

Achieving green production within a firm by looking outside

*An analysis of the influence of external orientation
on sustainable technology adoption in manufacturing firms*



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Abstract

Failure to act on climate change is one of the most important risks to the world. Industry is a major source of pollution, and firms are failing to respond to the threat in a substantial way. Manufacturing firms are increasingly being held accountable for their decisions regarding sustainability by society and government, and are now being forced to act. An important role for research is to discover which factors in a manufacturing firm might influence sustainable technology adoption. This research explores the effect of external orientation factors on sustainable technology adoption in manufacturing firms. External orientation is becoming a growing topic of interest due to increased globalization, which leads to substantial changes in a firm's strategy. Data of 169 manufacturing firms from the Dutch European Manufacturing Survey 2015 (EMS) was used to run a multiple regression analysis on the effects of external orientation factors on sustainable technology adoption. In contrast to expectations, export activities, offshoring and backshoring activities, external networking and external participation were found to not have a significant effect. The results did show that the degree of cooperation with firms had a significant positive effect on sustainable technology adoption. Further analysis of categories used in the cooperation with firms variable showed that cooperating with firms in a singular field did not have a significant effect on sustainable technology adoption. These findings suggest that to achieve a higher degree of sustainable technology adoption, managers should focus on cooperating with firms in a multitude of fields, instead of focusing their efforts on a specific field. These results could be due to the fact that manufacturing firms have more access to knowledge and experience by actively cooperating in more fields. Firms that are cooperating with other firms in a multitude of fields might also feel an increasing pressure to uphold to norms and sustainability standards of the other firms.

Keywords: sustainable technology adoption, manufacturing firms, external orientation, globalization, climate change, cooperation.

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Chapter 1: Problem Statement

The research field of sustainable technology adoption has become increasingly more important over the last few decades. Failure to act on climate change has been regarded as (one of the) the most important risk(s) to the world for several years now (Nuccitelli, 2013; Scata, 2016; Amnesty International, 2018). In addition to this, other important risks are mainly environmental factors, upon which climate action failure has a direct influence. These environmental risks are a direct result of society not acting on climate change (World Economic Forum, 2020, p. 12). UN Secretary-General Guterres has warned that “a point of no-return” in climate change is very real and fast approaching if we do not take action (Manzanaro, 2019). However, to take adequate actions towards halting climate change, society needs to know every aspect that there is to know about sustainability. Only then the right steps towards climate repair can be taken.

There has been extensive research conducted on this on the national macro level, focusing on successful or failing sustainable policies. However, there has been limited research in the field of adoption of sustainable technologies in manufacturing firms. Industry plays a key role in climate change repair, as it is a major source of pollution (European Commission, 2011). Firms are failing to respond to this growing threat in a substantial way and many are ignoring the need for action (Earley, 2016). Even if experts continue to highlight the potential benefits of sustainable technologies for firms, there are also potential downsides for firms (Amankwah-Amoah & Syllias, 2019, p. 242). In addition to this, research shows that the often stated benefits for firms are not as extensive in practice (Bansal, 2002, p. 131). These few positive results and even possible negative results might hinder firms to even consider these technologies at all. Even if manufacturing firms cannot see the threat themselves, society is increasingly holding them accountable (Laville, 2019). There are movements in place that can even make failure to act on climate change illegal by law (Timperley, 2020). It is not on the cards for manufacturing firms to merely focus on their own benefits anymore, and they are now being forced to act.

Firms can act on climate change by adopting sustainable technologies in their day-to-day practices. Developing sustainable technologies that firms can make use of is not sufficient to combat climate change, as these technologies have to be adopted to be of any use. Adoption is defined as a process of acceptance and implementation of new technologies. Adoption entails the continued full use and acceptance of a new technology within a firm

(Renaud & Van Biljon, 2008, p. 1-2). There are several sustainable technologies that can be implemented in a firm's production, but implementation is lagging behind.

Fu et al. (2018) have conducted a literature review on 34 articles to shed light on findings from research on factors influencing the adoption of sustainable technologies in manufacturing firms (p. 227, 229). They concluded that the results support conclusions regarding several influential factors, be it positive or negative. However, they also found that some factors have quite contradicting effects on adoption in these studies: ownership, export activities, knowledge stock, governmental economic and technical support, environmental policies and normative pressure from the public (Fu et al., 2018, p. 234-237).

Export activities can be seen as part of the external orientation of a firm, which will be the main focus of this research. Factors that are also considered in this research as part of external orientation are offshoring, backshoring and cooperation. The degree of external orientation of a firm has been found to have a positive effect on innovation and new product development (Nystrom et al., 2002, p. 238; O'Regan & Ghobadian, 2005, p. 92). It was found that technologies are more productive within a firm that has a higher external focus, leading to a higher degree of product innovation and higher productivity levels (Tambe et al, 2012, p. 844). This research will build upon these findings, testing the theory that the degree of external orientation of a firm has a significant effect on the adoption of sustainable technologies. This will be tested in the context of manufacturing firms by using data from the Dutch European Manufacturing Survey 2015 (Ligthart et al., 2015).

This paper will assess the degree of external orientation of a firm by applying four underlying factors: export activities, offshoring, backshoring and cooperation. The effect of these four factors on adoption of sustainable technologies in manufacturing firms will be tested through a multiple regression analysis. The purpose of this research is to make a contribution to the existing literature on the factors influencing adoption of sustainable technologies within manufacturing firms. The research question is as follows: *To what extent do external orientation factors have an influence on sustainable technology adoption in manufacturing firms?*

This research will shed further light on factors and their stimulating or hindering effect on adoption. The academic relevance of this research will be to build upon existing research in the field of sustainable technology adoption. It will do so by focusing on a variety of factors surrounding the external orientation of firms. The continuing changes within the aspects of external orientation of a firm lead to uncertainty of its effects on sustainable

technology adoption. It is important to remain aware of these changes and to provide a contribution to the field of technology adoption research.

As firms have to remain competitive in a global economy, they have to adapt to the changing environment to meet their customer's needs (Bayo, 2019, p. 99). Prior research has shown that growing globalization and technology development trends have led to a growth in firm's adaptability. This entails that firms feel the demand and need to develop their norms and beliefs to adapt to the external situation and the need for change. Managers play an important role in this, as they have to take action in deciding which sustainable technologies the firm should adapt and play an active role in adopting this technology. They have to manage the challenges that result from attempting to implement these new technologies (Bayo, 2019, p. 99). This is often proven to be very difficult, partly due to the employees' acceptance of new technologies (Bayo, 2019, p. 100). Additional limiting factors can also include systems that are already in place or manpower issues (Bayo, 2019, p. 104). As managers are responsible for the implementation of the technology, they have to overcome a variety of internal struggles. It is important for managers to be aware of factors influencing the adoption of sustainable technologies, as they can take appropriate action based on this knowledge to ease the adoption process. The problem that managers face is that they are responsible for implementation of these sustainable technologies, but there are factors that are influencing this adoption that they are unaware of. With new knowledge on influential factors, managers can take appropriate actions to increase the adoption of sustainable technologies. Therefore, the managerial relevance of this research is to provide more information on the limiting and stimulating factors of sustainable technology adoption, to ease the managerial role in this transition. Sustainability should be a factor that is considered with every strategic decision a company makes, as it is necessary to halt climate change. If more is known on whether or not an external orientation factor has a significant positive or negative effect on adoption, managers of manufacturing firms can adjust their policy and strategies regarding their factor to ease sustainable technology adoption.

This research will focus on manufacturing firms, which are firms that use raw material, parts, and components to produce fully finished goods. To do so, they make use of machines, robots, computers, and humans to produce the merchandise (Oberlo, 2021). The focus is on this sector as it has one of the largest impacts on the environment, accounting for a third of U.S. carbon dioxide (Roston, 2019).

The following chapter will address the relevant theories and studies to shed light on the underlying causal relationships between external orientation factors and sustainable

technology adoption. Chapter 3 will outline the methodology used in this research. The results from the analysis will be presented in Chapter 4. Finally, in Chapter 5 these results will be interpreted and conclusions will be drawn, in addition to the discussion of further managerial and theoretical implications, and limitations of this research.

Chapter 2: Theoretical Framework

2.1 Adoption of sustainable technologies in manufacturing firms

2.1.1 Adoption

Adoption can be defined as “the decision of any individual or organization to make use of an innovation” (Frambach & Schillewaert, 2002, p. 163). Adoption is different than diffusion, which entails the amount of users in a market (Rogers, 1976). As this research is focused on adoption of technologies within a single firm, diffusion theories do not apply here. The chosen definition of adoption states two different adoption groups, being individuals and organizations. This distinction is important for this research and is a key factor for the choice of an adoption theory. Adoption theories have mainly focused on consumer adoption (Frambach & Schillewaert, 2002, p. 163). The widely used Technology Acceptance Model (TAM) is a key example of this, focusing on individual technology adoption (Davis, 1989). As this research is focused on technology adoption in firms, this model and similar models are not applicable here. Instead, the Organizational Adoption Model by Frambach & Schillewaert (2002) will be applied, as this focuses on the organizational or firm level of adoption.

2.1.2 Sustainable technologies

Technology is often defined as "the application of knowledge to the achievement of particular goals or to the solution of particular problems" (Moore, 1972, p. 5). However, technology is not always implemented with the goal to solve problems, but also to maintain a competitive edge over other firms. In addition to this, technology has also been known to be the cause of problems (Mulder et al., 2017, p. 2). In this sense, the definition that will be adhered is the application of knowledge to “create tools, develop skills, and extract or collect material” (Aunger, 2010, p. 763). There are several types of technologies that have different purposes, one of these being sustainable technologies. Sustainable technologies are those that “are practical solutions to achieve economic development and human satisfaction in harmony with the environment” (Vanegas et al., 1996, p. 5). These are technologies that aid in achieving the goals of sustainable development, as sustainable technologies have been found to be one of the most important drivers for sustainable development in firms (Jakšić et al., 2018, p. 431).

Fu et al. (2018) concluded that a key factor effecting contradicting results in adoption of sustainable technologies research was the difference in interpretation of sustainable technologies. They found that most studies do not distinguish between different types of

sustainable technologies. In addition to this, some studies would unknowingly focus on one or a cluster of some types, while another would focus on different types. This inevitably leads to different results regarding the effect of the researched factors on adoption, due to differences in methodology. Fu et al. recognized four main types of sustainable technologies: CO₂/emission reduction technology, energy/material efficiency technology, material/fuel substitution technology and recycling technology. As these technologies have different performances and key aspects, factors influencing the adoption of these different types of technologies differ as well (Fu et al., 2018, p. 242).

2.2 External orientation

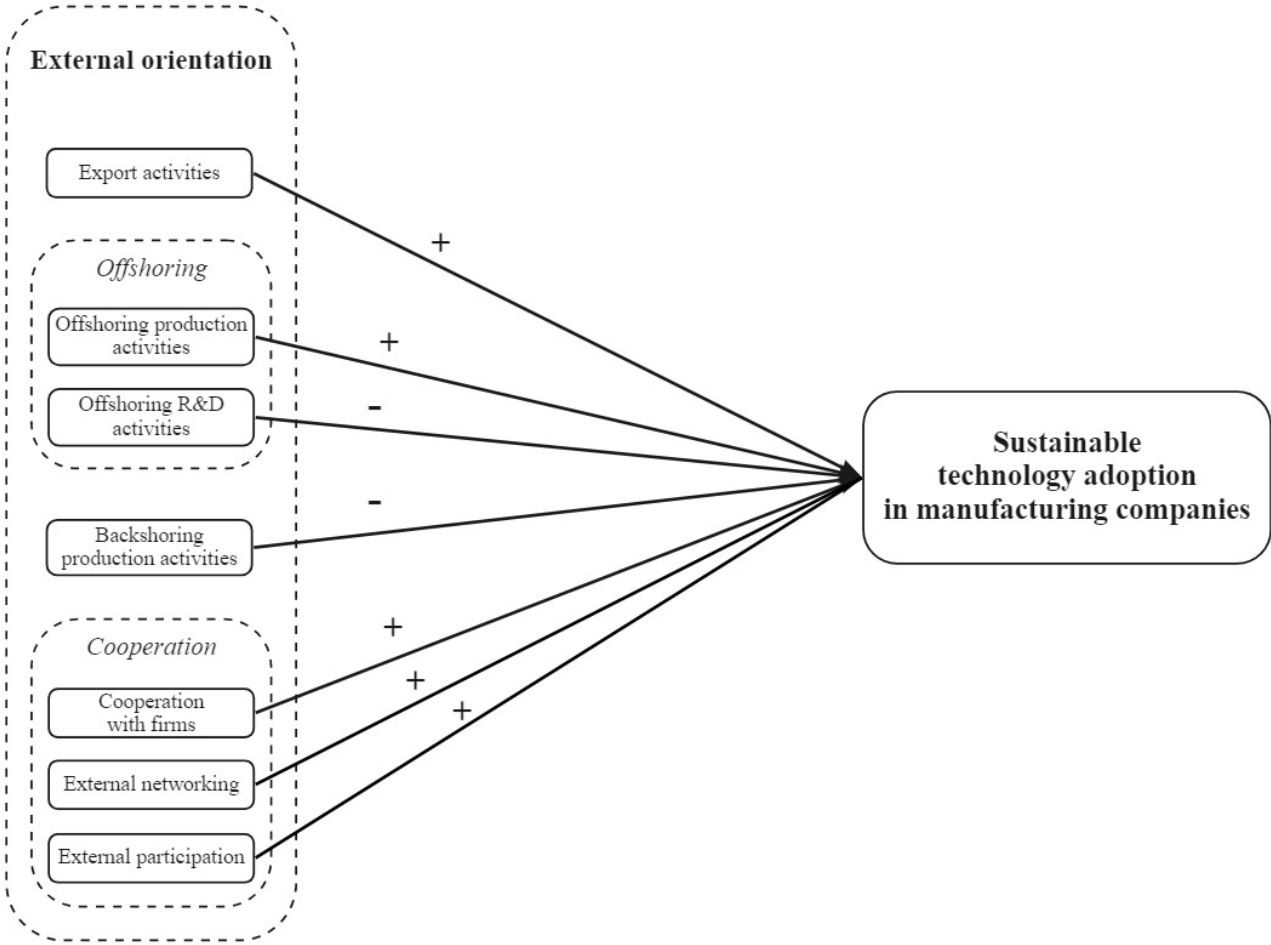
The Organizational Adoption Model of Frambach & Schillewaert (2002) propose factors that have an influence on organizational adoption. Among these factors are adopter characteristics, which capsule amongst others the strategies a firm has in place. The external orientation factors researched in this research can be seen as strategy decisions, which are an element of adopter characteristics. Adopter characteristics have a direct influence on the adoption decision and continued use of a technology by a firm (Frambach & Schillewaert, 2002, p. 165). External orientation factors as researched in this research are therefore expected to have an influence on the sustainable technology adoption in manufacturing firms.

External orientation is the firm's capacity for internal change in response to external conditions (Denison & Mishra, 1995, p. 215). These external conditions are formed and driven by external communities and other firms (Denison et al., 2003, p. 208-209). It was found that external orientation dimensions encourage firms to actively respond to change and adapt their firm to outside expectations (Nurdin et al., 2010, p. 87). A firm that is more externally oriented prioritizes coordination with partners in their network and their product development capabilities (Neirotti et al., 2017, p. 923). This shows that external orientation might lead to more innovation and better adoption. It also highlights that a firm's external orientation is in direct line with several factors regarding coordination with partners. The best way to measure a firm's external orientation and its effect on adoption of sustainable technologies would be to split the concept up and measure underlying aspects, as external orientation can be regarded as a latent construct.

A firm adjusts its strategy and takes appropriate business decisions based on their external orientation. These decisions can be regarding, amongst others, their export activities, offshoring activities, backshoring activities and the level of cooperation with others. These

factors are all directly linked to a firm’s external orientation as they are all focused on outside aspects, instead of aspects that are only existent within the firm. The external orientation factors that therefore will be focused upon in this research are export activities, offshoring, backshoring and cooperation. The conceptual model is formed as shown in Image 1. The expected effects of all factors on the dependent variable are visualized.

Image 1: Conceptual model



2.2.1 Export activities

Export activities are defined as selling firm products abroad (Arnold & Hussinger, 2005, p. 221). Studies have shown that export activities and innovation have a significant positive relationship that reinforces each other (Wakelin, 1998; Golovko & Valentini, 2011). Export increases technological innovation in firms (Alvarez & Robertson, 2004, p. 74). Export activities are positively related to the adoption of advanced manufacturing technologies (Mechling et al., 1995, p. 72). Exporters have to remain competitive with other firms that export in a globalizing world, and implementing advanced manufacturing technologies

provide the firm with more competitive capabilities (Mechling et al., 1995, p. 65). It was recently found that 66 percent of all advanced manufacturing technologies are green innovations, meaning that they have a distinct positive effect on the environment (Palčić & Prester, 2020, p. 3505). Thus, the majority of advanced manufacturing technologies are sustainable technologies.

A more recent study found that the effect of export activities on adoption of advanced manufacturing technologies was insignificant (Sohal et al., 2006). However, they did find a highly positive significant covariance between firm size and export activities. They suggest that export activities could be indirectly related to the adoption of advanced manufacturing technologies through the moderating effect of firm size (Sohal et al., 2006, p. 5240). The effect of export activities on the adoption of sustainable technologies is more positive for bigger firms than for smaller firms. It was also found that investment in sustainable technologies lead to a better export performance (Da Rocha Vencato et al., 2013, p. 443). This was confirmed by Palma et al. (2014), who found that firms that want to achieve higher export performance should focus more on the implementation of sustainable strategies (p. 40). However, economic motives are rarely a driving factor for firms to be more active in sustainable technology adoption. Higher exports are found to be a very unimportant reason to adopt sustainable technologies (Del Río González, 2005, p. 30). Even if there is a reverse positive effect, firms do not take this as a key reason to implement more sustainable technologies. Instead, increased export leads to increased sustainable technology adoption (Del Río González, 2005, p. 30). Overall, it is apparent that export activities can be expected to have a positive influence on sustainable technology adoption. The following hypothesis follows from this:

***H1:** A higher degree of export activities has a positive effect on sustainable technology adoption in manufacturing firms.*

2.2.2 Offshoring

Offshoring is defined as the relocation of services or production activities, or moved (branch) establishments to cross-border locations (Jahns et al., 2006, p. 219, 227). This definition fits the research as it encapsulates the movement of activities out of the domestic country of the firm. Since the 1980s, Western manufacturing firms have increasingly been implementing offshoring strategies to remain competitive in a globalizing market (Merino et al., 2021, p. 1). The most common motives for doing so are reduction of costs, but market and customer motives have gained importance as well (Kinkel et al., 2007, p. 272). Studies in the field of

proximity manufacturing, which includes offshoring and backshoring, are predominantly focused on the business dimension and are lacking in analysis of the environmental dimension (Dou & Sarkis, 2010, p. 567; Sirilertsuwan, 2018, p. 1368). Studies on the effects of offshoring and backshoring activities on the adoption of sustainable technologies are therefore very limited. Some studies show that promising innovations and internal process modernisation are often put aside in favour of offshoring strategies, as these are expected to be quicker remedies for internal problems (Kinkel, 2004; Naghavi & Ottaviano, 2007).

However, in a recent study on 3000 European manufacturing firms, it was found that there is a positive effect of production offshoring on innovation activities of the domestic firm (Dachs et al., 2015, p. 26). It was even found that offshoring firms employ more R&D and design personnel, invest more frequently in advanced process technologies, and introduce more new products compared to firms that are not active in offshoring activities (Dachs et al., 2015, p. 22).

This is in line with research findings related to the concept of ‘site competence’. It is defined as the competences that go beyond producing the goods and simple tasks, which are practices ‘on site’ in the headquarters of the domestic country. Offshoring enables to delegate the simpler tasks to focus on more important competences (Ferdows, 1997). The headquarters in the domestic country has “the ability and knowledge to innovate and create new processes, products, and technologies for the company” (Ferdows, 1997, p. 77). Site competence was found to be significantly directly related to successful sustainable technology adoption (Golini et al., 2003, p. 456). It is important to note that this only entails the offshoring of production activities, as these are the simple tasks. When a firm offshores testing and engineering, research and development and design, it is known as ‘overshoring’, and most benefits of offshoring are lost (Whitfield, 2017, p. 130). Over the past decade, firms have increasingly offshored R&D activities to seek out new knowledge (Ambos & Ambos, 2011, p. 107). However, the R&D activities should remain at domestic headquarters, otherwise the positive effect on sustainable technology adoption will be reversed (Ferdows, 1997). This is due to the fact that if R&D activities are kept domestically, the firm has a much greater ability to keep skilled and motivated workers under their direct management which they can easily oversee and control (Golini et al., 2003, p. 457).

Concluding from this research, offshoring production activities increases the adoption of sustainable technologies. Offshoring production activities is expected to have a positive effect on the adoption of sustainable technologies in manufacturing firms. This seems contradictory to actual effects of offshoring on the environment, as the increased distances for

transportation entail a significant increase in pollution (Jaegler & Burlat, 2014, p. 909). However, it should be considered that the negative effect on the environment of offshoring does not necessarily have a direct effect on the degree adoption of sustainable technologies. This research will attempt to discover if the clear distinction between offshoring production activities or R&D activities actually matters in practice. This leads to the following hypotheses:

H2: Offshoring production activities has a positive effect on the adoption of sustainable technologies in manufacturing firms.

H3: Offshoring R&D activities has a negative effect on the adoption of sustainable technologies in manufacturing firms.

2.2.3 Backshoring

Backshoring is defined as the moving of the task production back to the domestic country, reversing the previously mentioned offshoring activities (Foerstl et al., 2016, p. 5). This definition applies well to this research as backshoring will be regarded as the opposite action of offshoring, reversing the actions taken in offshoring activities. Backshoring task production of previous offshored manufacturing capacities are quite common (Kinkel et al., 2007, p. 265). The main reasons for backshoring are shrinking labour cost advantages cross-border, unsatisfactory product quality offshore, increasing transportation costs, and a growing demand from customers to be more flexible and responsive. In addition to this, there are growing benefits in moving activities back domestically, including new opportunities, growing attraction to domestically made products and government support (Ancarini et al., 2019, p. 360). It was found that backshoring manufacturing firms are generally not likely to adapt the newest technologies. This can be attributed to the fact that backshoring firms are experiencing high costs of the relocation and the necessary restructuring of their value and supply chains, which leaves low funds to spend on technological updating (Ancarini et al., 2019, p. 367). A current example is the backshoring policies put in place by the Trump presidency, which went hand in hand with a severe pullback of incentives to firms to contribute to technological improvement and energy innovation (Piatanesi & Arauzo-Carod, 2019, p. 816). However, contradicting results of the influence of backshoring on innovation were found in prior research (Dachs et al., 2017).

As backshoring is such a recent phenomenon, research on its effect on adoption of sustainable technologies is severely limited (Fratocchi & Di Stefano, 2019, p. 468). It is difficult to state from general research on new technologies that backshoring has a negative

effect on adoption of sustainable technologies, similar to the case of offshoring. In addition to this, backshoring does have direct positive effects on the environment as transportation emissions are drastically lowered (Jaegler & Burlat, 2014, p. 909). However, firms' managers and entrepreneurs generally do not consider sustainability a relevant factor in the decision to backshore activities (Fratocchi & Di Stefano, 2019, p. 468). In addition to this, existing research on core competence entails that backshoring the simpler tasks to your domestic headquarters limits the development of technology, and more importantly, the adoption of sustainable technology by being less able to focus on important competences (Ferdows, 1997, p. 77; Golini et al., 2003, p. 456). It should be noted that this effect is only applicable when a firm is backshoring its production activities (Ferdows, 1997; Whitfield, 2017, p. 130). Taking these studies into account, a clear relationship between backshoring production activities and sustainable technology adoption is uncovered. It is therefore expected that backshoring production activities has a negative effect on the adoption of sustainable technologies in manufacturing firms. This leads to the following hypothesis:

***H4:** Backshoring production activities has a negative effect on the adoption of sustainable technologies in manufacturing firms.*

2.2.4 Cooperation

Cooperation is defined as networks and relationship bonding with individuals in government, industry, and research and development institutions. It is found to be a key factor in innovation and adoption of technology within a firm (Bhaskaran, 2006, p. 69). It could be expected that cooperation leads to internal pressure to adhere to each other's standards of sustainability. If a (potential) cooperating firm has well developed sustainable technologies in place, a firm could feel the need to rise to those standards as well. This underlines the perception that firms feel pressure to adhere to each other's social norms in inter-firm relations (Arrighetti et al., 1997, p. 171).

However, some studies mainly found that cooperation merely has a positive effect on the adoption of incremental innovations. Incremental innovations are those that cause "novelty at the level of products, services and processes", while radical innovation "encompasses a wider sphere of activity and closer interaction with suppliers, regulators, civil society organisations and other stakeholders" (Szeckerly & Strebels, 2013, p. 469). The effect of cooperation on radical innovations remains doubtful, as contacts through cooperation may limit confidentiality that a firm would need to be a pioneer in implementing radical new technologies (Romero & Martínez-Román, 2015, p. 625). However, some studies find this to

be the exact opposite, claiming that partnerships lead to more protection and trust, thus a safer environment to share innovative ideas in (Gethen & Rothenburg, 2000, p. 181).

To obtain successful development in sustainability within a firm, firms have to adapt their choices regarding either incremental or radical sustainable technologies based on their particular context (Szekely & Strebel, 2013, p. 476). As this shows that sustainable technologies do not necessarily have to be either radical or incremental, it is difficult to apply this distinction to this research. As the effect of cooperation on radical technology adoption is merely doubtful, this research will focus on the overall effect of cooperation on technology adoption, which is expected to be positive. What strengthens this assumption, is that forming multiple partnerships is a key practice in the successful adoption of both incremental and radical sustainable technologies (Szekely & Strebel, 2013, p. 475).

This overall positive effect of cooperation on the adoption of sustainable technologies has been confirmed in multiple studies. Participation of different stakeholders and the formation of partnerships within the public sector, academia and business have a crucial influence on the successful adoption of sustainable technologies (Carrillo-Hermosilla et al., 2010, p. 1082). Successful adoption of sustainable technologies require support and cooperation of other organisations (Verghese & Lewis, 2007, p. 4397). Cooperation also seems to be more intense for environmental innovations than for other innovations, indicating that cooperation is a key factor in sustainable technology adoption (Horbach, 2008, p. 170; De Marchi, 2012, p. 612). Research shows ample support for the hypothesis that cooperation with external organisations has an overall positive effect on the adoption of sustainable technologies in manufacturing firms. In this research, a distinction will be made between cooperation with firms, external networking, and external participation (see Chapter 3.2.2). The hypotheses are thus as follows:

H5: *Cooperation with firms has a positive effect on the adoption of sustainable technologies in manufacturing firms.*

H6: *External networking has a positive effect on the adoption of sustainable technologies in manufacturing firms.*

H7: *External participation has a positive effect on the adoption of sustainable technologies in manufacturing firms.*

Chapter 3: Methodology

3.1 Research methods

This research requires a fairly large sample, as it attempts to form conclusions on all manufacturing firms in The Netherlands. Compared to a case study, which limits a research to only a handful of cases, a survey allows for a much larger sample (Mills et al., 2012). An experiment applies an artificial environment to test causal effect (Mills et al., 2012). However, this research focuses on existing conditions within a manufacturing firm, so a survey is more useable than an experiment. A survey allows for obtaining extensive information about attitudes, circumstances and behaviours (Mills et al., 2012). As this research is interested in current circumstances surrounding sustainable technology adoption, a survey is most applicable here.

3.2 Data collection

The dataset that has been used for this research is data from the Dutch European Manufacturing Survey, conducted in 2015. This dataset contains 179 valid cases. The respondents of this survey are CEOs or operation managers of Dutch manufacturing firms with 10 or more employees. It has been weighted by using the national population statistics from CBS in 2015, which makes the findings representative regarding sector and firm size. This entails that it is a valid representation of manufacturing firms in The Netherlands.

3.3 Measures

The variable overview can be found in the table in Appendix 1. The questions from the dataset connected to the measures can be found in Appendix 2.

3.3.1 Sustainable technology adoption

This research distinguishes between four different categories of sustainable technology adoption. CO₂/emission reduction technology aims to reduce emissions. Energy/material efficiency technology aims at reducing the use of materials and/or energy per unit of output. It tries to make the production more efficient by using less. Material/fuel substitution technology entails the replacing of current material or fuels with more sustainable options. Recycling technology aims at utilizing waste after it has been generated (Fu et al., 2018, p.

233). There were several indicators in the EMS that were connected to the three latter types of sustainable technologies. These items have been combined to form one dependent variable of sustainable technology adoption. The items are measured on a dichotomous scale. Each technology item consists out of the question if the firm has implemented the certain type of technology or if they are planning to do so before 2018, which have been combined to a singular no or yes answer (Appendix 3, Table 5a-5b). Each no or yes answer has been given the score of 0 and 1 respectively. Separate regression analyses for the different technology categories are not possible as their separate scores would not suffice for an interpretable ratio variable. By adding up the technology categories, an overall effect of the independent variables on sustainable technology adoption can be discovered. As there are 6 items in total from all categories, these scores have been added up from a scale of 0 to 6 (Appendix 3, Table 5c). Therefore, the dependent variable is considered to be a ratio variable.

3.3.2 External orientation

Export activities, offshoring production activities, offshoring R&D activities, backshoring production activities and cooperation are considered to be the independent variables of this research. This research has measured export activities by the ratio score of export vs sales in the domestic country, as previously done by Basile (2001). Export activities have been measured at a ratio score of 0 to 100 percent (Appendix 3, Table 6). Offshoring and backshoring production activities have been measured by assessing if a firm has siphoned or recalled production activities to or from foreign locations or foreign branches. This was previously done as such in a study by Dachs et al. (2012), which applied EMS datasets of several European countries, and measured the probability of being an offshoring firm of production activities by the question *“Has your factory offshored parts of production to foreign locations resp. foreign companies or backshored them to your factory from abroad in the last two years?”* (p. 21).

Connecting to the EMS dataset that will be used for this research, Offshoring R&D activities will be measured by the affiliate offshoring of R&D activities, which entails the offshoring to firms’ own offshore units and unaffiliated offshoring of R&D activities, which is the offshoring to subsidiaries (Bardhan & Jaffee, 2005, p. 7). Offshoring R&D activities has been previously measured by if a firm has offshored research and development activities (Nieto & Rodriguez, 2011; Steinberg et al., 2017). All the offshoring and backshoring variables are measured on a dichotomous scale. Both the answer options of ‘to/from other companies abroad’ and ‘to/from own branches abroad’ were taken into account. If they

answered either one or both of these options, they scored a 1. If they answered 'no', they scored a 0 (Appendix 3, Table 7a-9b).

As cooperation is a latent construct, three items/questions have been applied in this research. These three items have been regarded as separate variables, and their effects have therefore been interpreted apart from each other as well to test all three hypotheses. A variable that has been taken into account is the cooperation with firms on different activities, which has been previously measured as such by Fisher & Varga (2002) by separating the different network activities in sub items (p. 10). Cooperation with other firms has been measured on a ratio scale, as all 6 categories have been taken into account with yes or no answers (Appendix 3, Table 10a). To combine these categories, the data has been transformed into a ratio score of 0 to 6 by adding up the answers of 'no' and 'yes' (Appendix 3, Table 10b). A variable that has also been included is external networking for the specific intent of innovation. This was previously measured by examining the extent of R&D cooperation with organizations, other firms, suppliers and clients (Lalic et al., 2019, p. 1404). This research has only focused on the cooperation with other organizations, firms and possibly suppliers, as the item in the EMS dataset eliminated clients from the question. Finally, participation of firms in a consortium is a key part of cooperation as well, as it allows for inter-organizational learning and social capital benefits (Xia et al., 2011, p. 699). It has been measured by assessing how often firms have participated in projects or ventures to gain access to knowledge or to create knowledge. It was previously measured by participation in consortiums by a firm, which is in line with the items in the EMS (Xia et al., 2011, p. 728). The initial variables of external networking and external participation had scores of 0 for 'none', 1 for 'once' and 2 for 'more often' (Appendix 3, Table 11a, 12a). In this research, 'none' has been regarded as 'no' with a score of 0. 'Once' and 'more often' have been interpreted as 'yes' with a score of 1 (Appendix 3, Table 11b, 12b).

3.3.3 Control variables

Some control variables have been taken into account, as these are variables that could influence the outcome of this research. The control variables were firm size, education level of employees, policy for competence development and training, and the type of industry. First, firm size could have an influence on the relationship of export activities on sustainable technology adoption (Sohal et al., 2006). It has been measured by assessing the number of employees; which is a ratio scale (Acs & Audretsch, 1987; Appendix 3, Table 13a).

In addition to this, educational level of employees is often regarded as an influential factor on technology adoption within a firm as it highly influences technology adoption on an individual level (Talukder, 2011; Bucciarelli et al., 2011). As this research is based on the adoption within firms, and not on an individual level as proposed in the Technology Adoption Model, this variable has been controlled for. It has been measured by the level of education of employees in the EMS dataset, comparable by the research of Talukder (2011). The educational level of employees has been measured by taking the percentage of total employees' scores on 2 different types of education variables: higher education (HBO+WO) employees and technical education (MBO) employees. The variables have been interpreted as ratio scores (Appendix 3, Table 14). These types of education might differ in level of education, but also in the type of education, as practical skills learned from a technical education (MBO) are much different than more theoretical skills from an higher education (HBO+WO). These variables have therefore been taken into account separately.

A firm's expenditures in training and education for its employees also appears to have an effect on the individual acceptance of technologies, ultimately influencing technology adoption (Clegg et al., 1997). It has been measured by assessing if a firm has a policy in place for competence development and training in place (Boothby et al., 2010). Policy for competence development and training is a dichotomous variable, with 'no' (0) or 'yes' (1) options (Appendix 3, Table 15).

The type of industry that the firms are active in also has also been discovered to have a significant effect on technology adoption, often used as a moderating or control variable in analyses (Bhatt, 2000; Tan et al., 2012; Darbanhosseiniamirkhiz & Wan Ismail, 2012). This research has applied industry types that respondents state themselves to be the most active in, as they see themselves fit into one general industry type (Bhatt, 2000; Appendix 3, Table 16a). The type of industry has been divided into different categories, from which each case fitted into one. These categories are metal, food, textile, construction, chemical, machinery and electronic (Appendix 3, Table 16b). Metal has been used as the base category. Each respondent had a score of 1 in a singular category, and a score of 0 for the rest.

3.4 Data analysis

A confirmatory multiple regression analysis has been applied. Multiple regression is most applicable when one wants to test the effects of a model of several predictors (Field, 2013, p. 321). As this research dealt with a model of several external orientation predictors for

sustainable technology adoption, this technique fitted best. As there was only interest in the effects on one singular dependent variable, MANOVA did not apply (Field, 2013, p. 624). Factors appropriately measuring the proposed external orientation predictors have already been created, so a prior factor analysis was not needed (Field, 2013, p. 666). The missing data of all variables have been analysed and 7 cases have been deleted. Results from the missing data analysis can be found below in Table 1.1. As 4 cases had missing data on 4 or 7 of the 18 variables, they have been deleted. 3 cases are missing data on the independent variable *Offshoring R&D*. As this is a dichotomous variable with only 2 categories, substituting these cases with values would lead to biased results. As these only made up 1.7 percent of all data, they have been deleted as well. The sample size for the analysis prior the testing of assumptions was 171 cases.

Table 1.1 Missing data

| | <i>Frequency</i> | <i>Valid Percent</i> |
|--------------|------------------|----------------------|
| 0,00 | 171 | 96.1 |
| 1,00 | 3 | 1.7 |
| 4,00 | 2 | 1.1 |
| 7,00 | 2 | 1.1 |
| <i>Total</i> | 178 | 100.0 |

To conduct a multiple regression analysis, the minimum sample amount should be 5 cases to 1 variable (Hair et al., 2019, p. 279). As this research contains 7 independent and 10 control variables, the minimum sample size would be 85 observations. The sample size from the data of the EMS is 171, so this requirement has been met, as there are approximately 10 cases per variable. Several other assumptions regarding the variate have been tested, being linearity, multicollinearity, normality, homoscedascity and independence of the error terms (Hair, 2019, p. 272).

A hierarchical regression has been conducted to assess the improvement in explanatory power for the independent variable. All control variables have been added in the first model, after which all independent variables have been added to the regression equation in the second model (Field, 2013, p. 322). The adjusted R^2 has been used to assess the overall model predictive accuracy. The significance of F-change has been used to evaluate if there was a significant increase in explanatory power of the model. As the effects of the independent variables were controlled for several variables without directional hypotheses,

the regression analysis has been conducted as a two-tailed test. The effects of the control variables have been evaluated by adhering an alpha of .05. As the independent variables all have been connected to directional hypotheses, the p-values of the independent variables have been divided by half in the interpretation of effects to account for this (Field, 2013, p. 65-67). If effects were found to be significant, the unstandardized coefficients were interpreted as the effects of the variables on the dependent variable (Hair et al., 2019, p. 308-320).

3.4.1 Linearity

The assumption of linearity has been met. Linearity was tested by assessing the scatterplot of standardised predicted values, where the predicted values of the independent variable of the effects of the independent and control variables were plotted against the residuals (Hair, 2019, p. 288). The scatterplot of standardised predicted values for the effect of all independent variables on sustainable technology adoption showed a fairly linear relationship between the independent variables and the dependent variable (Appendix 3, Image 1). The results showed some signs of potential influential outliers among the threshold of a standardized residual value of 2.5 (Rousseeuw & Leroy, 2007, p. 77).

Next, the scatterplot of standardised predicted values of the variate of all independent variables and all control variables was assessed. It was clear that there were several outliers that were affecting the results (Appendix 3, Image 2). To assess the severity of these outliers, the Mahalanobis D^2 measure has been applied (Hair, 2019, p. 93). Outliers in the Mahalanobis D^2 values are of such great influence that they cause a shift of the entire regression equation (Hair, 2019, p. 262). The Mahalanobis D^2 values that were derived from the effect of the variate on the dependent variable have been assessed by dividing them by the degrees of freedom, which is 17. A threshold value of 3 was used, as the sample size of 171 was neither small nor large (Hair, 2019, p. 93). In assessing these results, 2 influential outliers have been identified, as their values were above the threshold of 3 (Appendix 3, Table 1). As this number of outliers was very low compared to the sample size, these cases were taken out of further analysis. This has left a sample size of 169. The scatterplot of standardised predicted values after taking the outliers out of the analysis showed a much improved result (Appendix 3, Image 3). There was a linear pattern and the values mainly cluttered around a value of 0.

3.4.2 Multicollinearity

The assumption of multicollinearity has been met. To evaluate if there were considerable problems with collinearity, VIF and tolerance values have been assessed. A problem is only occurring when there are variables that are accounting for some of the same variance.

Collinearity tests to see if the data met the assumption of collinearity indicated that multicollinearity was not a concern, as all VIF values were below 10 and were tolerance values are above .10 (Field, 2013, p. 325). As stated before, *Metal* was used as the base variable for the other industry type variables. These results are shown below in Table 1.2.

Table 1.2 Collinearity statistics

| | Collinearity statistics | |
|--|-------------------------|------|
| | Tolerance | VIF |
| Offshoring production activities | .74 | 1.35 |
| Offshoring R&D activities | .88 | 1.13 |
| Backshoring production activities | .85 | 1.17 |
| Export activities | .74 | 1.35 |
| Cooperation with firms | .74 | 1.36 |
| External networking | .75 | 1.33 |
| External participation | .72 | 1.39 |
| Firm size | .82 | 1.21 |
| Higher education of employees | .73 | 1.37 |
| Technical education of employees | .93 | 1.08 |
| Policy for competence development and training | .84 | 1.19 |
| Food | .69 | 1.46 |
| Textile | .69 | 1.46 |
| Construction | .75 | 1.32 |
| Chemical | .66 | 1.51 |
| Machinery | .55 | 1.81 |
| Electronic | .56 | 1.79 |

Dependent variable: Sustainable technology adoption

3.4.3 Normality

The assumption of normality of the error term distribution has not been met. To check for a normal error term distribution, a histogram of standardized residuals and a normal probability plot have been assessed. There was some room for improvement as the histogram showed a slight right skewed result and the plot showed some gaps between the residuals and the diagonal (Appendix 3, Image 4-5). To possibly improve on this, a Kolmogorov-Smirnoff test

was applied to the metric independent variables to check for possible non-normal distribution, from which significant results are regarded as non-normal (Field, 2013, p. 185). Interpretation of the Kolmogorov-Smirnoff test should be handled cautiously as larger sample sizes are more prone to be significant, while normality of single variables matters less in larger samples (Field, 2013, p. 184). However, it can indicate possible issues to be resolved. The K-S test was applied to the metric independent and control variables (Appendix 3, Table 2). The *Export activities* scores deviated significantly from normal ($D(169) = .172, p < .001$). The *Cooperation with firms* scores deviated significantly from normal as well ($D(169) = .149, p < .001$). *Higher education of employees* scores were significantly non-normal ($D(169) = .210, p < .001$). *Technical education of employees* scores deviated significantly from normal ($D(169) = .159, p < .001$). Finally, *Firm size* scores were significantly non-normal as well ($D(169) = .318, p < .001$).

Export activities had a slightly higher cluster of scores on both the lower and higher range (Appendix 3, Image 6). This was not necessarily a problem as the scores are still somewhat equally dispersed due to this, and a transformation of the variable would not have aided this. As *Cooperation with firms* has a quite small range, a non-normal distribution indication from this test was not unexpected. The histogram showed quite equally dispersed scores and the box-plot indicated a degree of normality (Appendix 3, Image 7). The histogram and boxplot of *Technical education of employees* showed a quite normal distribution (Appendix 3, Image 10). *Higher education of employees* and *Administrative and commercial education of employees* did show a quite right skewed distribution (Appendix 3, Image 9, 11). However, there are several scores in both variables of 0, as they were based on percentages, which would have been problematic for a log transformation (Field, 2013, p. 203). As both were not extremely non-normally distributed, they have been left as is. *Firm size* had the highest value in the K-S test, and showed a very apparent right skewed distribution (Appendix 3, Image 8). *Firm size* has therefore been transformed to a logarithmic variable to aid this (Field, 2013, p. 203). It has highly improved the normality (Appendix 3, Table 3; Appendix 3, Image 12). The *Firm size log* scores did not deviate significantly from normal ($D(169) = .068, p = .057$). The normal error term distribution has been re-tested after including the *Firm size log* instead of *Firm size*, which showed a slightly improved distributed histogram of standardized residuals and normal probability plot (Appendix 3, Image 12-13). However, the error terms cannot be said to be fully normally distributed, as it still shows fairly non-normal distribution. This could have been due to the fact that there are still some independent

variables with non-normal distributions. In addition to this, the dependent variable has a small value range, which amplified the non-normality.

3.4.4 Homoscedascity and independence of the error terms

The assumptions of homoscedascity and independence of the error terms have been met. To assess if there was a presence of unequal variances, the scatterplot of standardised predicted values has been evaluated. The scatterplot of standardised predicted values showed that the data has met the assumption of homogeneity of variance, as there was no clear pattern that shows a heteroscedastic form (Appendix 3, Image 3; Hair et al., 2019, p. 290).

As a final assumption, the error terms should be independent. The scatterplot of standardized predicted values showed a slight lean from top left to right bottom (Appendix 3, Image 3; Hair et al., 2019, p. 291). However, the Durbin-Watson test showed that there was no violation, as its value of 1.83 fell within the acceptable range of 1 to 3 (Appendix 3, Table 4; Field, 2013, p. 311). Therefore, the error terms have been assumed to be independent.

Chapter 4: Results

4.1 Regression analysis

4.1.1 Descriptive analysis

Table 2.1: Correlation matrix and descriptive statistics (metric variables)

| | 1 | 2 | 3 | 4 | 5 | 6 |
|--|--------|--------|--------|------|-------|-------|
| 1. Sustainable technology adoption | | | | | | |
| 2. Export activities | .07 | | | | | |
| 3. Cooperation with firms | .29*** | .13 | | | | |
| 4. Firm size | .37*** | .17* | .29*** | | | |
| 5. Higher education (WO+HBO) employees | -.02 | .30*** | .20** | -.03 | | |
| 6. Technical education (MBO) employees | .25** | -.01 | .10 | .07 | .05 | |
| Mean | 1.79 | 38.28 | 2.36 | 3.66 | 16.03 | 31.94 |
| Standard deviation | 1.47 | 33.00 | 1.70 | .83 | 14.75 | 25.50 |

n = 169; *** $p < .001$; ** $p < .01$; * $p < .05$; Spearman's Rho (2-tailed) was used for calculating correlations.

The correlation matrix and the key descriptive statistics of the metric variables can be found in Table 2.1. Overall, cases appeared to have somewhat lower scores on *Sustainable technology adoption* (mean = 1.79). This means that firms often only have a few sustainable technologies in place instead of having adopted almost all of the proposed sustainable technologies. *Export activities* had a relatively high standard deviation ($s = 33.00$). This means that firms in this dataset tend to have either lower or higher percentages of export vs import. Cases also appeared to score lower on *Higher education (HBO+WO)*. This means that firms are not likely to have mainly higher educated personnel employed, because manufacturing firms require more practically skilled employees in order to produce goods.

A Spearman's correlation was run to assess the relationships between all metric independent and control variables by checking for intercorrelation, as can be seen in Table 2.2. Spearman is used for non-parametric data to minimize the effects of violations of the assumptions of a test (Field, 2013, p. 276). Thus, Spearman was applied to account for the non-normality in the variables. The positive correlations found between *Sustainable technology adoption* and *Cooperation with firms* ($r_s = .29$, $p < .001$), *Firm size* ($r_s = .37$, $p < .001$), and *Technical education (MBO) employees* ($r_s = .23$, $p < .01$) were moderate. Based on these correlations, the degree of cooperation with firms, firm size and the technical education (MBO) level of employees could be predictors for sustainable technology adoption.

There was a moderate positive correlation between *Firm size* and *Cooperation with firms*, which was statistically significant ($r_s = .30, p < .001$). In addition to this, a moderate significant positive effect was found between *Higher education of employees* and *Export activities* ($r_s = .29, p < .001$). A moderate significant positive effect was found between *Higher education of employees* and *Cooperation with firms* ($r_s = .20, p < .01$). Finally, a weak significant positive relationship was found between *Firm size* and *Export activities* ($r_s = .17, p < .05$). The following was concluded from the correlations: larger manufacturing firms to a moderate degree tend to be more active in cooperation with other firms, and to a low degree tend to export a larger percentage of their products. Manufacturing firms with a higher percentage of employees with a higher education (WO+HBO) to a moderate degree tend to export a larger percentage of their products and be more active in cooperation with firms.

Table 2.2: Correlation matrix and frequency distribution (dichotomous variables)

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7a | 7b | 7c | 7d | 7e | 7f | 7g |
|---|---------|-------|------|------|----------|----------|------|------|------|------|------|------|------|------|
| 1. Offshoring production activities | | | | | | | | | | | | | | |
| 2. Offshoring R&D activities | | 4.43 | | | | | | | | | | | | |
| 3. Backshoring production activities | | 6.30* | .19 | | | | | | | | | | | |
| 4. External networking | | .00 | 1.63 | 2.80 | | | | | | | | | | |
| 5. External participation | | .32 | 1.19 | 3.14 | 22.86*** | | | | | | | | | |
| 6. Policy for competence development and training | | 1.80 | .31 | .51 | 1.41 | 16.17*** | | | | | | | | |
| 7a. Metal | | 7.03* | .08 | .01 | .26 | .40 | 1.27 | | | | | | | |
| 7b. Food | | 2.05 | .24 | .61 | 1.13 | 1.26 | 2.29 | | | | | | | |
| 7c. Textile | | 1.30 | .07 | .77 | .00 | .02 | .66 | | | | | | | |
| 7d. Construction | | .05 | .52 | 1.10 | .12 | .00 | .51 | | | | | | | |
| 7e. Chemical | | 1.57 | .93 | .22 | .26 | .39 | .32 | | | | | | | |
| 7f. Machinery | | 3.11 | .00 | 2.22 | .03 | .93 | .00 | | | | | | | |
| 7g. Electronic | | 5.47* | .93 | 1.16 | 1.31 | 1.79 | .09 | | | | | | | |
| Valid percent (%) | No (0) | 82.2 | 96.4 | 97.0 | 27.2 | 62.1 | 55.6 | 78.7 | 89.3 | 87.0 | 92.3 | 87.0 | 84.0 | 81.7 |
| | Yes (1) | 17.8 | 3.6 | 3.0 | 72.8 | 37.9 | 44.4 | 21.3 | 10.7 | 13.0 | 7.7 | 13.0 | 16.0 | 18.3 |

$n = 169$; *** $p < .001$; ** $p < .01$; * $p < .05$; Pearson's Chi-Square with Exact Sig. (2-tailed) was used for calculating correlations.

The correlation matrix and frequency percentage distributions for the dichotomous variables can be found in Table 2.2. As a Chi-square test is best used to evaluate if two dichotomous variables are independent (Rumsey, 2007, p. 231), this test was applied for these variables. *External participation* was found to have a statistical relationship with *External networking* ($X^2 = 22.86$, $p < .001$) and *Policy for competence development and training* ($X^2 = 16.17$, $p < .001$). Firms that are active in external participation are more likely to also be active in external networking and to have a policy for competence development and training in place than firms that aren't active in external participation. *Offshoring production activities* had a statistical relationship with *Backshoring production activities* ($X^2 = 6.30$, $p < .05$), *Metal* ($X^2 = 7.03$, $p < .05$) and *Electronic* ($X^2 = 5.47$, $p < .05$). Firms that have offshored their production activities are more likely to backshore production activities and be classified as a metal or electronic manufacturing firm than firms that have not offshored their production activities.

What stood out from the frequency distribution of these variables, was that *Offshoring R&D activities* and *Backshoring production activities* had a very low count of 1's. This means that only a few of the firms in the dataset have offshored their R&D activities and/or backshored their production activities. This extreme uneven distribution could lead to insignificant results in the regression analysis, as the effects of the few cases that have offshored their R&D activities and/or backshored their production activities is suppressed by the large amount of respondents that haven't done so. This is unfortunately not resolvable and implications are discussed in Chapter 5.4.

4.1.2 Regression analysis

Table 2.3: Effects on sustainable technology adoption

| | Model 1: | | | | Model 2: | | | |
|--|---------------|-----------------------|-----------|----------|----------------------|----------------------|-----------|----------|
| | Control model | | | | External orientation | | | |
| | <i>B</i> | β | <i>SE</i> | <i>p</i> | <i>B</i> | β | <i>SE</i> | <i>p</i> |
| Firm size (log) | .50 | .28*** | .13 | .000 | .37 | .21* | .14 | .010 |
| Higher education (WO+HBO) employees | -.00 | -.01 | .01 | .862 | -.01 | -.09 | .01 | .312 |
| Technical education (MBO) employees | .01 | .23** | .00 | .002 | .01 | .24** | .00 | .001 |
| Policy for competence development and training | .18 | .06 | .22 | .398 | .14 | .05 | .23 | .546 |
| Food | .55 | .12 | .40 | .172 | .47 | .10 | .40 | .245 |
| Textile | .66 | .15 ⁺ | .37 | .075 | .54 | .13 | .37 | .146 |
| Construction | .23 | .04 | .45 | .608 | .08 | .01 | .45 | .867 |
| Chemical | .42 | .10 | .37 | .263 | .33 | .07 | .38 | .384 |
| Machinery | .07 | .02 | .37 | .860 | -.02 | -.00 | .38 | .969 |
| Electronic | .03 | .01 | .34 | .935 | -.02 | -.01 | .36 | .962 |
| Export activities | | | | | -.00 | -.00 | .00 | .990 |
| Offshoring production activities | | | | | .13 | .03 | .31 | .687 |
| Offshoring R&D activities | | | | | .62 | .08 | .60 | .302 |
| Backshoring production activities | | | | | -.37 | -.04 | .66 | .575 |
| Cooperation with firms | | | | | .16 | .18* | .07 | .033 |
| External networking | | | | | .40 | .12 | .27 | .136 |
| External participation | | | | | .05 | .02 | .25 | .831 |
| R ² (Adjusted R ²) | | .19*** (.13) | | | | .25*** (.16) | | |
| ΔR^2 | | | | | | .06 | | |
| F (degrees of freedom, p-value) | | 3.61 (10, 158; <.001) | | | | 2.86 (7, 151; <.001) | | |

n = 169; *** *p* <.001; ** *p* <.01; * *p* <.05; ⁺*p* <.10 (2-tailed); *B* = unstandardized regression coefficient, β = Standardized regression coefficient, *SE* = standard error, *p* = p-value, *F* = F-value, *R*² = coefficient of determination.

Multiple regression analysis was used to determine if external orientation factors significantly explained sustainable technology adoption in manufacturing firms (see Table 2.3). The results of the regression indicated that the external orientation model (2) explained a significant proportion of the variance ($R^2 = .25$, $F(7,151) = 2.86$, $p < .001$), which was not significantly higher than the explained variance of the control model (1). Thus overall, the external orientation factors combined do not significantly improve the model.

Export activities do not have a significant effect on sustainable technology adoption. Thus, Hypothesis 1 is not supported. Offshoring production activities does not have a significant effect on sustainable technology adoption. Thus, Hypothesis 2 is not supported. Offshoring R&D activities does not have a significant effect on sustainable technology

adoption. Thus, Hypothesis 3 is not supported. Backshoring production activities does not have a significant effect on sustainable technology adoption. Thus, Hypothesis 4 is not supported. Cooperation with firms has a significant positive effect on sustainable technology adoption ($\beta = .18$, p (1-tailed) = .017), in support of Hypothesis 5. Cooperating with firms in one additional field leads to adopting 16 percent more of a sustainable technology, if all other variables remain constant. External networking does not have a significant effect on sustainable technology adoption. Thus, Hypothesis 6 is not supported. External participation does not have a significant effect on sustainable technology adoption. Thus, Hypothesis 7 is not supported.

4.1.3 Control variables

Higher education (WO+HBO) level of employees, policy for competence development and training, and all type of industry categories were found to not have any significant effects on sustainable technology adoption in the external orientation model (2). Firm size (log) has a significant positive effect on sustainable technology adoption ($\beta = .21$, $p = .010$). A 1 percent increase in the number of employees leads to adopting .37 percent more of a sustainable technology, if all other variables remain constant. Technical education (MBO) level of employees has a significant positive effect on sustainable technology adoption ($\beta = .24$, $p = .001$). A 1 percent increase in the percentage of employees that have a technical education (MBO) level leads to adopting 1 percent more of a sustainable technology, if all other variables remain constant, if all other variables remain constant. Insignificant or significant effects of the control variables did not change after including the independent variables in the second model.

4.2 Post-hoc analysis

As only cooperation with firms was found to have a significant effect on sustainable technology adoption, a post-hoc analysis was conducted to further analyse this effect.

4.2.1 Descriptive analysis

Table 3.1: Frequency distribution (cooperation with firms variables)

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|--|---------|----------|----------|----------|---------|----------|------|-------|
| 1. Purchasing cooperation | | | | | | | | |
| 2. Production cooperation | | 7.68** | | | | | | |
| 3. Sales/distribution cooperation | | 12.92*** | 34.13*** | | | | | |
| 4. Service cooperation | | 7.97** | 7.76** | 11.65** | | | | |
| 5. R&D cooperation with customers or suppliers | | .14 | 1.79 | 1.34 | .92 | | | |
| 6. R&D cooperation with research organizations or research entities | | 5.52* | 11.92** | 14.19*** | 9.75** | 19.40*** | | |
| 7. R&D cooperation with other companies (excl. customers or suppliers) | | .58 | 1.36 | .60 | .41 | .60 | 1.12 | |
| 8. Policy for competence development and training | | .65 | .41 | 2.61 | 1.23 | .95 | 2.91 | 1.26 |
| 9a. Metal | | 1.56 | .79 | 2.95 | 5.07* | 2.95 | .54 | .27 |
| 9b. Food | | .04 | 1.81 | .02 | .45 | 1.39 | .06 | .12 |
| 9c. Textile | | 1.93 | .57 | .72 | 1.44 | 1.08 | 1.22 | .15 |
| 9d. Construction | | .54 | 2.07 | 1.65 | .61 | 1.65 | .01 | 12.07 |
| 9e. Chemical | | .84 | .03 | .32 | .10 | .72 | .04 | .15 |
| 9f. Machinery | | .00 | 1.12 | 2.92 | 11.01** | .00 | .56 | .19 |
| 9g. Electronic | | 1.94 | .24 | 1.10 | .00 | .03 | .86 | .23 |
| Valid percent (%) | No (0) | 63.3 | 57.4 | 62.7 | 71.0 | 62.7 | 47.3 | 99.4 |
| | Yes (1) | 36.7 | 42.6 | 37.3 | 29.0 | 37.3 | 52.7 | .6 |

$n = 169$; *** $p < .001$; ** $p < .01$; * $p < .05$; Pearson's Chi-Square with Exact Sig. (2-tailed) was used for calculating correlations.

The *Cooperation with firms* variable was composed by combining 7 separate dichotomous variables. These 7 variables were all focused on cooperation in different fields and/or different entities. Firms could either answer the question if they worked together with other firms on different terrains with 'no' (0) or 'yes' (1). The frequency distribution shows the percentage of cases on '0' or '1' (see Table 3.1). This table also shows the correlation matrix.

A Chi-square test was applied to evaluate the independence of the dichotomous variables. Correlations between control variables can be found in Table 2.1 and Table 2.2. *Production cooperation* was found to have a significant relationship with *Purchasing cooperation* ($X^2 = 7.68$, $p < .01$), indicating that firms that cooperate in the production field are more likely to also cooperate in the purchasing field than firms that do not cooperate in the production field. *Sales/distribution cooperation* was found to have a significant relationship with *Purchasing cooperation* ($X^2 = 12.92$, $p < .001$) and *Production cooperation* ($X^2 = 34.13$, $p < .001$), indicating that firms that cooperate in the sales/distribution field are more likely to also cooperate in the purchasing and production field than firms that do not cooperate in the sales/distribution field. *Service cooperation* was found to have a significant relationship with *Purchasing cooperation* ($X^2 = 7.97$, $p < .01$), *Production cooperation* ($X^2 = 7.76$, $p < .01$) and *Sales/distribution cooperation* ($X^2 = 11.65$, $p < .01$). Firms that cooperate in the field of service are more likely to cooperate in the field of purchasing, production and sales/distribution than firms that do not cooperate in the field of service. *R&D cooperation with research organizations or research entities* was found to have a significant relationship with *Purchasing cooperation* ($X^2 = 5.52$, $p < .05$), *Production cooperation* ($X^2 = 11.92$, $p < .05$), *Sales/distribution cooperation* ($X^2 = 14.19$, $p < .001$), *Service cooperation* ($X^2 = 9.75$, $p < .01$) and *R&D cooperation with customers or suppliers* ($X^2 = 19.40$, $p < .001$). Firms that are cooperating with research organizations or research entities in the field of R&D are more likely to cooperate in the field of purchasing, production, sales/distribution, service and the field of R&D with customer or suppliers than firms that are not cooperating with research organizations or research entities in the field of R&D. Finally, *Service cooperation* was found to have a significant relationship *Metal* ($X^2 = 5.07$, $p < .05$) and *Machinery* ($X^2 = 11.01$, $p < .01$). Firms that are cooperating in the field of service are more likely to be classified as a metal manufacturing firm, as well as be classified as a machinery manufacturing firm than firms that do not cooperate in the field of service. There are a numerous amount of significant relationships between the cooperation with firms' variables, indicating that firms tend to be active in cooperation in multiple fields.

Only *R&D cooperation with other companies (excl. customer or suppliers)* stood out from the frequency distribution, as only .6 percent of the cases answered 'yes'. As results cannot be concluded from this, this variable has been left out of the regression analysis. All other variables showed no clear problems. There has been no clear prior theoretical analysis performed for each separate factor of the *Cooperation with firms* variable. A theoretical expectancy has only been provided for the overall effect of cooperation with firms. As there

has not been a clear directional hypothesis attached to the *Cooperation with firms*' factors, an alpha of .05 has been adhered in the interpretation of significance.

4.2.2 Regression analysis

Table 3.2: Effects on sustainable technology adoption

| | Model 1: | | | | Model 3: | | | |
|--|----------|-----------------------|-----------|----------|--------------------------------|----------------------|-----------|----------|
| | Control | | | | Cooperation with firms factors | | | |
| | <i>B</i> | β | <i>SE</i> | <i>p</i> | <i>B</i> | β | <i>SE</i> | <i>p</i> |
| Firm size (log) | .50 | .28*** | .13 | .000 | .39 | .22** | .14 | .005 |
| Higher education (WO+HBO) employees | -.00 | -.01 | .01 | .862 | -.01 | -.07 | .01 | .403 |
| Technical education (MBO) employees | .01 | .23** | .00 | .002 | .01 | .22** | .00 | .003 |
| Policy for competence development and training | .18 | .06 | .22 | .398 | .15 | .05 | .22 | .495 |
| Food | .55 | .12 | .40 | .172 | .53 | .11 | .20 | .189 |
| Textile | .66 | .15 ⁺ | .37 | .075 | .57 | .13 | .37 | .127 |
| Construction | .23 | .04 | .45 | .608 | .11 | .02 | .45 | .812 |
| Chemical | .42 | .10 | .37 | .263 | .32 | .07 | .38 | .399 |
| Machinery | .07 | .02 | .37 | .860 | .02 | .01 | .38 | .950 |
| Electronic | .03 | .01 | .34 | .935 | .03 | .01 | .34 | .923 |
| Purchasing cooperation | | | | | .22 | .07 | .24 | .355 |
| Production cooperation | | | | | .17 | .06 | .25 | .481 |
| Sales/distribution cooperation | | | | | -.13 | -.04 | .26 | .612 |
| Service cooperation | | | | | .13 | .04 | .26 | .616 |
| R&D cooperation with customers or suppliers | | | | | .27 | .09 | .24 | .261 |
| R&D cooperation with research organizations or research entities | | | | | .43 | .15 ⁺ | .24 | .079 |
| R ² (Adjusted R ²) | | .19*** (.13) | | | | .24*** (.16) | | |
| ΔR^2 | | | | | | .05 | | |
| F (degrees of freedom, p-value) | | 3.61 (10, 158; <.001) | | | | 2.93 (6, 152; <.001) | | |

n = 169; *** *p* <.001; ** *p* <.01; * *p* <.05; ⁺*p* <.10 (2-tailed); *B* = unstandardized regression coefficient, β = Standardized regression coefficient, *SE* = standard error, *p* = p-value, *F* = F-value, *R*² = coefficient of determination.

Multiple regression analysis was used to determine if different factors within the *Cooperation with firms* variable significantly explained sustainable technology adoption in manufacturing firms (see Table 3.2). The results of the regression indicated that the cooperation with firms factors model (3) explained a significant proportion of the variance ($R^2 = .24$, $F(6,152) = 2.93$, $p < .001$), which was not significantly higher than the explained variance of the control model

(1). Thus overall, the *Cooperation with firms* factors combined do not significantly improve the model.

No significant effects on sustainable technology adoption were found for all *Cooperation with firms* factors, in contrast to the significant effect of cooperation with firms on sustainable technology adoption in the external orientation model (2) ($\beta = .18$, $p = .033$). In addition to this, running the initial regression analysis in separate blocks for all independent variables, adding *Cooperation with firms* in Model 6 (Appendix 3, Table 32-33) led to a significant increase of 3.1% in the explained variance ($R^2 = .23$, $F(1,153) = 3.04$, $p < .001$). These results were also found when only adding *Cooperation with firms* to the control model (Appendix 4, Table 34-35). This led to a significant increase of 3.4% in the explained variance ($R^2 = .22$, $F(1,157) = 4.04$, $p < .001$). Adding all separate factors of *Cooperation with firms* did not lead to a significant increase in explained variance.

4.2.3 Control variables

Higher education (WO+HBO) level of employees, policy for competence development and training, and all industry categories were found to not have any significant effects on sustainable technology adoption in the external orientation model (2). Firm size (log) has a significant positive effect on sustainable technology adoption ($\beta = .22$, $p = .005$). A 1 percent increase in the number of employees leads to adopting .39 percent more of a sustainable technology, if all other variables remain constant. Technical education (MBO) level of employees has a significant positive effect on sustainable technology adoption ($\beta = .22$, $p = .003$). A 1 percent increase in the percentage of employees that have a technical education (MBO) level leads to adopting 1 percent more of a sustainable technology, if all other variables remain constant. Insignificant or significant effects of the control variables did not change after including the independent variables in the second model.

Chapter 5: Conclusion & Discussion

5.1 Conclusion

The research question was as follows: *To what extent do external orientation factors have an influence on sustainable technology adoption in manufacturing firms?* This was investigated by testing the effect of export activities, offshoring production activities, offshoring R&D activities, backshoring production activities, cooperation with firms, external networking, and external participation on sustainable technology adoption in manufacturing firms. Applying a multiple regression on a sample of firms in the Dutch manufacturing sector, the effects of the external orientation variables were controlled for firm size, educational level of employees, policy for competence development and training, and industry type. Results revealed that, in line with expectations, a higher degree of cooperation with other firms is positively statistically associated with a higher degree of sustainable technology adoption (H5). In contrast to prior expectations, no significant results were found for all other external orientation factors. No evidence was found for a positive effect on sustainable technology adoption of export activities (H1), offshoring production activities (H2), external networking (H6), or external participation (H7). In addition to this, no evidence was found for a negative effect on sustainable technology adoption of offshoring R&D activities (H3), or backshoring production activities (H4). Of all external orientation factors included in this research, only the degree of cooperation with firms was found to have a significant positive influence on sustainable technology adoption in manufacturing firms. The research question can thus be answered as follows: the external orientation of a manufacturing firm has a significant influence on sustainable technology adoption, as cooperation with firms was found to have a significant positive effect.

Multiple control variables were accounted for in this research, with the size of a firm and the technical education (MBO) level of employees having a significant positive effect on sustainable technology adoption. The standardized coefficients were used to assess the relative predictive power among the significant independent variables (Hair et al., 2019, p. 336). The technical education (MBO) level of employees was found to have the strongest relationship with sustainable technology adoption ($\beta = .24$). Firm size had the second strongest relationship ($\beta = .21$). Compared to the significant control variables, cooperation with firms had the lowest predictive power ($\beta = .18$). However, the values of the standardized coefficients are in such close proximity to each other that definite conclusions regarding the

relative strength are difficult to state. A more appropriate conclusion is that firm size, technical education (MBO) level of employees and cooperation with firms all predict a fairly similar amount of variance in sustainable technology adoption.

In post-hoc analysis, the effect of cooperation with firms on sustainable technology adoption was further investigated. As cooperation with firms was measured by adding up the scores of several dichotomous variables, the effects of these separate factors on sustainable technology adoption was tested. A multiple regression with the same previous base control model was applied, and results revealed that not one separate factor of the cooperation with firms variable had a significant effect on sustainable technology adoption. These results show that being active in only one single form of cooperation with firms does not have a significant influence on sustainable technology adoption in manufacturing firms. There is no field of cooperation that on itself has a significant influence. Only if manufacturing firms are cooperating with firms in a multitude of fields, there is a significant positive influence on sustainable technology adoption in manufacturing firms.

5.2 Theoretical implications

Findings in this research on the significant positive effect of cooperation with firms on sustainable technology adoption were in line with previous research (Verghese & Lewis, 2007; Carrillo-Hermosilla et al., 2010). This research builds upon these findings by confirming this effect in manufacturing firms. In addition to this, no significant results were found when only applying cooperation with firms in one field. The effect was only noticeable when a firm increasingly cooperated with firms on multiple fields. Therefore, this research provides a specification of prior research on the effect of cooperation by creating a clear distinction. A clear effect on sustainable technology adoption is only achieved when a firm is actively cooperating with firms in multiple fields, in contrast to merely focusing on one field. This could be due to the fact that when manufacturing firms are cooperating in a multiple fields, they have access to more knowledge and experience. Broadening their horizon can lead to connecting to firms on different levels, learning from their knowledge and experience. In addition to this, firms that cooperate in multiple fields might feel a high level of pressure to uphold to norms and sustainability standards of the firms that they are cooperating with (Arrighetti et al., 1997, p. 171). If a cooperating firm puts a lot of emphasis on sustainable production, the other firm can feel the need to do so as well. This could be due to a firm's own pride, in the sense that they want to show off that they uphold the same standards and

that the cooperating firm is not 'better' than them. Another possibility is that the cooperating firm in question does not want to be actively cooperating with a firm that does not uphold the same standards of sustainability, due to public image or own beliefs. In response, a firm improves the sustainability of production to fall in line with the cooperating firm's standards. This potential reasoning behind the significant effect of cooperation of firms on sustainable technology adoption is worthy of further theory building and research.

External networking and external participation were both found to not have any significant effects on sustainable technology adoption. This was found to be in contrast to prior research on the overall effect of cooperation by, amongst others, Vergheze & Lewis (2007) and Carillo-Hermosilla et al. (2010). Perhaps the reason of the non-significant effects of these variables can be interpreted in the same manner as for the separate variables of *Cooperation with firms*. It could be that cooperating for a singular goal, being innovation or access to knowledge, is limiting the effects on sustainable technology adoption in the same way as being actively cooperating in only one field is. The absence of significant effects for cooperation for a singular goal or in a singular field is a surprising result that should be looked into further in future research.

The degree of export of a firm was found to not have a significant effect on sustainable technology adoption, in contrast to prior findings of Mechling et al. (1995) and Del Río González (2005). Research by Sohal et al. (2006) indicated that export activities only had a significant effect on sustainable technology adoption through the moderating effect of the size of a firm. By including an interaction term of the mean-centred *Export activities* and *Firm size* variables in the regression analysis, the possibility of a significant moderating effect was tested (Appendix 3, Table 35-37). This model did explain a significant proportion of the variance ($R^2 = .25$, $F(1,150) = 2.72$, $p < .001$), but it was not significantly higher than the external orientation model (2). The interaction effect was not significant either. Thus, in contrast to prior research, the degree of export of a firm was found not to have a significant effect on sustainable technology adoption through the moderating effect of firm size. This research provides a critique on prior research by finding that export had no significant impact on sustainable technology adoption. Concluding, export activities is a factor that should be looked further into in research on sustainable technology adoption to fully capture the possible presence of an effect.

Building on the connection of site competence to sustainable technology adoption by Golini et al. (2003), this research attempted to find a connection between offshoring and backshoring specific activities. Though no significant results were found, a start to a

framework for a potential influence of off- and backshoring on sustainable technology adoption has been established. However, only one clear direction of the effects were built on in this and previous research. In hindsight, offshoring production activities could for example also lead to a loss of control over a firm's production facilities. If that is the case, a firm would likely not have much influence on adopting sustainable technologies in production activities, even if the firm has more room for focus on R&D. In addition to this, offshoring production activities to third-world countries could also lead to an immediate loss of sustainable production technologies, as some developing countries do not have strict government production standards and requirements to uphold (Zhou, 2017). As lower requirements and standards lead to a decrease in costs, this could even be a main reason for a manufacturing firm to offshore their production activities. In this way, offshoring production activities would lead to a decrease in sustainable technology adoption, and backshoring production activities would actually increase it. Concluding, there is a vast amount of underlying and intermediating factors that could potentially influence the effect of off- and backshoring on sustainable technology adoption that was not touched upon in this research. As off- and backshoring are still recent phenomena, theory should investigate this relationship more extensively in the future.

5.3 Practical implications

Concerning the practical implications of this research, only clear recommendations could be formed regarding a manufacturing firm's degree of cooperation with other firms. As results from this research have shown, a positive effect of cooperation with firms on sustainable technology adoption is not achievable within only a singular field. Managers of manufacturing firms should aim to cooperate with other firms on a number of fields to be able to see results. The more active the firm becomes in cooperating with other firms, the more sustainable technologies will be adopted into the firm's processes. Managers should seek out cooperation in the field of purchasing, production, sales/distribution, service, and R&D. These firms can include customers, suppliers, firms that are not specifically customers of suppliers, and even research organizations or research entities.

Another way to influence a manufacturing firm's degree of cooperation with other firms is by adjusting public policy. Policy influencing the degree of purchasing or production cooperation would be hard to achieve, but incentives for R&D cooperation are more manageable. Financial incentives like subsidies for firms and research organizations or

entities towards cooperated R&D initiatives could spark cooperation, and therefore lead to a higher degree of sustainable technology adoption.

Regarding the other external orientation factors that were found to have a non-significant effect on sustainable technology adoption, not much can be concluded from this. If a firm was previously focusing on factors to achieve more sustainable technology adoption that were found to have a non-significant effect in this research, the managers should expand their field of focus to consider other possible influential factors.

5.4 Limitations and further research

There are a number of limitations apparent in this research, which could be handled in a more proper way in future research. Regarding the sample, the size used for the analysis is 169 cases. Even though the minimum requirement of 5 cases per independent variable has been met, the desired level would be 15 to 20 cases per independent variable (Hair et al., 2019, p. 279). This research has approximately 10 cases per independent variable, which unfortunately does not adhere to the desired level. This is partially due to the fact that a large number of control variables were included in the analysis to increase the internal validity. Smaller sample sizes than desired can lead to an increase in insignificant results (Hair et al., 2019, p. 278). Future research should consider larger sample sizes or including fewer independent variables.

Sustainable technology adoption was initially to be analyzed post-hoc to detect possible significant differences among the sustainable technology categories as proposed by Fu et al. (2018, p. 233). Unfortunately, the EMS dataset had a limited number of items connected to sustainable technology adoption, which further limited the possibility for post-hoc tests on its categories. It would be very interesting to focus on this distinction of categories in future research, questioning firms about specific technologies connected to these categories prior analysis. This limited number of items could have also been affecting the results of the analysis. As firms were only questioned if they had sustainable technologies in place (now or planned for 2018) or not, combining these items lead to a limited scale that arguably was more ordinal than ratio. Testing effects of various variables on this limited scale could therefore have possibly led to distorted or insignificant results. In the future, research concerning effects on sustainable technology adoption should measure adoption in a much broader manner. Possibilities could either be splitting up the items from the EMS dataset into a much larger number of specific sustainable technologies, or measuring the adoption of the

sustainable technologies in a scale manner (*“To what extent does your firm apply the following sustainable technologies?”*). Adding this type of data would lead to a much richer variable.

Offshoring and backshoring activities are immense processes that cause major changes within a firm. These activities are forms of a singular decision in time, followed by an extensive overhaul of production or R&D. Results of these drastic changes may therefore not appear directly. This is in contrast to export activities and cooperation, which are more prone to frequent smaller changes that do not require major overhauls of processes. The EMS dataset used in this research only includes questions regarding decisions to offshore and backshore activities in the 2 years prior of the questionnaire being taken. The items of sustainable technology adoption were measured at the point of time that the questionnaire was taken. As decisions made 2 years or even less beforehand can be seen as a too short timeframe to see several effects, one could speak of a common method bias. The effects that this research aims to measure are not measured at the appropriate time. This was aided somewhat by including combined items for sustainable technology adoption, which incorporated a firm’s plans to adopt a sustainable technology in the next 3 years. However, this would still mean that offshoring and backshoring decisions are expected to show their effects on sustainable technology adoption in a time span of 2 years or less, as a firm’s future plans are still only measured at the point of time that the questionnaire is being taken.

The time span of 2 years in the question of if a firm has offshored or backshored activities are also leading to problems regarding the frequency distributions. As offshoring and backshoring activities are such immense decisions, they do not occur that often. If a random sample of manufacturing firms was questioned if they had decided to offshore production activities in the last two years, it would be extremely unlikely that approximately half of them have done so. An equal distribution of cases in the EMS dataset is therefore almost impossible to achieve with the time span of the questions in place, leading to distorted results. To solve both of these issues regarding offshoring and backshoring activities, future research should focus on a time span of 10 to 15 years and measure sustainable technology adoption at least 5 years post the time span. In this way, the expected longitudinal effects are accounted for.

Finally, cooperation with firms could be measured more in depth as well. As respondents could only select if they were or were not cooperating with firms on for example production, the depth of this cooperation was not measured. No distinctions were made between a firm that would only occasionally contact another firm, or firms that had extensive

partnerships and contact with other firms in a field. As this depth was not measured due to the broad scope of questions in the EMS, specific research regarding the effect of cooperation with firms could add to the strength of the findings on this relationship. In hindsight, external networking and external participation could have been considered to be a form of cooperation for the measuring of cooperation with firms. Both could have been added to the overall *Cooperation with firms* variable. As there is a clear focus on networks in external networking and ventures in external participation, this overall variable would not only focus on firms anymore. It would have likely better represented an overarching cooperation variable.

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Appendix 1: Variable overview

| Variable | Construct | Dimensions | Items/questions | Scale | Scale used in final analysis | Source |
|--|---|---|---|---------------------|------------------------------|----------------------------------|
| Dependent variable | Sustainable technology adoption | Energy/material efficiency technology | • Control systems that shut down machines if they are underutilized (section 8.1) | Nominal (no or yes) | Ratio (0 to 6) | Based on Fu et al. (2018) |
| | | | • OR planned before 2018 (section 8.1) | Nominal (no or yes) | | |
| | | | • Automated management systems for energy efficient production (section 8.1) | | | |
| | | | • OR planned before 2018 (section 8.1) | | | |
| | | | • Improving existing machines or installations to reduce energy use (section 8.2) | Nominal (no or yes) | | |
| | | • OR planned before 2018 (section 8.1) | Nominal (no or yes) | | | |
| | | • Upgrading existing machinery or equipment measures to reduce energy consumption (section 8.2) | | | | |
| Material/fuel substitution technology | • Technologies for energy and / or heat generation by solar, wind, hydropower, biomass or geothermal energy (section 8.1) | Nominal (no or yes) | | | | |
| • OR planned before 2018 (section 8.1) | Nominal (no or yes) | | | | | |
| Recycling technology | | • Systems for the recovery of kinetic and process energy (section 8.1) | | | | |
| • OR planned before 2018 (section 8.1) | | | | | | |
| Independent variable | Export activities | | • Products sold abroad (section 17) | Ratio (0-100%) | Ratio (0-100%) | Basile (2001) |
| Independent variable | Offshoring | Offshoring production activities | • Transfer of production activities since 2013 (section 16) | Nominal (no or yes) | Nominal (no or yes) | Based on Dachs et al. (2012) |
| | | | → To other companies abroad → To own branches abroad | | | |
| | | Offshoring R&D activities | • Relocation of research and development activities since 2013 (section 16) | Nominal (no or yes) | Nominal (no or yes) | Based on Bardhan & Jaffee (2005) |
| | | | → To other companies abroad → To own branches abroad | | | |
| Independent variable | Backshoring production activities | | • Relocation of (parts of) the production since 2013 (section 16) | Nominal (no or yes) | Nominal (no or yes) | Based on Dachs et al. (2012) |
| | | | → To other companies abroad → To own branches abroad | | | |
| Independent variable | Cooperation | Cooperation with firms | • Does your business location cooperate with other companies in the following areas? (section 6.1) | Ratio (0 to 6) | Ratio (0 to 6) | Based on Fisher & Varga (2002) |
| | | | → Purchase – production – distribution/sales – service – R&D with buyers and suppliers – R&D with research institutions - other companies | | | |
| | | External networking | • Activities in external networking (section 11) | Nominal (no or yes) | Nominal (no or yes) | Lalic et al. (2019) |
| | | External participation | • Activities in external participation (section 11) | Nominal (no or yes) | Nominal (no or yes) | Xia et al. (2005) |
| Control variable | Firm size | | • Number of employees (section 21) | Ratio (10 to 7800) | Log ratio (2.30 - 7.13) | Acs & Audretsch (1987) |
| Control variable | Educational level of employees | Higher education employees | • Higher education (HBO+WO) employees percent (section 15.1) | Ratio (0 to 80%) | Ratio (0 to 80%) | Based on Talukder (2011) |
| | | Technical education employees | • Technical education (MBO) employees percent (section 15.1) | Ratio (0 to 100%) | Ratio (0 to 100%) | |
| Control variable | Policy for competence development and training | | • Are there separate policies for competence development and training of production personnel? (section 4.3) | Nominal (no or yes) | Nominal (no or yes) | Based on Boothby et al. (2010) |
| Control variable | Industry type | Metal | • Metal (section 1.2) | Nominal (no or yes) | / | Based on Bhatt (2000) |
| | | Food | • Food (section 1.2) | Nominal (no or yes) | Nominal (no or yes) | |
| | | Textile | • Textile (section 1.2) | Nominal (no or yes) | Nominal (no or yes) | |
| | | Construction | • Construction (section 1.2) | Nominal (no or yes) | Nominal (no or yes) | |
| | | Chemical | • Chemical (section 1.2) | Nominal (no or yes) | Nominal (no or yes) | |
| | | Machinery | • Machinery (section 1.2) | Nominal (no or yes) | Nominal (no or yes) | |
| | | Electronic | • Electronic (section 1.2) | Nominal (no or yes) | Nominal (no or yes) | |

Appendix 2: EMS dataset variables

Image 1: Energy/material efficiency technology items

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 |
|--|--------------------------|--|--------------------------|---|
| Energie- en grondstoffenbesparing | | | | |
| <input type="checkbox"/> | <input type="checkbox"/> | Controlesystemen die machines stilleggen bij onderbenutting (bijv. PROFI-energy) | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | Geautomatiseerde beheerssystemen voor energie efficiënte productie | <input type="checkbox"/> | |

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

| Toepassing gepland voor 2018 | nee | ja |
|------------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

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)

Image 2: Material/fuel substitution technology item

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 |
|------------------------------|--------------------------|---|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | Technologieën voor energie- en/of warmteopwekking door middel van zon-, wind-, waterkracht, biomassa of geothermische energie | <input type="checkbox"/> | |

Image 3: Recycling technology item

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 |
|------------------------------|--------------------------|--|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | Systemen t.b.v. terugwinning van kinetische en procesenergie (bijv. terugwinnen afvalwarmte) | <input type="checkbox"/> | |

Image 4: Export activities item

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.

Producten verkocht in:

| | | | | |
|------------|----|----------------------|---|----------------------|
| binnenland | ca | <input type="text"/> | % | } =100% van de omzet |
| buitenland | ca | <input type="text"/> | % | |

Image 5: Offshoring production activities item

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 welk land (landen)? |
| | Naar andere bedrijven in Nederland | Naar andere bedrijven in het buitenland | naar eigen vestigingen in het buitenland | |
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| | Overheveling van productie-activiteiten sinds 2013 | | | |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="text"/> |

Image 6: Offshoring R&D activities item

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 welk land (landen)? |
| | Naar andere bedrijven in Nederland | Naar andere bedrijven in het buitenland | naar eigen vestigingen in het buitenland | |
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| | Verplaatsing onderzoeks- en ontwikkelingsactiviteiten sinds 2013 | | | |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="text"/> |

Image 7: Backshoring production activities item

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?

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 |
|--------------------------|-------------------------------------|---|--|----------------------|-----------|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | | |

Terugplaatsing van (delen van) de **productie** sinds 2013

Image 8: Cooperation: cooperation with other firms items

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) | buitenland |
| Samenwerking in inkoop | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Samenwerking in de productie (voor gezamenlijke systeembeleveringen of capaciteitsuitbreiding) | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Samenwerking in distributie/verkoop | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Samenwerking in service | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Samenwerking in onderzoek en ontwikkeling met afnemers of leveranciers | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Samenwerking in onderzoek & ontwikkeling (O&O) met onderzoeksinstituten (bijv. universiteiten, TNO) | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Image 9: Cooperation: external networking item

11 Hoe vaak heeft uw organisatie vanaf 2012 de volgende activiteiten verricht? (0=niet; 1=1 keer; 2=vaker)

| Extern netwerken | Het samenwerken met andere organisaties (niet klanten) voor innovatie | 0 | 1 | 2 |
|------------------|---|--------------------------|--------------------------|--------------------------|
| | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Image 10: Cooperation: external participation item

11 Hoe vaak heeft uw organisatie vanaf 2012 de volgende activiteiten verricht? (0=niet; 1=1 keer; 2=vaker)

| Externe participatie | Deelnemen (met bijv. vermogen, kennis) in ondernemingen om toegang te krijgen tot hun kennis of om andere synergieën te creëren? | 0 | 1 | 2 |
|----------------------|--|--------------------------|--------------------------|--------------------------|
| | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Image 11: Firm size item

21 Hier worden enkele gegevens over uw bedrijfsvestiging gevraagd:

| | | | | | | | |
|---|------|----------------------|----------------------|----------------------|----------------------|----------------------|--------|
| Aantal werknemers (excl. uitzendkrachten) | 2014 | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | aantal |
|---|------|----------------------|----------------------|----------------------|----------------------|----------------------|--------|

Image 12: Educational level of employees items

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

| | | | |
|--------------------------|-----|----------------------|---|
| Hoger onderwijs (HBO+WO) | ca. | <input type="text"/> | % |
| MBO technische opleiding | ca. | <input type="text"/> | % |

Image 13: Policy for competence development and training item

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

nee ja

Image 14: Industry type item

1.2 Bedrijfstak (bijv. textiel, chemische industrie, machinebouw, enz.):

Appendix 3: SPSS Output

Image 1: Scatterplot of standardised predicted values (all independent variables)

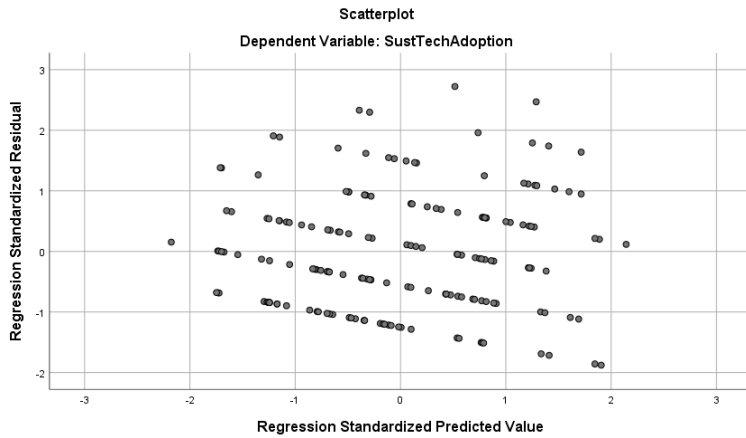


Image 2: Scatterplot of standardised predicted values (all independent variables and control variables)

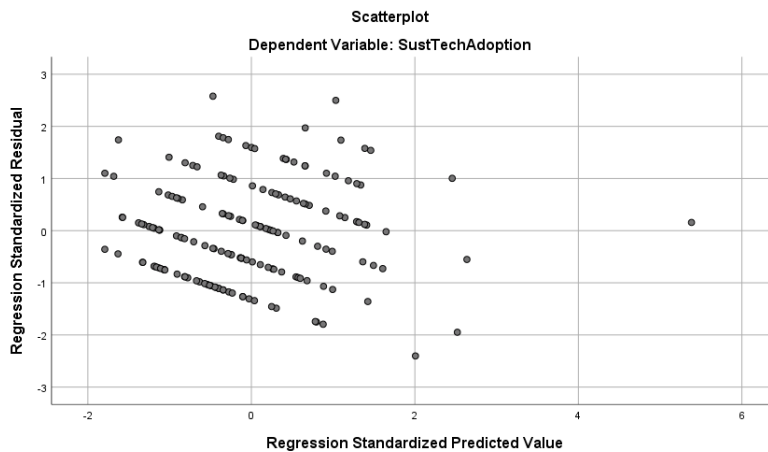


Table 1: Mahalanobis D^2/df

| Mahalanobis Distance/df | | | | | |
|-------------------------|-----------|---------|---------------|--------------------|-------|
| | Frequency | Percent | Valid Percent | Cumulative Percent | |
| Valid | 9,69 | 1 | ,6 | ,6 | ,6 |
| | 3,36 | 1 | ,6 | ,6 | 1,2 |
| | 2,92 | 1 | ,6 | ,6 | 1,8 |
| | 2,54 | 1 | ,6 | ,6 | 2,3 |
| | 2,46 | 1 | ,6 | ,6 | 2,9 |
| | 2,44 | 1 | ,6 | ,6 | 3,5 |
| | 2,29 | 1 | ,6 | ,6 | 4,1 |
| | 2,19 | 1 | ,6 | ,6 | 4,7 |
| | 2,18 | 1 | ,6 | ,6 | 5,3 |
| | 2,17 | 1 | ,6 | ,6 | 5,8 |
| | ,45 | 1 | ,6 | ,6 | 97,1 |
| | ,44 | 1 | ,6 | ,6 | 97,7 |
| | ,42 | 1 | ,6 | ,6 | 98,2 |
| | ,40 | 1 | ,6 | ,6 | 98,8 |
| | ,39 | 1 | ,6 | ,6 | 99,4 |
| | ,36 | 1 | ,6 | ,6 | 100,0 |
| Total | 171 | 100,0 | 100,0 | | |

Image 3: Scatterplot of standardised predicted values after deleted cases (all independent variables and control variables)

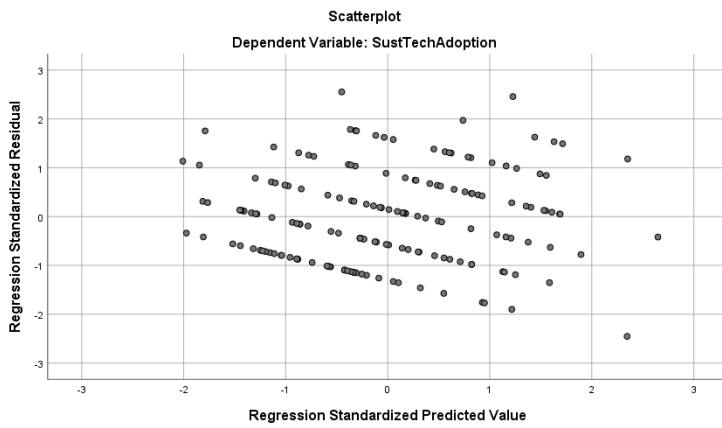


Image 4: Standardized residuals histogram

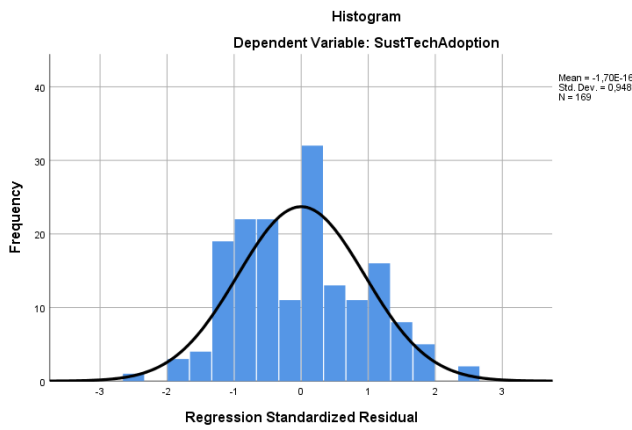


Image 5: Normal probability plot

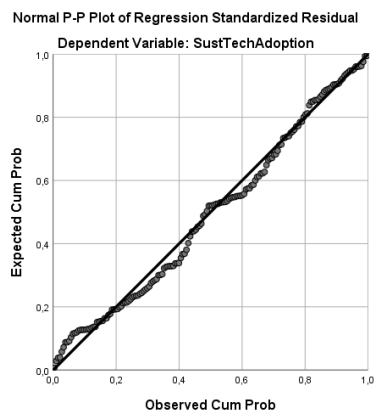


Table 2: Kolmogorov-Smirnov test

| Tests of Normality | | | |
|--|---------------------------------|-----|------|
| | Kolmogorov-Smirnov ^a | | |
| | Statistic | df | Sig. |
| Export activities (percentage of products sold abroad) | ,172 | 169 | ,000 |
| Cooperation with firms | ,149 | 169 | ,000 |
| Firm size | ,318 | 169 | ,000 |
| Higher education (HBO+WO) employees percent | ,210 | 169 | ,000 |
| Technical education (MBO) employees percent | ,159 | 169 | ,000 |

a. Lilliefors Significance Correction

Image 6: Export activities (Histogram & Boxplot)

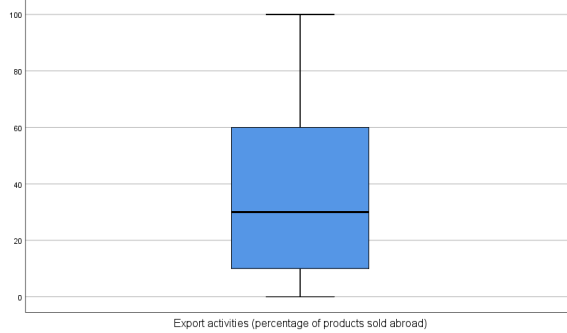
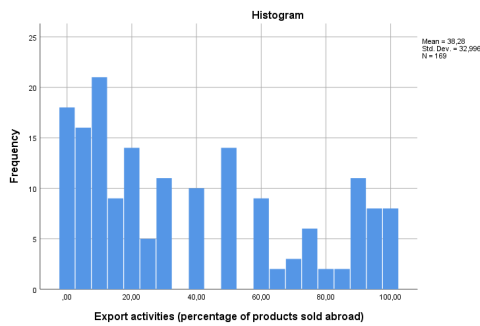


Image 7: Cooperation with firms (Histogram & Boxplot)

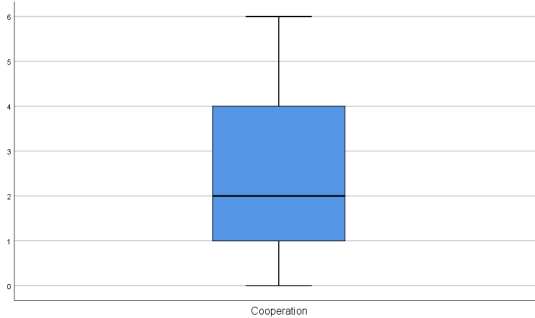
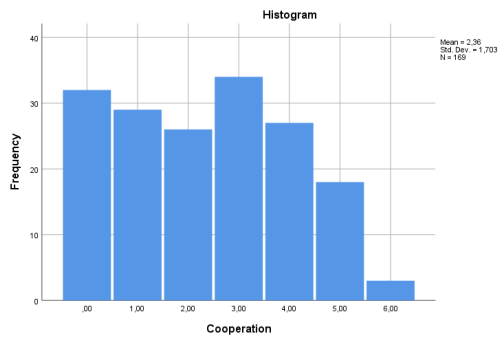


Image 8: Firm size (Histogram & Boxplot)

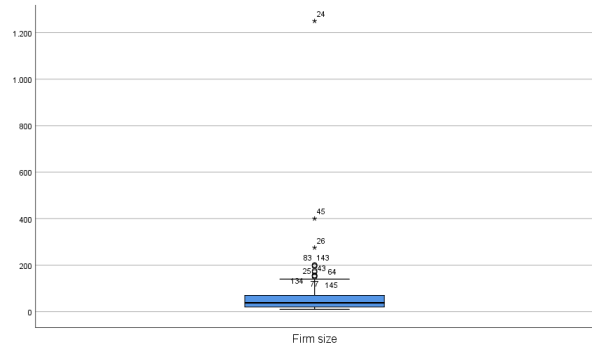
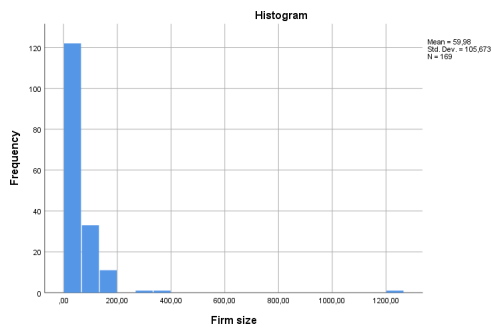


Image 9: Higher education (Histogram & Boxplot)

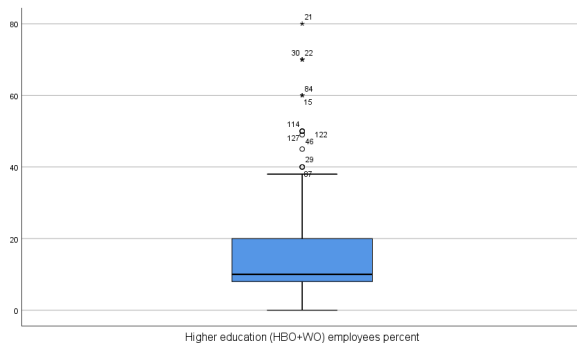
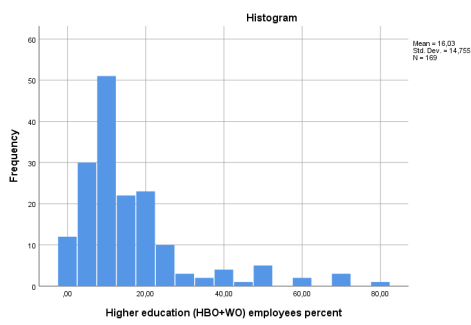


Image 10: Technical education (Histogram & Boxplot)

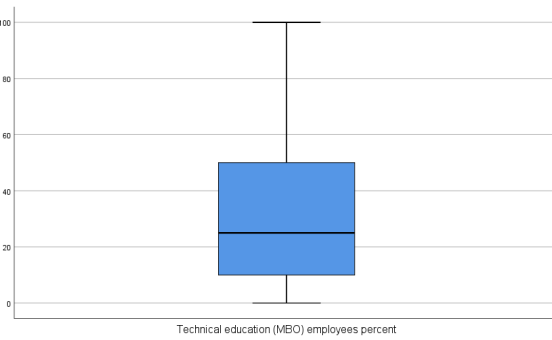
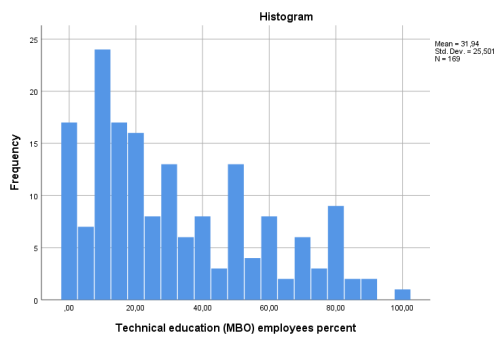


Table 3: Kolmogorov-Smirnov Test

| Tests of Normality | | | |
|--|---------------------------------|-----|------|
| | Kolmogorov-Smirnov ^a | | |
| | Statistic | df | Sig. |
| Export activities (percentage of products sold abroad) | ,172 | 169 | ,000 |
| Cooperation with firms | ,149 | 169 | ,000 |
| Firm size log | ,068 | 169 | ,057 |
| Higher education (HBO+WO) employees percent | ,210 | 169 | ,000 |
| Technical education (MBO) employees percent | ,159 | 169 | ,000 |

a. Lilliefors Significance Correction

Image 11: Firm size log (Histogram)

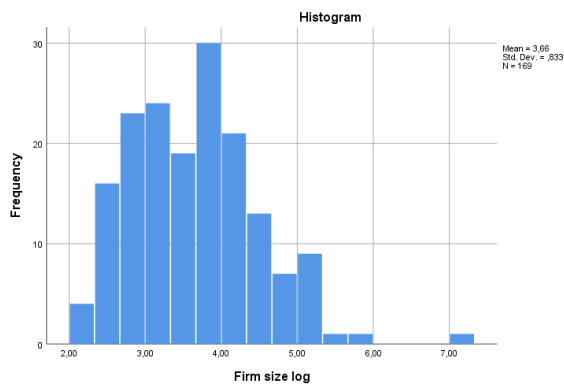


Image 13: Standardized residuals histogram

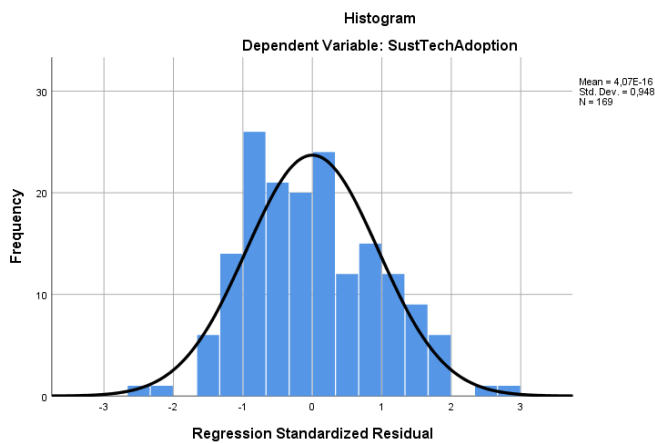


Image 14: Normal probability plot

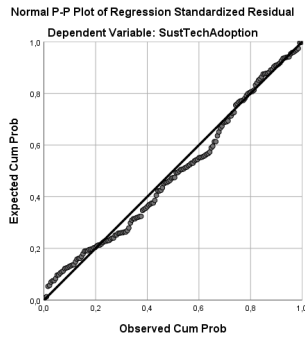


Table 4: Durbin-Watson test

Model Summary^b

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson |
|-------|-------------------|----------|-------------------|----------------------------|---------------|
| 1 | ,494 ^a | ,244 | ,159 | 1,34596 | 1,838 |

a. Predictors: (Constant), Electronic, Policy for competence development and training, Export activities (percentage of products sold abroad), Technical education (MBO) employees percent, Construction, External networking, Chemical, Offshoring R&D activities, Firm size log, Backshoring production activities, Food, Higher education (HBO+WO) employees percent, Textile, Offshoring production activities, Cooperation, External participation, Machinery

b. Dependent Variable: SustTechAdoption

Table 5a: Sustainable technology adoption; separate variables (Frequencies)

| Control system for shut down of machines in off-peak periods | | | | | |
|--|-----|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 167 | 93,8 | 93,8 | 93,8 |
| | yes | 11 | 6,2 | 6,2 | 100,0 |
| Total | | 178 | 100,0 | 100,0 | |

| Use planned until 2018 | | | | | |
|------------------------|--------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | -99,00 | 13 | 7,3 | 7,3 | 7,3 |
| | no | 161 | 90,4 | 90,4 | 97,8 |
| | yes | 4 | 2,2 | 2,2 | 100,0 |
| Total | | 178 | 100,0 | 100,0 | |

| Control-automation systems for an energy efficient production | | | | | |
|---|-----|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 162 | 91,0 | 91,0 | 91,0 |
| | yes | 16 | 9,0 | 9,0 | 100,0 |
| Total | | 178 | 100,0 | 100,0 | |

| Use planned until 2018 | | | | | |
|------------------------|--------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | -99,00 | 18 | 10,1 | 10,1 | 10,1 |
| | no | 154 | 86,5 | 86,5 | 96,6 |
| | yes | 6 | 3,4 | 3,4 | 100,0 |
| Total | | 178 | 100,0 | 100,0 | |

| Technologies for recuperation of kinetic and process energy | | | | | |
|---|-----|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 137 | 77,0 | 77,0 | 77,0 |
| | yes | 41 | 23,0 | 23,0 | 100,0 |
| Total | | 178 | 100,0 | 100,0 | |

| Use planned until 2018 | | | | | |
|------------------------|--------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | -99,00 | 43 | 24,2 | 24,2 | 24,2 |
| | no | 123 | 69,1 | 69,1 | 93,3 |
| | yes | 12 | 6,7 | 6,7 | 100,0 |
| Total | | 178 | 100,0 | 100,0 | |

| Switching off components, machinery or equipment measures to reduce energy consumption | | | | | |
|--|-----|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 86 | 48,3 | 48,3 | 48,3 |
| | yes | 92 | 51,7 | 51,7 | 100,0 |
| Total | | 178 | 100,0 | 100,0 | |

| planned 2018 Switching off components, machinery or equipment measures to reduce energy consumption | | | | | |
|---|--------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | -99,00 | 92 | 51,7 | 51,7 | 51,7 |
| | ,00 | 70 | 39,3 | 39,3 | 91,0 |
| | ticked | 16 | 9,0 | 9,0 | 100,0 |
| | Total | 178 | 100,0 | 100,0 | |

| Upgrading existing machinery or equipment measures to reduce energy consumption | | | | | |
|---|-----|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 112 | 62,9 | 62,9 | 62,9 |
| | yes | 66 | 37,1 | 37,1 | 100,0 |
| Total | | 178 | 100,0 | 100,0 | |

| planned 2018 Upgrading existing machinery or equipment measures to reduce energy consumption | | | | | |
|--|--------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | -99,00 | 66 | 37,1 | 37,1 | 37,1 |
| | ,00 | 99 | 55,6 | 55,6 | 92,7 |
| | ticked | 13 | 7,3 | 7,3 | 100,0 |
| | Total | 178 | 100,0 | 100,0 | |

| Technologies for generation energy heat | | | | | |
|---|-----|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 163 | 91,6 | 91,6 | 91,6 |
| | yes | 15 | 8,4 | 8,4 | 100,0 |
| Total | | 178 | 100,0 | 100,0 | |

| Use planned until 2018 | | | | | |
|------------------------|--------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | -99,00 | 17 | 9,6 | 9,6 | 9,6 |
| | no | 127 | 71,3 | 71,3 | 80,9 |
| | yes | 34 | 19,1 | 19,1 | 100,0 |
| Total | | 178 | 100,0 | 100,0 | |

Table 5b: Sustainable technology adoption; separate variables after transformation (Frequencies)

| Tech1 | | | | | Tech4 | | | | | | |
|-------|-----|-----------|---------|---------------|--------------------|-------|-----|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent | | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 156 | 92,3 | 92,3 | 92,3 | Valid | no | 69 | 40,8 | 40,8 | 40,8 |
| | yes | 13 | 7,7 | 7,7 | 100,0 | | yes | 100 | 59,2 | 59,2 | 100,0 |
| Total | | 169 | 100,0 | 100,0 | | Total | | 169 | 100,0 | 100,0 | |

| Tech2 | | | | | Tech5 | | | | | | |
|-------|-----|-----------|---------|---------------|--------------------|-------|-----|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent | | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 148 | 87,6 | 87,6 | 87,6 | Valid | no | 98 | 58,0 | 58,0 | 58,0 |
| | yes | 21 | 12,4 | 12,4 | 100,0 | | yes | 71 | 42,0 | 42,0 | 100,0 |
| Total | | 169 | 100,0 | 100,0 | | Total | | 169 | 100,0 | 100,0 | |

| Tech3 | | | | | Tech6 | | | | | | |
|-------|-----|-----------|---------|---------------|--------------------|-------|-----|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent | | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 117 | 69,2 | 69,2 | 69,2 | Valid | no | 123 | 72,8 | 72,8 | 72,8 |
| | yes | 52 | 30,8 | 30,8 | 100,0 | | yes | 46 | 27,2 | 27,2 | 100,0 |
| Total | | 169 | 100,0 | 100,0 | | Total | | 169 | 100,0 | 100,0 | |

Table 5c: Sustainable technology adoption (Frequencies)

| SustTechAdoption | | | | | |
|------------------|-------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | ,00 | 40 | 23,7 | 23,7 | 23,7 |
| | 1,00 | 41 | 24,3 | 24,3 | 47,9 |
| | 2,00 | 34 | 20,1 | 20,1 | 68,0 |
| | 3,00 | 30 | 17,8 | 17,8 | 85,8 |
| | 4,00 | 17 | 10,1 | 10,1 | 95,9 |
| | 5,00 | 6 | 3,6 | 3,6 | 99,4 |
| | 6,00 | 1 | ,6 | ,6 | 100,0 |
| | Total | | 169 | 100,0 | 100,0 |

Table 6: Export activities (Frequencies)

| Export activities (percentage of products sold abroad) | | | | |
|--|-----------|---------|---------------|--------------------|
| | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | .00 | 10 | 5,9 | 5,9 |
| | 1,00 | 5 | 3,0 | 8,9 |
| | 2,00 | 3 | 1,8 | 10,7 |
| | 3,00 | 1 | ,8 | 11,2 |
| | 4,00 | 1 | ,8 | 11,8 |
| | 5,00 | 13 | 7,7 | 19,5 |
| | 6,00 | 1 | ,8 | 20,1 |
| | 10,00 | 21 | 12,4 | 32,5 |
| | 15,00 | 9 | 5,3 | 37,9 |
| | 20,00 | 14 | 8,3 | 46,2 |
| | 25,00 | 5 | 3,0 | 49,1 |
| | 30,00 | 11 | 6,5 | 55,6 |
| | 40,00 | 10 | 5,9 | 61,5 |
| | 48,00 | 2 | 1,2 | 62,7 |
| | 50,00 | 12 | 7,1 | 69,8 |
| | 59,00 | 1 | ,8 | 70,4 |
| | 60,00 | 8 | 4,7 | 75,1 |
| | 65,00 | 2 | 1,2 | 76,3 |
| | 70,00 | 3 | 1,8 | 78,1 |
| | 75,00 | 5 | 3,0 | 81,1 |
| | 77,00 | 1 | ,8 | 81,7 |
| | 80,00 | 2 | 1,2 | 82,8 |
| | 85,00 | 2 | 1,2 | 84,0 |
| | 90,00 | 10 | 5,9 | 89,9 |
| | 92,00 | 1 | ,8 | 90,5 |
| | 93,00 | 1 | ,8 | 91,1 |
| | 94,00 | 1 | ,8 | 91,7 |
| | 95,00 | 6 | 3,6 | 95,3 |
| | 98,00 | 2 | 1,2 | 96,4 |
| | 99,00 | 1 | ,8 | 97,0 |
| | 100,00 | 5 | 3,0 | 100,0 |
| Total | | 169 | 100,0 | 100,0 |

Table 7a: Offshoring production activities; separate variables (Frequencies)

| no transfer parts of production or parts | | | | | offshored parts of production or parts to own locations abroad | | | | |
|--|-----------|---------|---------------|--------------------|--|-----------|---------|---------------|--------------------|
| | Frequency | Percent | Valid Percent | Cumulative Percent | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | 1,00 | 124 | 73,4 | 100,0 | Valid | 1,00 | 9 | 5,3 | 100,0 |
| Missing | System | 45 | 26,6 | | Missing | System | 160 | 94,7 | |
| Total | | 169 | 100,0 | | Total | | 169 | 100,0 | |

| offshored parts of production or parts to other foreign firms | | | | |
|---|-----------|---------|---------------|--------------------|
| | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | 1,00 | 22 | 13,0 | 100,0 |
| Missing | System | 147 | 87,0 | |
| Total | | 169 | 100,0 | |

Table 7b: Offshoring production activities (Frequencies)

| Offshoring production activities | | | | |
|----------------------------------|-----------|---------|---------------|--------------------|
| | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 139 | 82,2 | 82,2 |
| | yes | 30 | 17,8 | 100,0 |
| Total | | 169 | 100,0 | |

Table 8a: Offshoring R&D activities; separate variables (Frequencies)

| no transfer Production research and development | | | | | offshored research and development to own locations abroad | | | | | | |
|---|--------|-----------|---------|---------------|--|---------|--------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent | | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | 1,00 | 163 | 96,4 | 100,0 | 100,0 | Valid | 1,00 | 2 | 1,2 | 100,0 | 100,0 |
| Missing | System | 6 | 3,6 | | | Missing | System | 167 | 98,8 | | |
| Total | | 169 | 100,0 | | | Total | | 169 | 100,0 | | |

| offshored research and development to other foreign firms | | | | | |
|---|--------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | 1,00 | 4 | 2,4 | 100,0 | 100,0 |
| Missing | System | 165 | 97,6 | | |
| Total | | 169 | 100,0 | | |

Table 8b: Offshoring R&D activities (Frequencies)

| Offshoring R&D activities | | | | | |
|---------------------------|------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 163 | 96,4 | 96,4 | 96,4 |
| | 1,00 | 6 | 3,6 | 3,6 | 100,0 |
| Total | | 169 | 100,0 | 100,0 | |

Table 9a: Backshoring production activities; separate variables (Frequencies)

| no backshoring of production since 2013 | | | | | backshored of production from own locations abroad | | | | | | |
|---|--------|-----------|---------|---------------|--|---------|--------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent | | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | 1,00 | 164 | 97,0 | 100,0 | 100,0 | Valid | 1,00 | 3 | 1,8 | 100,0 | 100,0 |
| Missing | System | 5 | 3,0 | | | Missing | System | 166 | 98,2 | | |
| Total | | 169 | 100,0 | | | Total | | 169 | 100,0 | | |

| backshored of production from own other foreign firms | | | | | |
|---|--------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | 1,00 | 2 | 1,2 | 100,0 | 100,0 |
| Missing | System | 167 | 98,8 | | |
| Total | | 169 | 100,0 | | |

Table 9b: Backshoring production activities (Frequencies)

| Backshoring production activities | | | | | |
|-----------------------------------|-----|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 164 | 97,0 | 97,0 | 97,0 |
| | yes | 5 | 3,0 | 3,0 | 100,0 |
| Total | | 169 | 100,0 | 100,0 | |

Table 10a: Cooperation with firms; separate variables (Frequencies)

| Purchasing cooperation | | | | | Service cooperation | | | | | R&D cooperation with other companies (excl. customers or suppliers) | | | | | | | | |
|------------------------|-------|-----------|---------|---------------|---------------------|-------|-----|-----------|---------|---|--------------------|-----|-------|-----------|---------|---------------|--------------------|-------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent | | | Frequency | Percent | Valid Percent | Cumulative Percent | | | Frequency | Percent | Valid Percent | Cumulative Percent | |
| Valid | no | 107 | 63,3 | 63,3 | 63,3 | no | 120 | 71,0 | 71,0 | 71,0 | 71,0 | no | 168 | 99,4 | 99,4 | 99,4 | 99,4 | |
| | yes | 62 | 36,7 | 36,7 | 100,0 | yes | 49 | 29,0 | 29,0 | 100,0 | 100,0 | yes | 1 | ,6 | ,6 | 100,0 | 100,0 | |
| | Total | 169 | 100,0 | 100,0 | | Total | 169 | 100,0 | 100,0 | | Total | 169 | 100,0 | 100,0 | | Total | 169 | 100,0 |

| Production cooperation | | | | | R&D cooperation with customers or suppliers | | | | | | | | |
|------------------------|-------|-----------|---------|---------------|---|-------|-----|-----------|---------|---------------|--------------------|-----|-------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent | | | Frequency | Percent | Valid Percent | Cumulative Percent | | |
| Valid | no | 97 | 57,4 | 57,4 | 57,4 | no | 106 | 62,7 | 62,7 | 62,7 | 62,7 | | |
| | yes | 72 | 42,6 | 42,6 | 100,0 | yes | 63 | 37,3 | 37,3 | 100,0 | 100,0 | | |
| | Total | 169 | 100,0 | 100,0 | | Total | 169 | 100,0 | 100,0 | | Total | 169 | 100,0 |

| Sales/distribution cooperation | | | | | R&D cooperation with research organizations or research entities | | | | | | | | |
|--------------------------------|-------|-----------|---------|---------------|--|-------|-----|-----------|---------|---------------|--------------------|-----|-------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent | | | Frequency | Percent | Valid Percent | Cumulative Percent | | |
| Valid | no | 106 | 62,7 | 62,7 | 62,7 | no | 80 | 47,3 | 47,3 | 47,3 | 47,3 | | |
| | yes | 63 | 37,3 | 37,3 | 100,0 | yes | 89 | 52,7 | 52,7 | 100,0 | 100,0 | | |
| | Total | 169 | 100,0 | 100,0 | | Total | 169 | 100,0 | 100,0 | | Total | 169 | 100,0 |

Table 10b: Cooperation with firms (Frequencies)

| Cooperation with firms | | | | | |
|------------------------|-------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | ,00 | 32 | 18,9 | 18,9 | 18,9 |
| | 1,00 | 29 | 17,2 | 17,2 | 36,1 |
| | 2,00 | 26 | 15,4 | 15,4 | 51,5 |
| | 3,00 | 34 | 20,1 | 20,1 | 71,6 |
| | 4,00 | 27 | 16,0 | 16,0 | 87,6 |
| | 5,00 | 18 | 10,7 | 10,7 | 98,2 |
| | 6,00 | 3 | 1,8 | 1,8 | 100,0 |
| | Total | 169 | 100,0 | 100,0 | |

Table 11a: External networking; prior to transformation (Frequencies)

| Open innovation activity participated in external innovation networks since 2012 | | | | | |
|--|----------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | none | 45 | 26,6 | 26,6 | 26,6 |
| | once | 28 | 16,6 | 16,6 | 43,2 |
| | multiple | 96 | 56,8 | 56,8 | 100,0 |
| | Total | 169 | 100,0 | 100,0 | |

Table 11b: External networking (Frequencies)

| External networking | | | | | |
|---------------------|-------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 46 | 27,2 | 27,2 | 27,2 |
| | yes | 123 | 72,8 | 72,8 | 100,0 |
| | Total | 169 | 100,0 | 100,0 | |

Table 12a: External participation; prior to transformation (Frequencies)

Open innovation activity participated in other firms to access knowledge since 2012

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|----------|-----------|---------|---------------|--------------------|
| Valid | none | 106 | 62,7 | 62,7 | 62,7 |
| | once | 25 | 14,8 | 14,8 | 77,5 |
| | multiple | 38 | 22,5 | 22,5 | 100,0 |
| | Total | 169 | 100,0 | 100,0 | |

Table 12b: External participation (Frequencies)

External participation

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|-------|-----------|---------|---------------|--------------------|
| Valid | none | 105 | 62,1 | 62,1 | 62,1 |
| | yes | 64 | 37,9 | 37,9 | 100,0 |
| | Total | 169 | 100,0 | 100,0 | |

Table 13a: Firm size; before log transformation (Frequencies)

| Firm size | | | | |
|-----------|-----------|---------|---------------|--------------------|
| | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | 10,00 | 4 | 2,4 | 2,4 |
| | 11,00 | 4 | 2,4 | 4,7 |
| | 12,00 | 6 | 3,6 | 8,3 |
| | 13,00 | 2 | 1,2 | 9,5 |
| | 14,00 | 4 | 2,4 | 11,8 |
| | 15,00 | 6 | 3,6 | 15,4 |
| | 16,00 | 2 | 1,2 | 16,6 |
| | 17,00 | 4 | 2,4 | 18,9 |
| | 18,00 | 4 | 2,4 | 21,3 |
| | 20,00 | 7 | 4,1 | 25,4 |
| | 21,00 | 2 | 1,2 | 26,6 |
| | 22,00 | 1 | ,6 | 27,2 |
| | 23,00 | 3 | 1,8 | 29,0 |
| | 24,00 | 6 | 3,6 | 32,5 |
| | 25,00 | 7 | 4,1 | 36,7 |
| | 26,00 | 2 | 1,2 | 37,9 |
| | 27,00 | 1 | ,6 | 38,5 |
| | 28,00 | 2 | 1,2 | 39,6 |
| | 29,00 | 1 | ,6 | 40,2 |
| | 30,00 | 3 | 1,8 | 42,0 |
| | 32,00 | 4 | 2,4 | 44,4 |
| | 34,00 | 1 | ,6 | 45,0 |
| | 35,00 | 7 | 4,1 | 49,1 |
| | 36,00 | 1 | ,6 | 49,7 |
| | 38,00 | 2 | 1,2 | 50,9 |
| | 40,00 | 7 | 4,1 | 55,0 |
| | 42,00 | 3 | 1,8 | 56,8 |
| | 43,00 | 1 | ,6 | 57,4 |
| | 44,00 | 2 | 1,2 | 58,6 |
| | 45,00 | 5 | 3,0 | 61,5 |
| | 48,00 | 2 | 1,2 | 62,7 |
| | 50,00 | 5 | 3,0 | 65,7 |
| | 52,00 | 3 | 1,8 | 67,5 |
| | 53,00 | 1 | ,6 | 68,0 |
| | 54,00 | 1 | ,6 | 68,6 |
| | 55,00 | 3 | 1,8 | 70,4 |
| | 57,00 | 1 | ,6 | 71,0 |
| | 60,00 | 1 | ,6 | 71,6 |
| | 65,00 | 1 | ,6 | 72,2 |
| | 67,00 | 1 | ,6 | 72,8 |
| | 69,00 | 1 | ,6 | 73,4 |
| | 70,00 | 7 | 4,1 | 77,5 |
| | 71,00 | 1 | ,6 | 78,1 |
| | 72,00 | 2 | 1,2 | 79,3 |
| | 74,00 | 1 | ,6 | 79,9 |
| | 75,00 | 2 | 1,2 | 81,1 |
| | 80,00 | 2 | 1,2 | 82,2 |
| | 84,00 | 1 | ,6 | 82,8 |
| | 85,00 | 1 | ,6 | 83,4 |
| | 87,00 | 1 | ,6 | 84,6 |
| | 88,00 | 1 | ,6 | 85,2 |
| | 89,00 | 2 | 1,2 | 86,4 |
| | 90,00 | 3 | 1,8 | 88,2 |
| | 100,00 | 1 | ,6 | 88,8 |
| | 111,00 | 1 | ,6 | 89,3 |
| | 117,00 | 1 | ,6 | 89,9 |
| | 120,00 | 1 | ,6 | 90,5 |
| | 123,00 | 1 | ,6 | 91,1 |
| | 125,00 | 1 | ,6 | 91,7 |
| | 135,00 | 1 | ,6 | 92,3 |
| | 140,00 | 1 | ,6 | 92,9 |
| | 150,00 | 1 | ,6 | 93,5 |
| | 154,00 | 1 | ,6 | 94,1 |
| | 155,00 | 2 | 1,2 | 95,3 |
| | 170,00 | 1 | ,6 | 95,9 |
| | 175,00 | 1 | ,6 | 96,4 |
| | 195,00 | 1 | ,6 | 97,0 |
| | 200,00 | 2 | 1,2 | 98,2 |
| | 275,00 | 1 | ,6 | 98,8 |
| | 400,00 | 1 | ,6 | 99,4 |
| | 1250,00 | 1 | ,6 | 100,0 |
| Total | | 169 | 100,0 | 100,0 |

Table 13b: Firm size log (Frequencies)

| Firm size log | | | | |
|---------------|-----------|---------|---------------|--------------------|
| | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | 2,30 | 4 | 2,4 | 2,4 |
| | 2,40 | 4 | 2,4 | 4,7 |
| | 2,48 | 6 | 3,6 | 8,3 |
| | 2,56 | 2 | 1,2 | 9,5 |
| | 2,64 | 4 | 2,4 | 11,8 |
| | 2,71 | 6 | 3,6 | 15,4 |
| | 2,77 | 2 | 1,2 | 16,6 |
| | 2,83 | 4 | 2,4 | 18,9 |
| | 2,89 | 4 | 2,4 | 21,3 |
| | 3,00 | 7 | 4,1 | 25,4 |
| | 3,04 | 2 | 1,2 | 26,6 |
| | 3,09 | 1 | ,6 | 27,2 |
| | 3,14 | 3 | 1,8 | 29,0 |
| | 3,18 | 6 | 3,6 | 32,5 |
| | 3,22 | 7 | 4,1 | 36,7 |
| | 3,26 | 2 | 1,2 | 37,9 |
| | 3,30 | 1 | ,6 | 38,5 |
| | 3,33 | 2 | 1,2 | 39,6 |
| | 3,37 | 1 | ,6 | 40,2 |
| | 3,40 | 3 | 1,8 | 42,0 |
| | 3,47 | 4 | 2,4 | 44,4 |
| | 3,53 | 1 | ,6 | 45,0 |
| | 3,56 | 7 | 4,1 | 49,1 |
| | 3,58 | 1 | ,6 | 49,7 |
| | 3,64 | 2 | 1,2 | 50,9 |
| | 3,69 | 7 | 4,1 | 55,0 |
| | 3,74 | 3 | 1,8 | 56,8 |
| | 3,76 | 1 | ,6 | 57,4 |
| | 3,78 | 2 | 1,2 | 58,6 |
| | 3,81 | 5 | 3,0 | 61,5 |
| | 3,87 | 2 | 1,2 | 62,7 |
| | 3,91 | 5 | 3,0 | 65,7 |
| | 3,95 | 3 | 1,8 | 67,5 |
| | 3,97 | 1 | ,6 | 68,0 |
| | 3,99 | 1 | ,6 | 68,6 |
| | 4,01 | 3 | 1,8 | 70,4 |
| | 4,04 | 1 | ,6 | 71,0 |
| | 4,09 | 1 | ,6 | 71,6 |
| | 4,17 | 1 | ,6 | 72,2 |
| | 4,20 | 1 | ,6 | 72,8 |
| | 4,23 | 1 | ,6 | 73,4 |
| | 4,25 | 7 | 4,1 | 77,5 |
| | 4,26 | 1 | ,6 | 78,1 |
| | 4,28 | 2 | 1,2 | 79,3 |
| | 4,30 | 1 | ,6 | 79,9 |
| | 4,32 | 2 | 1,2 | 81,1 |
| | 4,38 | 2 | 1,2 | 82,2 |
| | 4,43 | 1 | ,6 | 82,8 |
| | 4,44 | 1 | ,6 | 83,4 |
| | 4,45 | 1 | ,6 | 84,0 |
| | 4,47 | 1 | ,6 | 84,6 |
| | 4,48 | 1 | ,6 | 85,2 |
| | 4,49 | 2 | 1,2 | 86,4 |
| | 4,50 | 3 | 1,8 | 88,2 |
| | 4,61 | 1 | ,6 | 88,8 |
| | 4,71 | 1 | ,6 | 89,3 |
| | 4,76 | 1 | ,6 | 89,9 |
| | 4,79 | 1 | ,6 | 90,5 |
| | 4,81 | 1 | ,6 | 91,1 |
| | 4,83 | 1 | ,6 | 91,7 |
| | 4,91 | 1 | ,6 | 92,3 |
| | 4,94 | 1 | ,6 | 92,9 |
| | 5,01 | 1 | ,6 | 93,5 |
| | 5,04 | 1 | ,6 | 94,1 |
| | 5,04 | 2 | 1,2 | 95,3 |
| | 5,14 | 1 | ,6 | 95,9 |
| | 5,16 | 1 | ,6 | 96,4 |
| | 5,27 | 1 | ,6 | 97,0 |
| | 5,30 | 2 | 1,2 | 98,2 |
| | 5,62 | 1 | ,6 | 98,8 |
| | 5,99 | 1 | ,6 | 99,4 |
| | 7,13 | 1 | ,6 | 100,0 |
| Total | 169 | 100,0 | 100,0 | |

Table 14: Education level of employees variables (Frequencies)

| Higher education (HBO+WO) employees percent | | | | | Technical education (MBO) employees percent | | | | |
|---|-----------|---------|---------------|--------------------|---|-----------|---------|---------------|--------------------|
| | Frequency | Percent | Valid Percent | Cumulative Percent | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | .00 | 8 | 4,7 | 4,7 | .00 | 16 | 9,5 | 9,5 | 9,5 |
| | 1,00 | 1 | ,6 | ,6 | 1,00 | 1 | ,6 | ,6 | 10,1 |
| | 2,00 | 3 | 1,8 | 1,8 | 3,00 | 1 | ,6 | ,6 | 10,7 |
| | 4,00 | 1 | ,6 | ,6 | 5,00 | 5 | 3,0 | 3,0 | 13,6 |
| | 5,00 | 27 | 16,0 | 16,0 | 7,00 | 1 | ,6 | ,6 | 14,2 |
| | 6,00 | 2 | 1,2 | 1,2 | 8,00 | 1 | ,6 | ,6 | 14,8 |
| | 8,00 | 10 | 5,9 | 5,9 | 10,00 | 20 | 11,9 | 11,8 | 26,6 |
| | 10,00 | 40 | 23,7 | 23,7 | 11,00 | 1 | ,6 | ,6 | 27,2 |
| | 11,00 | 1 | ,6 | ,6 | 12,00 | 2 | 1,2 | 1,2 | 28,4 |
| | 14,00 | 1 | ,6 | ,6 | 14,00 | 1 | ,6 | ,6 | 29,0 |
| | 15,00 | 21 | 12,4 | 12,4 | 15,00 | 14 | 8,3 | 8,3 | 37,3 |
| | 18,00 | 1 | ,6 | ,6 | 16,00 | 2 | 1,2 | 1,2 | 38,5 |
| | 20,00 | 22 | 13,0 | 13,0 | 20,00 | 16 | 9,5 | 9,5 | 47,9 |
| | 24,00 | 1 | ,6 | ,6 | 25,00 | 8 | 4,7 | 4,7 | 52,7 |
| | 25,00 | 7 | 4,1 | 4,1 | 30,00 | 13 | 7,7 | 7,7 | 60,4 |
| | 26,00 | 1 | ,6 | ,6 | 33,00 | 1 | ,6 | ,6 | 60,9 |
| | 27,00 | 1 | ,6 | ,6 | 35,00 | 5 | 3,0 | 3,0 | 63,9 |
| | 29,00 | 1 | ,6 | ,6 | 38,00 | 1 | ,6 | ,6 | 64,5 |
| | 30,00 | 2 | 1,2 | 1,2 | 40,00 | 7 | 4,1 | 4,1 | 68,6 |
| | 35,00 | 2 | 1,2 | 1,2 | 44,00 | 1 | ,6 | ,6 | 69,2 |
| | 38,00 | 1 | ,6 | ,6 | 45,00 | 2 | 1,2 | 1,2 | 70,4 |
| | 40,00 | 3 | 1,8 | 1,8 | 50,00 | 13 | 7,7 | 7,7 | 78,1 |
| | 45,00 | 1 | ,6 | ,6 | 53,00 | 1 | ,6 | ,6 | 78,7 |
| | 49,00 | 1 | ,6 | ,6 | 55,00 | 3 | 1,8 | 1,8 | 80,5 |
| | 50,00 | 4 | 2,4 | 2,4 | 60,00 | 8 | 4,7 | 4,7 | 85,2 |
| | 60,00 | 2 | 1,2 | 1,2 | 65,00 | 2 | 1,2 | 1,2 | 86,4 |
| | 70,00 | 3 | 1,8 | 1,8 | 70,00 | 6 | 3,6 | 3,6 | 89,9 |
| | 80,00 | 1 | ,6 | ,6 | 75,00 | 3 | 1,8 | 1,8 | 91,7 |
| | | | | | 78,00 | 1 | ,6 | ,6 | 92,3 |
| | | | | | 80,00 | 8 | 4,7 | 4,7 | 97,0 |
| | | | | | 85,00 | 2 | 1,2 | 1,2 | 98,2 |
| | | | | | 90,00 | 1 | ,6 | ,6 | 98,8 |
| | | | | | 92,00 | 1 | ,6 | ,6 | 99,4 |
| | | | | | 100,00 | 1 | ,6 | ,6 | 100,0 |
| Total | | 169 | 100,0 | 100,0 | Total | 169 | 100,0 | 100,0 | |

Table 15: Policy for competence development and training (Frequencies)

| Policy for competence development and training | | | | |
|--|-----------|---------|---------------|--------------------|
| | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 94 | 55,6 | 55,6 |
| | yes | 75 | 44,4 | 100,0 |
| Total | | 169 | 100,0 | 100,0 |

Table 16a: Industry type; initial variable (Frequencies)

| | Industry | | | Cumulative Percent |
|---|-----------|---------|---------------|--------------------|
| | Frequency | Percent | Valid Percent | |
| Valid | | | | |
| Agrarische industrie | 1 | ,6 | ,6 | ,6 |
| apparatenbouw | 2 | 1,2 | 1,2 | 1,8 |
| Apparatenbouw | 1 | ,6 | ,6 | 2,4 |
| automatisering | 1 | ,6 | ,6 | 3,0 |
| automotive | 1 | ,6 | ,6 | 3,6 |
| Automotive | 1 | ,6 | ,6 | 4,1 |
| automotive industrie | 1 | ,6 | ,6 | 4,7 |
| bakkerij | 2 | 1,2 | 1,2 | 5,9 |
| Bakkerij | 1 | ,6 | ,6 | 6,5 |
| betonindustrie | 1 | ,6 | ,6 | 7,1 |
| Betonindustrie | 1 | ,6 | ,6 | 7,7 |
| biofarmaceutisch | 1 | ,6 | ,6 | 8,3 |
| bouw | 3 | 1,8 | 1,8 | 10,1 |
| Bouwen industrie | 1 | ,6 | ,6 | 10,7 |
| Buizeninrichting | 1 | ,6 | ,6 | 11,2 |
| carrosserie | 1 | ,6 | ,6 | 11,8 |
| Carrosserie/interieurbou w | 1 | ,6 | ,6 | 12,4 |
| Carrosseriebouw | 1 | ,6 | ,6 | 13,0 |
| chemie | 3 | 1,8 | 1,8 | 14,8 |
| chemische industrie | 4 | 2,4 | 2,4 | 17,2 |
| Chemische industrie | 2 | 1,2 | 1,2 | 18,3 |
| Chemische industrie | 1 | ,6 | ,6 | 18,9 |
| chocolade en suikerwerkende industrie | 1 | ,6 | ,6 | 19,5 |
| Confectie | 1 | ,6 | ,6 | 20,1 |
| Deuren fabriek (poel, wies, gasdicht en schuifdeuren) | 1 | ,6 | ,6 | 20,7 |
| electronica | 2 | 1,2 | 1,2 | 21,9 |
| elektro-metaal | 1 | ,6 | ,6 | 22,5 |
| Elektrotechniek | 1 | ,6 | ,6 | 23,1 |
| Elektrotechnische maakindustrie | 1 | ,6 | ,6 | 23,7 |
| Emballage industrie | 1 | ,6 | ,6 | 24,3 |
| feedindustry / diervoeders | 1 | ,6 | ,6 | 24,9 |
| fijnmechanica | 1 | ,6 | ,6 | 25,4 |
| fijnmechanische industrie | 1 | ,6 | ,6 | 26,0 |
| fijnmetaal | 1 | ,6 | ,6 | 26,6 |
| garnijng | 1 | ,6 | ,6 | 27,2 |
| germaaksvoedingindustrie | 1 | ,6 | ,6 | 27,8 |
| gevelbouw | 1 | ,6 | ,6 | 28,4 |
| Graf media | 1 | ,6 | ,6 | 29,0 |
| grafisch | 1 | ,6 | ,6 | 29,6 |
| grafische | 1 | ,6 | ,6 | 30,2 |
| grafische industrie | 2 | 1,2 | 1,2 | 31,4 |
| Grafische industrie | 1 | ,6 | ,6 | 32,0 |
| grafische sector | 1 | ,6 | ,6 | 32,5 |
| Houtindustrie | 1 | ,6 | ,6 | 33,1 |
| industrie | 1 | ,6 | ,6 | 33,7 |
| Industrie | 3 | 1,8 | 1,8 | 40,8 |
| Industrie / Bouw | 1 | ,6 | ,6 | 41,4 |
| industriële automatisering | 1 | ,6 | ,6 | 42,0 |
| industriële productie | 1 | ,6 | ,6 | 42,6 |
| industriële verpakkingen | 1 | ,6 | ,6 | 43,2 |
| instrumenten | 1 | ,6 | ,6 | 43,8 |
| Interieurbouw | 2 | 1,2 | 1,2 | 45,0 |
| Jachtbouw | 1 | ,6 | ,6 | 45,6 |
| kartonnage | 1 | ,6 | ,6 | 46,2 |
| kleine industrie/ tandtechnisch laboratorium | 1 | ,6 | ,6 | 46,7 |
| kleinmetaal | 1 | ,6 | ,6 | 47,3 |
| klimaatbeheersing | 1 | ,6 | ,6 | 47,9 |
| kunststof verwerkende industrie | 1 | ,6 | ,6 | 48,5 |
| Levensmiddelen industrie | 1 | ,6 | ,6 | 49,1 |
| levensmiddelenindustrie | 1 | ,6 | ,6 | 49,7 |
| lichtlampen | 1 | ,6 | ,6 | 50,3 |
| maak industrie | 1 | ,6 | ,6 | 50,9 |
| machinebouw | 11 | 6,5 | 6,5 | 57,4 |
| Machinebouw | 6 | 3,6 | 3,6 | 60,9 |
| machinebouw en staalconstructie | 1 | ,6 | ,6 | 61,5 |
| machinebouw medische apparatuur | 1 | ,6 | ,6 | 62,1 |
| machinebouw toelevering | 1 | ,6 | ,6 | 62,7 |

| | | | | |
|--|-----|-------|-------|-------|
| Machiefabriek | 1 | ,6 | ,6 | 63,3 |
| medische toelevering | 1 | ,6 | ,6 | 63,9 |
| metaal | 6 | 3,6 | 3,6 | 67,5 |
| Metaal | 1 | ,6 | ,6 | 68,0 |
| METAAL | 1 | ,6 | ,6 | 68,6 |
| metaal en handel | 1 | ,6 | ,6 | 69,2 |
| metaal industrie | 1 | ,6 | ,6 | 69,8 |
| Metaal toelevering | 1 | ,6 | ,6 | 70,4 |
| metaal verwerking | 1 | ,6 | ,6 | 71,0 |
| metaalbewerking | 1 | ,6 | ,6 | 71,6 |
| Metaalbewerking | 1 | ,6 | ,6 | 72,2 |
| Metaalbewerking en machinebouw | 1 | ,6 | ,6 | 72,8 |
| Metaalconstructies | 1 | ,6 | ,6 | 73,4 |
| metaalindustrie | 2 | 1,2 | 1,2 | 74,6 |
| Metaalindustrie | 3 | 1,8 | 1,8 | 76,3 |
| metaalproducten | 1 | ,6 | ,6 | 76,9 |
| Metaalproductenindustrie | 1 | ,6 | ,6 | 77,5 |
| METAALWAREN | 1 | ,6 | ,6 | 78,1 |
| metaalwarenindustrie | 1 | ,6 | ,6 | 78,7 |
| meubelfabriek | 2 | 1,2 | 1,2 | 79,9 |
| meubelindustrie | 1 | ,6 | ,6 | 80,5 |
| natuursteen | 1 | ,6 | ,6 | 81,1 |
| orgelbouw | 1 | ,6 | ,6 | 81,7 |
| orthopedie | 1 | ,6 | ,6 | 82,2 |
| Papier, kunststof an selices | 1 | ,6 | ,6 | 82,8 |
| Producten medische hulpmiddelen | 1 | ,6 | ,6 | 83,4 |
| Productie | 2 | 1,2 | 1,2 | 84,6 |
| productie diervoeders | 1 | ,6 | ,6 | 85,2 |
| Productie van bouwonderdelen | 1 | ,6 | ,6 | 85,8 |
| ramen en gevel industrie | 1 | ,6 | ,6 | 86,4 |
| Reclame | 1 | ,6 | ,6 | 87,0 |
| Scheepsbouw | 1 | ,6 | ,6 | 87,6 |
| Semiconductoren | 1 | ,6 | ,6 | 88,2 |
| Sociale Verkeersontwikkeling | 1 | ,6 | ,6 | 88,8 |
| staal producerende en verwerkende industrie | 1 | ,6 | ,6 | 89,3 |
| Staalconstructie, dak- en gevelbeplating | 1 | ,6 | ,6 | 89,9 |
| Steenindustrie | 1 | ,6 | ,6 | 90,5 |
| Tak- en recycling | 1 | ,6 | ,6 | 91,1 |
| technische industrie | 1 | ,6 | ,6 | 91,7 |
| Tegel | 3 | 1,8 | 1,8 | 93,5 |
| Tegel | 1 | ,6 | ,6 | 94,1 |
| Tegel industrie | 1 | ,6 | ,6 | 94,7 |
| Tuinbouw | 1 | ,6 | ,6 | 95,3 |
| Verpakkingindustrie | 1 | ,6 | ,6 | 95,9 |
| Voedingindustrie | 1 | ,6 | ,6 | 96,4 |
| voedingindustrie | 1 | ,6 | ,6 | 97,0 |
| voedingingrediënten | 1 | ,6 | ,6 | 97,6 |
| voedingmiddelen industrie | 1 | ,6 | ,6 | 98,2 |
| Voedingmiddelenindust rie | 1 | ,6 | ,6 | 98,8 |
| voedselindustrie | 1 | ,6 | ,6 | 99,4 |
| Voertuigconversie / carrosseriebouw | 1 | ,6 | ,6 | 100,0 |
| Totaal | 169 | 100,0 | 100,0 | |

Table 16b: Industry type variables (Frequencies)

| Metal | | | | | |
|--------------|------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | .00 | 133 | 78,7 | 78,7 | 78,7 |
| | 1,00 | 36 | 21,3 | 21,3 | 100,0 |
| Total | | 169 | 100,0 | 100,0 | |

| Food | | | | | |
|-------------|------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | .00 | 151 | 89,3 | 89,3 | 89,3 |
| | 1,00 | 18 | 10,7 | 10,7 | 100,0 |
| Total | | 169 | 100,0 | 100,0 | |

| Textile | | | | | |
|----------------|------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | .00 | 147 | 87,0 | 87,0 | 87,0 |
| | 1,00 | 22 | 13,0 | 13,0 | 100,0 |
| Total | | 169 | 100,0 | 100,0 | |

| Construction | | | | | |
|---------------------|------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | .00 | 156 | 92,3 | 92,3 | 92,3 |
| | 1,00 | 13 | 7,7 | 7,7 | 100,0 |
| Total | | 169 | 100,0 | 100,0 | |

| Chemical | | | | | |
|-----------------|------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | .00 | 147 | 87,0 | 87,0 | 87,0 |
| | 1,00 | 22 | 13,0 | 13,0 | 100,0 |
| Total | | 169 | 100,0 | 100,0 | |

| Machinery | | | | | |
|------------------|------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | .00 | 142 | 84,0 | 84,0 | 84,0 |
| | 1,00 | 27 | 16,0 | 16,0 | 100,0 |
| Total | | 169 | 100,0 | 100,0 | |

| Electronic | | | | | |
|-------------------|------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | .00 | 138 | 81,7 | 81,7 | 81,7 |
| | 1,00 | 31 | 18,3 | 18,3 | 100,0 |
| Total | | 169 | 100,0 | 100,0 | |

Table 17: Model Summary

| Model Summary ^c | | | | | | | | | |
|----------------------------|-------------------|----------|-------------------|----------------------------|-----------------|-------------------|-----|-----|---------------|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | R Square Change | Change Statistics | | | Sig. F Change |
| | | | | | | F Change | df1 | df2 | |
| 1 | ,431 ^a | ,186 | ,134 | 1,36526 | ,186 | 3,608 | 10 | 158 | ,000 |
| 2 | ,494 ^b | ,244 | ,159 | 1,34596 | ,058 | 1,652 | 7 | 151 | ,125 |

a. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery

b. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Offshoring R&D activities, Backshoring production activities, External networking, Offshoring production activities, External participation, Export activities (percentage of products sold abroad), Cooperation with firms

c. Dependent Variable: SustTechAdoption

Table 18: ANOVA

| ANOVA ^a | | | | | | |
|--------------------|------------|----------------|-----|-------------|-------|-------------------|
| Model | | Sum of Squares | df | Mean Square | F | Sig. |
| 1 | Regression | 67,249 | 10 | 6,725 | 3,608 | ,000 ^b |
| | Residual | 294,503 | 158 | 1,864 | | |
| | Total | 361,751 | 168 | | | |
| 2 | Regression | 88,197 | 17 | 5,188 | 2,864 | ,000 ^c |
| | Residual | 273,555 | 151 | 1,812 | | |
| | Total | 361,751 | 168 | | | |

a. Dependent Variable: SustTechAdoption

b. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery

c. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Offshoring R&D activities, Backshoring production activities, External networking, Offshoring production activities, External participation, Export activities (percentage of products sold abroad), Cooperation with firms

Table 19: Coefficients Model 1

| Coefficients ^a | | | | | | |
|---------------------------|--|-----------------------------|------------|---------------------------|--------|------|
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | -,734 | ,536 | | -1,370 | ,173 |
| | Firm size log | ,494 | ,131 | ,280 | 3,758 | ,000 |
| | Higher education (HBO+WO) employees percent | -,001 | ,008 | -,014 | -,174 | ,862 |
| | Technical education (MBO) employees percent | ,013 | ,004 | ,233 | 3,187 | ,002 |
| | Policy for competence development and training | ,184 | ,217 | ,062 | ,848 | ,398 |
| | Food | ,553 | ,403 | ,117 | 1,373 | ,172 |
| | Textile | ,665 | ,371 | ,153 | 1,792 | ,075 |
| | Construction | ,230 | ,447 | ,042 | ,514 | ,608 |
| | Chemical | ,420 | ,374 | ,097 | 1,123 | ,263 |
| | Machinery | ,065 | ,370 | ,016 | ,176 | ,860 |
| | Electronic | ,028 | ,343 | ,007 | ,081 | ,935 |

Table 20: Coefficients Model 2

| | | | | | | |
|---|--|-----------|------|-------|--------|------|
| 2 | (Constant) | -,788 | ,554 | | -1,420 | ,158 |
| | Firm size log | ,365 | ,140 | ,207 | 2,607 | ,010 |
| | Higher education (HBO+WO) employees percent | -,008 | ,008 | -,085 | -1,014 | ,312 |
| | Technical education (MBO) employees percent | ,014 | ,004 | ,242 | 3,306 | ,001 |
| | Policy for competence development and training | ,137 | ,227 | ,047 | ,604 | ,546 |
| | Food | ,466 | ,399 | ,098 | 1,168 | ,245 |
| | Textile | ,543 | ,371 | ,125 | 1,462 | ,146 |
| | Construction | ,075 | ,449 | ,014 | ,168 | ,867 |
| | Chemical | ,331 | ,379 | ,076 | ,874 | ,384 |
| | Machinery | -,015 | ,380 | -,004 | -,039 | ,969 |
| | Electronic | -,017 | ,358 | -,005 | -,048 | ,962 |
| | Export activities (percentage of products sold abroad) | -4,490E-5 | ,004 | -,001 | -,012 | ,990 |
| | Offshoring production activities | ,126 | ,312 | ,033 | ,404 | ,687 |
| | Offshoring R&D activities | ,618 | ,596 | ,078 | 1,036 | ,302 |
| | Backshoring production activities | -,371 | ,662 | -,043 | -,561 | ,575 |
| | Cooperation with firms | ,156 | ,072 | ,181 | 2,158 | ,033 |
| | External networking | ,402 | ,268 | ,122 | 1,500 | ,136 |
| | External participation | ,054 | ,252 | ,018 | ,214 | ,831 |

a. Dependent Variable: SustTechAdoption

Table 21: Purchasing cooperation (Frequencies)

| Purchasing cooperation | | | | | |
|------------------------|-------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 107 | 63,3 | 63,3 | 63,3 |
| | yes | 62 | 36,7 | 36,7 | 100,0 |
| | Total | 169 | 100,0 | 100,0 | |

Table 22: Production cooperation (Frequencies)

| Production cooperation | | | | | |
|------------------------|-------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 97 | 57,4 | 57,4 | 57,4 |
| | yes | 72 | 42,6 | 42,6 | 100,0 |
| | Total | 169 | 100,0 | 100,0 | |

Table 23: Sales/distribution cooperation (Frequencies)

| Sales/distribution cooperation | | | | | |
|--------------------------------|-------|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 106 | 62,7 | 62,7 | 62,7 |
| | yes | 63 | 37,3 | 37,3 | 100,0 |
| | Total | 169 | 100,0 | 100,0 | |

Table 24: Service cooperation (Frequencies)

| Service cooperation | | | | | |
|---------------------|-----|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 120 | 71,0 | 71,0 | 71,0 |
| | yes | 49 | 29,0 | 29,0 | 100,0 |
| Total | | 169 | 100,0 | 100,0 | |

Table 25: R&D cooperation with customers or suppliers (Frequencies)

| R&D cooperation with customers or suppliers | | | | | |
|---|-----|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 106 | 62,7 | 62,7 | 62,7 |
| | yes | 63 | 37,3 | 37,3 | 100,0 |
| Total | | 169 | 100,0 | 100,0 | |

Table 26: R&D cooperation with research organizations or research entities (Frequencies)

| R&D cooperation with research organizations or research entities | | | | | |
|--|-----|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 80 | 47,3 | 47,3 | 47,3 |
| | yes | 89 | 52,7 | 52,7 | 100,0 |
| Total | | 169 | 100,0 | 100,0 | |

Table 27: R&D cooperation with other companies (excl. customers or suppliers) (Frequencies)

| R&D cooperation with other companies (excl. customers or suppliers) | | | | | |
|---|-----|-----------|---------|---------------|--------------------|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | no | 168 | 99,4 | 99,4 | 99,4 |
| | yes | 1 | ,6 | ,6 | 100,0 |
| Total | | 169 | 100,0 | 100,0 | |

Table 28: Model Summary

| Model Summary ^c | | | | | | | | | |
|----------------------------|-------------------|----------|-------------------|----------------------------|-----------------|-------------------|-----|-----|---------------|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | R Square Change | Change Statistics | | | Sig. F Change |
| | | | | | | F Change | df1 | df2 | |
| 1 | ,431 ^a | ,186 | ,134 | 1,36526 | ,186 | 3,608 | 10 | 158 | ,000 |
| 2 | ,486 ^b | ,236 | ,155 | 1,34858 | ,050 | 1,656 | 6 | 152 | ,136 |

a. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery

b. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Purchasing cooperation, Production cooperation, R&D cooperation with customers or suppliers, Service cooperation, R&D cooperation with research organizations or research entities, Sales/distribution cooperation

c. Dependent Variable: SustTechAdoption

Table 29: ANOVA

| ANOVA ^a | | | | | | |
|--------------------|------------|----------------|-----|-------------|-------|-------------------|
| Model | | Sum of Squares | df | Mean Square | F | Sig. |
| 1 | Regression | 67,249 | 10 | 6,725 | 3,608 | ,000 ^b |
| | Residual | 294,503 | 158 | 1,864 | | |
| | Total | 361,751 | 168 | | | |
| 2 | Regression | 85,315 | 16 | 5,332 | 2,932 | ,000 ^c |
| | Residual | 276,437 | 152 | 1,819 | | |
| | Total | 361,751 | 168 | | | |

a. Dependent Variable: SustTechAdoption

b. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery

c. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Purchasing cooperation, Production cooperation, R&D cooperation with customers or suppliers, Service cooperation, R&D cooperation with research organizations or research entities, Sales/distribution cooperation

Table 30: Coefficients Model 1

| Coefficients ^a | | | | | | |
|---------------------------|--|-----------------------------|------------|---------------------------|--------|------|
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | -.734 | ,536 | | -1,370 | ,173 |
| | Firm size log | ,494 | ,131 | ,280 | 3,758 | ,000 |
| | Higher education (HBO+WO) employees percent | -.001 | ,008 | -.014 | -.174 | ,862 |
| | Technical education (MBO) employees percent | ,013 | ,004 | ,233 | 3,187 | ,002 |
| | Policy for competence development and training | ,184 | ,217 | ,062 | ,848 | ,398 |
| | Food | ,553 | ,403 | ,117 | 1,373 | ,172 |
| | Textile | ,665 | ,371 | ,153 | 1,792 | ,075 |
| | Construction | ,230 | ,447 | ,042 | ,514 | ,608 |
| | Chemical | ,420 | ,374 | ,097 | 1,123 | ,263 |
| | Machinery | ,065 | ,370 | ,016 | ,176 | ,860 |
| | Electronic | ,028 | ,343 | ,007 | ,081 | ,935 |

Table 31: Coefficients Model 2

| | | | | | | |
|--|--|-------|------|-------|--------|------|
| 2 | (Constant) | -.656 | ,541 | | -1,212 | ,227 |
| | Firm size log | ,389 | ,138 | ,221 | 2,812 | ,006 |
| | Higher education (HBO+WO) employees percent | -.007 | ,008 | -.068 | -.839 | ,403 |
| | Technical education (MBO) employees percent | ,013 | ,004 | ,222 | 3,038 | ,003 |
| | Policy for competence development and training | ,149 | ,218 | ,051 | ,684 | ,495 |
| | Food | ,534 | ,404 | ,113 | 1,321 | ,189 |
| | Textile | ,570 | ,372 | ,131 | 1,535 | ,127 |
| | Construction | ,108 | ,452 | ,020 | ,238 | ,812 |
| | Chemical | ,317 | ,375 | ,073 | ,846 | ,399 |
| | Machinery | ,024 | ,375 | ,006 | ,063 | ,950 |
| | Electronic | ,033 | ,341 | ,009 | ,097 | ,923 |
| | Purchasing cooperation | ,219 | ,236 | ,072 | ,928 | ,355 |
| | Production cooperation | ,173 | ,245 | ,059 | ,707 | ,481 |
| | Sales/distribution cooperation | -.133 | ,261 | -.044 | -.509 | ,612 |
| | Service cooperation | ,130 | ,259 | ,040 | ,502 | ,616 |
| | R&D cooperation with customers or suppliers | ,271 | ,241 | ,090 | 1,127 | ,261 |
| R&D cooperation with research organizations or research entities | ,428 | ,242 | ,146 | 1,766 | ,079 | |

a. Dependent Variable: SustTechAdoption

Table 32: Model Summary

| Model Summary ⁱ | | | | | | | | | |
|----------------------------|-------------------|----------|-------------------|----------------------------|-----------------|-------------------|-----|-----|---------------|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | R Square Change | Change Statistics | | | Sig. F Change |
| | | | | | | F Change | df1 | df2 | |
| 1 | ,431 ^a | ,186 | ,134 | 1,36526 | ,186 | 3,608 | 10 | 158 | ,000 |
| 2 | ,431 ^b | ,186 | ,129 | 1,36953 | ,000 | ,017 | 1 | 157 | ,898 |
| 3 | ,437 ^c | ,191 | ,129 | 1,36951 | ,005 | 1,005 | 1 | 156 | ,318 |
| 4 | ,440 ^d | ,194 | ,126 | 1,37188 | ,002 | ,460 | 1 | 155 | ,499 |
| 5 | ,443 ^e | ,196 | ,123 | 1,37412 | ,003 | ,496 | 1 | 154 | ,482 |
| 6 | ,479 ^f | ,230 | ,154 | 1,34953 | ,034 | 6,664 | 1 | 153 | ,011 |
| 7 | ,494 ^g | ,244 | ,164 | 1,34173 | ,014 | 2,783 | 1 | 152 | ,097 |
| 8 | ,494 ^h | ,244 | ,159 | 1,34596 | ,000 | ,046 | 1 | 151 | ,831 |

- a. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery
- b. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Export activities (percentage of products sold abroad)
- c. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Export activities (percentage of products sold abroad), Offshoring production activities
- d. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Export activities (percentage of products sold abroad), Offshoring production activities, Offshoring R&D activities
- e. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Export activities (percentage of products sold abroad), Offshoring production activities, Offshoring R&D activities, Backshoring production activities
- f. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Export activities (percentage of products sold abroad), Offshoring production activities, Offshoring R&D activities, Backshoring production activities, Cooperation with firms
- g. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Export activities (percentage of products sold abroad), Offshoring production activities, Offshoring R&D activities, Backshoring production activities, Cooperation with firms, External networking
- h. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Export activities (percentage of products sold abroad), Offshoring production activities, Offshoring R&D activities, Backshoring production activities, Cooperation with firms, External networking, External participation
- i. Dependent Variable: SusTechAdoption

Table 33: ANOVA

| ANOVA ^a | | | | | | |
|--------------------|------------|----------------|-----|-------------|-------|-------------------|
| Model | | Sum of Squares | df | Mean Square | F | Sig. |
| 1 | Regression | 67,249 | 10 | 6,725 | 3,608 | ,000 ^b |
| | Residual | 294,503 | 158 | 1,864 | | |
| | Total | 361,751 | 168 | | | |
| 2 | Regression | 67,280 | 11 | 6,116 | 3,261 | ,000 ^c |
| | Residual | 294,472 | 157 | 1,876 | | |
| | Total | 361,751 | 168 | | | |
| 3 | Regression | 69,165 | 12 | 5,764 | 3,073 | ,001 ^d |
| | Residual | 292,586 | 156 | 1,876 | | |
| | Total | 361,751 | 168 | | | |
| 4 | Regression | 70,031 | 13 | 5,387 | 2,862 | ,001 ^e |
| | Residual | 291,721 | 155 | 1,882 | | |
| | Total | 361,751 | 168 | | | |
| 5 | Regression | 70,967 | 14 | 5,069 | 2,685 | ,002 ^f |
| | Residual | 290,784 | 154 | 1,888 | | |
| | Total | 361,751 | 168 | | | |
| 6 | Regression | 83,103 | 15 | 5,540 | 3,042 | ,000 ^g |
| | Residual | 278,648 | 153 | 1,821 | | |
| | Total | 361,751 | 168 | | | |
| 7 | Regression | 88,114 | 16 | 5,507 | 3,059 | ,000 ^h |
| | Residual | 273,638 | 152 | 1,800 | | |
| | Total | 361,751 | 168 | | | |
| 8 | Regression | 88,197 | 17 | 5,188 | 2,864 | ,000 ⁱ |
| | Residual | 273,555 | 151 | 1,812 | | |
| | Total | 361,751 | 168 | | | |

a. Dependent Variable: SustTechAdoption

b. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery

c. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Export activities (percentage of products sold abroad)

d. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Export activities (percentage of products sold abroad), Offshoring production activities

e. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Export activities (percentage of products sold abroad), Offshoring production activities, Offshoring R&D activities

f. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Export activities (percentage of products sold abroad), Offshoring production activities, Offshoring R&D activities, Backshoring production activities

g. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Export activities (percentage of products sold abroad), Offshoring production activities, Offshoring R&D activities, Backshoring production activities, Cooperation with firms

h. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Export activities (percentage of products sold abroad), Offshoring production activities, Offshoring R&D activities, Backshoring production activities, Cooperation with firms, External networking

i. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Export activities (percentage of products sold abroad), Offshoring production activities, Offshoring R&D activities, Backshoring production activities, Cooperation with firms, External networking, External participation

Table 34: Model Summary

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | R Square Change | Change Statistics | | | Sig. F Change |
|-------|-------------------|----------|-------------------|----------------------------|-----------------|-------------------|-----|-----|---------------|
| | | | | | | F Change | df1 | df2 | |
| 1 | ,431 ^a | ,186 | ,134 | 1,36526 | ,186 | 3,608 | 10 | 158 | ,000 |
| 2 | ,469 ^b | ,220 | ,166 | 1,34025 | ,035 | 6,953 | 1 | 157 | ,009 |

a. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery

b. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Cooperation with firms

c. Dependent Variable: SustTechAdoption

Table 35: ANOVA

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|-------|------------|----------------|-----|-------------|-------|-------------------|
| 1 | Regression | 67,249 | 10 | 6,725 | 3,608 | ,000 ^b |
| | Residual | 294,503 | 158 | 1,864 | | |
| | Total | 361,751 | 168 | | | |
| 2 | Regression | 79,737 | 11 | 7,249 | 4,036 | ,000 ^c |
| | Residual | 282,014 | 157 | 1,796 | | |
| | Total | 361,751 | 168 | | | |

a. Dependent Variable: SustTechAdoption

b. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery

c. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Cooperation with firms

Table 35: Mean-centered Export activities, Firm Size log, and interaction term (Frequencies)

| ExportCent | | | | |
|------------|-----------|---------|---------------|--------------------|
| | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | -38,28 | 10 | 5,9 | 5,9 |
| | -37,28 | 5 | 3,0 | 8,9 |
| | -36,28 | 3 | 1,8 | 10,7 |
| | -35,28 | 1 | ,6 | 11,2 |
| | -34,28 | 1 | ,6 | 11,8 |
| | -33,28 | 13 | 7,7 | 19,5 |
| | -32,28 | 1 | ,6 | 20,1 |
| | -28,28 | 21 | 12,4 | 32,5 |
| | -23,28 | 9 | 5,3 | 37,9 |
| | -18,28 | 14 | 8,3 | 46,2 |
| | -13,28 | 5 | 3,0 | 49,1 |
| | -8,28 | 11 | 6,5 | 55,6 |
| | 1,72 | 10 | 5,9 | 61,5 |
| | 9,72 | 2 | 1,2 | 62,7 |
| | 11,72 | 12 | 7,1 | 69,8 |
| | 20,72 | 1 | ,6 | 70,4 |
| | 21,72 | 8 | 4,7 | 75,1 |
| | 26,72 | 2 | 1,2 | 76,3 |
| | 31,72 | 3 | 1,8 | 78,1 |
| | 36,72 | 5 | 3,0 | 81,1 |
| | 38,72 | 1 | ,6 | 81,7 |
| | 41,72 | 2 | 1,2 | 82,8 |
| | 46,72 | 2 | 1,2 | 84,0 |
| | 51,72 | 10 | 5,9 | 89,9 |
| | 53,72 | 1 | ,6 | 90,5 |
| | 54,72 | 1 | ,6 | 91,1 |
| | 55,72 | 1 | ,6 | 91,7 |
| | 56,72 | 6 | 3,6 | 95,3 |
| | 59,72 | 2 | 1,2 | 96,4 |
| | 60,72 | 1 | ,6 | 97,0 |
| | 61,72 | 5 | 3,0 | 100,0 |
| Total | 169 | 100,0 | 100,0 | |

| FirmSizeLogCent | | | | |
|-----------------|-----------|---------|---------------|--------------------|
| | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | -1,35 | 4 | 2,4 | 2,4 |
| | -1,26 | 4 | 2,4 | 4,7 |
| | -1,17 | 6 | 3,6 | 8,3 |
| | -1,09 | 2 | 1,2 | 9,5 |
| | -1,02 | 4 | 2,4 | 11,8 |
| | -,95 | 6 | 3,6 | 15,4 |
| | -,88 | 2 | 1,2 | 16,6 |
| | -,82 | 4 | 2,4 | 18,9 |
| | -,77 | 4 | 2,4 | 21,3 |
| | -,66 | 7 | 4,1 | 25,4 |
| | -,61 | 2 | 1,2 | 26,6 |
| | -,57 | 1 | ,6 | 27,2 |
| | -,52 | 3 | 1,8 | 29,0 |
| | -,48 | 6 | 3,6 | 32,5 |
| | -,44 | 7 | 4,1 | 36,7 |
| | -,40 | 2 | 1,2 | 37,9 |
| | -,36 | 1 | ,6 | 38,5 |
| | -,33 | 2 | 1,2 | 39,6 |
| | -,29 | 1 | ,6 | 40,2 |
| | -,26 | 3 | 1,8 | 42,0 |
| | -,19 | 4 | 2,4 | 44,4 |
| | -,13 | 1 | ,6 | 45,0 |
| | -,10 | 7 | 4,1 | 49,1 |
| | -,07 | 1 | ,6 | 49,7 |
| | -,02 | 2 | 1,2 | 50,9 |
| | ,03 | 7 | 4,1 | 55,0 |
| | ,08 | 3 | 1,8 | 56,8 |
| | ,10 | 1 | ,6 | 57,4 |
| | ,13 | 2 | 1,2 | 58,6 |
| | ,15 | 5 | 3,0 | 61,5 |
| | ,21 | 2 | 1,2 | 62,7 |
| | ,25 | 5 | 3,0 | 65,7 |
| | ,29 | 3 | 1,8 | 67,5 |
| | ,31 | 1 | ,6 | 68,0 |
| | ,33 | 1 | ,6 | 68,6 |
| | ,35 | 3 | 1,8 | 70,4 |
| | ,39 | 1 | ,6 | 71,0 |
| | ,44 | 1 | ,6 | 71,6 |
| | ,52 | 1 | ,6 | 72,2 |
| | ,55 | 1 | ,6 | 72,8 |
| | ,58 | 1 | ,6 | 73,4 |
| | ,59 | 7 | 4,1 | 77,5 |
| | ,61 | 1 | ,6 | 78,1 |
| | ,62 | 2 | 1,2 | 79,3 |
| | ,65 | 1 | ,6 | 79,9 |
| | ,66 | 2 | 1,2 | 81,1 |
| | ,72 | 2 | 1,2 | 82,2 |
| | ,77 | 1 | ,6 | 82,8 |
| | ,79 | 1 | ,6 | 83,4 |
| | ,80 | 1 | ,6 | 84,0 |
| | ,81 | 1 | ,6 | 84,6 |
| | ,82 | 1 | ,6 | 85,2 |
| | ,83 | 2 | 1,2 | 86,4 |
| | ,84 | 3 | 1,8 | 88,2 |
| | ,95 | 1 | ,6 | 88,8 |
| | 1,05 | 1 | ,6 | 89,3 |
| | 1,10 | 1 | ,6 | 89,9 |
| | 1,13 | 1 | ,6 | 90,5 |
| | 1,15 | 1 | ,6 | 91,1 |
| | 1,17 | 1 | ,6 | 91,7 |
| | 1,25 | 1 | ,6 | 92,3 |
| | 1,28 | 1 | ,6 | 92,9 |
| | 1,35 | 1 | ,6 | 93,5 |
| | 1,38 | 1 | ,6 | 94,1 |
| | 1,39 | 2 | 1,2 | 95,3 |
| | 1,48 | 1 | ,6 | 95,9 |
| | 1,51 | 1 | ,6 | 96,4 |
| | 1,62 | 1 | ,6 | 97,0 |
| | 1,64 | 2 | 1,2 | 98,2 |
| | 1,96 | 1 | ,6 | 98,8 |
| | 2,33 | 1 | ,6 | 99,4 |
| | 3,47 | 1 | ,6 | 100,0 |
| Total | 169 | 100,0 | 100,0 | |

| InteractionExportFirmSize | | | | | |
|---------------------------|-----------|---------|---------------|--------------------|----------|
| | Frequency | Percent | Valid Percent | Cumulative Percent | Category |
| Valid | -1,40 | 1 | ,6 | ,6 | 1 |
| | -1,35 | 1 | ,6 | 1,2 | 2 |
| | -1,30 | 1 | ,6 | 1,8 | 3 |
| | -1,25 | 1 | ,6 | 2,4 | 4 |
| | -1,20 | 1 | ,6 | 3,0 | 5 |
| | -1,15 | 1 | ,6 | 3,6 | 6 |
| | -1,10 | 1 | ,6 | 4,2 | 7 |
| | -1,05 | 1 | ,6 | 4,8 | 8 |
| | -1,00 | 1 | ,6 | 5,4 | 9 |
| | -95 | 1 | ,6 | 6,0 | 10 |
| | -90 | 1 | ,6 | 6,6 | 11 |
| | -85 | 1 | ,6 | 7,2 | 12 |
| | -80 | 1 | ,6 | 7,8 | 13 |
| | -75 | 1 | ,6 | 8,4 | 14 |
| | -70 | 1 | ,6 | 9,0 | 15 |
| | -65 | 1 | ,6 | 9,6 | 16 |
| | -60 | 1 | ,6 | 10,2 | 17 |
| | -55 | 1 | ,6 | 10,8 | 18 |
| | -50 | 1 | ,6 | 11,4 | 19 |
| | -45 | 1 | ,6 | 12,0 | 20 |
| | -40 | 1 | ,6 | 12,6 | 21 |
| | -35 | 1 | ,6 | 13,2 | 22 |
| | -30 | 1 | ,6 | 13,8 | 23 |
| | -25 | 1 | ,6 | 14,4 | 24 |
| | -20 | 1 | ,6 | 15,0 | 25 |
| | -15 | 1 | ,6 | 15,6 | 26 |
| | -10 | 1 | ,6 | 16,2 | 27 |
| | -5 | 1 | ,6 | 16,8 | 28 |
| | 0 | 1 | ,6 | 17,4 | 29 |
| | 5 | 1 | ,6 | 18,0 | 30 |
| | 10 | 1 | ,6 | 18,6 | 31 |
| | 15 | 1 | ,6 | 19,2 | 32 |
| | 20 | 1 | ,6 | 19,8 | 33 |
| | 25 | 1 | ,6 | 20,4 | 34 |
| | 30 | 1 | ,6 | 21,0 | 35 |
| | 35 | 1 | ,6 | 21,6 | 36 |
| | 40 | 1 | ,6 | 22,2 | 37 |
| | 45 | 1 | ,6 | 22,8 | 38 |
| | 50 | 1 | ,6 | 23,4 | 39 |
| | 55 | 1 | ,6 | 24,0 | 40 |
| | 60 | 1 | ,6 | 24,6 | 41 |
| | 65 | 1 | ,6 | 25,2 | 42 |
| | 70 | 1 | ,6 | 25,8 | 43 |
| | 75 | 1 | ,6 | 26,4 | 44 |
| | 80 | 1 | ,6 | 27,0 | 45 |
| | 85 | 1 | ,6 | 27,6 | 46 |
| | 90 | 1 | ,6 | 28,2 | 47 |
| | 95 | 1 | ,6 | 28,8 | 48 |
| | 100 | 1 | ,6 | 29,4 | 49 |
| | 105 | 1 | ,6 | 30,0 | 50 |
| | 110 | 1 | ,6 | 30,6 | 51 |
| | 115 | 1 | ,6 | 31,2 | 52 |
| | 120 | 1 | ,6 | 31,8 | 53 |
| | 125 | 1 | ,6 | 32,4 | 54 |
| | 130 | 1 | ,6 | 33,0 | 55 |
| | 135 | 1 | ,6 | 33,6 | 56 |
| | 140 | 1 | ,6 | 34,2 | 57 |
| | 145 | 1 | ,6 | 34,8 | 58 |
| | 150 | 1 | ,6 | 35,4 | 59 |
| | 155 | 1 | ,6 | 36,0 | 60 |
| | 160 | 1 | ,6 | 36,6 | 61 |
| | 165 | 1 | ,6 | 37,2 | 62 |
| | 170 | 1 | ,6 | 37,8 | 63 |
| | 175 | 1 | ,6 | 38,4 | 64 |
| | 180 | 1 | ,6 | 39,0 | 65 |
| | 185 | 1 | ,6 | 39,6 | 66 |
| | 190 | 1 | ,6 | 40,2 | 67 |
| | 195 | 1 | ,6 | 40,8 | 68 |
| | 200 | 1 | ,6 | 41,4 | 69 |
| | 205 | 1 | ,6 | 42,0 | 70 |
| | 210 | 1 | ,6 | 42,6 | 71 |
| | 215 | 1 | ,6 | 43,2 | 72 |
| | 220 | 1 | ,6 | 43,8 | 73 |
| | 225 | 1 | ,6 | 44,4 | 74 |
| | 230 | 1 | ,6 | 45,0 | 75 |
| | 235 | 1 | ,6 | 45,6 | 76 |
| | 240 | 1 | ,6 | 46,2 | 77 |
| | 245 | 1 | ,6 | 46,8 | 78 |
| | 250 | 1 | ,6 | 47,4 | 79 |
| | 255 | 1 | ,6 | 48,0 | 80 |
| | 260 | 1 | ,6 | 48,6 | 81 |
| | 265 | 1 | ,6 | 49,2 | 82 |
| | 270 | 1 | ,6 | 49,8 | 83 |
| | 275 | 1 | ,6 | 50,4 | 84 |
| | 280 | 1 | ,6 | 51,0 | 85 |
| | 285 | 1 | ,6 | 51,6 | 86 |
| | 290 | 1 | ,6 | 52,2 | 87 |
| | 295 | 1 | ,6 | 52,8 | 88 |
| | 300 | 1 | ,6 | 53,4 | 89 |
| | 305 | 1 | ,6 | 54,0 | 90 |
| | 310 | 1 | ,6 | 54,6 | 91 |
| | 315 | 1 | ,6 | 55,2 | 92 |
| | 320 | 1 | ,6 | 55,8 | 93 |
| | 325 | 1 | ,6 | 56,4 | 94 |
| | 330 | 1 | ,6 | 57,0 | 95 |
| | 335 | 1 | ,6 | 57,6 | 96 |
| | 340 | 1 | ,6 | 58,2 | 97 |
| | 345 | 1 | ,6 | 58,8 | 98 |
| | 350 | 1 | ,6 | 59,4 | 99 |
| | 355 | 1 | ,6 | 60,0 | 100 |
| | 360 | 1 | ,6 | 60,6 | 101 |
| | 365 | 1 | ,6 | 61,2 | 102 |
| | 370 | 1 | ,6 | 61,8 | 103 |
| | 375 | 1 | ,6 | 62,4 | 104 |
| | 380 | 1 | ,6 | 63,0 | 105 |
| | 385 | 1 | ,6 | 63,6 | 106 |
| | 390 | 1 | ,6 | 64,2 | 107 |
| | 395 | 1 | ,6 | 64,8 | 108 |
| | 400 | 1 | ,6 | 65,4 | 109 |
| | 405 | 1 | ,6 | 66,0 | 110 |
| | 410 | 1 | ,6 | 66,6 | 111 |
| | 415 | 1 | ,6 | 67,2 | 112 |
| | 420 | 1 | ,6 | 67,8 | 113 |
| | 425 | 1 | ,6 | 68,4 | 114 |
| | 430 | 1 | ,6 | 69,0 | 115 |
| | 435 | 1 | ,6 | 69,6 | 116 |
| | 440 | 1 | ,6 | 70,2 | 117 |
| | 445 | 1 | ,6 | 70,8 | 118 |
| | 450 | 1 | ,6 | 71,4 | 119 |
| | 455 | 1 | ,6 | 72,0 | 120 |
| | 460 | 1 | ,6 | 72,6 | 121 |
| | 465 | 1 | ,6 | 73,2 | 122 |
| | 470 | 1 | ,6 | 73,8 | 123 |
| | 475 | 1 | ,6 | 74,4 | 124 |
| | 480 | 1 | ,6 | 75,0 | 125 |
| | 485 | 1 | ,6 | 75,6 | 126 |
| | 490 | 1 | ,6 | 76,2 | 127 |
| | 495 | 1 | ,6 | 76,8 | 128 |
| | 500 | 1 | ,6 | 77,4 | 129 |
| | 505 | 1 | ,6 | 78,0 | 130 |
| | 510 | 1 | ,6 | 78,6 | 131 |
| | 515 | 1 | ,6 | 79,2 | 132 |
| | 520 | 1 | ,6 | 79,8 | 133 |
| | 525 | 1 | ,6 | 80,4 | 134 |
| | 530 | 1 | ,6 | 81,0 | 135 |
| | 535 | 1 | ,6 | 81,6 | 136 |
| | 540 | 1 | ,6 | 82,2 | 137 |
| | 545 | 1 | ,6 | 82,8 | 138 |
| | 550 | 1 | ,6 | 83,4 | 139 |
| | 555 | 1 | ,6 | 84,0 | 140 |
| | 560 | 1 | ,6 | 84,6 | 141 |
| | 565 | 1 | ,6 | 85,2 | 142 |
| | 570 | 1 | ,6 | 85,8 | 143 |
| | 575 | 1 | ,6 | 86,4 | 144 |
| | 580 | 1 | ,6 | 87,0 | 145 |
| | 585 | 1 | ,6 | 87,6 | 146 |
| | 590 | 1 | ,6 | 88,2 | 147 |
| | 595 | 1 | ,6 | 88,8 | 148 |
| | 600 | 1 | ,6 | 89,4 | 149 |
| | 605 | 1 | ,6 | 90,0 | 150 |
| | 610 | 1 | ,6 | 90,6 | 151 |
| | 615 | 1 | ,6 | 91,2 | 152 |
| | 620 | 1 | ,6 | 91,8 | 153 |
| | 625 | 1 | ,6 | 92,4 | 154 |
| | 630 | 1 | ,6 | 93,0 | 155 |
| | 635 | 1 | ,6 | 93,6 | 156 |
| | 640 | 1 | ,6 | 94,2 | 157 |
| | 645 | 1 | ,6 | 94,8 | 158 |
| | 650 | 1 | ,6 | 95,4 | 159 |
| | 655 | 1 | ,6 | 96,0 | 160 |
| | 660 | 1 | ,6 | 96,6 | 161 |
| | 665 | 1 | ,6 | 97,2 | 162 |
| | 670 | 1 | ,6 | 97,8 | 163 |
| | 675 | 1 | ,6 | 98,4 | 164 |
| | 680 | 1 | ,6 | 99,0 | 165 |
| | 685 | 1 | ,6 | 99,6 | 166 |
| | 690 | 1 | ,6 | 100,0 | 167 |
| Total | 169 | 100,0 | 100,0 | | |

Table 36: Model Summary

| Model Summary | | | | | | | | | |
|---------------|-------------------|----------|-------------------|----------------------------|-----------------|-------------------|-----|-----|---------------|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | R Square Change | Change Statistics | | | Sig. F Change |
| | | | | | | F Change | df1 | df2 | |
| 1 | ,431 ^a | ,186 | ,134 | 1,36526 | ,186 | 3,608 | 10 | 158 | ,000 |
| 2 | ,494 ^b | ,244 | ,159 | 1,34596 | ,058 | 1,652 | 7 | 151 | ,125 |
| 3 | ,496 ^c | ,246 | ,156 | 1,34846 | ,002 | ,442 | 1 | 150 | ,507 |

a. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery

b. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Offshoring R&D activities, Backshoring production activities, External networking, Offshoring production activities, External participation, Export activities (percentage of products sold abroad), Cooperation with firms

c. Predictors: (Constant), Electronic, Policy for competence development and training, Technical education (MBO) employees percent, Construction, Higher education (HBO+WO) employees percent, Firm size log, Textile, Food, Chemical, Machinery, Offshoring R&D activities, Backshoring production activities, External networking, Offshoring production activities, External participation, Export activities (percentage of products sold abroad), Cooperation with firms, ExportFirmSize

Table 37: Coefficients

| Coefficients ^a | | | | | | |
|---------------------------|--|-----------------------------|------------|---------------------------|--------|------|
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | -,734 | ,536 | | -1,370 | ,173 |
| | Firm size log | ,494 | ,131 | ,280 | 3,758 | ,000 |
| | Higher education (HBO+WO) employees percent | -,001 | ,008 | -,014 | -,174 | ,862 |
| | Technical education (MBO) employees percent | ,013 | ,004 | ,233 | 3,187 | ,002 |
| | Policy for competence development and training | ,184 | ,217 | ,062 | ,848 | ,398 |
| | Food | ,553 | ,403 | ,117 | 1,373 | ,172 |
| | Textile | ,665 | ,371 | ,153 | 1,792 | ,075 |
| | Construction | ,230 | ,447 | ,042 | ,514 | ,608 |
| | Chemical | ,420 | ,374 | ,097 | 1,123 | ,263 |
| | Machinery | ,065 | ,370 | ,016 | ,176 | ,860 |
| 2 | (Constant) | -,788 | ,554 | | -1,420 | ,158 |
| | Firm size log | ,365 | ,140 | ,207 | 2,607 | ,010 |
| | Higher education (HBO+WO) employees percent | -,008 | ,008 | -,085 | -1,014 | ,312 |
| | Technical education (MBO) employees percent | ,014 | ,004 | ,242 | 3,306 | ,001 |
| | Policy for competence development and training | ,137 | ,227 | ,047 | ,604 | ,546 |
| | Food | ,466 | ,399 | ,098 | 1,168 | ,245 |
| 3 | (Constant) | -,418 | ,786 | | -,532 | ,595 |
| | Firm size log | ,264 | ,207 | ,150 | 1,275 | ,204 |
| | Higher education (HBO+WO) employees percent | -,007 | ,009 | -,074 | -,862 | ,390 |
| | Technical education (MBO) employees percent | ,014 | ,004 | ,236 | 3,191 | ,002 |
| | Policy for competence development and training | ,148 | ,228 | ,050 | ,649 | ,517 |
| | Food | ,468 | ,399 | ,099 | 1,172 | ,243 |
| | Textile | ,547 | ,372 | ,126 | 1,470 | ,144 |
| | Construction | ,066 | ,450 | ,012 | ,147 | ,883 |
| | Chemical | ,300 | ,382 | ,069 | ,786 | ,433 |
| | Machinery | -,041 | ,383 | -,010 | -,106 | ,916 |
| | Electronic | -,025 | ,358 | -,007 | -,069 | ,945 |
| | Offshoring production activities | ,158 | ,316 | ,041 | ,499 | ,619 |
| | Offshoring R&D activities | ,613 | ,598 | ,078 | 1,027 | ,306 |
| | Backshoring production activities | -,346 | ,664 | -,040 | -,522 | ,603 |
| | Export activities (percentage of products sold abroad) | -,010 | ,015 | -,218 | -,647 | ,519 |
| | Cooperation with firms | ,160 | ,073 | ,186 | 2,205 | ,029 |
| | External networking | ,382 | ,271 | ,116 | 1,411 | ,160 |
| External participation | ,069 | ,254 | ,023 | ,272 | ,786 | |
| ExportFirmSize | ,002 | ,004 | ,234 | ,665 | ,507 | |

a. Dependent Variable: SustTechAdoption