activities, and consequently decrease the environmental footprint made by companies. When a negative relation is identified research can provide an insight in the underlying dimensions that cause this negative relation. Managers can use this knowledge to overcome the negative effects that these dimensions cause. Both outcomes contribute to the personal aspiration of the researcher to make the world more sustainable and contribute to the problem of global warming.

Previous literature does not agree on the relationship between the implementation of sustainable activities and financial performance. There are studies that do not find a clear positive relationship between these concepts (Walley & Whitehead, 1994). Contradictory, there are also two main approaches that substantiate the positive relationship between sustainable activities and financial performance (Zeng, Meng, Yin, Tam & Sun, 2010). Porter and Kramer (2006) introduced the concept of shared value, which states that companies should incorporate practices that improve the environmental situation. Additionally, the authors state that these practices create competitive advantages and therefore are beneficial for the profitability of companies. Companies can create shared value “by reconceiving products and markets, redefining productivity in the value chain, and building supportive industry clusters at the

company's locations." (Porter & Kramer, 2011, p. 7). The natural-resource-based view (NRBV) initiated by Hart builds on the reasoning of Porter and Kramer. The NRBV also suggests that implementing environmental responsible activities leads to a competitive advantage, and consequently higher financial performance (Chan, 2005). The NRBV also identifies strategies to achieve this competitive advantage: pollution prevention (prevent waste and emissions), product stewardship (decrease environmental impact during life-cycle product), clean technologies (develop radical innovative technologies for future production processes) and base of the pyramid (increase quality of life underprivileged) (Hart, 1995; Hart & Dowell, 2011). Hart and Dowell (2011) differentiate their theory from that of Porter and Kramer by identifying two factors that are essential for the positive impact of pollution prevention strategies on the financial performance of firms: organizational capabilities and cognition & framing. Organizational capabilities are a company's competences to utilize its resources to respond to altering situations (Teece, 2012). This study considers the following organizational capabilities: engagement with the organization's employees or environment, and the creation of knowledge through internal or external collaboration (Eisenhardt & Martin, 2000). Additionally, cognition & framing can be defined as the motivation of managers to search for pollution prevention strategies caused by beneficial expectations related to these strategies (Hart & Dowell, 2011). This study takes into account the following beneficial expectations: energy expenses, strategical benefits, reductions in greenhouse gas emissions, increases in the amount of energy sources or regulatory benefits. In accordance with the NRBV this study focusses on a specific approach of pollution prevention, namely the implementation of energy and material saving activities.

This study intends to contribute to the scientific debate by studying the relationship between the implementation of energy and material saving activities and financial performance within the context of the Dutch manufacturing industry. With this research this study aims to gain an insight in the nature and the structure of this relationship. By gaining an insight in the structure of the relation, this study can identify what conditions cause a positive and what conditions cause a negative relation. Furthermore, the research aims to understand how the moderating effects of organizational capabilities and cognition & framing influence this relation. By understanding these moderating effects, this study can explain if and how these conditions increase the effect of energy and material saving activities on financial performance.

As a result of this research goal, the following research question can be formulated: *"To what extent, and in what way are financial benefits of adopting energy and material saving activities dependent upon a company's organizational capabilities and managerial cognition & framing?"*

It can be concluded that researchers disagree with each other whether the relation between sustainable activities and financial performance is positive or neutral. This study makes itself scientifically relevant as it addresses this inconsistency and examines conditions under which investments in energy and material saving activities might generate financial benefits to firms. Managers of companies that already experience a positive relation can use the outcome of this study. Managers can put in place the organizational capabilities and cognition & framing mindset that increase the positive influence of energy and material saving activities on the financial performance of their organizations. Companies that do not benefit from energy and material saving activities can use these insights of this study as well. By identifying how the relationship between energy and material saving activities and financial performance is formed, the study also gains an insight in the negative factors that influence the relationship. Managers can use this information to overcome the practices that cause this negative relation. These possible managerial implementations make the study practically relevant as well.

To answer this research question, this study will be organized as follows. First of all, a theoretical framework will be provided. The theoretical framework will address the influence of sustainable activities on financial performance by explaining the natural resource based view. Additionally, a quantitative study will be conducted to investigate the amount of influence energy and material saving activities have on the financial performance of firms, and how much this relationship is moderated by organizational capabilities and cognition & framing. Furthermore, a qualitative study will be conducted to investigate how energy and material saving activities influence the financial performance of organizations, and how organizational capabilities and cognition & framing influence this relation. Finally, a conclusion and discussion will be provided.

2. Theoretical framework

This chapter outlines the theoretical framework of this study. The first paragraph of this chapter explains the relation between energy and material saving activities and financial performance as proposed by the NRBV. This section also explains the concepts 'energy and material saving activities' and 'financial performance'. Paragraph 2.2 and 2.3 explain the moderating influences of 'organisational capabilities' and 'cognition & framing'. The final paragraph of this chapter provides a summary of the theoretical framework.

2.1 The Natural-Resource-Based View

As already explained, there are two main theories that aim to explain the relationship between sustainable activities and financial performance (Zeng et al., 2010). The theory of shared value outlines a new business strategy were companies can improve their competitive advantage and thereby improving both their own financial position and the circumstances of their environment (Beschorner, 2013). The NRBV also states that the implementation of sustainable strategies leads to a competitive advantage for firms, and consequently to increased financial performance (Tate & Bals, 2016). However, Hart and Dowell (2011) differentiate the NRBV from the theory of Shared Value by defining conditions that must be present in order for one of these strategies (pollution prevention) to result in improved financial performance. The defining of these conditions makes the NRBV more suitable for this study. An aspect of this study aims to focus on the conditions that are required for the presence of a positive relation between the implementation of energy and material saving activities and financial performance. The conditions defined by Hart and Dowell (2011) form an excellent starting point for this study. Considering this argumentation, this study will utilize the NRBV for the theoretical framework of its research.

The NRBV is based upon the resource based view (RBV) (Shi, Koh, Baldwin, & Cucchiella, 2012). The RBV outlines how companies can achieve a sustainable competitive advantage, namely by making use of its own resources (Fahy, 2000). The resources of an organization can be described as "all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness" (Barney, 1991, p. 101).

The RBV is based upon two basic assumptions. First of all, the theory states that companies within one sector may deploy different resources. Secondly, the resources that organisations

possess might be difficult to transfer between firms, making the differentiation between firms durable (Kraaijenbrink, Spender & Groen, 2010).

Barney developed a VRIN-framework for the RBV. This framework explains that organizations can achieve a sustainable competitive advantage when the resources of these organizations meet several characteristics (Newbert, 2008). The resources need to be valuable, rare, inimitable, and non-substitutable. Resources are *valuable* when they are able to turn an opportunity into a competitive advantage, or when it is able to defend against environmental threats. Resources are *rare* when these are unevenly accessible by different companies, or low in the amount of stock available. Additionally, resources are *inimitable* when it is difficult for other companies to copy the resource. And finally, a resource is *non-substitutable* when there is no other resource available that can substitute the current resource (Lockett, Thompson & Morgenstern, 2009).

Hart (1995) does agree with the RBV, however, he states that the theory is missing an important aspect, namely the consideration of the natural environment. Consequently, the NRBV states that companies should take into account the environment when developing their strategy. The theory further explains that companies can obtain a competitive advantage from this environmental friendly strategy (Jelavic, 2017).

Originally there were three sustainable strategies that could help organizations achieve this competitive advantage; pollution prevention, product stewardship and sustainable development (Markley & Davis, 2007). *Pollution prevention* can be defined as the decreasing of waste and emissions by changing internal activities (McDougall, Wagner & MacBryde, 2019). *Product stewardship* focuses on the negative effects a product has on its environment during its life-cycle. Organizations should minimize these negative effects by utilizing extensible materials, preventing the use of damaging materials and focussing on recyclability (McDougall, Wagner & MacBryde, 2019). *Sustainable development* has to do with the negative environmental influences that go hand in hand with the development of firms. This strategy especially focuses on the global development of firms. Developing markets are expected to grow extensively in the future. However, a large increase in the utilization of environmental harmful products will result in incurable environmental damage. Therefore, companies should focus on the development of new environmental friendly production technologies and goods.

In later literature the NRBV has been further elaborated on. As a consequence of these elaborations the sustainable development strategy has been divided into two different concepts; Clean Technology and Base of the Pyramid (BoP) (Tate & Bals, 2016). *Clean technologies* are

radical innovations concerning technologies that decrease the amount of energy and resources needed, and are developed for future production processes specifically (Hart & Dowell, 2011). *BoP* states that companies should offer their products to underprivileged populations, but simultaneously should assist these populations in increasing the quality of their existence. These practices are also beneficial for companies, as the result is higher financial performance (Landrum, 2014).

2.1.1 Pollution prevention

Hart and Dowell (2011) explain in their article that most research so far has focussed on the pollution prevention strategy. This study chooses to focus on this strategy as well, as energy and material saving activities can be regarded as a specific form of pollution prevention.

As explained before, pollution prevention can be defined as the decreasing of waste and emissions by changing internal activities (McDougall, Wagner & MacBryde, 2019). Hart explains that in practice companies can achieve this "through better housekeeping, material substitution, recycling, or process innovation" (Hart, 1995, 992).

Following this definition of pollution prevention, it can be concluded that energy and material saving activities are a specific form of these pollution prevention strategies. Energy and material saving activities consist of three different aspects. First of all, *energy saving technologies.* Energy saving can be defined as using the energy inputs as efficient as possible, and can be achieved by using more energy efficient technologies (Palcic & Buchmeister, 2016). A few examples of these technologies are "control systems for shut down of machines in off-peak periods, electric motors with rotation speed regulation, compressed air contracting" (Palcic & Buchmeister, 2016, p. 19). Secondly, *material saving technologies.* Material saving can be defined as the using of the available resources as effectively as possible (Sygulla, Bierer & Götze, 2011). Technologies that accomplish this material efficiently include "utilisation of recycled material in product manufacturing and product recovery after product life cycle" (Palcic & Buchmeister, 2016, p. 19). Finally, *environmental management systems (EMS)* also represent energy and material saving activities, because companies that implement energy and material saving technologies are also likely to implement management systems to support these technologies. "Enterprises that adopt an EMS systematically consider their impact to the natural environment by developing an environmental policy, evaluating their internal processes that affect the environment, creating objectives and targets, monitoring progress and obtaining management review "(Darnall & Edwards, 2006, p. 301). More concrete examples of EMS are the presence of objectives related to environmental impacts, the availability of assets necessary

to implement these objectives, the existence of systems that examine the emissions made during the production process, or the presence of individuals liable for environmental friendly production (Feldman, Soyka & Ameer, 1996).

Hart (1995) outlines in its study one major argument for the increased financial performance caused by pollution prevention strategies. This argument is related to the costs that can be saved by implementing these strategies. Hart (1995) defined several mechanisms through which companies can decrease their costs. First of all, companies can save costs as they do not have to organize end-of-pipe equipment that decrease pollution anymore. Secondly, companies can save costs by declining their waste and using their raw material more efficiently. Finally, companies can save costs by putting in place a lean production process.

Even though Hart explains in its early study (Hart, 1995) that the implementation of sustainable practices would result in a competitive advantage in the form of cost advantages, in a later study (Hart and Dowell, 2011) the researcher comes back to this conclusion. Hart and Dowell (2011) argue that costs benefits from sustainable activities are only present when a company possesses organizational capabilities and a positive cognition & framing attitude. By outlining these requirements, the authors initiate that solely implementing pollution prevention strategies do not result in financial benefits. The proposed relations are outlined in the conceptual model presented in Figure 1. Hart and Dowell (2011) do not explain how the neutral relation is formed, however there are studies that provide an inside in the underlying factors. The subsequent section outlines different studies on the relation between sustainable activities and financial performance of firms. The studies that propose a neutral relation also provide an explanation for this neutral relation, thereby covering the research gap Hart and Dowell (2011) failed to address in their study.

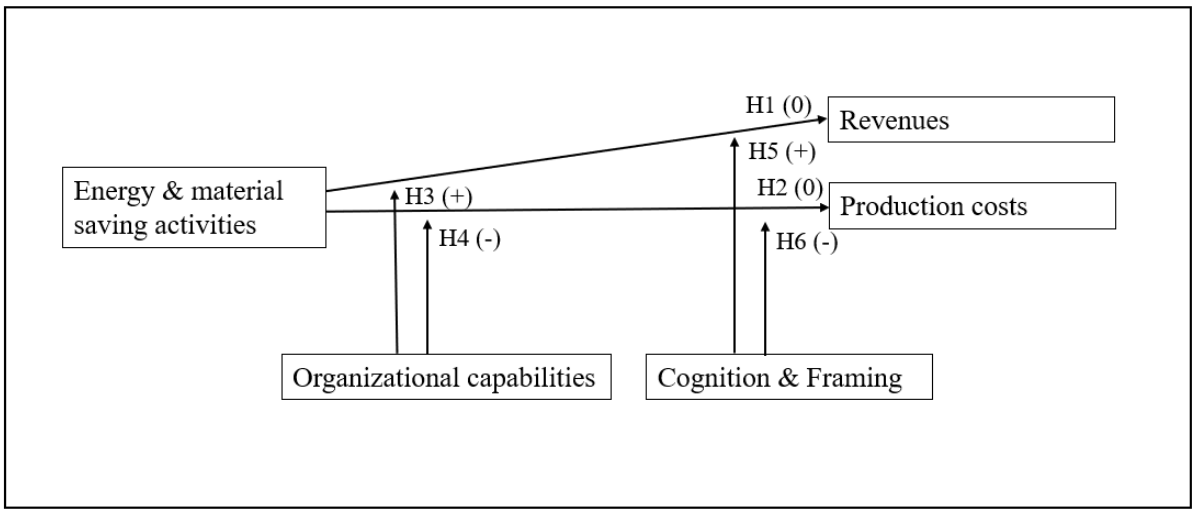


Figure 1: Conceptual Model

2.1.2 Empirical support

Several researchers have conducted research on the relationship between sustainable activities and financial performance of organizations. These studies outline mixed results on this relationship. There are studies that present a neutral relation between sustainable activities and financial performance. First of all, Sarkis and Dijkshoorn (2007) perform a study to investigate the existence of a positive relation between the implementation of environmental sustainable activities and environmental and financial achievements. Financial achievement focuses on the costs related to waste management, these costs should be lower when implementing environmental activities. The study uses 229 Welsh SMEs for its non-parametric statistical analysis. The findings show that the implementation of environmental friendly activities do not result in higher financial performance. The researchers provide some suggestions for the neutral relationship. The researchers suggest that companies might not be experienced enough to profit from the sustainable activities. Additionally, the researchers indicate that the effects of sustainable activities might not be visible on the short-term, because productivity might decrease as a result of applying these activities.

Secondly, Watson, Klingenberg, Polito and Geurts (2004) investigate the influence of environmental management systems (EMS) on the financial performance of organizations. To calculate financial performance the following measures are used: Price to Earnings Ratio, Market to Book Ratio, Return on Invested Capital, ROA, Profit Margin, Operating Margin, and Beta. Watson et al. (2004) conduct a survey to collect data, and consequently perform a Wilcoxon signed-rank test on ten pairs of organizations to analyse these results. In their study the researchers expect a positive relationship, as sustainable activities should result in lower costs. However, the results of this study indicate a neutral relationship between environmental and financial performance. The explanation for this relationship is that sustainable activities result in lower production costs, however, these are equalled out by the implementation costs. The researchers suggest that their study does not take into account the period that companies have been implementing sustainable activities. Additional research is necessary to investigate if, on the long-term, the cost reductions are larger compared to the implementation costs.

Furthermore, Adebanjo, Teh and Ahmed (2016) conduct a research to investigate the influences of outside pressures on green and business performance. During their study the authors also investigate the influence of sustainable activities on business performance. Business performance is measured by looking into production costs and benefits related to enhanced product design. The International Manufacturing Strategy Survey is used to collect data from

Chinese, Indian, an Malaysian companies. A structural equation modelling method is used to analyse the results of 159 respondents. The results indicate that there is no relation between green and business performance. The researchers indicate that sustainable activities can lead to cost advantages, however, the implementing of these activities equals out the benefits. Furthermore, the researchers suggest that potential benefits from sustainable activities should be assigned to other issues such as increased market share and product image.

Contradictory there are also studies that support the existence of a positive relation between sustainable activities and financial performance. Chan (2005), investigates if Chinese companies that implement sustainable activities also achieve higher financial performances. In this study financial performance is investigated using four aspects: returns on investment, earnings growth, sales growth, and market share change. The research for this study is conducted in China among 561 foreign invested organizations. From these 561 organizations, 332 responses are valid to use in the study. For the analysis of the results regression and multi-group analyses are used. The research indicates that the implementation of sustainable activities does result in higher financial performance. The authors explain that companies achieve higher financial performance through cost reductions, indicating that the NRBV is also applicable to China. Additionally, the authors state that financial performance is not increased as a result of higher sales. The authors state that the improvement of the organizational reputation as a result of the implementation of sustainable activities does not result in higher sales. However, a long-term study probably reveals a positive relation.

Additionally, Menguc & Ozanne (2005) aim to test the relation between natural environmental orientation (NEO) and organizational performance. Organizational performance is measured by the utilization of three variables: profit after tax, market share and sales growth. The research is conducted in Australia among 140 Australian manufacturing firms. To analyse the results of the investigation, the study uses a higher order path analysis. The study illustrates that NEO does have a significant positive influence on profit after tax and market share, but has a negative influence on sales growth of organizations. The researchers explain that sustainable activities will result in lower costs and an improved reputation, which both result in higher financial performance. Furthermore, the researchers attribute the difference between the three variables to the short time-period that the study covers. The three variables are measured over a 2 year time period, for profit after tax and market share this period is enough to reveal significant differences. However, sales growth is likely to require a long-term study.

Finally, Sambasivan, Bah and Jo-Ann (2013) investigated the influence of environmental initiatives on several performance variables: operational performance, organizational learning, environmental performance, stakeholder satisfaction and financial performance. The amount of cost decrease is an indication of financial performance. Structural Equation Modeling (SEM) is used to analyse the data from 291 Malaysian firms. The outcomes of this study support a positive relation between environmental initiatives and financial performance, presenting that environmental initiatives result in lower costs for an organization and consequently higher financial performance.

When comparing the studies outlined above, it can be concluded that the studies measure financial performance by using two different types of concepts. Financial performance could be measured by focussing on production costs or revenue outcomes. These two types of concepts are in line with definitions of financial performance. Klassen and McLaughlin (1996) suggest that financial performance can be affected by two different mechanisms: production costs & revenues. Revenue outcome can be defined as earning monetary quantities as a result of offering products or services to clients (Nobles, Mattison & Matsumura, 2015). Additionally production costs can be defined as the costs a company makes during the production process of a product or service (Kenton, 2019). "Production costs can include a variety of expenses, such as labor, raw materials, consumable manufacturing supplies, and general overhead" (Kenton, 2019, para 1). Given the fact that previous research uses revenue outcomes and production costs as a measure for financial performance, and the variating outcomes of these studies, this study focuses on both concepts in its research. By doing this the study can provide a complete understanding of the influence of energy and material saving activities on the financial performance of firms.

In conclusion, it can be stated that the studies that support a neutral relation define several explanations for this relation. Companies do save costs when implementing sustainable practices, however these benefits are not visible because a lack of experience, high implementation costs and a lack of influence on the organizational reputation neutralize the effects of cost savings. Most studies assign this negative relation to the short time period wherein the study is conducted. There are also studies that define a positive relation due to cost reductions and improved reputations that are associated with sustainable activities. A study that outlines a positive relation also explains that the effects are probably better visible on the long-term. Both neutral and positive studies state that positive effects are (better) visible on the long-term, indicating the possible existence of a learning effect when implementing sustainable

activities. This reasoning can provide an explanation for the mixed results presented by the studies outlined above. Companies need time to learn how to overcome the negative effects associated with the lack of experience, high implementation costs and lack of influence on the organizational reputation. The organizational capabilities and positive cognition & framing attitude concepts defined by Hart and Dowell (2011) could be possible outcomes of this learning period. The implementation of these concepts could transform the negative consequences related to sustainable activities into positive ones. When applying the foregoing to the concepts of this study, it can be stated that investments in energy and material saving activities cannot be expected to unconditionally be reflected in production costs reductions or higher revenue outcomes. Consequently, the following hypotheses can be formulated:

Hypothesis 1: Companies' investments in energy and material saving activities is not significantly autonomously correlated with an increase in their revenue outcomes.

Hypothesis 2: Companies' investments in energy and material saving activities is not significantly autonomously correlated with a reduction in their production costs.

2.2 Organizational Capabilities

According to Hart and Dowell (2011) profitable financial outcomes of pollution prevention strategies by a firm depend, among other things, upon the firm's organizational capabilities. Organizational capabilities can be defined in many different manners (Collis, 1994). Organizational capabilities are commonly described as the ability of organizations to manage its resources in order to execute an activity that increases business results (Inan, 2015). Hart and Dowell (2011) focus in their paper on organizational innovations as a definition of organizational capabilities. This focus matches the dynamic capabilities definition of Teece. Following this reasoning, in this study organizational capabilities can be attributed the same definition as dynamic capabilities, which are "higher-level competences that determine the firm's ability to integrate, build, and reconfigure internal and external resources/competences to address, and possibly shape, rapidly changing business environments" (Teece, 2012, p. 1395). Eisenhardt and Martin (2000) provide a few concrete examples of dynamic capabilities. In order for companies to successfully innovate, companies should engage its environment in its innovation process, put in place routines that increase the input from and communication among managers and employees, and increase its knowledge. Firms can enhance their knowledge by internal knowledge creation, but knowledge can also be obtained from outside actors through alliance or acquisition. For knowledge creation through external actors, a

company needs employees that dynamically communicate with these actors. This study distinguishes organizational capabilities from environmental management systems. Environmental management systems specifically support the energy and material saving technologies, while organizational capabilities support the energy and material saving activities in general.

Hart and Dowell (2011) state in their study that organizational capabilities are necessary for a positive relation between pollution prevention and financial performance. The researchers base their argumentation on the RBV. The RBV states that individual resources do not create a competitive advantage by itself, but that combinations of resources do cause this advantage (Bowman & Ambrosini, 2003). Furthermore, combining resources increases complexity and consequently makes it more difficult for competitors to imitate (Hart & Dowell, 2011). When applying this to the pollution prevention strategy, Hart and Dowell (2011) state that the strategy by itself does not result in higher financial performances. However, when combining pollution prevention strategies with organizational capabilities, the pollution prevention strategy is more likely to achieve higher financial performance. This is especially true for the capabilities that are linked to innovation.

Hart and Dowell (2011) do not provide any empirical evidence for the proposed relationship. However, there are several studies that do provide empirical evidence for the reasoning of the RBV, and thus support the reasoning that combined resources result in higher financial performance (Chae, Yang, Olson & Sheu, 2014; Ravichandran & Lertwongsatien, 2005; Robins & Wiersema, 1995).

Taking into account the reasoning of Hart and Dowell (2011) and the empirical evidence on the RBV, it can be concluded that the possession of organizational capabilities moderates the influence of pollution prevention on financial performance. When applying this to the concepts of this study, it can be stated that the combination of organizational capabilities with energy and material saving activities results in greater possibilities to increase revenue outcomes and reduce production cost. Subsequently, the following hypotheses can be formulated.

Hypothesis 3: The greater the organizational capabilities of a company, the stronger the impact of its investments in energy and material saving activities upon revenue growth.

Hypothesis 4: The greater the organizational capabilities of a company, the stronger the impact of its investments in energy and material saving activities upon production cost savings.

2.3 Cognition & Framing

Apart from organizational capabilities, Hart and Dowell (2011) suggest management's cognition and framing attitude to affect the impact of a firm's investments in pollution prevention strategies upon firm performance. Hart & Dowell (2011) explain that organizations can only benefit from pollution prevention strategies when organizations put effort in finding these opportunities. Additionally, the researchers argue that organizations are only willing to put effort in the search for pollution prevention strategies when executives expect the presence of beneficial opportunities. Following this reasoning, cognition and framing can be defined as the motivation of managers to search for pollution prevention strategies caused by beneficial expectations related to these strategies. Hart & Dowell do not provide examples of beneficial expectations. Consequently, to increase the accuracy of this study, a wide range of beneficial expectations related to sustainable activities is considered. This study takes into account the following beneficial expectations: energy expenses, strategical benefits, reductions in greenhouse gas emissions, increases in the amount of energy sources, or regulatory benefits.

There is not much empirical evidence that can substantiate the above reasoning. Hart and Dowell (2011) refer for their argumentation to the article of King and Lenox published in 2002. King and Lenox (2002) state that the expectations of the executives regarding opportunities has an influence on the focus and the willingness to put effort into the exploration of opportunities. However, the article also states that it did not directly include a measure that represents executive expectations. Additionally, Hart and Dowell (2011) refer to the article of Sharma and Vredenburg (1998) to substantiate their reasoning. This study aims to explore the relation between proactive environmental strategies and the development of organizational capabilities that result in competitive advantages. To test this relationship a case study and (follow up) mail survey are conducted among 7 Canadian organizations working in the oil and gas industry. The study shows that organizations that link increased financial performance to the implementation of sustainable activities implement proactive environmental strategies. Furthermore, proactive environmental strategies result in the development of organizational capabilities that result in a competitive advantage. It can be concluded that this study does support the reasoning proposed by Hart and Dowell (2011).

In conclusion, it can be stated that cognition and framing positively moderate the relation between pollution prevention and financial performance. However, there is not much empirical evidence that can substantiate this reasoning. Therefore the fifth and sixth hypotheses are for a large extent based upon the logical argumentation of Hart and Dowell (2011). Additionally, the

reasoning of Hart and Dowell can be applied to the concepts of this study as well. It can be stated that combining cognition & framing with energy and material saving activities leads to greater possibilities to increase revenue outcomes and production cost reductions. Subsequently, the following hypotheses can be formulated.

Hypothesis 5: The more positive a company's cognition & framing attitude regarding investments in energy and material saving activities the stronger the impact of these investments upon revenue growth.

Hypothesis 6: The more positive a company's cognition & framing attitude regarding investments in energy and material saving activities the stronger the impact of these investments upon production cost savings.

2.4 Summary

The above theory can be summarized as follows. The theory is based on the relation between energy and material saving activities and the financial performance of firms. The implementation of these activities does not result in increased revenue outcomes or reductions in production costs. Consequently, it is proposed that the financial performance of organizations does not increase when implementing energy and material saving activities. Additionally, two conditions can be identified that can transform this neutral relation into a positive relation: organizational capabilities and cognition & framing. Organizational capabilities result in combinations of resources that cause a competitive advantage and makes imitation by competitors more difficult. Additionally, cognition & framing can be defined as the motivation of managers to search for pollution prevention strategies caused by beneficial expectations related to these strategies.

3. Methodology

This chapter outlines the methodological aspect of this study. Paragraph 3.1 first explains the research approach. After that paragraph 3.2 and 3.3 further elaborate on the quantitative and qualitative parts of this study. Finally, paragraph 3.4 outlines how a high ethical standard is guaranteed by this study.

3.1 Research Approach

There are several approaches to conduct research. A researcher can choose between an inductive or deductive approach. With inductive research the researcher uncovers a pattern from the collected data and attempts to transform these patterns into a specific theory (Soiferman, 2010). With deductive data the researcher starts with a theory and attempts to test this theory by collecting data. The researcher concludes its study with the acceptance or non-acceptance of the theory (Schadewitz & Jachna, 2007). This study utilizes a deductive research approach, as the NRBV is tested in this study.

Additionally, a researcher can choose between a qualitative, quantitative or mixed research method. Qualitative research bases its research upon language outputs and observations (Amaratunga, Baldry, Sarshar & Newton, 2002). This type of research is used to gain an understanding of how participants interpret a specific situation (Almalki, 2016). Quantitative bases its research upon statistical inputs (Antwi & Kasim, 2015). The outcomes of this study are used to reveal the effects of independent variables on dependent variables, or to apply the outcomes to a broader set of circumstances (Yilmaz, 2013). With mixed research methods the qualitative and quantitative methods are combined (Johnson, Onwuegbuzie & Turner, 2017). By combining the two methods, this type of research is able to reveal both aspects of qualitative and quantitative research: the underlying meanings of participants and the relations between variables (Frels & Onwuegbuzie, 2013). This study aims to test the relation between energy and material saving activities and financial performance of organization, and aims to reveal the underlying reasons for the existence of this relation. The study thus contains both quantitative and qualitative aspects, and therefore a mixed research method is most suitable to use.

3.2 Quantitative research

For its quantitative research this study uses the data of the European Manufacturing Survey (EMS) of 2015. The EMS questionnaire focusses on the performance growth of manufacturing companies caused by techno-organisational innovations (Fraunhofer, n.d.). In this study the data results from Dutch companies are used for the analysis. All business locations of Dutch

manufacturing companies that employ more than 10 employees are approached to participate in the survey. From the participating companies, the business location manager, R&D manager or product manager are asked to fill in the questionnaire. The questionnaire can be found in Appendix 1.

The variables of this study are operationalized following a table format. An overview of this operationalization can be found in Table 1. The table outlines the dependent, independent, moderating, and control variables required for this study. For each variable the table presents a short description of the items that measure the variables, the minimum and maximal values possible for the items, the measurement level and the question that represents the items.

Type of variable	**Name of variable**	**Item**	**Min**	**Max**	**Measurement level**	**Comments**
Dependent	Revenue Changes	Differences in revenue 2012-2014	-∞	+∞	Ratio	Appendix 1, question 21, item 1
	Production Cost Changes	Development of costs per production unit 2014	≤10%	≥10%	Ordinal	Appendix 1, question 12
Independent	Energy and Material Saving Activities	Different technologies and management systems that reduce the utilization of energy and materials	0	6	Ratio	Appendix 1, question 8.1, item: 3-6, question 8.2, item: 1-3 & question 3, item: 12-14
Moderating	Organizational Capabilities	Number of capabilities related to innovation processes	0	5	Ratio	Appendix 1, question 11, item: 3-7
		Educational level of employees	0	4	Nominal	Appendix 1, question 15.1
		Training provided by organisation	0	5	Ratio	Appendix 1, question 5.2, item: 1, 3-6
	Cognition & Framing	Non-compulsory searching	0	4	Ratio	Appendix 1, question 8.3, item: 1-4
		Compulsory searching	0	1	Nominal	Appendix 1, question 8.3, item: 5
Control	Industry	Type of industry sector	0	6	Nominal	Appendix 1, question 1.2
	Firm Size	Number of employees	10	+∞	Ratio	Appendix 1, question 21, item 2

	Age	Year of founding	-∞	2014	Ratio	Appendix 1, question 21, item 12

Table 1: Operationalisation Table

It should be noted that 'Organizational capabilities' could be measured with the help of different items in the questionnaire. As already explained, organizational capabilities are a company's competences to utilize its resources to respond to altering situations (Teece, 2012). The EMS questionnaire contains questions related to this definition, First of all, the EMS questionnaire asks questions about capabilities related to the innovation process (Utilization of knowledge and initiatives of non-R&D employees for the realization of innovations; Engagements of customers in innovation processes; Collaboration with externalities (not customers) for innovation; Participating (for example with capital, knowledge) with organizations to access knowledge or create synergies; Outsourcing of R&D to other organizations, such as universities, public resource institutions, engineers or suppliers). Innovations are essential to respond to altering situations. Therefore the capabilities related to this concept are selected for this study and represented by the variable 'Number of capabilities related to innovation processes'. Additionally, the variable 'Educational level of employees' also represents an important capability, because it is expected that individuals with a higher educational level possess more knowledge and therefore are better able to respond to changing situations (Eisenhardt & Martin, 2000). Finally, the knowledge of the employees can also be improved by training (Eisenhardt & Martin, 2000). The last capability focusses on this phenomenon by outlining the manners in which organisations train their employees (Training for specific skills; E-learning; On-the-job training; Supplying of information; Activities focussing on quality improvements). The items are represented by the variable 'Training provided by organisation'. Several items outlined above could be measured with the help of multiple questions. The items present in the operationalisation table are chosen as these represent the concept 'organizational capabilities' in the most adequate manner when compared to other similar questions and corresponding items.

The moderating variable 'Cognition & framing' is also measured by the EMS questionnaire. Cognition & framing can be defined as the expectations of managers that benefits can be gained from sustainable activities, and the search for these benefits as a result of these expectations (Hart & Dowell, 2011). The items of the variable 'Non-compulsory searching' (Expected developments of energy prices; Strategic considerations; Decreases of greenhouse gas emissions; Private energy generation to increase energy sources), all represent positive

expectations of managers with regard to energy and material saving activities. These expectations result in the voluntary searching for benefits related to energy and material saving activities, thereby perfectly representing the cognition & framing concept. Contradictory, there are also managers that do not expect benefits from energy and material saving activities. However, it could be that managers still search for energy and material saving activities because laws and regulations compel to implement these activities. This aspect is presented by the variable 'Compulsory searching' and is measured by the item 'Laws and regulation'. It is important to study this aspect of cognition & framing as well to provide a full overview of the concept.

To analyse the data from the EMS a multiple regression analysis is conducted. "Multiple regression analysis is a statistical technique that can be used to analyse the relationship between a single dependent (criterion) variable and several independent (predictor) variables" (Hair, Black, Babin, & Anderson,, 2014, p. 157). A requirement to use a regression analysis is that both the dependent and independent variables are metric. Variables that are non-metric can be transformed into dummy variables and thereafter used in the analysis (Hair et al., 2014). Consequently, the variable industry is transformed into a dummy variable. Considering the adjustments that can be made to this variable, the multiple regression analysis is appropriate for this study. To be able to conduct this analysis several assumptions need to be met. The linearity and normality assumptions are tested with the help of a P-P plot and a histogram. Additionally, the homoscedasticity and independence of error terms assumptions are tested with the help of a scatterplot. The analysis also needs to be tested for outliers. This is done by looking at Cook's distance and leverage points. Once all these tests are performed, the analysis itself can be performed. The analysis is performed with the help of a stepwise regression model. Three different models are tested, a model that only consists of the control variables, a model including the control and independent variables, and a model that contains the control, independent, and moderating variables.

3.2.1 Validity and reliability

This study takes into account validity and reliability concerns to guarantee the quality of this study. Validity is represented by two different concepts: internal and external validity. Internal validity indicates if a study presents outcomes that correspond to reality (Davis, 1992). To ensure internal validity this study takes several measures. The questionnaire contains detailed questions, and these questions are tested among several individuals before actually sending out the questionnaire. Additionally, several international meetings with representatives from 15

countries are organized to discuss the clearest formulation of the questions in the survey. External validity indicates to what extend the outcomes are applicable to other circumstances (Davis, 1992). Several measures are taken to increase the amount of participants, because it is expected that a greater amount of participants increases external validity. The external validity of the quantitative research is increased by sending a benchmark report with the questionnaire, so that companies can compare their performance to other companies. These benchmark reports serve as a reward for the participating companies, and thereby stimulates companies to participate. Additionally, two reminders are send to participate in the study. Finally, a high level of reliability shows that the research is likely to result in comparable outcomes when repeated (Golafshani, 2003). To ensure the reliability of this study the questions in the questionnaire are very detailed and ask for objective data. These type of questions are likely to result in similar answers when asked to different participants.

3.3 Qualitative research

This study uses interviews for the qualitative part of its research. Interviews are suitable to gather facts, or to understand the thoughts, views, or encounters of participants (Rowley, 2012). More specifically, this study uses semi-structured interviews for its research. With semi-structured interviews researchers have a few standard questions, but can also deviate from the interview guide when something interesting is mentioned by the participant. This offers the opportunity to gain a deeper insight in specific matters that are valuable for the research (Stewart, Treasure & Chadwick, 2008). The use of semi-structured interviews is suitable for this study, because it is not clear how energy and material saving activities influence the financial performance of firms. Additionally, it is not clear how organizational capabilities and cognition & framing influence this relation. By using semi-structured interviews the interviewer can delve deeper into interesting dimensions when these become visible, and consequently gain more in-depth knowledge about this dimension. This provides the researcher more valuable research outcomes. An interview guide that covers questions related to the NRBV is developed, and is presented in Appendix 2. The interviews take approximately 60 minutes.

Interviews are conducted with approximately five organizations. The interviewing of this number of organizations is likely to result in consistent outcomes, and consequently reliable conclusions. The organizations that are approached for the interviews are all organizations that put in place energy and material saving activities. When selecting the organizations the amount of energy and material consumptions need to be taken into account. It is expected that interviews with companies that have high energy and material consumptions result in clearer

outcomes, as these companies have to handle more extreme energy and material consuming conditions. The interviews are conducted with financial managers. It is expected that these individuals possess most knowledge regarding the influence of energy and material saving activities on the financial performance of their organization.

The interviews are recorded and thereafter transcripts are being made. The transcripts are not included in this study to guarantee the confidentially of the participants. When required, individual request can be made to gain access to the transcripts. However, the granting of access needs to be approved by the participants.

The transcripts are analysed with a deductive coding method. With a deductive coding method codes are formulated before the start of the actual analysis. These codes can be based upon an established coding dictionary or an existing theory (Stuckey, 2015). This study uses a deductive coding method because this study is based upon the NRBV. The concepts of this theory are used for the coding process, and as a result the following codes are identified: energy and material saving activities, production cost changes, revenue changes, organizational capabilities, and cognition & framing. The transcripts are coded manually. Every code is linked to a colour, and phrases that match the code are highlighted with this specific code-colour. The codes and the assigned colours are outlined in Appendix 3.

3.3.1 Validity and reliability

As with the quantitative study, the qualitative part of this study also takes into account validity and reliability concerns to guarantee the quality of this study. As explained before, internal validity indicates if a study presents outcomes that correspond to reality (Davis, 1992). This study takes several measures to ensure internal validity. First of all, the questions of the interviews are tested among several individuals to ensure the questions are understood by the participants. Moreover, the concepts that are likely to be unknown by the participants are explained during the interview. Questions that are well understood by participants are more likely to correspond to reality. External validity indicates to what extend the outcomes are applicable to other circumstances (Davis, 1992). To increase the external validity of the qualitative research interviews are held with companies that have large energy and material consumption patterns. It is expected that interviews with these companies provide clearer outcomes, because these companies deal with more extreme conditions. These clearer outcomes make the outcomes of this study more applicable to other organizations, thereby increasing external validity. Finally, as previously explained, a high level of reliability shows that the research is likely to result in comparable outcomes when repeated (Golafshani, 2003). To

guarantee the reliability of this study the interview contains questions that are very detailed and ask for objective data. It is expected that these questions result in similar answers when asked to different participants.

3.4 Ethical considerations

This study takes into account ethical considerations to guarantee the wellbeing of the participants. The study uses ethical guidelines based on the suggestions made by Babbie (2010). The first guideline states that it should be clear to the participants that their contribution to the study is voluntary. The study ensures this principle by explaining before the participants start with the questionnaire or interview that it is not mandatory to participate in this study. The second guideline states that the study should not damage the individuals participating in it. To ensure the realisation of this principle the questionnaire or interview do not contain questions that are likely to cause any mental harm to the participants. The third guideline outlines that the contestants need to participate anonymously. In practice this means that the names of the organization and the participants are not mentioned in the questionnaire or interview. The final guideline states that the answers of the participants need to be threated confidentially. This means that the transcripts of the interviews are not included in this study. The transcripts can be requested, however these will only be provided when the participants agree with this.

4. Quantitative Analysis

This chapter outlines the results of the quantitative research conducted for this study. In paragraph 4.1 several characteristics of the respondents of the EMS database are discussed. Paragraph 4.2 explains how the variables for the analyses are constructed. Subsequently, the univariate, bivariate and multivariate analyses are described in paragraph 4.3, 4.4 and 4.5 respectively. Finally, paragraph 4.6 provides a summary of this chapter.

4.1 Respondents characteristics

The EMS database includes 177 respondents. The respondents of this research should meet two conditions. First of all, the companies participating in this study should all be working in the industry branch. The database distinguishes seven industry sectors: metal, food, textile, construction, chemical, machinery and electronic. The dataset contains two missing values, indicating that it is unclear for two companies in which industry sector they operate. The questionnaire is only send to companies that operate in the industry branch, therefore the decision is made to preserve these two respondents in the dataset even though the specific industry sector is unknown.

When comparing the division of the industry sectors to reality, there can be seen that the database does not correctly represent this division. Table 2 outlines the division of the industry sectors according to the EMS database, and the actual Dutch industry division in 2017 (Gessel-Dabekaussen, 2018). Table 2 illustrates that the EMS dataset especially assigns too large percentages to the textile industry (Δ11.35%) and electronic & machinery industry (Δ13.5%), and to small percentages to the chemical industry (Δ10.0%). This failure to correctly represent reality does not form a problem for this study, because this study focusses on the industry branch in general, and does not aim to discuss differences between industry sectors.

Industry type	**Frequency**	**Valid Percent**	**Netherlands valid Percent (2017)**
Metal	37	21.1%	12.0%
Food	18	10.3%	18.5%
Textile	22	12.6%	1.25%
Construction	13	7.4%	3.5%
Chemical	22	12.6%	22.6%
Machinery	31	17.7%	22.5% (Electronic & Machinery)
Electronic	32	18.3%	-

Table 2: Industry Distribution

Secondly, only companies that employ at least ten employees should be included in this study. The database meets this requirement, as she lowest amount of employees filled in by companies is ten. Table 3 shows that most companies employ less than 49 employees, and that only a few companies employ 100 employees or more. This distribution indicates a skewed representation of the variable firm size. However, the distribution of employees does correspond to the labour characteristics of the industry branch in the Netherlands. The CBS (2020) outlines on its website that most companies employ up to 50 employees in the Netherlands. The number of companies that employ 50 employees or more is half of the above amount. Consequently the skewed representation of firm size does not form a problem for this study.

Amount of employees	Frequency	Valid Percent
Less than 20	37	20.9%
20 to 49	74	41.8%
50 to 99	43	24.3%
100 to 249	19	10.7%
250 or more	4	2.3%

Table 3: Firm size Overview

4.2 Variable construction

The following section describes how the different variables used in the analyses are constructed. First the construction of the dependent and independent variables are explained. After this it is explained how the moderating variables are constructed. Finally, the construction of the control variables are discussed.

Revenue Changes

The questionnaire presented in Appendix 1 contains one question related to revenue changes. Question 21 asks for the annual revenue in millions for the years 2012 and 2014. The variable revenue changes is constructed by subtracting the revenue of 2012 from the revenue of 2014. The resulting variable contains extreme values that result in high levels of skewness and kurtosis (respectively: -5.818 and 49.685). According to Field (2014) the skewness and kurtosis of a variable should not be larger than -3 or +3. A manner to decrease skewness and kurtosis is by applying transformations (Hair et al, 2014). Several transformations have been applied: log transformation, natural log transformation, square root transformation, reciprocal transformation, and cubic function transformation. However, all these transformations do not result in significant improvements. Another manner to decrease skewness and kurtosis is to divide the numbers that represent the variable into categories. Most values of the variable

revenue changes lie between -4 and +4 million euro's. Accordingly, the decision is made to divide the variable into the categories presented in Table 4.

Category	Million (€)
1,00	<-4
2,00	-4 to -3
3,00	-3 to -2
4,00	-2 to -1
5,00	-1 to 0
6,00	Stable
7,00	0 to 1
8,00	1 to 2
9,00	2 to 3
10,00	3 to 4
11,00	>4

Table 4: Categorisation Revenue Changes

Production Cost Changes

The variable production cost changes is represented by Question 12 of the EMS questionnaire outlined in Appendix 1. This question directly asks for the percentual difference in production costs per product unit in 2014. The variable is divided into 7 categories which are outlined in Table 5.

Category	Difference production costs (%)
1,00	<-10%
2,00	-10% to -5%
3,00	-5% to 0%
4,00	Stable
5,00	0 to 5%
6,00	5% to 10%
7,00	>10%

Table 5: Categorisation Production Cost Changes

Energy and Material Saving Activities

As explained in operationalisation table the variable energy and material saving activities is formed by combining several items from questions 8.1, 8.2 and 3 of the questionnaire presented in Appendix 1. To construct the variable the different items are added together. The third item of question 8.1 is missing in the database, therefore this item is not included in the variable construction. Because the variable consists of multiple items it is necessary to check for consistency between the items. This consistency check is done by looking at Cronbach's Alpha. According to Field (2014) a Cronbach's Alpha between .7 and .8 is good. However, a value of

.6 is also acceptable. The items that are included in this variable result in a Cronbach's Alpha of .652, therefore none of the items are deleted from the variable.

Organisational Capabilities

The operationalisation table outlines that the variable organisational capabilities is constructed by combining capabilities related to innovation, educational level and training. These aspects are covered by the items in questions 11, 15 and 5.2 of the survey outlined in Appendix 1. The variables innovation and training consist of different items and are therefore added together. The consistency of the items representing innovation is very low with a Cronbach's Alpha of .186.

Item	Cronbach's Alpha if item deleted
Employee engagement	.148
Customer engagement	.142
External innovation networks	.140
External participation	.145
Outsourcing R&D	.647

Table 6: Change in Cronbach's Alpha for Innovation Items

Deleting the item outsourcing R&D increases Cronbach's Alpha up to .647, which is an increase to an acceptable Cronbach's Alpha level (Field, 2014). The decision is made to delete this item from the variable innovation.

Cronbach's Alpha for the variable training is .523. This is a low Cronbach's Alpha (Field, 2014), however the deletion of an item does not result in a higher Cronbach's Alpha. The decision is made to include the variable training in the variable organisational capabilities because the theory outlined in chapter 2 does support the inclusion of this variable.

To check for consistency between all the items of innovation, educational level and training Cronbach's Alpha for all these items is provided. Cronbach's Alpha for all the items is .094, which is very low.

Item	Cronbach's Alpha if item deleted
Employee engagement	.063
Customer engagement	.073
External innovation networks	.074
External participation	.094
IT-based self-learning	.091
On-the-job training	.084
Quality improvement training	.084

Information offers training	.086
Educational Level	.668

Table 7: Change in Cronbach's Alpha for Organisational Capabilities Items

Cronbach's Alpha increases up to .668 when deleting the variable educational level. The decision is made to delete this variable from the variable organisational capabilities, because Cronbach's Alpha increases to an acceptable level (Field, 2014).

Finally, the variables that construct the variable organisational capabilities are standardized, because the items are represented by different score-ranges.

Cognition & Framing

Cognition & framing is measured by two different variables. The first variable is non-compulsory searching, which is represented by four items of question 8.3 in the questionnaire presented in Appendix 1. The different items are added together to form the variable non-compulsory searching. Cronbach's Alpha for this variable is .674. This value is acceptable, consequently the decision is made to not delete any item from this variable (Field, 2014).

The second variable that measures cognition & framing is compulsory searching. This variable is also represented by an item of question 8.3 of the questionnaire presented in Appendix 1.

Firm Size

The variable firm size is measured by an item of question 21 of the questionnaire outlined in Appendix 1. This item focusses on the amount of employees that are working in the organisation.

Age

The variable age is also measured by an item of question 21 presented by the questionnaire in Appendix 1. This item asks for the year of establishment of the participating companies. To gain an insight in the amount of years that companies exist age is subtracted from the year 2014.

Industry

The variable industry represents the industry sector that the participating companies operate in. Question 1.2 in the questionnaire presented in Appendix 1 focuses on the type of industry that companies are working in.

4.3 Univariate Analysis

This section provides a description of the variables that are used in the analysis. The description is summarized in Table 8 and focusses on different aspects: mean, standard deviation, minimum and maximum values, skewness and kurtosis. The control variable industry is not outlined in this table, because this is a nominal variable and therefore the values for the concepts outlined in the table do not provide meaningful outcomes.

Variable	Mean	Sd.	Min.	Max.	Skewness	Kurtosis
Revenue Changes	6.720	2.630	1.00	11.00	-.615	.147
Production Cost Changes	3.876	1.278	1.00	7.00	-.029	-.417
EMSA	2.079	1.829	.00	8.00	.930	.472
Organisational Capabilities	.000	1.649	-3.75	3.06	-2.42	-.666
Non-compulsory searching	2.277	1.141	1.00	4.00	.346	-1.295
Compulsory searching	.568	.497	.00	1.00	-.278	-1.945
Firm size	2.316	.995	1.00	5.00	.554	-.166
Age	43.271	28.688	1.00	174.00	1.298	2.659

Table 8: Description variables

Table 8 starts with the description of the dependent variables. The first dependent variable that is described is the variable revenue changes. Table 8 shows that on average the revenue of companies in the period between 2012 and 2014 was 6.720. When looking at table 4 this means that on average the revenue outcomes of companies in this period was stable.

The second dependent variable in Table 8 is production cost changes. The mean of the variable production cost changes has a score of 3.876. When looking at table 5 this indicates that the production costs per product unit decreased with -5% to 0% in 2014.

Furthermore, table 8 outlines de independent variable energy and material saving activities. This variable has a mean of 2.079 which indicates that on average companies implement ± 2 energy and material saving activities out of 9 optional activities. None of the companies participating in this study did implement the highest amount of energy and material saving activities possible, as the maximum value for this variable was 8.00.

Table 8 also outlines the moderating variables. The first moderating variable that is described is organisational capabilities. The variable has a mean of exactly .000. This mean is a result of the standardisation of the two capabilities (innovation and training) that make up the variable. Furthermore, the skewness of the variable is rather high, however not higher than -3 and

therefore at an acceptable level. The kurtosis is also acceptable with a score of -.666. Metric variables that make up a moderating variable need to be mean-centred (Field, 2014). The independent variable energy and materials saving activities and the moderating variable organisational capabilities are both mean-centred. After this the mean-centred variables are multiplied to constitute the moderating variable.

Additionally, the moderating variables that make up cognition and framing are described. This variable outlines whether the searching for energy and material saving activities pays off. The variable non-compulsory searching focusses on a voluntary search and has a mean score of 2.277 indicating that on average companies are motivated to search for energy and material saving activities by two non-compulsory motivations. The skewness and kurtosis are respectively .346 and -1.295 falling within the range defined by Field (2014). Non-compulsory searching is also a moderating variable. Consequently, this variable is also mean-centred and multiplied by the mean-centred variable energy and material saving activities.

The variable compulsory searching focusses on an involuntary search and has a mean of .568. Given the fact that this variable has a minimum score of .00 and a maximum score of 1.00 it can be concluded that there are slightly more companies that (besides the non-compulsory searching motivations) search for energy and material saving activities because of compulsory motivations. This can also be seen in Table 9 which indicates that 56.8% of the participating companies search for energy and material saving activities because of compulsory searching motivations.

Compulsory searching	**Frequency**	**Valid Percent**
.00 – no motivation for compulsory searching	76	43.2%
1.00 – motivation for compulsory searching	100	56.8%

Table 9: Frequencies Compulsory searching

Compulsory searching is a moderating variable as well. This variable is also mean-centred and multiplied by the mean-centred variable energy and material saving activities.

Finally, Table 8 outlines 2 control variables. The first variable is firms size. This variable has a mean of 2.316. When looking at Table 3 this means that on average companies employ 20 to 99 employees.

The second control variable is age. The mean value for this variable is 43.271, indicating that on average the companies participating in this study have an age of ±43 years. The standard

deviation is quite high, with a minimum score of 1.00 and a maximum score of 174.00 it can be concluded that the difference between the age of companies is very large.

Table 8 does not outline the control variable industry as this is a nominal variable. However, Table 2 provides an overview of the frequencies for this variable. From this table it can be concluded that the metal industry is best represented in this survey.

4.4 Bivariate analysis

This section focuses on the multicollinearity between the different variables that are used in the analysis. Independent variables need to be correlated with the dependent variable, however they should not be correlated with each other (Field, 2014). This study analyses the correlation matrix to check for multicollinearity. Appendix 4 presents the correlation matrix that outlines Pearson correlation values. According to Hair et al (2014), correlations higher than .90 suggest a large amount of correlation. The highest significant correlation value in this table is .463, which indicates that multicollinearity is not present among the variables.

Besides checking for multicollinearity the Pearson correlation matrix can also provide an initial understanding in the insights that the multivariate analysis might provide. Field (2014) explains that Pearson's correlation coefficient (r) of .10 indicates a small effect size, a r of .30 indicates a medium effect size and a r of .50 indicates a large effect size. The correlation matrix outlines a very small positive effect of .065 between energy and material saving activities and revenue changes. The effect size is very small and can therefore also be regarded as neutral. This supports the neutral relation that is outlined in hypothesis 1. Furthermore, the correlation matrix indicates a very small negative effect of -.054 between energy and material saving activities and production cost changes. As explained before, this effect size can be regarded as neutral and thereby supports hypothesis 2 that also outlines a neutral relation.

Besides the outcomes related to the hypotheses there are other insights that are remarkable. First of all, the correlation matrix indicates a small/medium effect of .205 between production cost changes and firm size, suggesting that larger firms have more production costs. Secondly, energy and material saving activities have a medium/large effect of .429 with organisational capabilities. This suggests that organisations that implement a high level of energy and material saving activities also possess a high level of organisational capabilities. The multivariate analysis can clarify if this combination also results in higher revenue outcomes/lower production costs, and consequently if hypotheses 3 and 4 can be supported. Furthermore, the correlation table outlines a medium/large effect of .429 between energy and material saving

activities and firm size. This indicates that larger firms also implement a higher amount of energy and material saving activities. Finally, a medium/large effect of .463 is found between organisational capabilities and firm size, indicating that large organisations possess more organisational capabilities. Based on the final three outcomes, the question arises whether large organisations possess high levels of energy and material saving activities and organisational capabilities because these concepts complement each other in this specific situation, or whether the explanatory factor is solely the size of the organisation. The multivariate analysis can provide an insight in this insecurity.

4.5 Multivariate Analysis

This section focusses on the regression analysis that is conducted to test the hypotheses. Two regression analyses have been conducted, for revenue changes and production cost changes respectively. In paragraph 4.5.1 it is checked whether the assumptions of a regression analysis are met for both analyses. In paragraph 4.5.2 the explanatory power of the model is discussed. Additionally, in paragraph 4.5.3 potential influential outliers are discussed for both models. Furthermore, in paragraph 4.5.4 the results of the analysis are discussed. Finally, paragraph 4.6 provides a summary of the outcomes of the regression analysis.

4.5.1 Model assumptions

To be able to conduct a regression analysis four assumptions need to be met: linearity, normality, homoscedasticity, and independence of the errors terms (Hair et al, 2014). Appendix 6 outlines the figures that are needed to test these assumptions for the analysis with *revenue changes* as the dependent variable. The first P-P plot and histogram show that the linearity and normality assumptions are violated. Several transformations have been performed: log transformation, natural log transformation, square root transformation, reciprocal transformation, cubic function transformation and quadratic function transformation. The quadratic function transformation resulted in the most successful outcomes. The second P-P plot and histogram in Appendix 6 present a linear relation and a normal distribution. Additionally, the scatterplot that is presented in Appendix 6 shows no specific pattern among the residuals demonstrating that the assumptions regarding homoscedasticity and independence of the error terms are met. Appendix 6 also outlines the figures that are related to the four assumptions for the analysis with *production cost changes* as the dependent variable. The P-P plot demonstrates that the linearity assumption is met. Additionally, the histogram outlines a normal distribution. Finally, the scatterplot presents no pattern among the residuals, thus the homoscedasticity and independence of the error terms assumptions are met.

4.5.2 Explanatory power

The significance of the overall model needs to be assessed (Hair et al, 2014). The model is evaluated with the help of two measures. First of all, the R^2 outlines the amount of variability in the outcome that is explained by the predicting variables (Field, 2014). Additionally, the F-ratio is part of the ANOVA and tests "whether the model is significantly better at predicting the outcome than using the mean as a 'best guess'"(Field, 2014, p. 337). First of all, the significance of the overall *revenue changes* model is assed. In analysis 1 the control variables explain 26.3% of the variability in the dependent variable revenue changes (R^2 = .263). When adding the variable energy and material saving activities this percentage is also 26.3% (R^2 = .263). When the moderating variables are added to the analysis, this percentage is 28.0% (R^2 = .280). Table 10 outlines significant F-ratio's ($p < .01$). The significant F-ratio's indicate that fitting the models result in significant better predictions compared to a model that is not fitted (Field, 2014). Secondly, the significance of the overall *production cost changes* model is assessed. In the first analysis the control variables explain 8.3% of the variability in the dependent variable production cost changes (R^2 = .083). The addition of the independent variable energy and material saving activities results in a percentage of 8.7% (R^2 = .087). When the moderating variables are added this percentage increases up to 18.3% (R^2 = .183). F-ratio is only significant for the third analysis ($p < .05$), indicating that fitting the model that includes the control variables, the independent variable and the moderating variables, results in significant better predictions compared to a model that includes all these variables but is not fitted.

4.5.3 Potential Outliers

Additionally, both models need to be evaluated for possible influential outliers. Cook's distance and leverage points can be utilized to gain an insight in influential outliers. Values for Cook's distance higher than 1 cause a concern, and the leverage values should be close to the average leverage value. The following formula can be used to determine the leverage value cut-off point: (3(k + 1)/n. K is the amount of variables in the model, and n is the amount of respondents (Field, 2014). Appendix 7 presents the Cook's distance and leverage points for the analysis with *revenue changes* as dependent variable. Appendix 7 shows that the highest value for Cook's distance is .08, indicating that the rule of thumb for Cook's distance is not exceeded. The leverage value cut-off point would be .36 (3(12+1)/113). Appendix 7 presents that the leverage values do not exceed this point. Appendix 7 also presents the Cook's distance and leverage points for the analysis with *production cost changes* as dependent variable. Appendix 7 outlines that Cook's distance does not exceed the value of 1, as the highest value in this figure is slightly

above .08. The following value can be used as cut-off point for the leverage value: .33 (3(12+1)/121). Appendix 7 outlines that none of the leverage values exceed this point.

4.5.4 Outcomes

Finally, a stepwise regression is performed. The first analysis only consist of the control variables, in the second analysis the variable energy and material saving activities is added, and in the third analysis the moderating variables are added. The outcomes of the regression analysis are summarized in Table 10, and can be used to evaluate the hypotheses.

	Dependent variable: Revenue Changes			**Dependent variable: Production Cost Changes**		
	Analysis 1	**Analysis 2**	**Analysis 3**	**Analysis 1**	**Analysis 2**	**Analysis 3**
	b	***b***	***b***	***b***	***b***	***b***
Control Variables						
Firm Size	177.547**	180.021**	174.865**	.002	-.036	.006
Age	-.219	-.213	-.261	.008	.007	.007
Food	150.233	151.854	128.506	.153	.128	.282
Textile	-11.299	-7.928	-17.895	-.541	-.583	-.593
Construction	-77.798	-80.524	-122.788	.034	.074	.256
Chemical	-56.472	-55.501	-95.935	-.828	-.848	-.593
Machinery	126.694	124.667	123.045	-.146	-.118	-.134
Electronic	-11.779	-12.013	-14.527	-.215	-.219	-.202
Independent Variable						
EMSA		-3.505	.262		.053	.063
Moderating Variables						
EMSA*Organisational Capabilities			-8.327			-.343
EMSA*Non-Compulsory Searching			-23.275			.114
EMSA*Compulsory Searching			33.222			-.380**
	Model Statistics					
R^2	.263	.263	.280	.083	.087	.183
F-ratio	4.634**	4.084**	3.234**	1.269	1.176	2.010*
N	113	133	113	121	121	121
*p < .05; **p < .01						

Table 10: Regression Analysis Revenue Changes & Production Costs

The first hypothesis proposes the following: *Companies' investments in energy and material saving activities is not significantly autonomously correlated with an increase in their revenue outcomes.* The regression analysis outlines a non-significant relation between energy and material saving activities and revenue changes ($p > .05$). The non-significant outcome indicates that investing in energy and material saving activities does not result in revenue changes and therefore hypothesis 1 can be confirmed.

The second hypothesis proposes the following: *Companies' investments in energy and material saving activities is not significantly autonomously correlated with a reduction in their production costs.* The regression analysis outlines a non-significant relation between energy and material saving activities and production costs ($p > .05$). This outcome suggests that solely implementing energy and material saving activities does not result in any changes in the production costs and thereby confirms hypothesis 2.

The third hypothesis suggests the following: *The greater the organizational capabilities of a company, the stronger the impact of its investments in energy and material saving activities upon revenue growth.* The regression analysis proposes a non-significant moderating relation of organisational capabilities ($p > .05$). This outcome indicates that companies that possess a large amount of organisational competences do not achieve higher revenue outcomes from investing in energy and material saving activities. Consequently, hypothesis 3 should be rejected. The theory provided by Jayaraman, Singh and Anandnarayan (2012) offers an explanation for the absence of this relation. This theory indicates that a company needs to bring its sustainable practices under the attention of customers for it to result in increased revenues. Consequently, a company can possess a large amount of organisational competences, if customers are not aware of the sustainable practices in the first place an increase in revenue is not likely to be achieved.

The fourth hypothesis suggest the following: *The greater the organizational capabilities of a company, the stronger the impact of its investments in energy and material saving activities upon production cost savings.* The regression analysis suggests a non-significant moderating relation of organisational capabilities ($p > .05$). The outcome of the regression analysis indicates that the possession of organisational competences does not influence the ability to achieve cost savings from investments in energy and material saving activities. Based upon this outcome hypothesis 4 should be rejected. The paper by Collis and Anand (2018) provides a possible explanation for the absence of the influence of organisational capabilities. The authors state that guileless implementing organisational competences is not likely to be effective. Organisational competences need to be adjusted to the structure of the organisation for the capabilities to be effective. Consequently, cost saving are not likely to be achieved, as ineffective organisational competences are not able to influence the relation between energy and material saving activities and production cost changes.

The fifth hypothesis suggests the following: *The more positive a company's cognition & framing attitude regarding investments in energy and material saving activities the stronger the impact of these investments upon revenue growth.* The regression analysis outlines a non-significant moderating relation of non-compulsory- and compulsory searching ($p > .05$). This indicates that searching for energy and material saving activities does not result in higher revenue outcomes, and that hypothesis 5 should be rejected. The theory of Jayaraman, Singh and Anandnarayan (2012) is also applicable to the cognition & framing concept. If a company searches for energy and material saving activities, but does not promote its sustainable practices revenue growth is very unlikely to be achieved.

The sixth hypothesis proposes the following: *The more positive a company's cognition & framing attitude regarding investments in energy and material saving activities the stronger the impact of these investments upon production cost savings.* The regression analysis shows that the non-compulsory searching variable of cognition & framing is non-significant ($p > .05$). However, the compulsory searching variable is significant. This indicates that companies that search for energy and material saving activities motivated by laws and regulations can reduce their production costs ($b = -.380$; $p < .01$). The theory of Porter and Van der Linde (1995) provides a possible explanation for this effect. The authors state that voluntary searching for sustainable business opportunities is not beneficial, as companies need outside pressure to stimulate creative thinking and to overcome organisational inertia that is associated with sustainable activities. Roodt, Kinnear and Erwee (2003) explain that organisational inertia can be defined as the inability of a company to change its current activities. The outcomes thus suggest that Hart & Dowell (2011) are correct that searching for pollution prevention strategies is necessary to reduce the production costs. However, the searching needs to be combined with laws and regulations. Based on the above reasoning it can be stated that hypotheses 6 can be partly confirmed.

Besides the outcomes related to the hypotheses, there is another outcome that is remarkable. The analysis shows that an increase in firm size results in a grow in revenue (b analysis 1 = 177.547; b analysis 2 = 180.021; b analysis 3 = 174.865; $p < .01$). This outcome can be explained by the intellectual capital theory. Abdulaali (2018) explains that "intellectual capital impacts the business organization in various ways such as enhancing the competitive advantage, facilitating innovation, enhancing the competency of the employees and increasing the organizational performance" (para. 1). These positive impacts all have a positive influence on the revenue outcomes of an organisation. Consequently, it can be concluded that companies

with a larger amount of employees also possess more intellectual capital and therefore achieve higher revenue outcomes.

4.6 Summary

In this study, some hypotheses are confirmed, others are rejected. The outcomes suggest that autonomously implementing energy and material saving activities does not result in an increase in revenue outcomes or a decrease in production costs. Additionally, organisational capabilities and a positive cognition & framing attitude do not have a positive influence on the relation between energy and material saving activities and revenue changes. Furthermore, organisational capabilities do not positively influence the relation between energy and material saving activities and production cost changes. Moreover, a positive cognition & framing attitude results in a reduction in production costs. However this attitude should be motivated by laws and regulations. Finally, the analysis provides an additional outcome. An increase in firm size (number of employees) results in an increase in revenue.

5. Post-Hoc Analyses

Initially, this study aimed to gain further insight in the outcomes of the regression analysis by conducting interviews. However, due to the COVID-19 virus manufacturing companies are unable to participate in any research. A suitable alternative is to conduct post-hoc analyses that provide insights into the outcomes of the regression analysis. Post-hoc analyses focussing on the following aspects have been conducted. The first analysis focuses on the energy costs of firms, because these cost are expected to be a small percentage of the overall production costs, and therefore could result in different outcomes. The second analysis focuses on the introduction year of energy and material saving activities as chapter 2 suggests that companies need time to learn to effectively implement energy and material saving activities. The third analysis focuses the power consumptions of companies, because increasing power consumptions can nullify the effects of energy and material saving activities on production costs changes. The fourth analysis focuses on the difference between technologies and management systems, because there is a possibility that significant results for technologies are not visible as they are nullified by non-significant management systems results (and vice versa). The final analysis focuses on the size of firms, as the bivariate analysis indicates a possible relation between energy and material saving activities, organisational capabilities and firm size. Only post-hoc analyses that present significant results are presented in this chapter.

5.1 Energy Costs

The first post-hoc analysis that shows significant results is the production cost changes analysis focussing on low energy costs. It is important to note that the N for this analysis is rather low (N = 52). Table 11 indicates that firms with low energy costs do not achieve production cost changes when they involuntary search for energy and material saving activities ($p > .05$), and achieve higher production costs when they voluntary search for these activities ($b = .200$; $p < .05$). These relations can be explained by the fact that companies that already have low energy costs are not very motivated to extensively search for sustainable practices, and consequently companies are not able to find the most profitable energy and material saving activities. In this situation the theory of Porter and Van der Linde (1995) about regulatory forces is not applicable, and no production cost saving are achieved by involuntary searching. Additionally, the transaction costs theory explains that costs are related to the searching for opportunities and the gaining of information about these opportunities (Cordella, 2006). The Dutch government provides much information about sustainable practices that are eligible for subsidiary stimulations (RVO, n.d.). This large amount of information makes searching for sustainable

practices simpler. Therefore the searching costs for involuntary searching are lower compared to voluntary searching. The result is that the combination of unmotivated- and voluntary searching causes an increase in production costs.

	Dependent variable: Production Cost Changes		
	Analysis 1	**Analysis 2**	**Analysis 3**
	B	**B**	**B**
Control Variables			
Firm Size	.346	.287	.399
Age	.010	.010	.010
Independent Variable			
EMSA		.083	.035
Moderating Variables			
EMSA*Organisational Capabilities			-.381
EMSA*Non-Compulsory Searching			.200*
EMSA*Compulsory Searching			-.249
*p < .05; **p < .01			

Table 11: Post-Hoc Analysis Production Costs - Low Energy Costs

5.2 Power Consumption

The second post-hoc analysis shows significant results is the analysis that focusses on power consumption. It should be noted that the N for this analysis is very low (N = 25). Table 12 indicates that firms that have increasing power consumptions can decrease their production costs by involuntary searching for energy and material saving activities (b = -1.100; p < .01). This outcome can be explained by the theory of Porter and Van der Linde (1995). The increasing power consumptions increase company's tax expenses related to power consumptions (Rijksoverheid, n.d.). These expenses form the outside forces that highly motivate organisations to overcome organisational inertia and stimulate creative thinking. Consequently, production cost savings can be achieved.

	Dependent variable: Production Cost Changes		
	Analysis 1	**Analysis 2**	**Analysis 3**
	B	**B**	**B**
Control Variables			
Firm Size	.541	.611	.364
Age	.012	.015	.019
Independent Variable			

EMST		-.184	-.109
Moderating Variables			
EMSA*Organisational Capabilities			.091
EMSA*Non-Compulsory Searching			.021
EMSA*Compulsory Searching			-1.100**
*p < .05; **p < .01			

Table 12: Post-Hoc Analysis Production Cost Changes - Increase Power

5.3 Management Systems vs. Technologies

The third post-hoc analysis that presents significant results is the analysis that focusses on the difference between management systems and technologies. Table 13 shows the results for the analysis that focusses on management systems and revenue changes. The analysis indicates that companies that involuntary search for energy and material saving management systems experience a growth in their revenue outcomes (b = 228.306; p < .05). This outcome can be explained by the fact that most of the management systems discussed in this study are related to sustainability certifications. Lannuzzi (2017) describes in its book that certifications can support the promotion of sustainable practices. Chapter 4 outlined that sustainable activities do not influence revenue outcomes because of a lack of promotion. The certification characteristic of management systems overcomes this problem. The theory of Porter and Van der Linde (1995) can be applied to this case and thereby explain an increase in revenue outcomes.

	Dependent variable: Revenue Changes		
	Analysis 1	**Analysis 2**	**Analysis 3**
	B	**B**	**B**
Control Variables			
Firm Size	177.547	187.696	187.230
Age	-.219	-.188	-.360
Food	150.233	146.684	139.012
Textile	-11.299	4.407	4.225
Construction	-77.798	-100.637	-89.215
Chemical	-56.472	-38.051	-63.017
Machinery	126.694	112.800	109.907
Electronic	-11.779	-15.601	13.881
Independent Variable			
Management Systems		-42.735	-52.462
Moderating Variables			
EMSA*Organisational Capabilities			-2.626

EMSA*Non-Compulsory Searching			-33.758
EMSA*Compulsory Searching			228.306*
*p < .05; **p < .01			

Table 13: Post-Hoc Analysis Revenue Changes - Management Systems

The outcomes of the analyses that have production cost changes as dependent variable are outlined in Table 14. Table 14 indicates that companies that involuntary search for energy and material saving technologies end up with lower production costs (b = -.439; p < .05). Companies that involuntary search for energy and material saving management systems do not experience production cost changes (p > .05). The differences in these outcomes can be clarified by the implementation scale of management systems and technologies. The implementation of management systems is related to strategy changes and therefore has company-wide consequences, while the implementation of technologies is rather local (Abdelaziz, Saidur & Mekhilef, 2011). The organisational inertia for these large-scale changes are likely to be larger compared to small scale changes (Oreg, 2006). In accordance with the theory of Porter and Van der Linde (1995), it can be suggested that regulatory forces are effective enough to overcome the amounts of organisational inertia related to technologies, and thereby achieve production cost savings. However, these forces are not effective enough for management systems.

Table 14 also shows that companies that voluntary search for energy and material saving technologies do not achieve changes in their production costs (p > .05). However, companies that voluntary search for energy and material saving management systems end up with higher production costs (b = .410; p < .05). According to Porter and Van der Linde (1995) voluntary searching is not effective to achieve financial benefits. Moreover, the searching process for management systems is quite complex, because the company wide consequences that are related to these systems all need to be taken into account. In line with the searching cost reasoning outlined in paragraph 5.1 (Cordella, 2006; RVO, n.d.), this results in higher searching- and production cost for management systems compared to technologies.

	Dependent variable: Production Cost Changes (Management Systems)			**Dependent variable: Production Cost Changes (Technologies)**		
	Analysis 1	**Analysis 2**	**Analysis 3**	**Analysis 1**	**Analysis 2**	**Analysis 3**
	B	**B**	**B**	**B**	**B**	**B**
Control Variables						
Firm Size	.002	.023	.022	.002	-.044	-.019

Age	.008	.008	.006	.008	.007	.008
Food	.153	.149	.277	.153	.105	.175
Textile	-.541	-.518	-.609	-.541	-.592	-.575
Construction	.034	-.014	.063	.034	.056	.214
Chemical	-.828	-.789	-.556	-.828	-.823	-.649
Machinery	-.146	-.173	-.183	-.146	-.126	-.135
Electronic	-.215	-.224	-.251	-.215	-.232	-.217
Independent Variable						
Management Systems		-.091	-.058		.094	.109
Moderating Variables						
EMSA*Organisational Capabilities			-.273			-.221
EMSA*Non-Compulsory Searching			.410*			.069
EMSA*Compulsory Searching			-.616			-.439*
*p < .05; **p < .01						

Table 14: Post-Hoc Analysis Production Cost Changes - Management Systems vs. Technologies

5.4 Firm Size

The multicollinearity table indicates a possible relation between energy and material saving activities, organisational capabilities and firm size. The post-hoc analysis focussing on firm size is conducted to provide clarity regarding this possible relation. To conduct the analysis the respondents of the dataset are divided into two different groups: small firms (≤ 49 employees) and large firms (≥ 50 employees). It is important to note that the N for this analysis is rather low (N small firms = 74; N large firms = 47). Table 15 indicates that small firms can achieve lower production costs when they involuntary search for energy and material saving activities (b = -.419; p < .05). Contradictory, the analysis shows that large companies do not achieve production cost savings when involuntary searching for energy and material saving activities (p > .05). These different outcomes can be explained by the fact that it is more expensive for small firms to comply to regulations compared to larger firms (Randolp, Tasto & Salvino Jr., 2017). The theory of Porter and Van der Linde (1995) is applicable to small firms, as the regulatory forces are highly effective for these firms to overcome organisational inertia and to stimulate creative thinking. However, these outside forces are not effective for larger firms, and production costs savings are not achieved.

Furthermore, the post-hoc analysis indicates that voluntary searching for energy and material saving activities by small organisations does not result in production cost changes (p > .05). The voluntary searching for energy and material saving activities by large organisations even results in an increase in production costs (b = .295; p < .05). These outcomes can be explained

by the fact that outside pressures are necessary to achieve financial benefits from searching for sustainable practices (Porter & Van der Linde (1995). Additionally, larger firms possess more assets to invest in the searching for sustainable practices (Black, 2015). Consequently, in line with the searching cost reasoning outlined in paragraph 5.1 (Cordella, 2006; RVO, n.d.) higher searching- and production cost are achieved by large firms, while small firms do not experience production cost savings.

The post-hoc analysis also outlines two additional significant variables. The control variable age is significant in the analysis that focusses on production cost changes for small firms (b = .011; p < .05). Secondly, in the analysis that focusses on production cost changes for large firms the variable energy and material saving activities is significant (b = .371; p < .05). Both variables are only significant in the third analyses. It is not argumentative that an autonomous effect suddenly becomes significant when adding independent or moderating variables. Therefore, these significant effects are ignored in this study.

Finally, in the bivariate analysis the suggestion was made that combining energy and material saving activities with organisational capabilities results in changes in the revenue outcomes or production costs only in the specific case of large organisations. The post-hoc analysis focussing on firm size does not outline a significant moderating influence of organisational capabilities. This indicates that large companies just possess a large amount of energy and material saving technologies and organisational capabilities. These two concepts do not complement each other in their influence on the revenue and production cost changes.

	Dependent variable: Production Cost Changes (Small Firms)			**Dependent variable: Production Cost Changes (Large Firms)**		
	Analysis 1	**Analysis 2**	**Analysis 3**	**Analysis 1**	**Analysis 2**	**Analysis 3**
	B	**B**	**B**	**B**	**B**	**B**
Control Variables						
Age	.009	.009	.011*	.002	.002	-.008
Food	.218	.213	.121	.064	.028	.379
Textile	-.518	-.522	-.656	-.543	-.655	-1.171
Construction	-.322	-.317	-.332	.895	.897	1.417
Chemical	-.899	-.903	-.703	-.698	-.737	-.678
Machinery	.352	.355	.177	-.612	-.584	-.427
Electronic	-.300	-.298	-.324	.167	.067	-.490
Independent Variable						
EMSA		.008	-.031		.077	.371*
Moderating Variables						
EMSA*Organisational Capabilities			-.282			-.993

EMSA*Non-Compulsory Searching			.067			.295*
EMSA*Compulsory Searching			-.419*			-.411
*p < .05; **p < .01						

Table 15: Post-Hoc Analysis Production Cost Changes - Firm Size

5.5 Summary

In summary it can be stated that the post-hoc analyses provide a few additional insights to the regression analysis. Firms that deal with low energy costs accomplish higher production costs. Firms that deal with increases in power consumptions can achieve reductions in their production costs. Compulsory searching results in higher revenue outcomes when a company solely searches for energy and material saving management systems. Firms that involuntary search for technologies achieve production cost savings, while firms that involuntary search for management systems do not achieve production cost changes. Firms that voluntary search for technologies do not achieve production cost changes, while voluntary searching for management systems results in production cost increasements. Small firms realize reductions in their production costs when involuntary searching for energy and material saving activities, and large firms do not achieve production cost changes from these activities. Small firms do not achieve production cost changes from voluntary searching, while large firms realize higher production costs from these activities.

6. Conclusion

This chapter outlines the conclusion of this study. Firstly, a short summary is provided. Additionally, a conclusion is provided that answers the research question of this study.

This study bases its theoretical framework on the theory of Hart and Dowell (2011). This theory explains the relation between sustainable strategies and the financial performance of companies. One of these sustainable strategies is the pollution prevention strategy. Pollution prevention can be defined as the decreasing of waste and emissions by changing internal activities (McDougall, Wagner & MacBryde, 2019). This study focusses on one specific form of pollution prevention strategies, namely energy and material saving activities. Hart and Dowell (2011) argue that autonomously implementing energy and material saving activities does not result in increased revenue outcomes or reductions in production costs. However, the authors define two conditions that need to be present in organisations for these organisations to benefit financially from investments in energy and material saving activities. The conditions are organisational capabilities and cognition & framing. Organizational capabilities result in combinations of resources that cause a competitive advantage and makes imitation by competitors more difficult (Teece, 2012). Additionally, cognition & framing can be defined as the motivation of managers to search for pollution prevention strategies caused by beneficial expectations related to these strategies (Hart & Dowell, 2011).

The theory outlined above results in the development of six different hypotheses. These hypotheses are tested with the help of a regression analysis. Additionally, several post-hoc analyses are conducted to gain an insight in the outcomes of the regression analysis. For the analyses this study uses the data of the European Manufacturing Survey (EMS) of 2015. The EMS database includes 177 respondents.

The regression analysis provides the following outcomes. First of all, the regression analysis shows that autonomously investing in energy and material saving activities does not result in revenue growth or reductions in production costs. Additionally, the regression analysis shows that the possession of organisational capabilities and the searching for sustainable practices does not result in revenue growth when investing in energy and material saving activities. An explanation for the absence of a relation might be the lack of awareness for the sustainable activities among customers (Jayaraman, Singh and Anandnarayan, 2012). Furthermore, the regression analysis shows that companies that possess organisational capabilities do not achieve reductions in their production costs when they invest in energy and material saving activities.

The absence of this relation can be explained by the fact that organisational competences need to be adjusted to the organisational structure to be effective (Collis and Anand, 2018). The regression analysis outlines that companies can achieve reductions in their production costs when they search for energy and material saving activities. This relation only holds when the companies are forced by laws and regulations to search for energy and material saving activities. Theory explains that companies need outside forces in the form of laws and regulations to overcome organisational inertia and to stimulate creative thinking. Roodt, Kinnear and Erwee (2003) outline that organisational inertia can be explained as a company its inability to change. Only when these challenges are overcome financial benefits can be achieved. (Porter & Van der Linde, 1995). The regression analysis also shows an additional outcome, namely that larger firms are able to accomplish revenue growth. It is proposed that an increase in intellectual capital results in revenue growth (Abdulaali, 2018). Companies that employ more employees also possess more intellectual capital and therefore achieve higher revenue outcomes.

After completing the regression analysis, several post-hoc analyses are performed to gain further insights in the outcomes of the regression analysis. The post-hoc analyses show that firms that deal with low energy costs accomplish higher production costs, because of a lack of motivation to extensively search for sustainable activities and higher searching costs (Cordella, 2006; RVO, n.d.). Firms that deal with increases in power consumptions can achieve reductions in their production costs with involuntary searching because increasing tax expenses stimulate companies to overcome organisational inertia and encourage creative thinking (Porter & Van der Linde, 1995). Involuntary searching results in higher revenue outcomes when a company solely searches for energy and material saving management systems, because these management systems relate to sustainability certifications. These certifications form promotion mechanisms that can increase revenue outcomes when combined with regulatory forces (Lannuzzi, 2017). Firms that involuntary search for technologies achieve production costs savings, while searching for management systems does not result in production cost changes. Technologies are implemented at a local scale which results in lower amounts of organisational inertia. The large-scale implementation of management systems is related to higher levels of inertia. Regulatory forces are effective enough to overcome these low levels of organisational inertia, but not effective enough to overcome these high levels of inertia (Oreg, 2006). Voluntary searching for technologies does not result in production cost changes, and voluntary searching for management systems results in higher production costs. This is caused by the

fact that voluntary searching is not effective to realize financial benefits (Porter & Van der Linde, 1995), and on top of that is voluntary searching for management systems associated with high amounts of searching costs (Cordella, 2006; RVO, n.d.). Small firms achieve production cost savings from involuntary searching, while large firms do not achieve production cost changes. This can be explained by the fact that it is more expensive for small firms to comply to regulatory forces (Randolp, Tasto & Salvino Jr., 2017), which makes the reasoning of Porter and Van der Linde (1995) more effective for small firms. Small firms do not achieve production cost changes from voluntary searching, and large firms even achieve production cost increasements. In this case voluntary searching is also not effective to achieve financial benefits (Porter & Van der Linde, 1995). Additionally, in line with the searching cost reasoning (Cordella, 2006; RVO, n.d.), larger firms have more assets to spend on voluntary searching (Black, 2015).

In conclusion, an answer to the research question of this study can be provided. The research question of this study is as follows: *"To what extent, and in what way are financial benefits of adopting energy and material saving activities dependent upon a company's organizational capabilities and managerial cognition & framing?"* It can be concluded that the financial benefits of energy and material saving activities solely depends upon a company its managerial cognition & framing attitude that is motivated by regulatory forces. This outcome suggests that regulatory forces do not necessarily negatively affect the competitiveness of companies. Regulatory forces help companies to overcome organisational inertia and stimulate creative thinking, and thereby help achieve financial benefits. Companies financially benefit form involuntary searching for energy and material saving activities in two manners. First of all, involuntary searching for energy and material saving activities results in production cost savings. There are two requirements for this relation. The regulatory forces need to highly motivate companies to search extensively for energy and material saving activities. Furthermore, the regulatory forces need to be effective enough to overcome the levels of organisational inertia that the companies experience. Secondly, involuntary searching for energy and material saving activities results in revenue growth. This relation also has a prerequisite, companies need to promote their energy and material saving activities among their customers to make them aware of their sustainable practices. Contrary, voluntary searching for energy and material saving activities can even result in increases in production costs. This relation also has a prerequisite, increases in production costs are only achieved when voluntary searching is associated with high searching costs.

7. Discussion

This chapter outlines the discussion of this study. Paragraph 7.1 outlines a reflection on the theory of this study. Additionally, paragraph 7.2 provides recommendations for further research. Furthermore, paragraph 7.3 outlines some practical implications. Finally, paragraph 7.4 discusses the limitations of this study.

7.1 Reflection on the theory

When evaluating the theory of Hart and Dowell (2011) based upon the outcomes of this study a few remarks can be made. Hart and Dowell (2011) correctly state that autonomously implementing sustainable practices does not result in financial benefits. However, the outcomes of this study suggest that their argument regarding the possession of organisational capabilities is incorrect. Companies that possess organisational capabilities do not achieve financial benefits from investing in sustainable practices. The theory of Hart and Dowell (2011) can be enhanced by adapting or removing the organisational capabilities concept. Furthermore, Hart and Dowell (2011) argue that companies that put effort in searching for sustainable practices achieve financial benefits. The outcomes of this study indicate that this statement is partly true as the searching should be stimulated by regulatory forces. Moreover, the outcomes of the study indicate that there are situations in which involuntary searching is not effective to achieve production cost savings, and that there also cases in which voluntary searching even results in increased production costs. The theory of Hart and Dowell (2011) can be improved by including these specifications.

7.2 Recommendations for further research

The outcomes of this study indicate that there are several topics on which further research can be done. First of all, further research needs to be done to investigate why and how involuntary searching for sustainable activities results in financial benefits. Furthermore, the explanations for the deviating outcomes of this study are only based on theoretical reasoning. Consequently, further research needs to be done to investigate the influence of a lack of promotion and the not adjusting of organisational capabilities on the relation between energy and material saving activities and financial performance by firms. The same is true for the outcomes of the post-hoc analyses. The outcomes are explained based upon theoretical reasoning. Further research needs to be done to investigate whether the explanations regarding the (in)effectiveness of (in)voluntary searching in these circumstances are true.

In addition to the research suggestions initiated by the outcomes of this study, further research needs to be done to discover any other conditions (besides involuntary searching) that positively moderate the relation between energy and material saving activities and financial benefits. Following the outcomes of this research, companies are dependent upon laws and regulations for effective cognition & framing. It would be beneficial for companies if they themselves can implement mechanisms with similar effects to laws and regulations to overcome organisational inertia and to stimulate creative thinking. Additionally, further research needs to be done to identify whether there are conditions (besides voluntary searching with high searching costs) that negatively influence the relation between energy and material saving activities and financial benefits, and how these factors can be deleted.

7.3 Practical implications

The outcomes of this study can also be used by managers to improve the practices in their company. First of all, managers of companies that do not invest in energy and material saving activities yet can use the outcomes of this study to convince their colleagues to invest in these activities. The managers can show their colleagues that their production costs can be reduced when their search for energy and material saving activities is stimulated by laws and regulations. The managers can also show their colleagues that their revenue outcomes can be increased when they involuntary search for and implement energy and material saving management systems specifically. Secondly, managers of companies that already financially benefit from energy and material saving activities can increase their financial benefits by putting in place more effective cognition & framing mechanisms. Thirdly, managers of companies that implement energy and material saving activities but not financially benefit from it can change their current practices. For example, managers that search for and implement energy and material saving activities that do not result in financial benefits yet can start searching for activities that are stimulated by regulatory forces. Besides the practical implications for managers, the outcomes of this study can also be used by governmental organisations. The outcomes of this study suggest that laws and regulations regarding sustainability do not harm the financial performance of companies. Governmental organisations can use these outcomes to convince policy makers to put in place additional sustainable regulatory forces.

7.4 Limitations of the research

This study also contains some limitations that should be considered when reading this study. The first limitation focusses on the theoretical framework of this study. This study uses the

theory of Hart and Dowell (2011) as its main theoretical reasoning. However, not much research is done to some parts of this theory and therefore these parts are not well developed. Consequently, the explanations in this study regarding these aspects are rather vague or undetailed. This is especially true for the concepts organisational capabilities and cognition & framing. The second limitation concentrates on the utilization of the EMS database for the regression analysis and post-hoc analyses. The questions of the EMS survey are not specifically designed for this study, consequently the questions in the survey and the concepts of this study do not fully correspond to each other. For example question 8.3 of the questionnaire asks for the motivations to implement energy and material saving technologies. This question relates to the concept cognition & framing, however this concept has to do with searching for sustainable activities, and not the implementation. The motivations to search for or implement energy and material saving activities are likely to be similar and therefore do not cause a big concern. However, it is an important remark to consider when reading the study. The third limitation of this study focusses on the specific type of organisational capabilities that are studied in the regression analysis and post-hoc analyses. The organisational capabilities that are considered during the analysis focus on innovation or training. However, it is likely that there are other types of organisational capabilities that also influence the relation between energy and material saving activities and financial performance of organisations. Other organisational capabilities might have a more extreme or different influence on this relation. The fourth limitation has to do with the post-hoc analyses specifically. The N of some of the post-hoc analyses is very small (N energy costs = 52; N power consumption = 25; N small firms = 74; N large firms = 47). This small sample size decreases the statistical power and consequently increases the probability of a type II error. The fifth limitation focusses on the decision to replace the qualitative component of this study (interviews) with several post-hoc analyses. The post-hoc analyses outline valuable outcomes, however, interviews provide more in depth explanations for phenomena. Consequently, the outcomes of this study are less valuable when compared to a study that contains interviews. The final limitation has to do with the generalizability of the outcomes of this study. This study focusses on the manufacturing industry specifically, therefore the outcomes of this study cannot be generalized to non-manufacturing industries.

References

Abdelaziz, E. A., Saidur, R. & Mekhilef, S. (2011). A review on energy saving strategies in industrial sector. *Renewable and Sustainable Energy Reviews,* 15, 150-168. DOI: 10.1016/j.rser.2010.09.003

Abdulaali, A. R. (2018). The Impact of Intellectual Capital on Business Organization. *Academy of Accounting and Financial Studies Journal,* 22 (6). Retrieved from https://www.abacademies.org/articles/the-impact-of-intellectual-capital-on-business-organization-7630.html

Adebanjo, D., Teh, P. & Ahmed, P. K. (2016). The impact of external pressure and sustainable management practices on manufacturing performance and environmental outcomes. *International Journal of Operations & Production Management,* 36 (9), 995-1013. DOI: 10.1108/IJOPM-11-2014-0543

Almalki, S. (2016). Integrating Quantitative and Qualitative Data in Mixed Methods Research—Challenges and Benefits. *Journal of Education and Learning,* 5 (3), 288-296. DOI: 10.5539/jel.v5n3p288

Amaratunga, D., Baldry, D., Sarshar, M. & Newton, R. (2002). Quantitative and qualitative research in the built environment: application of "mixed" research approach. *Work Study,* 51 (1), 17-31. DOI: 10.1108/00438020210415488

Antwi, S. K. & Kasim, H. (2015). Qualitative and Quantitative Research Paradigms in Business Research: A Philosophical Reflection. *European Journal of Business and Management,* 7 (3), 217-225. Retrieved from https://www.researchgate.net/profile/Hamza_Kasim2/publication/295087782_Qualitative_and_Quantitative_Research_Paradigms_in_Business_Research_A_Philosophical_Reflection/links/56c7587108ae5488f0d2cd62.pdf

Babbie, E. (2010). *The Practice of Social Research.* Wadsworth: Cengage Learning

Barney, J. (1991) Firm Resources and Sustained Competitive Advantage. *Journal of Management,* 17 (1), 99-120. Retrieved from https://journals.sagepub.com/doi/pdf/10.1177/014920639101700108?casa_token=49eQhRHMNpcAAAAA:3Obl6zupfeHptfergXfczJl8eHc6kEghIBYpWVCnqxKqZpvW0IwqTBQ-Av9PfR9hpv-zsTRzqpFk

BBC NEWS (2019, November 11). Is climate change to blame for Australia's bushfires? Retrieved on 27 February 2020, from https://www.bbc.com/news/world-australia-50341210

Beschorner, T. (2013). Creating Shared Value: The One-Trick Pony Approach. *Business Ethics Journal Review*, 1 (17), 106-112. Retrieved from https://www.pdcnet.org/collection/fshow?id=bejr_2013_0001_0017_0106_0112&pdfname=bejr_2013_0001_0017_0002_0008.pdf&file_type=pdf

Black, P. J. (2015). *Sustainability: Are businesses looking beyond profit?* Retrieved from https://books.google.nl/books?id=OnGHDgAAQBAJ&pg=PA52&lpg=PA52&dq=large+companies+more+motivated+to+become+sustainable&source=bl&ots=29-uyAvydO&sig=ACfU3U0yZXLWLNZVzi52VIqucKIrnX1b9w&hl=nl&sa=X&ved=2ahUKEwiD2cjbuOjpAhUQGewKHYkeAiIQ6AEwCXoECAgQAQ#v=onepage&q=large%20companies%20more%20motivated%20to%20become%20sustainable&f=false

Bowman, C. & Ambrosini. V. (2003). How the Resource-based and the Dynamic Capability Views of the Firm Inform Corporate-level Strategy. *British Journal of Management*, 14, 289-303. Retrieved from https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1467-8551.2003.00380.x

CBS (2020). Bedrijven; bedrijfstak. Retrieved on 30 April 2020, from https://opendata.cbs.nl/#/CBS/nl/dataset/81589NED/table

Chae, B., Yang, C., Olson, D. & Sheu, C. (2014). The impact of advanced analytics and data accuracy on operationalperformance: A contingent resource based theory (RBT) perspective. *Decision Support Systems,* 59, 119-126. DOI: 10.1016/j.dss.2013.10.012

Chan, R. Y. K. (2005). Does the Natural-Resource-Based View of the Firm Apply in an Emerging Economy? A Survey of Foreign Invested Enterprises in China. *Journal of Management Studies*, 42 (3), 625-672. Retrieved from https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1467-6486.2005.00511.x?casa_token=0C0znynVovEAAAAA:8CrR7ikZb15ww_E6IHahf8HTSX8jP6NF2CGS1CeRKTqBkT_e4MbmWZ6MH3MGwDQ_MAZLgHHIYfEvNDhrfw

Chaput, L. (2011). *Project Design: Strategic Information: A Process Approach.* Quebec, Canada: Presses de L'Universite Du Quebec.

Collis, D. J. (1994). Research Note: How Valuable Are Organizational Capabilities? *Strategic Management Journal*, 15, 143-152. Retrieved from https://www.jstor.org/stable/pdf/2486815.pdf

Collis, D. J. & Anand, B. N. (2018). The Limitations of Dynamic Capabilities. *Harvard Business School.* Retrieved from https://www.hbs.edu/faculty/Publication%20Files/20-029_517ce6b4-4c4a-492f-b56e-01f78886e03b.pdf

Cordella, A. (2006). Transaction costs and information systems: does IT add up? *Journal of Information Technology*, 21, 195-202. Retrieved from https://journals.sagepub.com/doi/pdf/10.1057/palgrave.jit.2000066?casa_token=f4stTdz_RUQAAAAA:7BNALM1eRFsZ1AIoj_cA297c7Sa9c-byF4So4WsqiRJLDzF03ZucvU9I_kPUHVRgsjI648hV0acKvsk

Darnall, N. & Edwards, JR, D. (2006). PREDICTING THE COST OF ENVIRONMENTAL MANAGEMENT SYSTEM ADOPTION: THE ROLE OF CAPABILITIES, RESOURCES AND OWNERSHIP STRUCTURE. *Strategic Management Journal*, 27, 301-320. DOI: 10.1002/smj.518

Davis, K. A. (1992). Validity and Reliability in Qualitative Research on Second Language Acquisition and Teaching. Another Researcher Comments. *TESOL Quarterly*, 26 (3), 605-608. Retrieved from https://www.jstor.org/stable/pdf/3587190.pdf?casa_token=LYfJ4N6SNLEAAAAA:BXLr7HOnX-xOI6ztsh7lQgYD7xuDm6qKYFdr9aaEOZVR4OqhqzQlOH2CQafPtLmCUugmcpwnOBT9sX1D-iA23OHerfjiSE4ccM4zM1xHEdofi4QtIlvNGQ

Dummett, K. (2006). Driver for corporate environmental responsibility (CER). *Springer*, 8, 375-389. DOI: 10.1007/s10668-005-7900-3

Eisenhardt, K. M. & Martin, J. A. (2000). Dynamic capabilities: what are they? *Strategic Management Journal*, 21, 1105-1121. Retrieved from https://onlinelibrary.wiley.com/doi/pdf/10.1002/1097-0266%28200010/11%2921%3A10/11%3C1105%3A%3AAID-SMJ133%3E3.0.CO%3B2-E

Epstein, M.J. & Buhovac, A.R. (2010). Solving the sustainability implementation challenge. *Organizational Dynamics*, 39, 306-315. DOI: 10.1016/j.orgdyn.2010.07.003

Fahy, J. (2000). The resource-based view of the firm: some stumbling-blocks on the road to understanding sustainable competitive advantage, *Journal of European Industrial Training*, 24, 94-104. DOI: 10.1108/03090590010321061

Feldman, S. J., Soyka, P. A. & Ameer, P. (1996). DOES IMPROVING A FIRM'S ENVIRONMENTAL MANAGEMENT SYSTEM AND ENVIRONMENTAL PERFORMANCE RESULT IN A HIGHER STOCK PRICE? ICF *Kaiser International, Inc.* Retrieved from https://pdfs.semanticscholar.org/a52f/587eeadc0fc0a06aa9d9ba8d57ee9a1ebc71.pdf

Field, A. (2014). *Discovering Statistics using IBM SPSS Statistics.* London: SAGE Publications Ltd

Fraunhofer. (n.d.). European Manufacturing Survey. Retrieved on 13 March 2020, from https://www.isi.fraunhofer.de/en/themen/industrielle-wettbewerbsfaehigkeit/fems.html#tabpanel-367861728

Frels, R. K. & Onwuegbuzie, A. J. (2013). Administering Quantitative Instruments With Qualitative Interviews: A Mixed Research Approach. *Journal of Counseling & Development*, 91, 184-194. DOI: 10.1002/j.1556-6676.2013.00085.x

Gessel-Dabekaussen, G. (2018). *Het industriële landschap van Nederland.* Retrieved from CBS website: https://www.cbs.nl/nl-nl/achtergrond/2018/31/het-industriele-landschap-van-nederland

Golafshani, N. (2003). Understanding Reliability and Validity in Qualitative Research. *The Qualitative Report*, 8 (4), 597-607. Retrieved from http://www.brown.uk.com/teaching/HEST5001/golafshani.pdf

Hair, J. F., Black, W. C., Babin, B. J. & Anderson, R. E. (2014). *Multivariate Data Analysis* (7th edition, new international edition). Edinburg, Great Britain: Pearson.

Hart, S. L. & Dowell, G. (2011). A natural-resource-based view of the firm: fifteen years after. *Journal of Management*, 37 (5), 1464-1479. DOI: 10.1177/0149206310390219

Hart, S. L. (1995). A natural-resource-based view of the firm. *Academy of Management Review*, 20 (4), 986-1014. Retrieved from https://www.uhu.es/alfonso_vargas/archivos/HART-1995-A%20NATURAL-RESOURCE-BASED%20VIEW%20OF%20THE%20FIRM.pdf

Inan, G. G. (2015). Understanding organizational capability theories in the context of micro enterprises. *Research Gate.* Retrieved from https://www.researchgate.net/publication/280712887_Understanding_organizational_capability_theories_in_the_context_of_micro_enterprises

Jayaraman, V, Singh, R. & Anandnarayan, A. (2012). Impact of sustainable manufacturing practices on consumer perception and revenue growth: an emerging economy perspective. *International Journal of Production Research,* 50 (5), 1395-1410. DOI: 10.1080/00207543.2011.571939

Jelavic, S. R. (2017). A NATURAL RESOURCE-BASED VIEW OF THE FIRM: RESOURCEBASED ANALYSIS. In Yongqiang. L., Hunjet, A. & Roncevic, A. (Ed.), *Economic and Social Development* (pp. 588-597). Prague, Croatia: Varazdin Development and Entrepreneurship Agency.

Johnson, R. B., Onwuegbuzie, A. J. & Turner, L. A. (2007). Toward a Definition of Mixed Methods Research. *Journal of Mixed Methods Research,* 1 (2), 112-133. DOI: 10.1177/1558689806298224

Kenton, W. (2019). Production Costs. Retrieved on 24 March 2020, from https://www.investopedia.com/terms/p/production-cost.asp

King, A. & Lenox, M. (2002). Exploring the Locus of Profitable Pollution Reduction. *Management Science,* 48 (2), 289-299. DOI: 10.1287/mnsc.48.2.289.258

Klassen, R. D. & McLaughlin, C. P. (1996). The Impact of Environmental Management on Firm Performance. *Management Science,* 42 (8), 1199-1214. Retrieved from https://www.jstor.org/stable/pdf/2634452.pdf?casa_token=Gru8qbgu_7gAAAAA:fVN5d3pGNiDNdj2qBhLArAOa1CWaK7RgCK0gPdWk2GVoH81bGHipQaDuUiGgit4Jy6oS8J2u7cEGqjxm3UexPwElY6vlYk1KVL-PzN0exAh7hICML8Mq0g

Kraaijenbrink, J., Spender, J. C. & Groen, A. J. (2010). The Resource-Based View: A review and Assessment of Its Critiques. *Journal of Management,* 36 (1), 349-372. DOI: 10.1177/0149206309350775

Landrum, E. N. (2014). Defining a base of the pyramid strategy. *Int. J. Business and Emerging Markets,* 6 (4), 286-297. Retrieved from https://www.researchgate.net/publication/280769934_Defining_a_base_of_the_pyramid_strategy

Lannuzzi, A. (2017). *Green Products: The making and Marketing of Sustainable Brands* (2nd edition). Boca Raton, United States: CRC Press.

Lockett, A., Thompson, T. & Morgenstern, U. (2009). The development of the resource-based view of the firm: A critical appraisal. *International Journal of Management Reviews,* 11 (1), p. 9-28. DOI: 0.1111/j.1468-2370.2008.00252.x

Markley, M. J. & Davis, L. (2007). Exploring future competitive advantage through sustainable supply chains. *International Journal of Physical Distribution & Logistics Management*, 37 (9), 763-774. DOI: 10.1108/09600030710840859

Masson-Delmotte, V., Zhai, P., Pörtner, H., Roberts, D., Skea, J., Shukla, P.R., Pirani, A., Moufouma-Okia,W., Péan, C., Pidcock, R., Connors, S., Matthews, J.B.R., Chen, Y., Zhou, X., Gomis, M.I. ., Lonnoy, E., Maycock, T., Tignor, M. & Waterfield, T. (2018). *Global Warming of 1.5 ºC.* Retrieved from IPCC Website: https://www.ipcc.ch/sr15/

McDougall, N., Wagner, B. & MacBryde, J. (2019). An empirical explanation of the natural-resource-based view of the firm. *Taylor & Francis,* 30 (16), 1366-1382. DOI: 10.1080/09537287.2019.1620361

Menguc, B. & Ozanne, L. K. (2005). Challenges of the "green imperative": a natural resource-based approach to the environmental orientation–business performance relationship. *Journal of Business Research*, 58 (4), 430-438. DOI: 10.1016/j.jbusres.2003.09.002

Newbert, S. L. (2008). VALUE, RARENESS, COMPETITIVE ADVANTAGE, AND PERFORMANCE: A CONCEPTUAL-LEVEL EMPIRICAL INVESTIGATION OF THE RESOURCE-BASED VIEW OF THE FIRM. *Strategic Management Journal*, 29, 745-768. DOI: 10.1002/smj.686

Nobles, T., Mattison, B. & Matsumura, E. M. (2015). *Horngren's Accounting* (10th edition, global edition). Edinburg, Great Britain: Pearson.

Oreg, S. (2006). Personality, context, and resistance to organisational change. *European Journal of Work and Organizational Psychology,* 15 (1), 73-101. DOI: 10.1080/13594320500451247

Palcic, I. & Buchmeister, B. (2016). Energy and Material Saving Technologies in Slovenian Manufacturing Firms. *DAAAM International.* DOI: 10.2507/27th.daaam.proceedings.003

Porter, M. E. & Kramer, M. R. (2006). The link between competitive advantage and corporate social responsibility. *Harvard Business Review,* 84, 78-92. Retrieved from https://www.comfama.com/contenidos/servicios/Gerenciasocial/html/Cursos/Columbia/Lecturas/Strategy-Society.pdf

Porter, M. E. & Kramer, M. R. (2011). The Big idea: creating shared value. *Harvard Business Review.* Retrieved from http://www.coherence360.com/praxis/wp-content/uploads/2015/08/Michael_Porter_Creating_Shared_Value.pdf

Porter, M. E. & Van der Linde, C. (1995). Green and Competitive: Ending the Stalemate. *Harvard Business Review.* Retrieved from http://dl.ueb.edu.vn/bitstream/1247/12375/1/Porter_Linde.pdf

Randolph, G. M., Tasto. M. T. & Salvino Jr., R., F. (2017). *Public Policy, Productive and Unproductive Entrepreneurship: The Impact of Public Policy on Entrepreneurial Outcomes.* Cheltenham, United Kingdom: Edward Elgar Publishing.

Ravichandran, T. & Lertwongsatien, C. (2005). Effect of Information Systems Resources and Capabilities on Firm Performance: A Resource-Based Perspective. *Journal of Management Information* Systems, 21 (4), 237-276. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.474.2812&rep=rep1&type=pdf

Rijksoverheid (n.d.). Energiebelasting. Retrieved on 12 May 2020, from https://www.rijksoverheid.nl/onderwerpen/milieubelastingen/energiebelasting

Robins, J. & Wiersema, M. F. (1995). A Resource-Based Approach to the Multibusiness Firm: Empirical Analysis of Portfolio Interrelationships and Corporate Financial Performance. *Strategic Management Journal,* 16 (4), 277-299. Retrieved from https://www.jstor.org/stable/pdf/2486958.pdf

Roodt, G., Kinnear, C. & Erwee, R. (2003). Organisational Inertia: Contrasting Results in Australia and South Africa. *Journal of Industrial Psychology*, 29 (2), 1-5. Retrieved from https://eprints.usq.edu.au/2849/4/Roodt_Kinnear_Erwee_SAJIP_v29n2_PV.pdf

Rowley, J. (2012). Conducting research interviews. *Management Research Review*, 35 (3/4), 260-271. DOI: 10.1108/01409171211210154

RVO (n.d.). Energie Besparen. Retrievef on 4 June 2020, from https://www.rvo.nl/onderwerpen/duurzaam-ondernemen/energie-besparen

Sambasivan, M., Bah, S. M. & Jo-Ann, H. (2013). Making the case for operating "Green": impact of environmental proactivity on multiple performance outcomes of Malaysian firms. *Journal of Cleaner Production*, 42, 69-82. DOI: 10.1016/j.jclepro.2012.11.016

Sarkis, J., & Dijkshoorn, J. (2007). Relationships between solid waste management performance and environmental practice adoption in Welsh small and medium-sized enterprises (SMEs). *International Journal of Production Research*, 45 (21), 4989-5015. DOI: 10.1080/00207540600690529

Schadewitz, N. & Jachna, T. (2007). Comparing inductive and deductive methodologies for design patterns identification and articulation. *International Association of Societies of Design Research.* Retrieved from https://oro.open.ac.uk/15257/1/IASDR_PAPER_schadewitz_final.pdf

Sharma, S. & Vredenburg, H. (1998). PROACTIVE CORPORATE ENVIRONMENTAL STRATEGY AND THE DEVELOPMENT OF COMPETITIVELY VALUABLE ORGANIZATIONAL CAPABILITIES. *Strategic Management Journal*, 19, 729-753. Retrieved from https://onlinelibrary.wiley.com/doi/pdf/10.1002/(SICI)1097-0266(199808)19:8%3C729::AID-SMJ967%3E3.0.CO;2-4?casa_token=gf2Ktq0MCTsAAAAA:3Q4v2rrHJmnsYJAmoo-w_SMDVDMOa0h7k5F9Vcv8bYw7LmmYB4gWZJQ_mXTg932XXeHhH3I9iXrmep39XQ

Shi, V. G., Koh, S. C. L., Baldwin, J. & Cucchiella, F. (2012). Natural resource based green supply chain management. *Supply Chain Management: An International Journal*, 17 (1), 54-67. DOI: 10.1108/13598541211212203

Sindhi, S., & Kumar, N. (2012). Corporate environmental responsibility - transitional and evolving. *Management of Environmental Quality: An International Journal*, 23 (6), 640-657. DOI: 10.1108/14777831211262927

Soiferman, L. K. (2010). Compare and Contrast Inductive and Deductive Research Approaches. *ERIC.* Retrieved from https://files.eric.ed.gov/fulltext/ED542066.pdf

Stewart, P. G., Treasure, E. & Chadwick, B. (2008). Methods of data collection in qualitative research: interviews and focus groups. *British Dental Journal*, 204 (6), 291-295. DOI: 10.1038/bdj.2008.192

Stuckey, H. L. (2015). The second step in data analysis: Coding qualitative research data. *Journal of Social Health and Diabetes*, 3 (1), 7-10. Retrieved from https://www.thieme-connect.com/products/ejournals/pdf/10.4103/2321-0656.140875.pdf

Sygulla, R., Bierer, A. & Götze, U. (2011). Material Flow Cost Accounting – Proposals for Improving the Evaluation of Monetary Effects of Resource Saving Process Designs. *Proceedings of the 44th CIRP Conference on Manufacturing Systems.* Retrieved from https://pdfs.semanticscholar.org/ed72/9cb74d10de082cfb9c80b652e2025919f035.pdf

Tate, W. & Bals, L. (2016). Achieving Shared Triple Bottom Line (TBL) Value Creation: Toward a Social Resource-based View (SRBV) of the firm. *Journal of Business Ethics.* Retrieved from https://research-api.cbs.dk/files/46630327/lydia_bals_achieving_shared_triple_postprint.pdf

Teece, D. J. (2012). Dynamic Capabilities: Routines versus Entrepreneurial Action. *Journal of Management Studies*, 49, 8, 1395-1401. DOI: 10.1111/j.1467-6486.2012.01080.x

Walley, N., Whitehead, B. (1994). It's not easy being green. *Harvard Business Review*, 72, 46–52. Retrieved from https://hbr.org/1994/05/its-not-easy-being-green

Watson, K., Klingenberg, B., Polito, T. & Geurts, T. G. (2004). Impact of environmental management system implementation on financial performance: A comparison of two corporate strategies. *Management of Environmental Quality*, 15 (6), 622-628. DOI: 10.1108/14777830410560700

Yilmaz, K. (2013). Comparison of Quantitative and Qualitative Research Traditions: epistemological, theoretical, and methodological differences. *European Journal of Education*, 48 (2), 311-325. Retrieved from https://onlinelibrary.wiley.com/doi/pdf/10.1111/ejed.12014?casa_token=f2NFWzHJEpYAAAAA:Sk8fz2gaNLJyC19oAXa99T8sjaYPDY6fKv5cXIgd3WLrp9kifJydXU4Hm61ZusEsSOZtVPnt5rdbRIa08g

Zeng, S. X., Meng, X. H., Yin, H. T., Tam,, C. M. & Sun, L. (2010). Impact of cleaner production on business performance. *Journal of Cleaner production.* DOI: 10.1016/j.jclepro.2010.02.019

Appendix 1: Questionnaire

Radboud Universiteit Nijmegen
Institute for Management Research

Modernisering van de productie
Enquête 2015

Deze vragenlijst heeft als doel inzicht te krijgen in de inspanningen van industriële bedrijven in Nederland om hun productie en bedrijfsprocessen te moderniseren. 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. Bij het invullen van de vragenlijst kunt u zowel de muis als de tab-toets gebruiken.

Voor vragen kunt u terecht bij. dr. Peter Vaessen E-Mail: P.Vaessen @ fm.ru.nl Tel.: 024 3611266 Fax: 024 3611933

1.1 **Is uw bedrijfsvestiging** (kruis slechts één optie aan):

- ☐ Het hoofdkantoor van een onderneming/groep met ook buitenlandse vestigingen
- ☐ Een dochter/divisie van een buitenlandse onderneming/groep
- ☐ Het hoofdkantoor van een onderneming/groep met alleen binnenlandse vestigingen
- ☐ Een dochter/divisie van een onderneming/groep met alleen binnenlandse vestigingen
- ☐ Een zelfstandige onderneming

1.2 Bedrijfstak (bijv. textiel, chemische industrie, machinebouw, enz.): _____ hoofdproductgroep _____ aandeel van hoofd-product (groep) in omzet ca. ____ %

1.3 **Is uw bedrijfsvestiging gelet op uw hoofdproduct(groep) leverancier van eindfabricaten of een toeleverancier van onderdelen/ materialen of bewerkingen?** (Kruis slechts één optie aan)

producent van eindfabricaten		toeleverancier		aanbieder van bewerkingen
☐ voor consumenten	☐ voor bedrijven	☐ van systemen/ installaties	☐ van halffabricaten/ onderdelen	☐ aanbieder van bewerkingen (draaien, coaten, lassen, vermalen, e.a.)

1.4 **Als u uw hoofdproduct(groep) levert aan andere bedrijven (als eindfabrikant of toeleverancier), aan welke bedrijfstak levert u dan hoofdzakelijk?** (Kruis slechts één optie aan)

Machinebouw ☐ Chemische industrie ☐ Automotive industrie ☐ Elektro-techniek ☐ andere bedrijfstak, nl.: _____

1.5 **In hoeverre voert uw bedrijfsvestiging voor het hoofdproduct de volgende activiteiten uit van het waardecreatieproces?**
Kruis voor elke activiteit aan in welke mate die in uw eigen bedrijfsvestiging dan wel elders wordt uitgevoerd.
Kruis ook aan of een activiteit in het geheel geen deel uitmaakt van het waardecreatieproces

	Waardecreatie-activiteiten					
	Onderzoek en Ontwikkeling	Ontwerp/ Vormgeving	Productie/ Verwerking/Recycling	Assemblage	Onderhoud/ Dienstverlening	Verpakken/ Distributie
grotendeels intern > 85%	☐	☐	☐	☐	☐	☐
relevant deel intern (25%-85%)	☐	☐	☐	☐	☐	☐
klein deel intern (<25%)	☐	☐	☐	☐	☐	☐
niet nodig voor vervaardiging van het hoofdproduct	☐	☐	☐	☐	☐	☐

2 **Hoe belangrijk zijn de volgende factoren voor de concurrentiepositie van uw bedrijfsvestiging?** (geef de volgorde van belangrijkheid aan met een score van 1 tot 6; 1 is het belangrijkst, gebruik elke score slechts één keer)

productprijs	productkwaliteit	innovatieve producten	aanpassing producten aan klantenwensen	tijdige levering/ korte levertijden	dienstverlening en service
☐	☐	☐	☐	☐	☐

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

Toepassing gepland voor 2018	Nee	Organisatieconcepten	Ja	Voor het eerst toegepast[1]	Omvang van het toegepaste potentieel [2]
		Organisatie van het werk			
☐	☐	Gedetailleerde voorschriften voor de werkplekinrichting van apparatuur en opslag van tussenproducten (bijv. 5-S methode)	☐	19/20 ☐	☐☐☐
☐	☐	Gestandaardiseerde en gedetailleerde werkinstructies	☐	19/20 ☐	☐☐☐
☐	☐	Taakverrijking productiemedewerker (integratie van planning, uitvoering of controle)	☐	19/20 ☐	☐☐☐
		Organisatie van de productie			
☐	☐	Maatregelen ter verbetering van de interne logistiek (Value Stream Mapping/Design, ruimtelijke inrichting van productiestappen)	☐	19/20 ☐	☐☐☐
☐	☐	Klant- of productgeoriënteerde inrichting van productie-eenheden (i.t.t. functionele indeling)	☐	19/20 ☐	☐☐☐
☐	☐	Vraaggestuurde productie (bijv. KANBAN, afschaffen van tussenvoorraden)	☐	19/20 ☐	☐☐☐
☐	☐	Voorgeschreven methoden voor het verkorten van omstel- en aanlooptijden bij productwisseling (bijv. Single Minute Exchange of Die; Quick Change Over)	☐	19/20 ☐	☐☐☐
		Productiemanagement/ -beheersing			
☐	☐	Grafische weergave werkprocessen en -status (Visual Management; dashboard)	☐	19/20 ☐	☐☐☐
☐	☐	Kwaliteitsmanagement (bijv. preventieve onderhoud, total quality management/TQM, total productie-onderhoud/TPM)	☐	19/20 ☐	☐☐☐
☐	☐	Methoden voor operation management o.b.v. wiskundige analyse van productie (bijv. Six Sigma methode)	☐	19/20 ☐	☐☐☐
☐	☐	Methoden van continu verbeteren (Kaizen, kwaliteitscirkels e.d.)	☐	19/20 ☐	☐☐☐
		Energie- en milieubeheersing			
☐	☐	Gecertificeerd energie-management systeem volgens ISO 50001, voorheen: EN 16001	☐	19/20 ☐	☐☐☐
☐	☐	Instrumenten voor productlevenscyclus-analyse (bijv. EU Ecolabel, Cradle-to-Cradle certificaat, ISO-14020)	☐	19/20 ☐	☐☐☐
☐	☐	Het opnemen van sociale en duurzaamheidseffecten in het vaststellen van bedrijfsprestaties	☐	19/20 ☐	☐☐☐
		Human resource management			
☐	☐	Maatregelen voor het behoud van oudere werknemers of hun kennis voor uw bedrijfsvestiging (bijv. teams met verschillende leeftijdsgroepen, begeleidingsprogramma's, senior-junior tandems)	☐	19/20 ☐	☐☐☐
☐	☐	Instrumenten ter bevordering van werknemersbetrokkenheid (bijv. gratis kantine, ondersteuning kinderopvang, gezinsvriendelijke werktijden)	☐	19/20 ☐	☐☐☐
☐	☐	Gestandaardiseerde methoden van functie-ontwerp ter verbetering van gezondheids- en veiligheidsomstandigheden op het werk (bijv. Methods-time measurement (MTM))	☐	19/20 ☐	☐☐☐
☐	☐	Financiële participatie toegankelijk voor alle werknemersgroepen (bijv. winstdelingsregelingen, aandelen(optie)plannen, enz.)	☐	19/20 ☐	☐☐☐

Toelichting:

1 Het jaar waarin deze technologie voor het eerst werd toegepast in uw bedrijfsvestiging (maak een schatting indien u onzeker bent over het exacte jaar)

2 Daadwerkelijke toepassing ten opzichte van maximaal zinvolle toepassingsmogelijkheden: omvang van het gebruikte potentieel is "gering" bij eerste aanzetten, "midden" bij gedeeltelijke toepassing en "hoog" bij omvangrijke toepassing

4.1 **Welke van de volgende activiteiten worden uitgevoerd voor uw productiepersoneel in uw bedrijfsvestiging?**

Aanwezige competenties van productiewerknemers worden systematisch vastgelegd? ☐ nee ☐ ja

Functiebeschrijvingen zijn ontwikkeld voor specifieke functiegebieden in de productie? ☐ nee ☐ ja

Er bestaan specifieke competentieprogramma's voor bepaalde functies ☐ nee ☐ ja

4.2 **Bij welke personeelsgroepen worden deze instrumenten gebruikt?**

☐ LBO of ongeschoold personeel ☐ MBO geschoold personeel ☐ Hooggeschoold personeel (HBO+WO)

4.3 **Bestaat er afzonderlijk beleid voor competentie-ontwikkeling en training van productiepersoneel?**

☐ nee ☐ ja → Is er in uw bedrijf voor dit beleid een vast jaarlijks budget beschikbaar? ☐ nee ☐ ja

5.1 **Is er een vastgesteld aantal dagen per jaar voor verdere kwalificatie, training en ontwikkeling van het productiepersoneel?**

☐ nee ☐ ja → **Hoeveel dagen per jaar is er per persoon vastgesteld?** ca. ☐ dagen per jaar

5.2 **Zijn de volgende activiteiten voor verdere kwalificatie, training en ontwikkeling toegepast voor het productiepersoneel in uw bedrijfsvestiging?**

	nee	ja	In aanmerking komen de volgende groepen van productiepersoneel: LBO of ongeschoold	MBO technisch geschoold	Hooggeschoold (WO+HBO)
Training voor specifieke vaardigheden (bijv. machine-onderhoud)	☐	☐ →	☐	☐	☐
Training met interdisciplinair oogmerk (bijv. taalcursussen, leiderschapstraining)	☐	☐ →	☐	☐	☐
Digitale zelfscholingprogramma's (e-learning)	☐	☐ →	☐	☐	☐
On-the-job training (bijv. taakrotatie, werkplekinstructie, georganiseerde ervaringsuitwisseling met collega's)	☐	☐ →	☐	☐	☐
Informatie-aanbod (bijv. bedrijfstak specifieke beurzen, externe databases)	☐	☐ →	☐	☐	☐
Deelname aan activiteiten voor continue kwaliteitsverbetering (bijv. kwaliteitscirkels, Kaizen)	☐	☐ →	☐	☐	☐

6.1 **Werkt uw bedrijfsvestiging samen met andere bedrijven op de volgende terreinen?**
(samenwerking = vrijwillige samenwerking die verder gaat dan eenmalige transacties tussen bedrijven)

	nee	ja	Locatie van de partners: regionaal (< 50km)	nationaal (> 50km)	buiten-land
Samenwerking in inkoop	☐	☐ →	☐	☐	☐
Samenwerking in de productie (voor gezamenlijke systeemleveringen of capaciteitsuitbreiding)	☐	☐ →	☐	☐	☐
Samenwerking in distributie/verkoop	☐	☐ →	☐	☐	☐
Samenwerking in service	☐	☐ →	☐	☐	☐
Samenwerking in onderzoek en ontwikkeling met afnemers of leveranciers	☐	☐ →	☐	☐	☐
Samenwerking in onderzoek & ontwikkeling (O&O) met onderzoeksinstituten (bijv. universiteiten, TNO)	☐	☐ →	☐	☐	☐

6.2 **Indien uw bedrijfsvestiging voor onderzoek en ontwikkeling samenwerkt met andere bedrijven, zijn daarbij bedrijven actief op het gebied van nanotechnologie, micro-elektronica, photonen, nieuwe materialen, of biotechnologie?**

☐ nee ☐ ja → ☐ nanotechnologie ☐ micro-elektronica ☐ photonen ☐ nieuwe materialen ☐ biotechnologie

7.1 **Welke van de volgende maatregelen zijn genomen om het risico van industriële spionage te vermijden in uw bedrijfsvestiging? Sinds wanneer zijn deze ingevoerd?**

	nee	ja	sinds wanneer?
Speciale IT-veiligheidsmaatregelen (bijv. geen gebruik cloud computing, versleutelen van documenten, algemeen verbod op gebruik van draagbare data media)	☐	☐ →	19/20 ☐
Werknemerstrainingen en verhoging van waakzaamheid voor het gevaar van industriële spionage	☐	☐ →	19/20 ☐
Veiligheidsmaatregelen voor toegang tot terrein, gebouwen of kamers	☐	☐ →	19/20 ☐
Veiligheidsinstructies over illegale verspreiding van informatie (bijv. regelingen voor omgaan met gevoelige gegevens in relatie tot derde partijen)	☐	☐ →	19/20 ☐

7.2 **Heeft uw bedrijfsvestiging te maken gehad met spionage door andere bedrijven, buitenlandse overheidsorganisaties of met verdachte gevallen in de laatste vijf jaar?**

concre(e)t(e) geval(len) ☐ nee ☐ ja → ☐ ander bedrijf ☐ buitenlandse overheidsorganisatie ☐ onbekend

verdacht(e) geval(len) ☐ nee ☐ ja → ☐ ander bedrijf ☐ buitenlandse overheidsorganisatie ☐ onbekend

7.3 **Indien er sprake was van een verdacht of concreet geval, welke informatie was het doelwit van industriële spionage?**

Informatie over....

☐ Producten (bijv. ideeën, studies, ontwikkeling, ontwerp) ☐ Productie- of fabricageprocessen ☐ Klanten/toeleveranciers (bijv. contracten, prijzen) ☐ Bedrijfsstrategie (bijv. investeringsplannen)

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

Toepassing gepland voor 2018	Nee	Technologieën	Ja	Voor het eerst gebruikt (Jaar)[1]	upgrade sinds 2012 Ja	upgrade sinds 2012 Nee	Omvang van het toegepaste potentieel[2]
		Automatisering en robotisering					
☐	☐	Industriële robots voor bewerking en fabricage (bijv. lassen, coaten, snijden)	☐	19/20 ☐☐	☐	☐	☐☐☐
☐	☐	Industriële robots voor hanteren van gereedschap en werkstukken in productie (bijv. verplaatsen, assemblage, sorteren, verpakken)	☐	19/20 ☐☐	☐	☐	☐☐☐
		Energie- en grondstoffenbesparing					
☐	☐	Controlesystemen die machines stilleggen bij onderbenutting (bijv. PROFI-energy)	☐	19/20 ☐☐	☐	☐	☐☐☐
☐	☐	Geautomatiseerde beheerssystemen voor energie efficiënte productie	☐	19/20 ☐☐	☐	☐	☐☐☐
☐	☐	Systemen t.b.v. terugwinning van kinetische en procesenergie (bijv. terugwinnen afvalwarmte)	☐	19/20 ☐☐	☐	☐	☐☐☐
☐	☐	Technologieën voor energie- en/of warmteopwekking door middel van zon-, wind-, waterkracht, biomassa of geothermische energie	☐	19/20 ☐☐	☐	☐	☐☐☐
		Bewerkingstechnologieën voor nieuwe materialen					
☐	☐	Productietechnologieën voor micromechanische componenten (micromachinale bewerking, lithografie, micro-injectie e.d.)	☐	19/20 ☐☐	☐	☐	☐☐☐
☐	☐	Nanotechnologische productieprocessen (bijv. oppervlaktebewerking)	☐	19/20 ☐☐	☐	☐	☐☐☐
☐	☐	Technieken voor verwerking van composietmateralen (bijv. carbonvezel, glasvezel)	☐	19/20 ☐☐	☐	☐	☐☐☐
☐	☐	Bio- en gentechnologie in fabricageprocessen (bijv. catalysatoren, bioreactoren)	☐	19/20 ☐☐	☐	☐	☐☐☐
☐	☐	Technieken voor verwerking van legeringen (aluminium-, magnesium-, titaniumlegeringen, enz.)	☐	19/20 ☐☐	☐	☐	☐☐☐
		Additieve productietechnologieën					
☐	☐	Additive productietechnologie voor maken van prototypes (bijv. 3D printing, rapid prototyping; Selective Laser Sintering; Stereolithografie, Laser Beam Melting)	☐	19/20 ☐☐	☐	☐	☐☐☐
☐	☐	Productie met additieve productietechnologie (incl. enkelstuksproductie; kleine productieseries; reserveonderdelen)	☐	19/20 ☐☐	☐	☐	☐☐☐
☐	☐	Systemen voor Machine2Machine communicatie, Multi-agent systemen	☐	19/20 ☐☐	☐	☐	☐☐☐
☐	☐	Systemen voor Cyber-Physical systems, cloud-computing	☐	19/20 ☐☐	☐	☐	☐☐☐
		Digitale fabriek / IT netwerken					
☐	☐	Digitale productieplanning en roostering (bijv. ERP-systeem)	☐	19/20 ☐☐	☐	☐	☐☐☐
☐	☐	Bijna real-time productiebeheersingssystemen (bijv. systemen voor gecentraliseerde aansturing en machinegegevensverwerking	☐	19/20 ☐☐	☐	☐	☐☐☐
☐	☐	Digitale uitwisseling van productieplanningsgegevens met toeleveranciers en/of klanten (supply chain management)	☐	19/20 ☐☐	☐	☐	☐☐☐
☐	☐	Systemen voor geautomatiseerd management van interne logistiek en orderverzameling (e.g. RFID, warehouse management system)	☐	19/20 ☐☐	☐	☐	☐☐☐
☐	☐	Mobiele/draadloze apparaten voor programmering en bediening van installaties en machines (e.g. tablets)	☐	19/20 ☐☐	☐	☐	☐☐☐
☐	☐	Product Lifecycle Management (PLM) systemen of Product/Productieproces datamanagement	☐	19/20 ☐☐	☐	☐	☐☐☐
☐	☐	Technologieën voor veilige mens-machine interactie (bijv. coöperatieve robots, open werkstations e.d.)	☐	19/20 ☐☐	☐	☐	☐☐☐
☐	☐	Digitale oplossingen voor het direct beschikbaar maken van tekeningen, werkschemas en -instructies op de werkvloer (e.g. tablets, smartphones)	☐	19/20 ☐☐	☐	☐	☐☐☐

Toelichting:

1 Het jaar waarin deze technologie voor het eerst werd toegepast in uw bedrijfsvestiging (maak een schatting indien u onzeker bent over het exacte jaar)

2 Daadwerkelijke toepassing ten opzichte van maximaal zinvolle toepassingsmogelijkheden: omvang van het gebruikte potentieel is "gering" bij eerste aanzetten, "midden" bij gedeeltelijke toepassing en "hoog" bij omvangrijke toepassing

8.2 Welke van de volgende maatregelen nam uw bedrijfsvestiging om energieverbruik te verminderen?

	Toepassing gepland voor 2018	nee	ja
Afschakelsystemen voor onderdelen, machines of installaties indien niet in gebruik (bijv. afschakeling luchttoevoer, aangepaste verlichtingssensoren)	☐	☐	☐
Verbeteren van bestaande machines of installaties (bijv. hoogefficiënte motoren (IE3), aanbrengen isolatie, warmtewisseleraar)	☐	☐	☐
Voortijdige vervanging van bestaande machines of installaties door nieuwe machines of installaties	☐	☐	☐

8.3 Welke van de volgende redenen en welke van de genoemde barrières zijn van doorslaggevende betekenis voor het wel of niet invoeren van energie en warmte opwekkende technologieën op basis van hernieuwbare energie in uw vestiging?

Redenen voor invoering	Energie	Warmte	Belangrijke barrières	Energie	Warmte
Verwachte ontwikkeling van de energieprijzen	☐	☐	Te grote investeringen of voordelen ontbreken	☐	☐
Strategische redenen (bijv. "groen imago")	☐	☐	Administratieve last (bijv. goedkeuringsprocedures)	☐	☐
Terugdringen broeikasgassen	☐	☐	Niet van toepassing in deze bedrijfsvestiging	☐	☐
Eigen energie-opwekking ter vergroting aantal energiebronnen	☐	☐	Vooralsnog geen relevant onderwerp in deze vestiging	☐	☐
Politieke of wettelijke bepalingen	☐	☐	Andere barrières	☐	☐

9.1 Heeft uw bedrijf sinds 2012 producten geïntroduceerd die nieuw waren voor uw bedrijf of die technisch ingrijpend zijn vernieuwd?
(Bijv. door nieuwe grondstoffen of materialen te gebruiken, veranderingen in productiefuncties of werking e.d.)

☐ nee ☐ ja → Hoe groot was het aandeel van deze producten in de omzet van het jaar 2014? ca. ☐ %

→ Hoe lang duurde gemiddeld genomen de ontwikkeling van zo'n product? (van productidee tot en met lancering) ca. ☐ maanden

9.2 Hebben deze productvernieuwingen ook geleid tot betere milieu-effecten bij gebruik of verwijderen van deze nieuwe producten?

☐ nee ☐ ja → Welke verbeteringen in de milieu-effecten zijn met deze producten bereikt? (Kruis aan wat van toepassing is)

☐ Vermindering van gezondheidsrisico's bij gebruik
☐ Vermindering van energieverbruik bij gebruik
☐ Vereenvoudiging van onderhoud of herstel
☐ Verlenging productlevensduur
☐ Vermindering van milieuvervuiling bij gebruik (van grond, water, lucht, of geluid)
☐ Verbeterde recycling, terugwinning of verwijderingseigenschappen

9.3 Bevonden zich bij deze nieuwe producten (nieuw sinds 2012) ook producten, die nieuw-voor-de-markt waren en die uw bedrijfsvestiging als eerste op de markt introduceerde?

☐ nee ☐ ja → Wat was hun aandeel in de omzet van 2014? ca. ☐ %

→ Zijn deze producten speciaal ontwikkeld vooral voor (kruis slechts één optie aan):

☐ bestaande klanten binnen uw huidige markt
☐ aantrekken van nieuwe klanten binnen uw huidige markt
☐ toetreding tot markten nieuw voor *uw bedrijfsvestiging*
☐ het ontwikkelen van geheel nieuwe markten

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

☐ nee ☐ ja → Welk percentage van de omzet hadden deze producten in 2014? ca. ☐ %

10.1 Welke van de volgende productgerelateerde diensten biedt u uw klanten aan?
Als uw bedrijfsvestiging dergelijke diensten aanbiedt, worden zij dan ook aangeboden voor producten van andere bedrijven?

	nee	ja	Voor producten van andere bedrijven		nee	ja	Voor producten van andere bedrijven
Installatie, inbedrijfstelling	☐	☐→	☐	Software-ontwikkeling (bijv. software-aanpassing)	☐	☐→	☐
Onderhoud en reparatie	☐	☐→	☐	Klantondersteuning op afstand (helpdesk, service hotline, website)	☐	☐→	☐
Training	☐	☐→	☐	Reviseren, vernieuwen (incl. functie opwaardering of software-uitbreidingen)	☐	☐→	☐
Ontwerp, technisch advies (incl. testen, simulaties, O&O voor klanten)	☐	☐→	☐	End-of-life dienstverlening (bijv. recycling, opheffen, terugname)	☐	☐→	☐

10.2 **Indien u productgerelateerde diensten aanbiedt, hoe hoog schat u het aandeel daarvan in de totale omzet van 2014?**
► In geval van geen omzet, vul in „0".

Aandeel in totale omzet van diensten die u in 2014 direct, d.w.z. apart, in rekening heeft gebracht ca. ☐ %

Aandeel van diensten die u in 2014 indirect in rekening heeft gebracht (via de productprijs) ca. ☐ %

10.3 **Heeft uw bedrijfsvestiging vanaf 2012 nieuwe productgerelateerde diensten aangeboden, die geheel nieuw zijn voor uw bedrijfsvestiging of belangrijke verbeteringen bevatten?**

☐ nee ☐ ja → Hoe groot was het aandeel in de omzet van 2014 van deze sinds 2012 nieuw aangeboden productgerelateerde diensten, die uw bedrijfsvestiging direct of indirect in rekening heeft gebracht? ca.. ☐ %

11 **Hoe vaak heeft uw organisatie vanaf 2012 de volgende activiteiten verricht?**

		(0=niet; 1=1 keer; 2=vaker)
Spin-offs	Opstarten van nieuwe organisaties of activiteiten buiten de onderneming	☐ ☐ ☐
Uitgaand intellectueel eigendom	Verkopen, of aanbieden van licenties/patenten aan andere organisaties	☐ ☐ ☐
Werknemer-betrokkenheid	Benutten van kennis en initiatieven van niet-O&O medewerkers bij het realiseren van innovaties	☐ ☐ ☐
Klantbetrokkenheid	Direct betrekken van klanten in uw innovatieprocessen	☐ ☐ ☐
Extern netwerken	Het samenwerken met andere organisaties (niet klanten) voor innovatie	☐ ☐ ☐
Externe participatie	Deelnemen (met bijv. vermogen, kennis) in ondernemingen om toegang te krijgen tot hun kennis of om andere synergieën te creëren?	☐ ☐ ☐
Uitbesteden van O&O	Uitbesteden van O&O (diensten) aan andere organisaties, zoals universiteiten, publieke onderzoeksinstellingen, commerciële ingenieurs of leveranciers?	☐ ☐ ☐
Inkomend intellectueel eigendom	Kopen of in licentie nemen van intellectueel eigendom van andere organisaties	☐ ☐ ☐

12 **Hoe hebben zich in uw bedrijfsvestiging de productiekosten per eenheid product (eenheidskosten) ontwikkeld in 2014?**

Gedaald met 10% of meer	Gedaald 5 - < 10%	Gedaald 0 - < 5%	Gelijk gebleven	Gestegen 0 - < 5%	Gestegen 5 - < 10%	Gestegen met 10% of meer
☐	☐	☐	☐	☐	☐	☐

13 **In de voorafgaande vragen heeft u informatie gegeven over verschillende velden van innovatie. Rangorden deze innovatievelden naar mate van belangrijkheid voor uw bedrijfsvestiging.**
Geef met een score van 1 tot 4 de volgorde van belangrijkheid aan met 1 als het belangrijkst; gebruik elke score slechts één keer.

Toevoegen van diensten aan uw producten	Organisatie-vernieuwing	Technische vernieuwing in het productieproces	Ontwikkeling van nieuwe producten
○	○	○	○

14 **Welke van de onderstaande informatiebronnen zijn het meest relevant voor belangrijke innovatie-impulsen/ideeën in uw bedrijfsvestiging op de volgende gebieden?** (Kruis maximaal drie informatiebronnen aan voor elk gebied van innovatie)

	intern				extern			
	O&O, engineering	productie-afdeling	Klanten-service	Leiding bedrijfsvestiging	Klant of gebruiker	Leverancier	Onderzoeks-instellingen, universiteiten	Conferenties, beurzen
Nieuwe producten	☐	☐	☐	☐	☐	☐	☐	☐
Nieuwe proces-technologieën	☐	☐	☐	☐	☐	☐	☐	☐
Nieuwe diensten	☐	☐	☐	☐	☐	☐	☐	☐
Nieuwe organisatie-concepten	☐	☐	☐	☐	☐	☐	☐	☐

15.1 **Wat is het opleidingsniveau van het personeel van uw bedrijfsvestiging?**

Hoger onderwijs (HBO+WO)	ca. ☐	%	=100%
MBO technische opleiding	ca. ☐	%	
MBO adminstratieve en commerciële opleiding	ca. ☐	%	
LBO of ongeschoold	ca. ☐	%	
Personeel in opleiding (leerlingen, stagiaires)	ca. ☐	%	

15.2 **Hoe is het personeel in uw bedrijfsvestiging verdeeld over de volgende werkterreinen:**

Onderzoek en ontwikkeling	ca. ☐	%	=100%
Ideevorming, ontwerp en vormgeving	ca. ☐	%	
Fabricage en montage	ca. ☐	%	
Klantenservice	ca. ☐	%	
Overige (administratie, inkoop, logistiek/distributie, onderhoud, productieplanning enz.)	ca. ☐	%	

16 **Heeft uw bedrijfsvestiging in de afgelopen twee jaar delen van de productie of delen van onderzoek en ontwikkeling (O&O) overgeheveld naar andere bedrijven (uitbesteding) of eigen vestigingen in het buitenland (verplaatsing) danwel vestigingen vanuit het buitenland teruggeplaatst?**

Overheveling:

nee	Ja:(meerdere opties mogelijk) Naar andere bedrijven in Nederland	Naar andere bedrijven in het buitenland	naar eigen vestigingen in het buitenland	Naar welk land (landen)?	**Redenen:** (meerdere opties mogelijk) Arbeidskosten	Ontsluiting nieuwe markten	Nabijheid belangrijke klanten	Toegang tot nieuwe kennis technologieën/clusters	Belasting, heffingen, subsidies	Gebrek aan gekwalificeerd personeel in eigen land	Importbeperkingen	Nabijheid van O&O of productie die reeds is overgeheveld	Toegang tot natuurlijke hulpbronnen leveranciers	Aanwezigheid van concurrenten
Overheveling van **productie-activiteiten** sinds 2013														
Verplaatsing **onderzoeks- en ontwikkelingsactiviteiten** sinds 2013														

Terugplaatsing (repatriëring) vanuit het buitenland naar het thuisland

Nee	Ja	Vanuit andere bedrijven in het buitenland	Vanuit eigen vestigingen in het buitenland	Uit welk land/landen	Kwaliteit	Flexibiliteit, leversnelheid	Capaciteitsbenutting	Beschikbaarheid gekwalificeerd personeel	Arbeidskosten	Transportkosten/ logistieke kosten	Kosten van coördinatie en toezicht	Nabijheid van binnenlandse O&O	Verlies van kennis/ -kopiëren/piraterij	Infrastructuur
Terugplaatsing van (delen van) de **productie** sinds 2013														

17 **Geef a.u.b. de herkomst van uw toeleveringen (inputs) en de bestemming van uw producten in 2014.**
► Toeleveringen zijn gekochte onderdelen, (ruwe) materialen, productiemiddelen en diensten. Geef alleen het aandeel aan van producten gemaakt in uw bedrijfsvestiging.

Toeleveringen afkomstig uit

binnenland ca ____ % }
buitenland ca ____ % } =100% van de inkoopwaarde

Producten verkocht in:

binnenland ca ____ % }
buitenland ca ____ % } =100% van de omzet

18.1 **Heeft uw bedrijfsvestiging onderzoek en ontwikkelingsactiviteiten (O&O) uitgevoerd of laten uitvoeren door externe partners in 2014?**

☐ nee ☐ ja → O&O-uitgaven in procenten van de omzet in 2014 ca. ____ %

18.2 **Heeft uw bedrijfsvestiging sinds 2012 continu O&O uitgevoerd of laten uitvoeren door externe partners?**

☐ nee ☐ ja

19 **Welk van de volgende kenmerken zijn het meest van toepassing op uw hoofdproduct(groep)?**

Productontwikkeling (kruis slechts één optie aan)

- Op specificatie van klant ☐
- Voor een standaardprogramma waarbinnen klantspecifieke wensen gerealiseerd kunnen worden ☐
- Voor een standaardprogramma, waaruit de klant kan kiezen ☐
- Niet aanwezig in deze bedrijfsvestiging ☐

Fabricage/montage (kruis slechts één optie aan)

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

Seriegrootte (kruis slechts één optie aan)

- Enkelstuksproductie ☐
- Kleine of middelgrote series (20-1.000 stuks per maand) ☐
- Grote series (meer dan 1.000 stuks per maand) ☐
- Geen discrete productie (procesindustrie) ☐

Productcomplexiteit (kruis slechts één optie aan)

- Eenvoudige producten ☐
- Producten van middelgrote complexiteit ☐
- Complexe producten ☐

20 Beantwoordt u de volgende vragen over uw hoofdproduct(groep).

Wat is de gemiddelde productietijd van uw hoofdproduct(groep)? (doorlooptijd vanaf moment dat opdracht binnenkomt bij productie tot product klaar is voor levering) ca. ☐ werk-dagen of ☐ uren

Hoeveel procent van de orders wordt op tijd afgeleverd? ca. ☐ %

Hoeveel procent van uw productie moet na kwaliteitscontrole nabewerking ondergaan of geheel worden afgekeurd? ca. ☐ %

Welk percentage van de geleverde bestellingen heeft klachten van klanten opgeleverd vanwege kwaliteitsproblemen? ca. ☐ %

21 Hier worden enkele gegevens over uw bedrijfsvestiging gevraagd:

Jaaromzet 2014 ☐ miljoen € 2012 ☐ miljoen €

Aantal werknemers (excl. uitzendkrachten) 2014 ☐ aantal

Aantal werknemers dat is afgevloeid in 2014 2014 ☐ aantal

Had uw bedrijfsvestiging uitzendkrachten in dienst in 2014? ☐ nee ☐ ja → Hoeveel uitzendkrachten waren in 2014 gemiddeld in dienst bij uw bedrijfsvestiging? ca. ☐ aantal

Inkoop 2014 (ingekochte onderdelen, materialen en diensten) ☐ miljoen €

Afschrijvingen op machines en installaties 2014 (zonder grond en gebouwen) ☐ miljoen €

Investeringen in machines en installaties 2014 ☐ miljoen €

Personeelskosten als percentage van de omzet in 2014 (incl. loonnevenkosten) ☐ %

Graad van capaciteitsbenutting (gemiddeld in 2014) ☐ %

Totale energiekosten als percentage omzet 2014 ☐ %

Rendement op de omzet (vóór belasting in 2014) ☐ negatief ☐ 0 tot 2% ☐ > 2 tot 5% ☐ > 5 tot 10% ☐ > 10%

Jaar van oprichting, c.q. inschrijving bij de Kamer van Koophandel jaar: ☐

Heeft uw bedrijfsvestiging een ondernemingsraad? ☐ nee ☐ ja

22.1 Geef uw energieverbruik aan als volgt:

Wat was het aandeel groene stroom in het totale stroomverbruik van uw bedrijfsvestiging in 2014? ca. ☐ %

Hoe groot is de te verwarmen oppervlakte van uw bedrijfsvestiging? ca. ☐ m^2

22.2 Hoe heeft het stroomverbruik van uw bedrijfsvestiging zich ontwikkeld in 2014?

Gedaald met 10% of meer	Gedaald 5 - < 10%	Gedaald 0 - < 5%	Gelijk gebleven	Gestegen 0 - < 5%	Gestegen 5 - < 10%	Gestegen met 10% of meer
☐	☐	☐	☐	☐	☐	☐

22.3 Hoe heeft het olie- en gasverbruik van uw bedrijfsvestiging zich ontwikkeld in 2014?

Gedaald met 10% of meer	Gedaald 5 - < 10%	Gedaald 0 - < 5%	Gelijk gebleven	Gestegen 0 - < 5%	Gestegen 5 - < 10%	Gestegen met 10% of meer
☐	☐	☐	☐	☐	☐	☐

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

☐ Private eigenaar/ familie ☐ Financiële investeerder (bijv durfkapitaal) ☐ Ander bedrijf (bijv. niet-financiële investeerder) ☐ stichting ☐ overige eigenaren ☐ Geen meerderheidseigenaar

→ Is de familie actief in het management? ☐ Nee ☐ Ja

Hartelijk dank voor uw bijdrage aan dit onderzoek.

Wij verzoeken u de ingevulde vragenlijst terug te sturen per e-mail naar: P.Vaessen@fm.ru.nl

of per post naar:

Radboud Universiteit Nijmegen, t.a.v Dr P.Vaessen, Antwoordnummer 1908, 6500 VC Nijmegen

Appendix 2: Interview Guide

First of all, thank you for your time. We, Iris and Daphne, are master's students of Innovation and Entrepreneurship at the Radboud University Nijmegen. We are currently investigating the influence of energy and material saving activities on the financial performance of manufacturing firms in the Netherlands. This interview is part of both our separate graduation studies. The interview is expected to take 45 minutes to an hour.

We would like to record this interview so that we can transcribe it and no information is lost. Do you agree with this? We will present the interview transcript to you, so that you have the opportunity to make any adjustments. We will treat the information you have given us confidentially and if you wish we can anonymize the interview. If you wish, you will receive a copy of the final study. Do you have further questions?

Then we will now start with the interview.

Interview details:

Name of interviewee:

Date and time:

Location:

General questions

- In what type of industry does your organization operate?
- What is your position within the organization?
- How many employees does the organization employ?

During this interview we will ask you questions related to energy and material saving activities. These are the technologies and the supporting management systems that decrease the amount of energy and material needed during the production process.

Examples of energy and material saving technologies are control systems for shut down of machines in off-peak periods or the utilisation of recycled material in product manufacturing.

Examples of supporting management systems are systems that examine the emissions made during the production process, or the presence of individuals liable for environmental friendly production.

Energy and material saving technologies

- What kind of energy and material saving activities have been implemented since 2015?
    - Can you name the technologies?
    - Can you name the supporting management systems?
- How much energy is saved by the implementation of these energy and material saving activities?
- How much materials are saved by the implementation of these energy and material saving activities?
- Why did you choose to implement these energy and material saving activities? For example, because of laws and regulation, greener image, etc.

We will continue with a proposition. Several questions are related to this proposition.

Cognition and framing

"The implementation of energy and material saving activities can result in beneficial opportunities for organizations."

- Do you agree with this proposition? Why?
- Agree: Does this conviction make that you put extra effort in the search for these opportunities?
- Does not agree: Do you search for these opportunities even though you do not agree with the proposition?

Energy and material saving technologies can have an influence on both the production costs and the revenues of the organization. We will start with asking question about the production costs.

Production costs

- How do these energy and material saving activities influence the production costs within the organization?
    - How does it influence the implementation costs on the short term? For example training employees to use the new technologies, lack of experiences causes inefficient processes, etc.
    - How does it influence the structural costs on the long-term?

We will continue with questions about the revenues.

Revenues

- How do these energy and material saving activities influence the revenues of the organization?
    - Does the use of these energy and material saving activities influence the sales of your product? How?
    - Does the use of these energy and material saving activities lead to a competitive advantage? How?
    - Does the use of these energy and material saving activities lead to an environmental friendly image? How?
    - To what extend do you think customers value this environmental friendly image?
- Do you think that the use of these energy and material saving activities contribute in another way to an increase in revenues?

Organizational capabilities

The following questions focus on the capabilities of an organization. There are the capabilities of the organization to manage its skills and resources in such a way that it can tackle or influence changes in the environment. Examples of these capabilities are cross-functional teams, or the possession of specific knowledge.

- Did the organization possess capabilities that are able to support these energy and material saving activities?

    - Can you name these capabilities?
- Do you think that the effect of energy and material saving activities on the production costs would be different when the organization would not have possessed these capabilities? Why?
- Do you think that the effect of energy and material saving activities on the revenues would be different when the organization would not have possessed these capabilities? Why?

- Did the organization invest in capabilities that are able to support these energy and material saving technologies and management systems?
    - Can you name these capabilities?
- Do you think that the effect of energy and material saving activities on the production costs would be different when the organization would not have invested in these capabilities? Why?
- Do you think that the effect of energy and material saving activities on the revenues would be different when the organization would not have invested in these capabilities? Why?

Appendix 3: Qualitative codes

Code	Colour
Energy and material saving activities	
Production cost changes	
Revenue changes	
Organizational capabilities	
Cognition & framing	

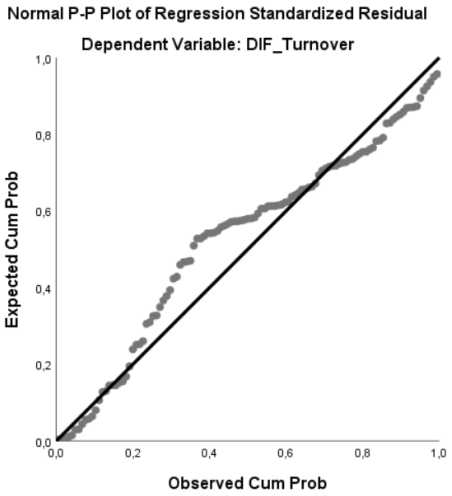
Appendix 4: Output Bivariate Analysis

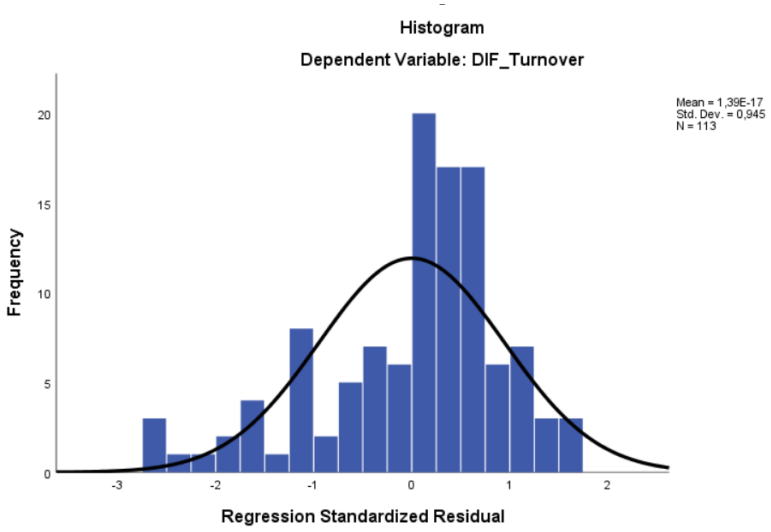
Correlation Matrix – Pearson Correlation

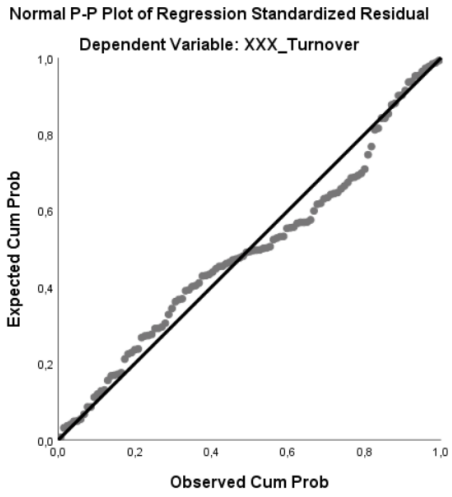
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Revenue Changes	1	-.029	.065	-.063	.118	.116	.016	.168*	.174*	-.123	-.134	.007	.122	.015
2. Production Cost Changes		1	-.054	.045	.037	-.134	.205*	-.072	.007	-.067	.048	-.108	.003	.028
3. EMSA			1	-.003	.013	.429**	.060	.429**	.128	.105	-.001	.076	-.038	-.119
4. Non-Compulsory Searching				1	.064	-.021	.100	-.131	-.059	.176*	.133	-.107	-.093	-.085
5. Compulsory Searching					1	.084	-.142	.071	.029	-.053	.071	-.018	.011	-.036
6. Organisational Capabilities						1	-.062	.463**	.012	-.078	.106	.109	.128	-.046
7. Age							1	.044	-.023	.064	-.035	.029	.117	-.084
8. Firm Size								1	0.42	-.035	.084	.068	.106	-.107
9. Food									1	-.128	-.096	-.128	-.157*	-.160*
10. Textile										1	-.107	-.144	-.176*	-.179*
11. Construction											1	-.107	-.131	-.134
12. Chemical												1	-.176*	-.179*
13. Machinery													1	-.219**
14. Electronic														1
*Correlation is significant at the 0,05 level; ** Correlation is significant at the 0,01 level														

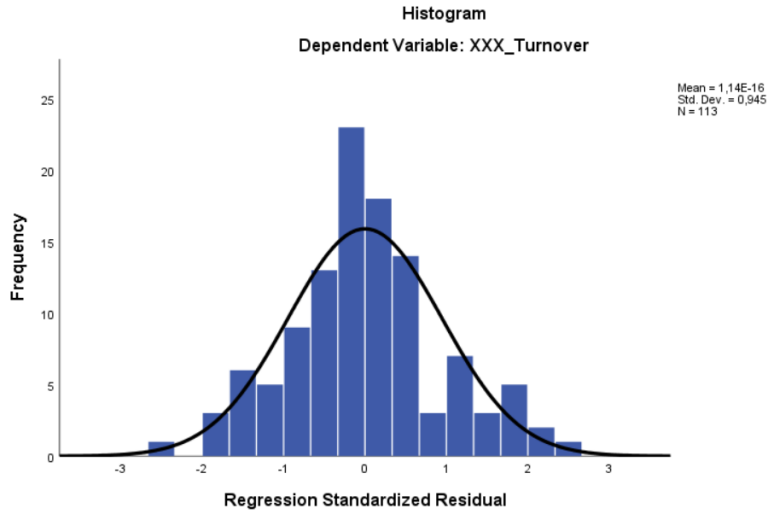
Appendix 5: Assumptions Regression Analysis

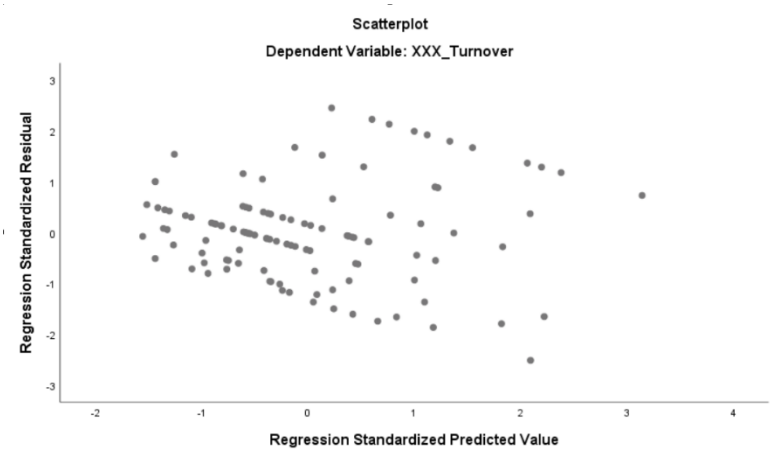
Assumptions Regression Analysis - Revenue Changes



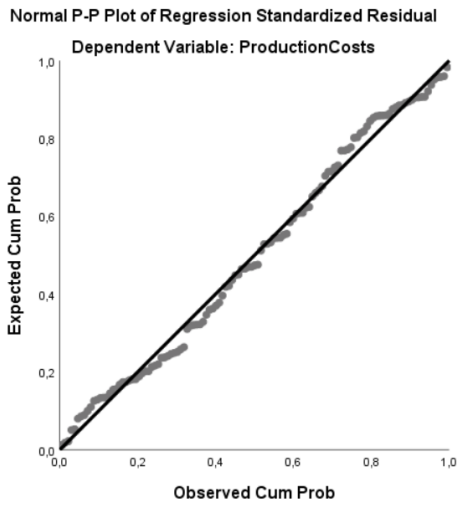


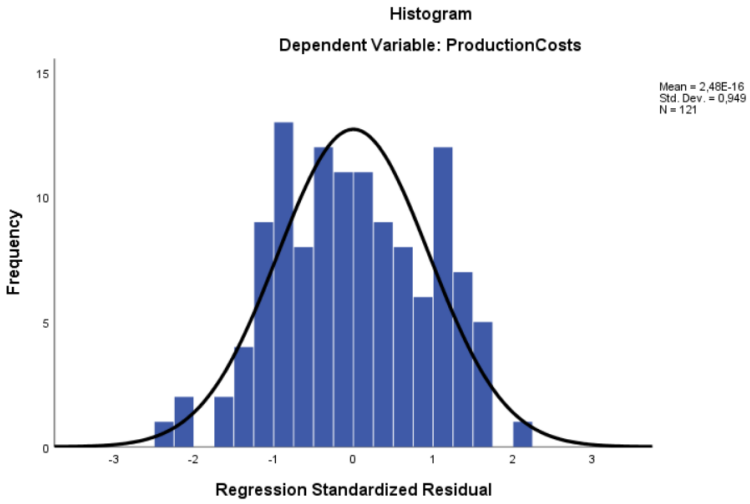


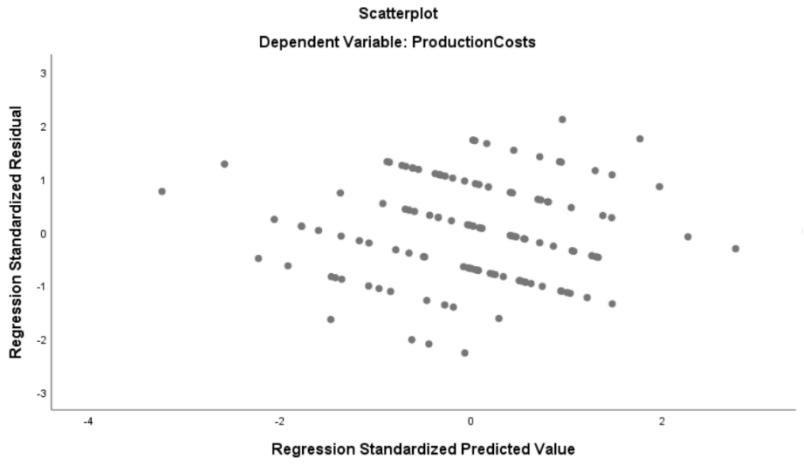




Assumptions Regression Analysis – Production Cost Changes

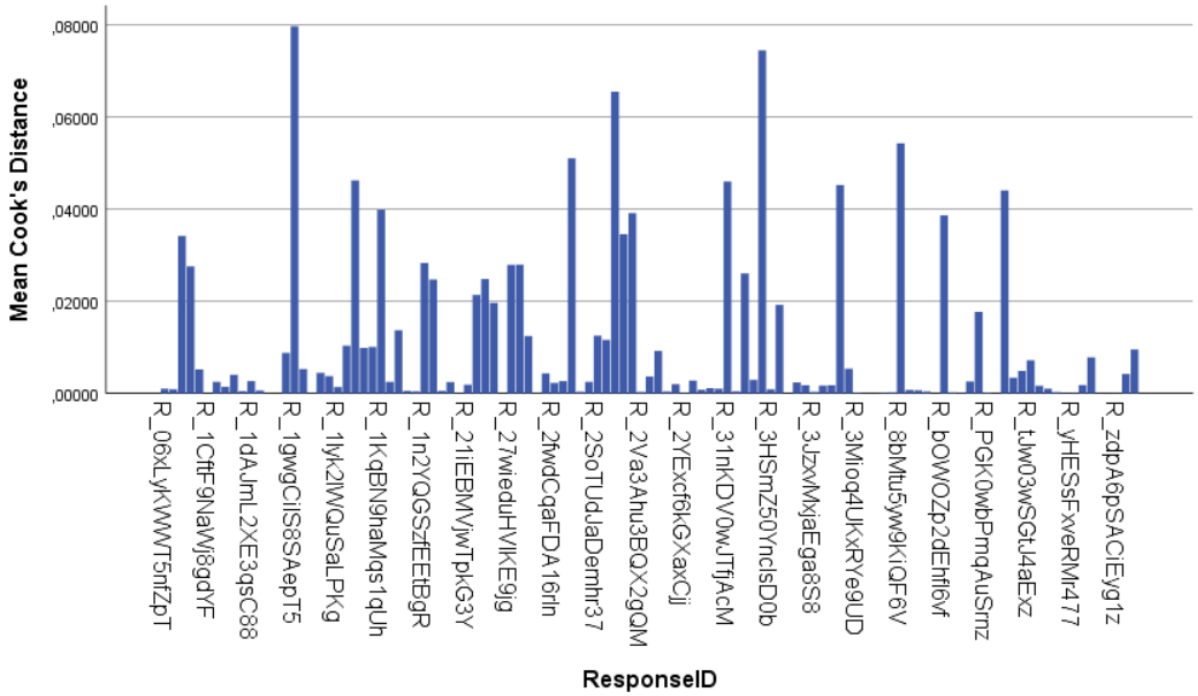


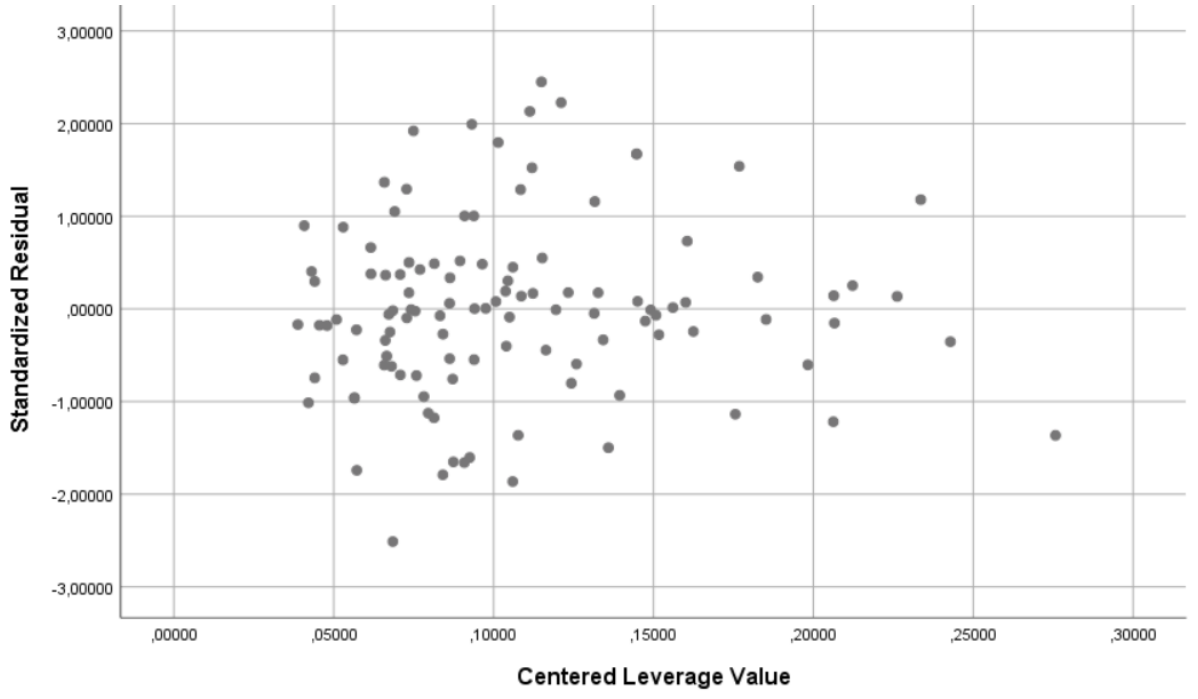




Appendix 6: Outliers Regression Analysis Revenue Changes

Outliers Regression Analysis - Revenue Changes





Outliers Regression Analysis – Production Cost Changes