

## **Finding a Common Ground:**

Which implications does the introduction of Environmental Management Systems have for the competitiveness of small and medium sized enterprises in Baden-Württemberg, Germany?

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## Abstract

The objectives of this thesis are to find a common ground for business and environmental interests and to evaluate the potential of Environmental Management Systems (EMSs) as transition tools to lead towards a greener economic paradigm. For these purposes it was assessed, which implications EMSs have for the competitiveness of small and medium sized enterprises (SMEs) within the first three years after their introduction. As representatives, the International Organization [sic!] for Standardization [sic!] (ISO) 14001 and the Eco-Management and Audit Scheme (EMAS) were chosen. The research site was the county of Baden-Württemberg in Germany. A survey, which contained quantitative and qualitative elements, was sent to 73 SMEs of the metal sector.

Competitiveness was defined by the business and environmental performance. The aim of this approach was to determine if the EMSs improved the status quo of the firm and which Environmental Management System (EMS) performed better in the separate categories. Therefore, each performance set was assessed and then combined in Porter's Diamond (PsD) to evaluate the overall competitiveness.

EMAS outperformed ISO14001 in 10 of 12 business variables, improved five variables and satisfied two of three improvement goals. ISO14001 outperformed EMAS in two of 12 business variables, improved one variable and reached one of three improvement goals. Thus, the business performance was better for EMAS certified SMEs. For the environmental indicators, EMAS performed better in six of 11 variables, improved five and impaired two indicators, and satisfied one of four improvement goals. The two impaired variables were *Waste reduction* and *Energy efficiency*. ISO14001 performed better in five of 11 environmental variables, also improved five indicators and reached two of four improvement goals. This concludes that for the environmental indicators, the results were mixed. Regarding the overall competitiveness, EMAS scored in five of six categories and thus enhanced the competitiveness of SMEs significantly more than ISO14001 did.

Although EMAS seemed to create a win-win situation, no clear answer could be provided when discussing the potential of EMSs leading towards a greener economic paradigm. This was mainly due to the probability of a negative correlation between business and environmental indicators being the result of an EMS implementation. Furthermore, although PsD was combined with environmental indicators, its inherent framework adheres to the principles of modernity and is therefore probably not suited for an integration of environmental aspects.

**Key words:** Environmental Management System, ISO14001, EMAS, Small and medium sized enterprise, Porter's Diamond, Competitiveness, Ecological Modernisation



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People, who dare to dream.





## Table of Contents

<b>Abbreviations</b> .....	<b>I</b>
<b>List of Tables</b> .....	<b>I</b>
<b>List of Figures</b> .....	<b>I</b>
<b>List of Appendices</b> .....	<b>II</b>
<b>1 Introduction</b> .....	<b>1</b>
1.1 Outline.....	1
1.2 Objectives and Research Question .....	3
<b>2 Methodology</b> .....	<b>4</b>
2.1 Ontological and Epistemological Considerations .....	4
2.2 Survey Design .....	5
2.2.1 <i>Choosing the Companies</i> .....	5
2.2.2 <i>Questions and Indicators</i> .....	6
2.3 Analysing the Results .....	7
2.3.1 <i>Distribution of Survey Responses for Business and Environmental Indicators</i> .....	7
2.3.2 <i>Evaluation of Business and Environmental Performance</i> .....	7
2.3.3 <i>Porter’s Diamond Framework</i> .....	9
2.4 Limitations to the Research.....	10
<b>3 Background</b> .....	<b>11</b>
3.1 Environmental Management Systems .....	11
3.1.1 <i>ISO14001</i> .....	12
3.1.2 <i>EMAS</i> .....	13
3.2 Small and Medium sized Enterprises .....	13
3.3 German Framework Conditions.....	13
<b>4 The Revolution from within: a Way past Modernity</b> .....	<b>14</b>
4.1 The Era of Modernity .....	14
4.2 Ecological Modernisation .....	15
4.3 Sustainability Science and Ecological Modernisation .....	17
<b>5 Measuring Competitiveness: Porter’s Diamond</b> .....	<b>18</b>
5.1 Porter’s Theory of Strategy .....	18

5.2 Porter's Diamond as Conceptual Framework.....	19
<b>6 Results and Discussion.....</b>	<b>21</b>
6.1 Business Performance .....	22
6.1.1 Comparison and Discussion of Results.....	22
6.1.2 Assessment of Indicator Changes .....	24
6.1.3 Discussion of Improvement Goals .....	24
6.2 Environmental Performance .....	26
6.2.1 Comparison and Discussion of Results.....	26
6.2.2 Assessment of Indicator Changes .....	28
6.2.3 Discussion of Improvement Goals .....	28
6.3 The external Business Environment.....	30
6.4 Evaluation of Competitiveness .....	33
6.4.1 Factor Conditions.....	34
6.4.2 Demand Conditions.....	35
6.4.3 Firm Strategy, Structure and Rivalry .....	35
6.4.4 Related and Supported Industries .....	36
6.4.5 Chance.....	36
6.4.6 Government.....	37
6.5 The Potential of EMSs as Tools for a Transition .....	37
<b>7 Conclusion.....</b>	<b>39</b>
<b>References .....</b>	<b>43</b>
<b>Appendix .....</b>	<b>53</b>

## Abbreviations

BW	– Baden-Württemberg
CC	– Certified companies
CNIPMMR	– National Council of Small and Medium Sized Private Enterprises in Romania
DIN	– Deutsches Institut für Normung
e.g.	– exempli gratia
EM	– Ecological Modernisation
EMAS	– Eco-Management and Audit Scheme
EMS	– Environmental Management System
EMSs	– Environmental Management Systems
EU	– European Union
ISO	– International Organization [sic!] for Standardization [sic!]
PsD	– Porter’s Diamond
PDCA	– Plan-Do-Check-Act
RQ	– Research question
SME	– Small and medium sized enterprise
SMEs	– Small and medium sized enterprises
SQ	– Sub-question

## List of Tables

Table 1. Differences in percentage points between ISO14001 and EMAS responses for business indicators. ....	22
Table 2. Differences in percentage points between ISO14001 and EMAS responses for environmental indicators. ....	26
Table 3. Factor conditions. ....	34
Table 4. Demand conditions.....	35
Table 5. Firm Strategy, Structure and Rivalry. ....	35
Table 6. Related and Supported Industries. ....	36
Table 7. Chance. ....	36
Table 8. Government.....	37

## List of Figures

Figure 1. Can EMSs be a step towards a green economic paradigm? .....	2
Figure 2: Plan-Do-Check-Act cycle for an EMS.....	12
Figure 3: Porter’s Diamond. ....	20
Figure 4. Top business indicators firms wanted to improve by the introduction of the EMSs. ....	25
Figure 5. Top environmental indicators firms wanted to improve by the introduction of the EMSs. ...	29
Figure 6. Responses to the question: “What percentage of the changes in business indicators can be attributed directly to the introduction of EMAS/ISO14001?”. ....	30
Figure 7. Responses to the question: “What percentage of the changes in environmental indicators can be attributed directly to the introduction of EMAS/ISO14001?”. ....	32
Figure 8. The combined Diamond-Shared Value framework.....	68

**List of Appendices**

Appendix 1. Most important differences between ISO14001 and EMAS. ....53

Appendix 2. Blank survey questions.....53

Appendix 3. Certification procedure for ISO14001.....63

Appendix 4. Certification procedure for EMAS.....63

Appendix 5. Challenges and opportunities of SMEs and the implications for EMSs.....63

Appendix 6. Privileging of EMAS certified enterprises by the ministry of BW. ....65

Appendix 7. The external business environment. ....66

Appendix 8. Porter and Kramer’s framework of Shared Value.....67

Appendix 9. Single steps realised by multi-level purposive sampling.....68

Appendix 10. Business indicators. ....70

Appendix 11. Environmental indicators. ....70

Appendix 12. Changes in business indicators within the first three years of the introduction of ISO14001.....71

Appendix 13. Changes in business indicators within the first three years of the introduction of EMAS. ....72

Appendix 14. Differences in percentage points between ISO14001 and EMAS responses for business indicators. ....73

Appendix 15. Changes in environmental indicators within the first three years of the introduction of ISO14001.....74

Appendix 16. Changes in environmental indicators within the first three years of the introduction of EMAS.....75

Appendix 17. Differences in percentage points between ISO14001 and EMAS responses for environmental indicators. ....76

Appendix 18. Percentages of change in business and environmental indicators that can be directly attributed to the EMSs. ....76

# 1 Introduction

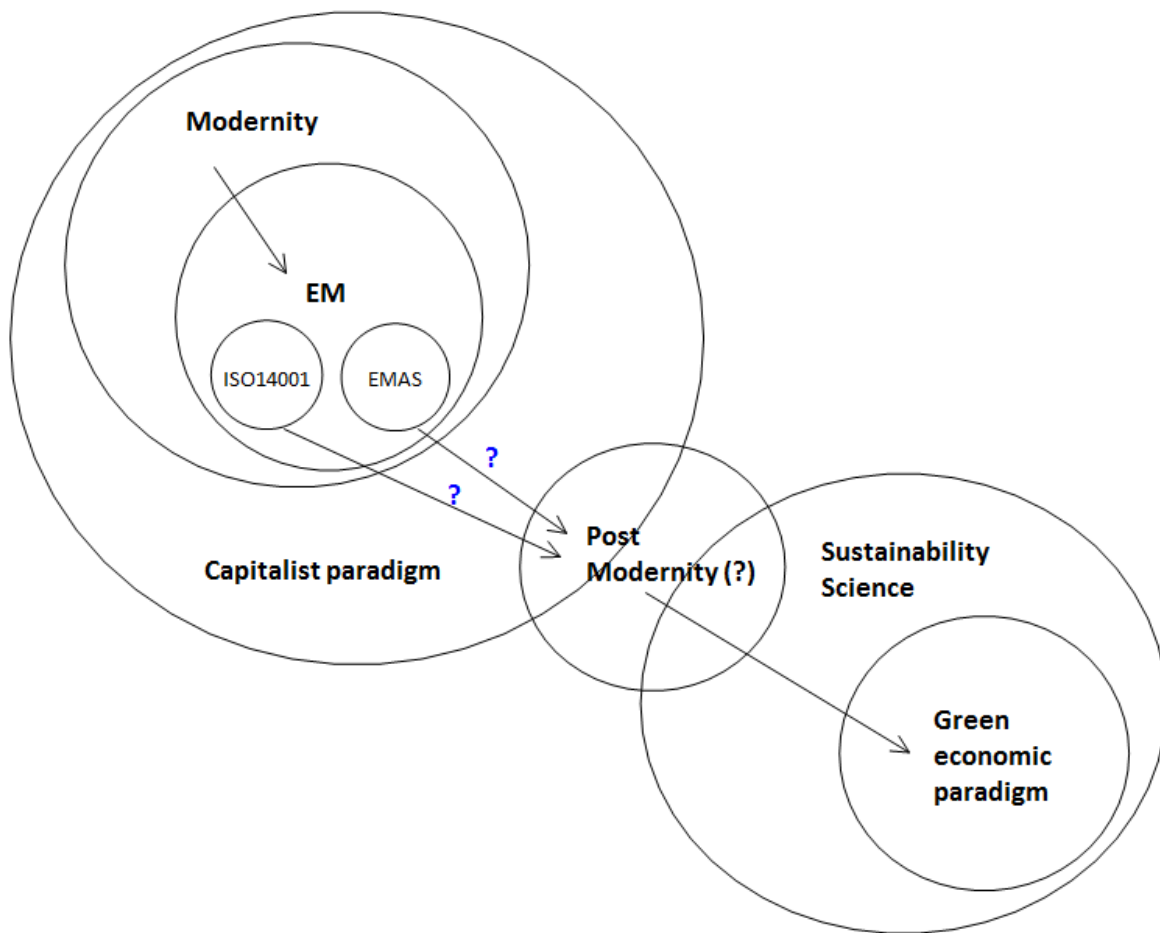
## 1.1 Outline

The transition into a greener economic paradigm has been debated since the flaws of the current capitalist system became ever more apparent (Gibbs, 2006; Li, 2009). Within this debate, the seemingly so different fields of ecology and economy are in conflict with each other (Lyon Dahl, 1996). A crucial role has been assigned to companies since they possess an enormous potential to bring about change: firms are not only the producers of goods and services but also form and influence the desires of society with the values they promote (Daly & Farley, 2011). However, in this era of modernity, the highest priority for a firm is to create profits to satisfy its owners, which can lead to unsustainable processes straining the carrying capacity of the planet (Tyler Miller Jr. & Spoolman, 2012, p. 602). According to Daly and Farley (2011), a sustainable economic paradigm is one adhering to strong sustainability standards whose most outstanding criterion is that natural capital cannot be replaced by man-made capital. It demands not only a disruption and renewal of the current economic mindset, but also of the social one by e.g. redefining the necessity of consumption. What that entails was already put forward by Daly and Farley (2011) who are concerned with developing alternative measures of welfare, considering economy as a subset of ecology and acknowledging that linear throughput on a finite planet is not feasible. The capacity for such a strong mindset needs to be built up in incremental steps; a sudden change is highly improbable due to a great number of varying interests of the actors, the complexity of the subject and high uncertainty due to information asymmetry (Parker, Karlsson, Hjerpe, & Linnér, 2012). The dissatisfaction with the consequences modernity entails, lead to its branching (Szerszynski, 1996). One sub-branch of modernity is Ecological Modernisation (EM) under whose umbrella competitiveness is newly defined. In the era of EM, a variety of tools and technologies have been created to facilitate the incorporation of environmental responsibility into business practices. Amongst these tools are Environmental Management Systems (EMSs), which provide guidelines for organisations on how to interact with the environment. Designed as voluntary regulations<sup>1</sup>, these systems have been promoted vigorously in Europe and worldwide and promise to create a “win-win situation” (Bansal & Bogner, 2002, p. 272). By providing economic incentives to the company owners and simultaneously improving the environmental impact of a company, EMSs might be eligible as tools of transition and have the potential to guide the next step towards a sustainable future via a post-modern<sup>2</sup> era (see Figure 1).

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<sup>1</sup>Although the term regulation is commonly used in association with the EMSs ISO14001 and EMAS, EMSs are considered to be norms. In the following, the term regulation will not be used as a mandatory governmental imposition, but as voluntary, legally recognised universal rule (IHK Koblenz, n.d.).

<sup>2</sup> The term “post-modern” designates here an era after modernity, which is likely to challenge modernity’s assumptions.



**Figure 1. Can EMSs be a step towards a green economic paradigm?**

The EMSs that are assessed in this paper are the two most popular and well-known EMSs in Germany (Kahlenborn & Freier, 2005): International Organization[sic!] for Standardization [sic!] (ISO) 14001 and the Eco-Management and Audit Scheme (EMAS). Whereas ISO14001 can be implemented worldwide and is a private regulation with less strict guidelines, EMAS develops the ISO14001 guidelines further, is managed by the European Commission and is a norm that focuses on European companies (Appendix 1) (Bayerisches Landesamt für Umwelt, 2011; European Commission, 2013a). Both were introduced in the 1990s, so they are well-established, well-known amongst enterprises, and both schemes can be introduced in companies from all sectors, no matter the size of the firm (TÜV Nord, n.d.; Umweltgutachterausschuss, n.d.). Although these two EMSs are similar in their basic structure, they were chosen for a comparison in the interest of future norm design by dealing briefly with the question how the strictness of an EMS influences the performances and the competitiveness of SMEs. The widely discussed Porter Hypothesis, which applies to the severity of mandatory regulations, introduced the controversial debate over the relationship between strictness and business performance. This topic, however, was only touched upon briefly within this thesis, and not assessed further for voluntary norms, but might provide insights for further design discussions.

The research about the implications of an Environmental Management System (EMS) introduction has been broad and has yielded differing results: it has mostly concentrated on a single EMS, whereby the methodology of the studies used differs widely with regard to size, sector, economic variables used to measure the economic performance etc. (Pedersen, 2007; Vries, Bayramoglu, & Wiele, 2012). Although the emphasis in previous research is rather on international companies, I focus on SMEs of the metal producing sector in the county of Baden-Württemberg (BW), a choice that is further motivated in Appendix 9 (Comoglio & Botta, 2012; Neugebauer, 2012). The voluntary attribute of the EMS has been assessed and considered mostly as superior to command-and-control mechanisms, which has implications for the further design of instruments for environmental protection (Anton, Deltas, & Khanna, 2004; Arimura, Hibiki, & Katayama, 2008). Research is still deficient in determining how effectively these EMS schemes can lead to improved performances and competitiveness and how well competitiveness frameworks are suited for integrating environmental sustainability, which is the key to competitiveness in EM (Francis, 2011).<sup>3</sup> An example is Porter's Diamond (PsD), a competitiveness framework that is until today still mostly used in combination with business indicators as in the paper of Barbe and Triay (2011). Furthermore, EMSs are mostly considered only in an operational firm-context, and not placed into the broader context of modernity, EM and a transition towards a greener paradigm.

Because of these research gaps, questions like the following ones have not been answered, yet: How do EMSs influence the business and environmental performance of SMEs? Which EMS improves which performance better? Which EMS enhances the competitiveness of an SME best? And are EMSs suited as leading tools towards a greener economic paradigm? These are aspects that will be addressed in the paper at hand, which is summarised in the following chapter.

## **1.2 Objectives and Research Question**

The objectives of this thesis are:

- (1) to find a common ground for business and environmental interests by including environmental sustainability into the competitiveness aspect of a firm; and
- (2) to discuss the potential of EMSs to lead towards a greener economic paradigm by evaluating their strengths and weaknesses, and thereby contributing to their future design.

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<sup>3</sup> Competitiveness in the following paper will as of now be used as competitiveness defined by EM and thus including not only business but also environmental aspects.



These objectives are reflected in the following research question (RQ). Each sub-question (SQ) will respond to a separate part of the RQ in detail:

**RQ: To what extent do the Environmental Management Systems ISO14001 and EMAS influence the competitiveness of SMEs in BW, Germany, and what are the resulting implications for these instruments' potential to pave the way for a transition towards a greener economic paradigm?**

SQ 1: How did the business performance develop after the introduction of the EMSs?

SQ 2: How did the environmental performance develop after the introduction of the EMSs?

SQ 3: Which EMS enhances the competitiveness of the SMEs best and what are the implications for EM and the transition to a greener economic paradigm?

The thesis is structured as follows: the subsequent chapter describes the methodology, including epistemological and ontological considerations and limitations of the research. Chapter three will provide background information on EMS and SMEs, in particular in the German context. Chapter four and five elaborate on the theoretical framework of EM and on the conceptual framework of PsD, before the assessment and discussion of the results in Chapter six. In the final chapter, a conclusion will be drawn and recommendations for further research topics will be given.

## **2 Methodology**

### **2.1 Ontological and Epistemological Considerations**

My ontological position pertains to Critical Realism. Thus, I hold the view that there is only one true reality that actors cannot influence and that is “. . . independent of human consciousness . . .” (Bryman, 2008; Flowers, 2009, p. 3). Nevertheless, knowledge is socially created according to one's own perspectives, which results in our knowledge of reality being “. . . a result of social conditioning”, making it impossible to attain a single version of reality (Flowers, 2009, p. 3; Maxwell, 2012). Therefore, my epistemology is Interpretivism, which is a position Critical Realism is compatible with (Maxwell, 2012).

Emerging eras as Modernity or EM are shaped by the actions of the actors, like wider awareness of environmental issues in firms can lead to increased well-being and a changed definition of growth. Values and priorities change over time via the construction of multiple subsequent realities, whereby each “reality” is only a temporary truth. In order to achieve a transition, the standpoints on

environmental protection will have to change and to be re-constructed. This will lead to the construction of new temporary realities, which are likely to apply more sophisticated tools and approaches. In this process, the actors might approach the one *true* reality, but their knowledge is too limited to apprehend reality's true form.

Since critical realism defends “. . . the power of both natural *and* social science to *explain*, as well as *observe* and *interpret*”, I used a mixed-method survey design that employed quantitative as well as qualitative elements (Platenkamp & Botterill, 2013, p. 112). Although the online survey provides an anonymous form that allows for the results to be gathered in an objective and value-free way, the knowledge I gained through my survey cannot be generalised and differs according to the local context. Furthermore, there is “. . . a distinction between the objects . . .” I focus on, as e.g. the business performance, the terms I use to describe them and how the respondents understand them (Bryman, 2008, p. 15). Due to a pre-interpreted social reality, every respondent has a different perception of how to interpret the indicators, in particular the ones that cannot be expressed in monetary and quantitative terms. Finally, I also re-constructed PsD according to the principles of EM by combining its categories with the environmental aspect.

## **2.2 Survey Design**

After a literature review of EMSs, competitiveness and EM, I designed the survey in the form of a self-completion questionnaire using a mixed-method design by using multiple-choice questions and Likert-scales, as well as text boxes, comments and later e-mail conversations. I used the internet survey platform *surveymethods.com* and sent a link leading to the survey via e-mail to the selected firms on 13 May 2013. Two days after I sent out the survey, I started calling the participants to get their attention and interest for my research topic. It took approximately 15-20 minutes for the respondents to finish the questionnaire and I closed it on 7 June 2013. The survey was administered in German and its English translation can be consulted in Appendix 2.

### **2.2.1 Choosing the Companies**

I selected certified organisations due to their relevance for answering my research question by multi-level purposive sampling, which is a valid approach for mixed-methods research designs (Bryman, 2008; Lærd Dissertation, n.d.). The multiple levels of sampling were: country, county, ISO14001 and EMAS certified companies (CC), SMEs, sector and headquarters (Appendix 9). Since all of the samples share main characteristics like being situated in BW, being SMEs, etc., the type of purposive sampling is Homogeneous sampling (Lærd Dissertation, n.d.). By starting with spatial features and narrowing it

down to company features, I increased the comparability of different firms as I tried to guarantee for equal legal and market environments. In total, my sample size amounted to 73 firms I would send the survey to.

### **2.2.2 Questions and Indicators**

By starting with filter questions that provided me with direct measures, I planned to do a post-survey elimination of companies that did not classify as SMEs, which was not possible before. The main body of the survey had the purpose to investigate which implications the introduction of an EMS had for the business and environmental performance of the firm. Each performance consists of three parts: (1) the comparison of indicator changes between the two EMSs that evaluates which EMS performs better; (2) the assessment of how many variables<sup>4</sup> improved, worsened or remained the same, which determines the impacts the EMSs have on the status quo of the firm; and (3) the evaluation of the improvement goals the firms set themselves, which puts the research into an operational context with the chosen SMEs as representatives for the certifications. To decrease errors due to individual interpretation, I provided according indicators. Furthermore, I used a multiple-indicator approach, providing thus the possibility to assess the change in performance more detailed and reduced the risk of misunderstanding (Bryman, 2008).

The business indicators were partly based on Best's (2004) market-based performance metrics, whereby I concentrated on Internal Performance Metrics as overall measures of profitability. I deemed it reasonable to leave out variables like market share or research and development expense, which can be more easily determined and measured by global companies (Appendix 10). The interpretation of these indicators was partially dependent on the respondents' perceptions, which was the only way to measure the business performance, since there have been no core indicators introduced so far in the context of an EMS evaluation. Although some indicators as *Profits*, *Sales volume* etc. present rather hard, universal indicators that can be measured in monetary and quantitative terms, other variables are very firm-specific and present a softer profile as *Awareness of company/products*, *Process and time efficiency* and *Employee morale*. Being a pioneering approach for the purpose of my thesis, I do not claim a definite accuracy of this indicator composition. My results will rather attribute to further research by assessing the business performance in detail.

To measure the environmental performance, I provided environmental indicators that were partly based on Yin and Schmeidler (2009) (Appendix 11). The interpretation of these was easier for EMAS

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<sup>4</sup> The term "variables" will be used synonymously with "indicators".

respondents since EMAS introduced environmental core variables. However, the list of these core indicators is not extensive and thus the facilitated interpretation was only the case for *Energy efficiency, Resource use, Waste reduction* and *Emission output* (EMAS, 2010a). The other variables relied, again, mostly on the firm-specific measurements.

Apart from developing the measures of performance, I had to account for the different components that could influence my outcome (Bryman, 2008). Therefore, I also designed questions, which enquired about the obstacles before, during and after the introduction, the perceived degree of strictness of the EMSs and the specific challenges SMEs in particular are facing.

## **2.3 Analysing the Results**

To begin with, I provided the gross and net response rate, whereby the latter was calculated by subtracting the firms that were “unsuitable or uncontactable members of the sample” (Bryman, 2008, p. 181). To answer and reflect upon the survey questions, ISO14001 and EMAS were compared by assessing how the competitiveness of the SMEs changed within three years after the introduction of the EMS. For this purpose, the business and environmental performance were evaluated separately first. Second, the two performance sets were combined with PsD to evaluate the overall competitiveness. Within the course of this research, renewed awareness is brought to the short-term profit maximising mindset, which is considered a market failure, leading to profitability that cannot be sustained (Daly & Farley, 2011; Porter & Kramer, 2011).

### **2.3.1 Distribution of Survey Responses for Business and Environmental Indicators**

I continued by highlighting the changes in business performance for ISO14001 (Appendix 12) and EMAS (Appendix 13) and the changes in environmental performance for ISO14001 (Appendix 15) and EMAS (Appendix 16) within the first three years after the introduction of the EMSs. This visualised the results and facilitated interpreting the differences. The cells have been highlighted in colour according to the percentages of respondents selecting one of the five noted categories of the Likert-scale in each row.

### **2.3.2 Evaluation of Business and Environmental Performance**

In the following, I assessed how the business and environmental indicators of ISO14001 had changed compared to EMAS, to detect which EMS provided better results.<sup>5</sup> That allowed me to split up the competitiveness variable and to single out the weak spots of the EMSs. Within these sections I

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<sup>5</sup> “Better” refers here to the economical standpoint the firms take.

provided answers to the SQ one and two. I first calculated the differences between the two respondent groups in percentage points, given in absolute values (Appendix 14 and 17). The orange cells indicate better results for ISO14001 for a variable in the according category and the same applies to EMAS that is highlighted in purple. An example is the business variable *Revenues per customer* with a difference of 11 percentage points in the category *decreased slightly* (Appendix 14). Since a decrease is a negative outcome, the EMS that has a lower percentage in this cell performs better. In this case, this is ISO14001 displaying 11 percentage points less in this cell than does EMAS. The middle column *not changed* has been taken out since this category belongs neither to a positive nor a negative performance. For a better understanding I have also put either a “D” for *decrease* or an “I” for *increase* behind the according variable to point out the desired direction for the according row. From this table, however, I cannot make a fair comparison because I cannot state that e.g. 12 points for ISO14001 CC in the category *decreased slightly* outweigh 10 points for EMAS CC in the category *increased significantly* since the impact of a significant variable, as rated so by the respondent groups, is higher than a slight change. Because of that, I chose to weigh the categories, whereby slight changes received a weight of 0.15 and the two significant categories were allocated higher weights with 0.35. The EMS, which displayed the highest sum value in a row, performed better in helping the according variable to its favourable outcome.

To assess the total business and environmental performance, I furthermore observed to what extent the variables changed. The introduction of an EMS can improve, worsen or have no effect on an indicator compared to the status of the variable before the implementation. An indicator was considered as improved when >50% of the respondents selected either increased slightly and increased significantly or decreased slightly and decreased significantly, depending on the desired outcome of the variable, again, from the standpoint of the firm. For the third performance aspect, I evaluated if the most important improvement goals, the firms set before the introduction, were reached. A goal was considered to be reached when the same 50% rule as for the variation of variables applied. Finally, I commented on the influence of the external business environment that was rated very differently amongst the respondents. The reasons for these differences in percentages will have to be interpreted context specifically by the means of in-depth research, since they depend on the individual situation of the firm.

### **2.3.3 Porter's Diamond Framework**

To respond to my SQ three, I used PsD to determine which EMS leads to more competitiveness.<sup>6</sup> This competitiveness framework is situated within the capitalist paradigm but in this paper extended by the environmental aspect, according to the principles of EM. I furthermore included the categories *Government* and *Chance* and assigned environmental and business indicators to each category (see Tables 3-8). This would allow me to assess the performance of the companies within the structure of the diamond and to assess the competitiveness by adhering to the principles of EM.

#### Factor Conditions

I divided the Factor conditions that decide on the disposability of basic and specialised production factors, into *Human and knowledge resources*, *Natural resources* and *Capital resources*, which I did according to the factors of production in economics: labour, land and capital (Mankiw, 2007; Porter, 1991).

#### Demand Conditions

This category attends to influencing and responding to buyers' needs and by that increasing the capacity of the company to " . . . improve products and services over time" (Porter, 1991, p. 112). Clients of most SMEs of my samples are wholesale customers, and as Business-to-Business companies the respondents are situated in the middle of the supply chain. Several respondents mentioned that a certification nowadays is mandatory and demanded by the clients. In this regard, it was also mentioned that the certification forms part of the supplier evaluation and pressure was built on part of the clients, which can lead to better environmental standards.

#### Firm Strategy, Structure and Rivalry

This category reflects aspects having long-term impacts on the performance and thus competitiveness of the company. It presents ". . . the context in which firm are created, organized [sic!] and managed as well as the nature of domestic rivalry" (Porter, 1990, p. 107).

#### Related and Supported Industries

This part of PsD relates to locally-based upstream and downstream companies and the creation of business clusters, leading to advantages like shorter communication ways, knowledge hubs, just-in-time production, greater influence of companies on their suppliers etc. (Porter, 1991). The

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<sup>6</sup>Note: The results do not indicate which company is more competitive in absolute terms but have to be considered in relative terms, assessing which EMS leads to a better firm performance and competitiveness.

respondents were asked whether they consider themselves situated in a cluster region, which was defined within a circuit of 100 kilometres.

### Chance

*Chance* refers to the influences of the external business environment that cannot be directly controlled. Examples will be given in Chapter 6.3. The better the change in business or environmental indicators can be attributed to the EMS, the lower is the uncertainty.

### Government

The government in this framework is represented by the ministry of BW.

## **2.4 Limitations to the Research**

I detected a data collection error, which is due to an unclear wording of indicators (Bryman, 2008). Examples are the missing words “relative” or “absolute” when I asked about the resource use, waste reduction, emission output and energy efficiency. However, I hold the view that the majority of the respondents decided to select these variables in the same manner and with a tendency towards “relative” due to the subject of the research. Thus, the differences should be marginal and the results still valid. Furthermore, the variable *Waste reduction* presents a negative wording in itself and thus might have lead to incoherent responses. Because of that, I contacted the respondents, again, in this matter and the ones that replied had interpreted the indicator in the right way with only one exception. A sampling-related error, which influenced my research, was non-response (Bryman, 2008): firms refused to cooperate or firms could not be contacted. An explanation for that could be that only companies, which recorded medium or highly successful implementations of the EMS, responded to my survey, which might increase the probability of a biased study.

Another challenge of online surveys is whether the given answers reflect reality or whether the respondents provided false statements due to low motivation, time pressure etc. Unfortunately, there are no means to test the truth of the content, which is simply a limitation of this data collection method. For some questions, as the filter questions asking for the revenues and profits in 2011, several respondents informed me that they provided wrong information on purpose due to firm confidentiality. This posed a challenge because the SME status could thus not be confirmed by using these figures. I had to rely on the employee number and the information on the homepages.

Multi-level purposive sampling, in contrast to random sampling, leads to limits to generalisation (Bryman, 2008). However, in particular seeing that other counties have different legal frameworks

and support schemes, this approach highly increased the comparability of the CC. The small sample size is another reason, why scaling up is not possible.

The probability of a negative correlation between the environmental and business indicators leads to measurement difficulties. Focusing on separate assessments, I did not account for a cross-influencing of the variables, a limitation not only for my research but possibly for EMSs themselves: should the assumption of a negative correlation hold, then these tools would not be considered further as vehicles towards a greener economic paradigm.

On a macroeconomic level, the paradigm of capitalism provides obstacles to the desired transition and also to the tools of EM itself. EMSs are hindered by the short-term profit maximising mindset, leading to respondents evaluating the benefits of EMSs under capitalist standards. Thus, these systems are likely to be portrayed worse than they are, which might result in a lower acceptance.

## **3 Background**

### **3.1 Environmental Management Systems**

An EMS “. . . is a set of processes and practices that enable an organization [sic!] to reduce its environmental impacts and increase its operating efficiency” by means of a “. . . consistent control of its [the company’s] operations” (Environmental Protection Agency, 2013). EMSs are voluntary norms standing in stark contrast to command-and-control mechanisms, which are rather cost-inefficient, inflexible, are unlikely to stimulate improvements unless required and pose a high risk of non-compliance when not sufficiently monitored (Arimura et al., 2008). As long as the implementation of an EMS is not mandatory, the motivation to decide in favour of an EMS may be much greater than if imposed. As one of the respondents stated: “Selbstverpflichtung ist besser als Vorgaben von Außen [sic!]“ (Self-commitment is better than following external rules) (Fischer, 2013). The benefits of introducing an EMS are amongst others “. . . compliance with environmental regulations”, exceeding these regulations in anticipation of stricter future provisions, increased efficiency by scrutinising internal processes and decreased environmental costs (Christini, Fetsko, Hendrickson, & Asce, 2004, p. 330). These activities create a favourable setting for gaining a competitive advantage, since they are company specific and rely on knowledge-based skills (Hart, 1995 as cited in Darnall & Edwards, 2006). ISO14001 and EMAS have been improved over the last decades whereby the adoption of the revised norm is mandatory (Lodigiani, 2013). The steps of an EMS implementation are often



presented by the four-step Plan-Do-Check-Act (PDCA) cycle, which refers to the tasks carried out during the adoption of the system (see Figure 2).



**Figure 2: Plan-Do-Check-Act cycle for an EMS. The continuous improvement is a particular attribute of EMAS. (European Commission, 2012)**

### **3.1.1 ISO14001**

In October 1996, ISO14001 was published to set a standard for the interaction of companies with the environment and is further on managed by the ISO and its national institutions, which is the *Deutsches Institut für Normung* (DIN) in Germany. With certifications in more than 250,000 organisations worldwide by 2012, ISO14001 has developed into “. . . the world’s largest EMS framework. . .” (Beuth Verlag GmbH, 2012; Stalley, 2009 as cited in Zhu, Cordeiro, & Sarkis, 2013, p. 234). The certification of ISO14001 is realised via private accreditation organisations as the TÜV or DEKRA in Germany. The latest version to implement is ISO14001:2004 + Cor.1:2009, which is a corrected version of the 2004 revision (Lingscheid, n.d.). With the intention of improving its attraction for SMEs, ISO14001 is currently undergoing another revision including the introduction of environmental indicators (NA 172 Normenausschuss Grundlagen des Umweltschutzes, 2013). It is expected to replace ISO14001:2004 as of 2015 (Wührl, 2013). The certification procedure follows the PDCA cycle that is described in more detail in Appendix 3.

### **3.1.2 EMAS**

EMAS was adopted as a European EMS in June 1993 by the European Council and was open for participation as of April 1995 (European Commission, 2013b). As of its first revision, EMAS II in 2001, firms and organisations of all sectors were eligible to be certified (EMAS, 2010b). The second revision, EMAS III, followed in 2010 and included, amongst others, the provision of environmental core indicators and it granted SMEs the possibility to request longer verification cycles (European Commission, 2013b; Geschäftsstelle des Umweltgutachterausschusses, 2010). In contrast to ISO14001, EMAS is a public regulation managed by the European Commission and its national bodies. It was adopted by more than 4,500 organisations in Europe by 2013 (European Commission, 2013c). EMAS is a more demanding and stringent EMS than ISO14001, and is known as “ISO Plus” since it includes the ISO14001 guidelines and develops them further (Bayerisches Landesamt für Umwelt, 2011; Zippel, 2011). The certification of EMAS also follows the PDCA-cycle and is accomplished by a professional who was accredited by a national Accreditation Body (Appendix 4).

### **3.2 Small and Medium sized Enterprises**

The European Commission gave the Recommendation 2003/361/EC of 6 May 2003 on how to define micro, small and medium sized enterprises:

*“The category of micro, small and medium-sized enterprises (SMEs) is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million” (European Commission, 2003).*

In the European Union (EU), “SMEs constitute 99% of companies . . .” and act as “. . . national economic engines” by contributing “. . . to more than half of the total value-added created by businesses in the EU” and employ approximately 133 million people (Abor & Quartey, 2010, p. 218; European Parliament, 2013, p. 1). There are various action plans existing or under development to facilitate e.g. the access to finance for SMEs or to support the firm’s competitiveness in general as has been accomplished by passing the “Small Business Act” in 2008 (European Parliament, 2013). These supportive measures provide crucial assistance for enterprises that have a different financial and structural point of departure, posing numerous challenges to their “. . . performance, growth and development” and consequently to the introduction of an EMS (Appendix 5) (Angela, 2011, p. 431).

### **3.3 German Framework Conditions**

In 2010 there were approximately two million enterprises in Germany classified as SMEs; this accounts for 99.3% of the overall number of firms in Germany (DESTATIS - Statistisches Bundesamt,

2013). SMEs in Germany<sup>7</sup> contribute to almost 52% of the total economic output and account for about 39% of the overall turnover of companies in Germany, which was approximately 1.91 trillion Euros in 2010 (Federal Ministry of Economics and Technology, n.d.). ISO14001 and EMAS are the most common EMSs in Germany (Kahlenborn & Freier, 2005). In 2011, 6,253 companies were certified with ISO14001 and in 2012 there were 1,206 entries of EMAS certified companies (CC) (EMAS, 2013; ISO, 2011). I chose the county of BW as my research site in Germany, which is further motivated in Appendix 9. BW does currently not support the introduction of ISO14001. However, due to a downward trend of EMAS, its lacking acceptance and its high requirements, the ministry decided to introduce funding for ISO14001 as of 2014 (Representative of the Ministry for Environment in BW, 2013). The introduction of EMAS is encouraged by financial privileges for EMAS CC (Appendix 6) and the programme *EMAS im Konvoi* (EMAS in convoy). This programme supports SMEs in conducting their eco-audit by allocating financial means via provider organisations to the companies (Ministerium für Umwelt Klima und Energiewirtschaft Baden-Württemberg, 2012). By working in groups under the guidance of a professional, the participants learn from each other and share experiences (Ministerium für Umwelt Klima und Energiewirtschaft Baden-Württemberg, 2012). The convoy-idea is not only appreciated for the introduction of the EMS: one firm stated that until today they accomplish the internal audit for EMAS together with a partner firm of the convoy (Fischer, 2013). Up to now, approximately 35 convoys with 230 participants were initiated (Ministerium für Umwelt Klima und Energiewirtschaft Baden-Württemberg, n.d.).

## **4 The Revolution from within: a Way past Modernity**

### **4.1 The Era of Modernity**

Modernity, as it will be used within this work, is the cultural and economic system that emerged in the early 19<sup>th</sup> century. It replaced “. . . traditional social forms. . . [with] industrial social forms . . .” (Beck, Giddens, & Lash, 1994, p. 2). This new time period was characterised by technology as an universal driver for innovation and for modernity itself, capitalism as the predominant paradigm, a more and more fragmented religion, the increasing importance of the individual, rational behaviour as replacement of emotions and science as an external entity, which was regarded as the highest form of knowledge (Brey, 2003; Merriam-Webster, n.d.-a; Szerszynski, 1996). Modernity needs to be separated from the process of modernisation, which is the general path traditional societies have taken to become modern societies and the conditions and forces that lead to this development (Offe,

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<sup>7</sup> The German definition of SMEs differs from the European one. It includes companies with up to 500 employees and up to 50 million Euros annual turnover (Federal Ministry of Economics and Technology, n.d.).

1996). Although separated, the process of modernisation has become closely linked with the changes induced by the industrial revolution and urbanisation movements of the West, which was the beginning of the era of modernity itself (Escobar, 2005). The mindset of modernity is dominated by the neoclassical belief that companies are rational actors making optimal choices by following their self-interest, which is to maximise profit (Söderbaum, 2008, p. 6). Adhering to the capitalist paradigm, this mindset complicates the pursuit for a sustainable long-term strategy and thus sustained competitiveness (Daly & Farley, 2011). It led to an alienation of nature, viewing the human subject as superior and as legitimate exploiter of the environment (Leonard, 1996; Szerszynski, 1996). Infinite throughput in a world with finite resources is impossible, instead, economics has to be considered as an open system (Söllner, 1997). Thoughts like that led to a critique of modernity that increased in the late 20<sup>th</sup> century and that condemned the lack of reality in economic theory reaching from gender inequalities over the idea of universalism to the ignorance of environmental issues (Daly & Farley, 2011; Mol & Spaargaren, 2000; Panayotakis, 2010; Stiglitz, 2002; Toffanin, 2011). These discontents led to the Green Revolution in the 1960s and '70s (Leonard, 1996). Ethical wake-up calls like Rachel Carson's *Silent Spring* (1962) or *The Limits to Growth* by Meadows, Meadows, Randers and Behrens III (1972) formed part of this movement and led eventually to a branching of modernity into different pathways (Walby, 2012). One of these directions focused explicitly on environmental challenges and responsibilities - the branch of EM.

## **4.2 Ecological Modernisation**

The discourse of EM started to be a dominating topic in politics around 1984 (Hajer, 1996). EM functions as intermediate connector between Ecology and Economics and as such does not fit with either approach to sustainable development (Young, 2000): neither weak sustainability, which “. . . assumes substitutability between natural and man-made capital” nor strong sustainability, which holds that “. . . certain forms of natural capital are critical and non-substitutable”, since it possesses attributes of both concepts (Jain & Jain, 2013, p. 116; Young, 2000). As such, EM is characterised by the belief that economics and ecology can be reconciled whereby eco-innovations play a significant role (Francis, 2011). Environmental concerns are integrated into the predominant political and corporate structures, making sustainability no opponent anymore, but the key (Francis, 2011). That stands in stark contrast to the authors voicing their opinions during the Green Revolution in the 1970s who demanded a break from industrial society achieved by either “. . . radical social change” or a “. . . legal administrative response” (Hajer, 1996, p. 248) Instead, procedural and technical innovation are perceived as remedies to the ecological crisis coupled with anticipatory policy-making that led to an elimination of end-of-pipe-solutions to the benefit of precautionary measures (Hajer,

1996). The most well-known uptake of the EM approach into the political realm has been by the Brundtland report *Our Common Future* in 1987 (Hajer, 1996). With pollution being framed as a matter of efficiency, clean technologies, procedures and payment schemes were introduced in the early 1990s (Hajer, 1996). Within the EM era, which in my opinion prevails until today, the “. . .key to the maintenance and increase of economic competitiveness” is environmental sustainability (Francis, 2011, p. 148). This creates a new competitive climate, rendering a company competitive by combining its business and environmental performance.

Although EM seems to be an advance compared to modernity, the approach also possesses serious flaws. One apparent critique of EM is that it does not question the paradigm of capitalism or the industrial production system itself (Lidskog & Elander, 2012; Mol & Spaargaren, 2000). A transformation of the structure of modernity is carried out in a weak manner as institutions inherent to the capitalist system are not on the agenda of change (Mol & Spaargaren, 2000). Furthermore, by transcending into the everyday political realm, environmentalism has been spread, but simultaneously diffused (Jamison, 1996). By that, EM has indeed lead to a “. . . real change in *thinking* about nature and society . . .” but it has also lost the former clout and fierceness of the original environmental idea (Hajer, 1996, p. 250; Jamison, 1996). EM also contradicts partly with sustainable development by taking a top-down approach, which is rather technocratic, to community involvement and by not relating to intragenerational equity (Hajer, 1995 as cited in Young, 2000). Because of these reasons, EM cannot be considered the optimal solution to the ecological crisis we are facing but it is rather a more advanced variation of modernity. EMSs, as tools of EM, might have the potential to lead from EM into a more advanced era, and thus to take a step into the direction towards a greener economic paradigm.

On the pathway to a greener economic paradigm, economy and ecology can only find a common ground by transforming the economy in incremental steps due to the mentioned reasons (see Chapter 1). This gradual transformation, starting with modernity and progressing via EM into a Postmodernity<sup>8</sup>, is a crucial process. To gain credibility and power is done best by using the tools of capitalism against its very own nature: the major weakness of the market, to strive for short-term profits, needs to be used to integrate environmental protection into corporate agendas. This transition will lead from the once radical environmentalism via the integration of mild environmentalism into everyday politics to a renewed radicalisation of these thoughts with one

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<sup>8</sup> I define Postmodernity as “of, relating to, or being a theory that involves a radical reappraisal of modern assumptions about culture, identity, history, or language”, an era we have in my opinion not yet reached (Merriam-Webster, n.d.-b).

difference: whereas the strong environmental demands in the 1970s were still coming from the exterior, a renewed radicalisation<sup>9</sup> of thoughts is now possible from within the system since the basic ideas have been integrated and rooted within the capitalist system. During this time, these ideas had time to mature and gain acceptance through their formalised and moderate design. The goal is to change the structures from within, which is launched by aligning the interests of businesses. Thus, the environmental ideas, likely belonging to strong sustainability by then, will rise above the institutions they were formed in, which will not be able to deny their legitimacy anymore.

### **4.3 Sustainability Science and Ecological Modernisation**

To deal with the complexity of finding a common ground for economics and ecology, Sustainability Science provides the interdisciplinary mindset that is needed to tackle this challenge. With its focus on the interaction of nature and society it shares characteristics with EM, which strives for a combination of environment and business (Francis, 2011; Kates et al., 2001). However, whilst EM tries to provide a solution within rigid structures, Sustainability Science uses more flexible approaches and frameworks on how to connect these different fields. In its attempt to understand and to change the character of the nature-society interaction, it constitutes the road that leads to a transition: a transition, not only into a green *economic* paradigm, but into a sustainable paradigm in general, encompassing every global trend that needs to change for that purpose (Kates & Parris, 2003). The vehicles chosen to guide us there can be of various natures, in this thesis, they take the form of EMSs. One of the “Core Questions of Sustainability Science” Kates (2001) formulated in his work, refers to these very mechanisms (p. 642): “How can today's operational systems for monitoring and reporting on environmental and social conditions be integrated or extended to provide more useful guidance for efforts to navigate a transition toward sustainability?” (p. 642). With this thought in mind, I have conducted a study that presents the weaknesses and strength of two EMS representatives. One of my aims is to contribute to an improved design of EMSs, so they can be integrated better and in a more accepted way into companies and pave the way for a change of mind from within.

Sustainability Science also encompasses the interactions of the global realm with local initiatives (Kates et al., 2001). The universal cross-border nature of both EMSs guarantees an implementation adhering to the same guidelines in different places. By focusing on producer responsibility, EMSs act as buffer to the growing multiple stresses on companies worldwide, as stricter regulation imposing imperative standards, the scarcity of resources and an increased responsibility on businesses

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<sup>9</sup> “Radicalisation” is used in the sense of “favoring extreme changes in existing views, habits, conditions, or institutions” and thereby providing the opportunity of change on all systemic levels (Merriam-Webster, n.d.-c).

themselves. By the introduction of EMSs, the private sector takes on the responsibility that was inflicted on it by the state in the era of EM. Certain tasks were outsourced due to the “. . . structural affinity between capital and the bureaucratic state . . .” (Jänicke, 1986 as cited in Mol & Spaargaren, 2002, p. 45) that hindered the introduction of “. . . significant preventive environmental policies . . .” (Mol & Spaargaren, 2002, p. 45). While voluntary measures as EMSs might have an advantage on a national level, in particular regarding SMEs, it might be a fallacy to apply such a voluntary approach internationally. When governments, multinational companies or international organisations are concerned, binding measures might be needed because vested interests are likely to eliminate every spark of voluntary, self-motivated actions. Furthermore, developing countries have to be included into the calculations. Since the implementation of EMSs can be too costly even for firms in industrialised countries, either a less expensive alternative needs to be developed or a whole different approach. By optimising the products and processes right from the start, sunk costs and unnecessary investments can be avoided.

## **5 Measuring Competitiveness: Porter’s Diamond**

After having established that in the present-day era of EM the key to economic competitiveness is environmental sustainability, the framework for measuring competitiveness needs to be introduced. Porter was searching for the reasons why some companies were able to obtain a competitive advantage and sustain it and others could not, although they were faced with the same conditions at first glance (Porter, 1991). Solving this enigma would provide him with a theory for strategy explaining why firms fail or succeed. In his “Theory of Strategy”, which I will briefly discuss in the following, Porter first dissembled the decisive external and internal aspects of a firm: industry structure and the firm’s activities (Porter, 1991, pp. 99–104). Afterwards the firm’s “proximate environment” will be evaluated, which is presented by the four categories of the diamond (Porter, 1991, p. 111).

### **5.1 Porter’s Theory of Strategy**

Porter draws some of his thoughts from organisational economists and thus considers the industry as the “. . . central focus of strategic attention” (Hax, 2010, p. 207). The characteristics of the industry structure are according to Porter’s framework the best explanations for variance in a firm’s performance (Hax, 2010). In his work, Porter does not share the thought of the early competitive strategy perspective where industry structure is completely exogenous and instead argues that it “. . . is partly exogenous, and partly subject to influence by firm actions” (Porter, 1991, p. 100). If that

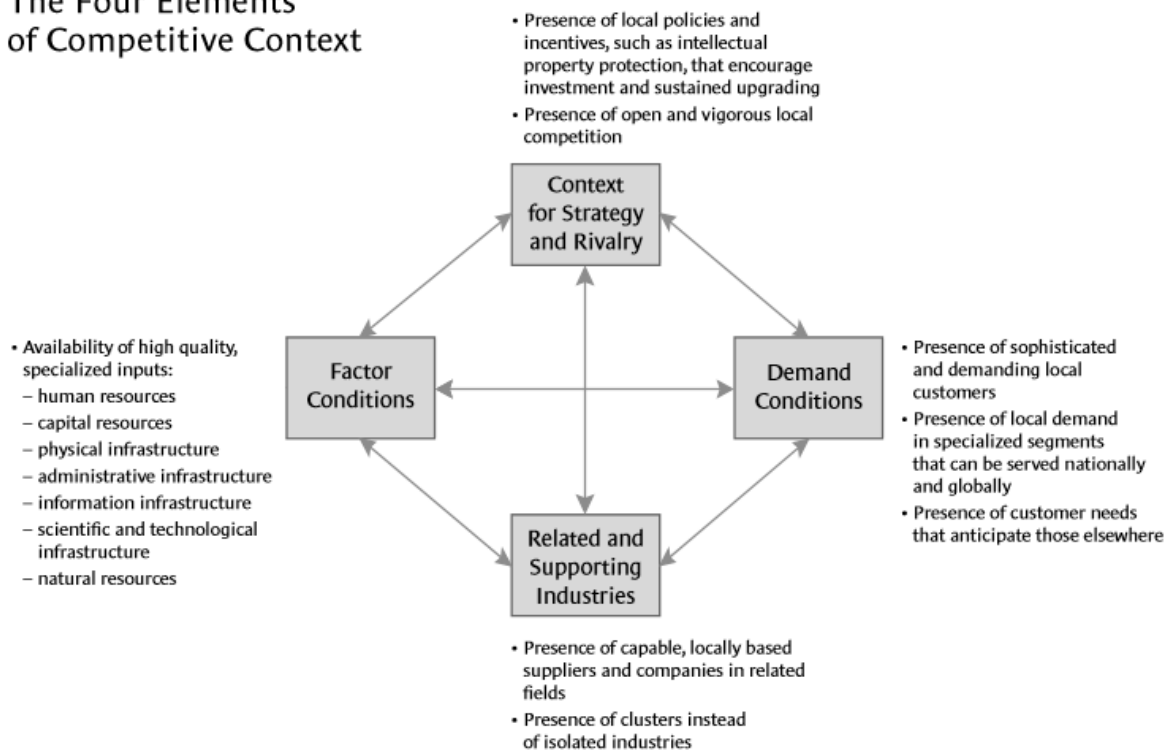
industry structure, however, is held constant, then a firm possessing an attractive position relative to its rivals obtains a competitive advantage (Porter, 1991). According to Porter (1991), this attractive position can only be achieved in two ways: either by “lower cost than rivals, or the ability to differentiate . . .” (p. 101). The strategy of a company defines how activities in the firm are interrelated in response to the industry structure (Spanos & Lioukas, 2001). These “discrete activities” are Porter’s basic units of competitive advantage and are the units that are responsible for using the firm’s resources efficiently (Porter, 1991). By stating that, Porter takes position on the resource-based view of the firm. This view is held by a second school that developed in response to the competitive strategy perspective, advocated by Porter, which focuses on resources of a firm as the sole source of competitive advantage (Hax, 2010). According to Porter, resources have an “. . . intermediate position in the chain of causality” because they are acquired by activities and have their origin outside of the firm (Porter, 1991, p. 108). Furthermore, he argues that the competitive value of resources internal to the firm can be increased or eliminated by changes in exogenous factors, the environment, as the ones he presents in his Diamond framework. For a further discussion about the general external business environment, please refer to Appendix 7.

## **5.2 Porter’s Diamond as Conceptual Framework**

This framework was initially designed in Porter’s book *The Competitive Advantage of Nations*, which was first published in 1990 (Porter, 1990). Porter presented four categories equalling the proximate environment of the firm that were declared as the most influential determinants to spur innovation and thus competitiveness (Porter, 1991) (see Figure 3):



## The Four Elements of Competitive Context



**Figure 3: Porter's Diamond. (Porter & Kramer, 2002, p. 60).**

These four categories “. . . shape the information firms have available to perceive opportunities, the pool of inputs, skills and knowledge they can draw on, the goals that condition investment, and the pressures on firms to act” (Porter, 1991, p. 111). Visualised by the numerous arrows, the interconnectedness and mutual influence of the factors is emphasised. Additionally to the four shown categories, *Chance* and *Governance* were introduced as factors influencing competitiveness indirectly.<sup>10</sup> Porter describes the diamond as a dynamic system where the effect of one category always depends on the state of others. This explains why a disadvantage in certain factors can lead to innovation in some countries and to a decline in others (Porter, 1991). The categories are mutually reinforcing, as e.g. rivalry stimulates demand and supporting industries (Porter, 1991). Firms that gain competitive advantage only on basis of one category build on a very unstable environment: to develop sustained competitiveness “. . . requires the interaction of favorable [sic!] conditions in several of the determinants . . .” (Porter, 1991, p. 114).

The Diamond framework has been an often used tool whenever Porter consulted governments or helped drafting a company's strategy improving its competitiveness (Fathollah, Aghdaie, Seidi, &

<sup>10</sup> I have not included these two categories in the visualisation of the diamond because of simplicity reasons.

Riasi, 2012; Harvard Business School, n.d.). What has been neglected in this conventional framework, are the societal and environmental implications for the competitiveness of business-as-usual operating companies. Porter and Kramer (2011) have taken this idea forward by introducing their framework on Shared Value. This framework is as such very similar to EM, but differs in that its goal is not redistribution, exemplified by the functioning of EMSs, which increase efficiency by decreasing the environmental impact, but rather an improvement of the situation as a whole (see Appendix 8). The authors furthermore speak out against environmental regulation in form of command-and-control mechanisms and point towards standards, support for innovative technologies and phase-in periods (Porter & Kramer, 2011).

To conclude, competitive advantage according to Porter is gained in two major ways: First, PsD presents the environment of a firm, which presents the greatest influences on a firm's ability to innovate, leading, according to Porter and Linde (1995), to competitiveness. Second, if the external industry structure is held constant the competitive advantage is determined by the internal activities of the value chain, being linked to the Shared Value framework (Porter & Kramer, 2011; Porter & Linde, 1995). However, Porter (1991) stresses that the configuration of activities and thus the value chain is determined by the strategy, and the strategy is part of one of the categories of the Diamond. Since the Diamond seems to include the most important determinants for gaining a competitive advantage, I will assess the competitiveness of my samples on the basis of its categories. The competitiveness, in this case, consists of the combined business and environmental indicators and various other performance measures that were included in the survey.

## **6 Results and Discussion**

In this chapter, I will first discuss my response rates and second assess the implications the EMSs had for the business performance of the SMEs, followed by the environmental performance. In a third step, these two performance sets will be combined in PsD to assess the overall competitiveness. Finally, the potential of EMSs for leading to a transition will be assessed.

My gross response rate amounted to 39% for ISO14001 CC and to 33% for EMAS CC. The net response rates were higher with  $17/(44-15)=59\%$  for ISO14001 CC, and 43% for EMAS CC, which was calculated by  $9/(27-6)$ . With regard to my results, the lower response rate of EMAS can only be explained by a lack of interest on behalf of the firms or absent environmental managers. It cannot be attributed to a lower employee number since the majority of EMAS CC employed 11-50 employees,

as do ISO14001 CC. It can also not be due to less staff employed in quality management and environmental protection because EMAS involves the personnel of a firm much more than ISO14001, being one of its main distinctions. Thus, the low response rate for EMAS seems to be a random outcome.

**6.1 Business Performance**

*SQ 1: How did the business performance develop after the introduction of the EMSs?*

**6.1.1 Comparison and Discussion of Results**

**Table 1. Differences in percentage points between ISO14001 and EMAS responses for business indicators. Given in weighed form and in absolute values.**

	Increased significant ly 0.35	Increased slightly 0.15	Decreased slightly 0.15	Decreased significant ly 0.35	Sum of results
Acquisition of new customers		0.3			0.3>0
Revenues		5.7			5.7>0
Revenue per customer		2.25	1.65		2.25>1.65
Awareness of company/products		0.45			0.45>0
Profit		4.8	0.9		5.7>0
ROI		2.4	1.8		4.2>0
Product quality	3.85	7.35			11.2>0
Costs	2.1	1.35	0.3	2.1	2.1<3.75
Sales volume		3.15			3.15>0
Return on sales		2.25	0.9		3.15>0
Process and time efficiency	7.7	3.9	2.7		14.3>0
Employee morale	11.55	4.8			11.55>4.8

Better results for ISO14001

Better results for EMAS

Table 1 presents the weighed differences in percentage points between EMAS and ISO14001 respondents (please refer to Appendix 14 for the plain differences without weighting). EMAS CC display more significant changes into the desired direction than ISO14001 CC for every business variable except *Acquisition of new customers* and *Costs*. Thus, the stricter regulation seems to lead to better results for business indicators. The better outcomes of ISO14001 CC for *Acquisition of new customers* could be attributed to ISO14001 being “. . . adopted at a much larger scale than EMAS” in Europe, resulting in it being the more widely recognised EMS (Neugebauer, 2012, p. 250; Representative of the Ministry for Environment in BW, 2013). Although *Costs* display a great variance, the better findings for ISO14001 CC could point to less bureaucracy and less strict environmental standards, which may result in fewer expenses for external consulting, less time needed for audits and less expensive improvements due to the lesser requirements.

The highest differences between ISO14001 CC and EMAS CC are in *Process and time efficiency* (14.3), *Product quality* (11.2) and *Employee morale* (6.75) (see Table 1). The following quoted values can be looked up in Appendix 12 for ISO14001 and in Appendix 13 for EMAS related responses.

41% of ISO14001 respondents noticed a slight increase in *Process and time efficiency* and the same percentage of respondents stated that the variable remained unchanged. However, 18% of ISO14001 respondents felt that the variable decreased. That is in strong contrast to EMAS, where 33% of the respondents felt a significant increase of *Process and time efficiency* and 44% still voted for a slight increase. Thus, EMAS CC outperformed ISO14001 CC by 14.3 percentage points (weighed). Although some EMAS respondents mentioned the EMAS documentation being more extensive and its higher level of bureaucracy, *Process and time efficiency* displayed better results under EMAS conditions. This is likely due to the inclusion of all employees into the EMS implementation, leading to competent replacements in case of absence of the environmental manager, shorter communication times because the knowledge about the EMS is already existent and a higher probability for further improvements because this innovative input can originate from all staff levels (see Table 5).

With regard to *Product quality*, similar patterns can be detected. Whereas the variable remains mostly unchanged with 71% and increases slightly for 29% of ISO14001 respondents, 78% of EMAS respondents felt a slight increase and 11% even a significant one. *Product quality*, which presented better outcomes under an EMAS certification, can be likely attributed to EMAS being site specific and

not organisation specific like ISO14001.<sup>11</sup> I assume that *Product quality* only increases significantly when all the production facilities in the organisation are certified and improved. However, there are also ISO14001 certified firms with only one site, where this argument is not applicable. Another explanation for the better results of *Product quality* would be the *continuous* improvement of environmental performance under EMAS, which also leads to a continuous improvement of quality standards.

For *Employee morale*, EMAS CC experienced a significant increase of 33%, whereas there is no significant increase for ISO14001 firms at all. This development for EMAS could be due, again, to all employees being included in the implementation, transformation and later responsibility for the EMS. Another explanation could be that due to 32% slightly increased profits for EMAS, the salaries have been raised, as well. Finally, linking it to the results of the environmental indicators, EMAS performs better in *Health of employees*, which is also likely to have an impact on *Employee morale*.

### **6.1.2 Assessment of Indicator Changes**

The introduction of ISO14001 and EMAS either improved the business indicators, or did not influence their development, which was true for both EMSs. For ISO14001, one variable improved and 11 indicators presented no changes.<sup>13</sup> The result was better for EMAS with five improved variables and seven indicators remaining unchanged. There was no variable that was impeded by the introduction of either EMS.<sup>12</sup>

### **6.1.3 Discussion of Improvement Goals**

When asked which business indicators they wanted to improve by the introduction of EMAS, the respondents rated *Cost reduction* first, *Employee morale* second and *Process and time efficiency* third (see Figure 4). As discussed above, *Employee morale* increased by 77%; this means the goal to improve this variable has been reached.<sup>13</sup> The same can be said for *Process and time efficiency* with 89% of respondents selecting the favourable two categories. *Costs*, in contrast, have decreased only by 22% and even increased for 44% of the respondents, meaning this goal has been missed.

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<sup>11</sup> Whereas firms can use their ISO14001 certificate for all sites although only one has been assessed, EMAS is site specific, which means that the certification status of one site is not transferrable to others.

<sup>12</sup> A variable is considered as impeded when >50% of the respondents have either selected increased slightly and increased significantly or decreased slightly and decreased significantly, depending on the undesired outcome of the variable (from the standpoint of the firm).

<sup>13</sup> The goal is considered to be reached when >50% of the respondents have either selected increased slightly and increased significantly or decreased slightly and decreased significantly, depending on the desired outcome of the variable (from the standpoint of the firm).

Therefore, two of three improvement goals were clearly met for over 50% of EMAS respondents. For these two variables, EMAS outperformed ISO14001.

ISO14001 respondents rated *Employee morale* first and *Cost reduction* and *Acquisition of new customers* second (see Figure 4). *Employee morale* has seen a slight increase for 76% of the respondents, meaning that this goal has been clearly met. For *Costs*, the firms stated a 41% increase and a 30% decrease, a rather ambiguous result that cannot be considered an improvement. *Acquisition of new customers* has seen a slight increase of 35%, which is not sufficient to satisfy the goal. Only one of the three improvement goals could be reached for over 50% of the ISO14001 respondents, whereby EMAS performed better for this variable.

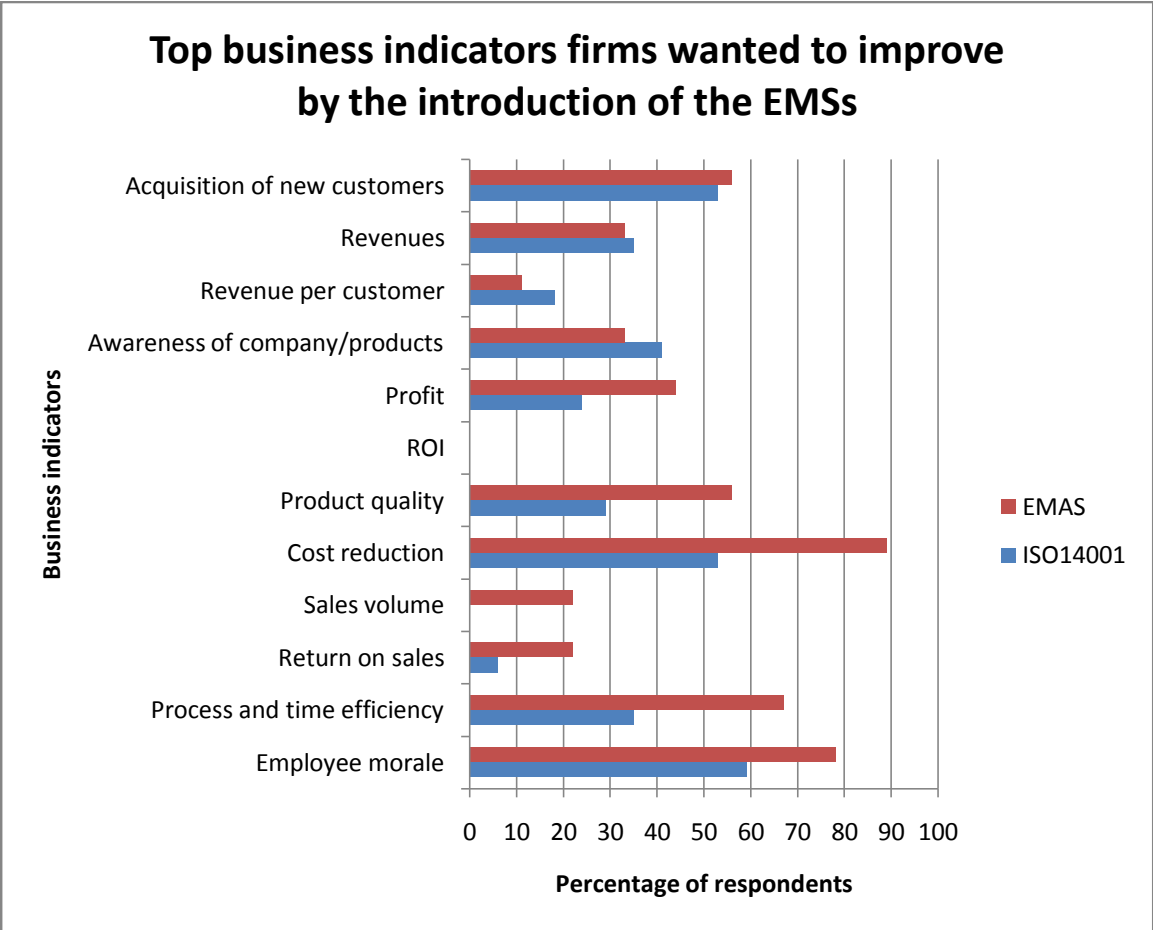


Figure 4. Top business indicators firms wanted to improve by the introduction of the EMSs.

To conclude, the overall business performance was better for EMAS: it outperformed ISO14001 with 10 indicators displaying better results, presented four more variables that improved through the introduction and met two of three improvement goals.

## 6.2 Environmental Performance

SQ 2: How did the environmental performance develop after the introduction of the EMSs?

### 6.2.1 Comparison and Discussion of Results

**Table 2. Differences in percentage points between ISO14001 and EMAS responses for environmental indicators. Given in weighed form and in absolute values.**

	Increased significantly 0.35	Increased slightly 0.15	Decreased slightly 0.15	Decreased significantly 0.35	Sum of results
Resource use		1.65	0.6	1.75	2.25>1.75
Waste reduction	2.1	3.6	3.75	15.4	21.1>3.75
Emission output	2.1	1.65	3	7.7	12.8>1.65
Energy efficiency	7.7	7.2	6.6		13.8>7.7
Costs of regulation				2.1	2.1>0
Health of employees		1.35		2.1	3.45>0
Quality of living for residents		1.5			1.5>0
Use of recycled material	1.75	1.2	1.65	2.1	3.85>2.85
Environmental incidents			2.85	5.25	2.85<5.25
Emergency Preparedness	1.75	1.35	1.65	2.1	3.85>3
Transparency of env. policy	1.05	3.9			1.05<3.9

Better results for ISO14001

Better results for EMAS

It can be observed in Table 2, that the development of the environmental indicators is almost equally good for both EMSs (please refer to Appendix 17 for the plain differences without weighting). EMAS displays better results in six of 11 variables, which is due to it having more variables that scored in a significant category. Although slight changes were dominant for ISO14001, it still outperformed EMAS in five indicators.

The highest differences between ISO14001 CC and EMAS CC are in *Waste reduction* (17.35) and *Emission output* (11.15). The following quoted values can be looked up in Appendix 15 for ISO14001 and in Appendix 16 for EMAS related responses.

Whereas *Waste reduction* increased for 30% of ISO14001 respondents, it did not increase at all according to EMAS respondents. In fact, there was a significant decrease of 44%. Thus, the variable presents a better outcome under an ISO14001 certification. However, the negative wording might have led to wrong interpretations of the variable, explaining the differing results (see Chapter 2.4).

With regard to *Emission output*, the 6% that increased significantly for ISO14001 CC seem to present an outlier. The inclination is rather towards the category *decreased slightly* with a respondent percentage of 24%, whereby most of the firms observed no change at all. For EMAS, the tendency is also towards a decrease with a combined percentage of 66%. Thus, EMAS certified SMEs were able to reduce their emissions on a greater scale than ISO14001 CC. However, to reduce the emissions was only for about 55% of respondents of both samples considered a goal of the implementation and does hence not support a convincing argument for the introduction of an EMS (see Figure 5).

Highly surprising is that the change in *Transparency of environmental policy* is higher for ISO14001 CC with 100% of respondents that observed an increase, compared to only 77% of EMAS respondents. The lack of transparency is one of the major flaws of ISO14001 and in stark contrast to EMAS that includes much higher reporting standards (Marsh, 2012). Thus, this result can only be explained by a differing perception of the concept of transparency for the respondents in ISO14001 and EMAS CC. Another unexpected result is the decrease in *Energy efficiency* for 56% of EMAS respondents. One explanation could be that external business influences have higher negative impacts on some SMEs than on others. An example would be higher energy prices that cannot be outweighed by the savings gained through the EMS. The differences between SMEs of the same sector could be explained by some SMEs having more energy intensive production processes than others, even after an efficient re-structuring of the firm.

ISO14001 CC outperformed EMAS CC mainly in the use of natural resources (waste, energy, resource use), which might initially point towards a better process efficiency. This is, however, disproved by the results presented in Table 1. The result could also be due to more innovations in ISO14001 CC or firms being situated predominantly in clusters, but is, again, disproved (Tables 5 and 6). Another possibility might be a slightly more inaccurate and/or more subjective measurement of these indicators in ISO14001 CC. The reason therefore could be that ISO14001 does not provide universal



core environmental indicators for the measurement of the changes in environmental indicators as EMAS does as of the introduction of EMAS III. Finally, the resource efficiency could be better for ISO14001 because ISO14001's less strict design leaves more room for improvements, whereas EMAS might already have a slight tendency towards command-and-control-mechanisms. There is also the possibility of the respondents selecting the wrong category unintentionally but I believe that this happening can be marginalised, as well as that the unclear formulation whether to state "absolute" or "relative" values had a major influence (see Chapter 2.4).

### **6.2.2 Assessment of Indicator Changes**

The introduction of the EMSs mostly improved the environmental variables or did not change their performance. For ISO14001, five of 11 variables improved and six indicators experienced no changes. EMAS also improved five of 11 variables, but only four variables stayed the same. The remaining two variables, *Waste reduction* and *Energy efficiency*, presented an exception since they both decreased for over 50% of the firms and were thus impeded in their desired development by the introduction of EMAS. This might point to a serious flaw of stricter regulation and will be discussed in the end of this chapter.

### **6.2.3 Discussion of Improvement Goals**

When asked which environmental indicators the SMEs wanted to improve by the introduction of EMAS, the respondents rated *Resource use* and *Energy efficiency* first and *Waste reduction* and *Health of employees* second (see Figure 5). 89% of EMAS respondents stated that the *Resource use* decreased slightly or significantly, and although 11% also stated it increased slightly, the goal of resource reduction has been reached. For *Energy efficiency* the goal has not been reached with over 50% of respondents stating that the variable decreased slightly. Sixty-six percent of respondents selected either *slightly* or *significantly decreased* for *Waste reduction*, which is an unfavourable result for the SMEs from an economical standpoint. The last variable, *Health of employees*, has seen a slight increase for 33% of respondents, which is a good tendency but below 50% of the respondents. To conclude, only one of four improvement goals has been reached for over 50% of the EMAS respondents and for this goal of *Resource use* they were outperformed by ISO14001 CC.

For ISO14001 CC, the main environmental variables that respondents desired to improve were *Waste reduction* on the first place and *Resource use*, *Energy efficiency* and *Health of employees* on the second place (see Figure 5). Although *Waste reduction* has increased for 30% of the respondents it also has decreased for 47%; this leads to the conclusion that this goal has not been reached.

Resource use has declined with 88%, which is a clear improvement. Although Energy efficiency has slightly declined for 12% of the respondents it has also slightly increased for 59%, which is a positive outcome. Finally, Health of employees has only increased for 24% of the respondents, being not sufficient to be counted as a great improvement. Thus, over 50% of the ISO14001 respondents have reached two of four goals in which they also outperformed EMAS.

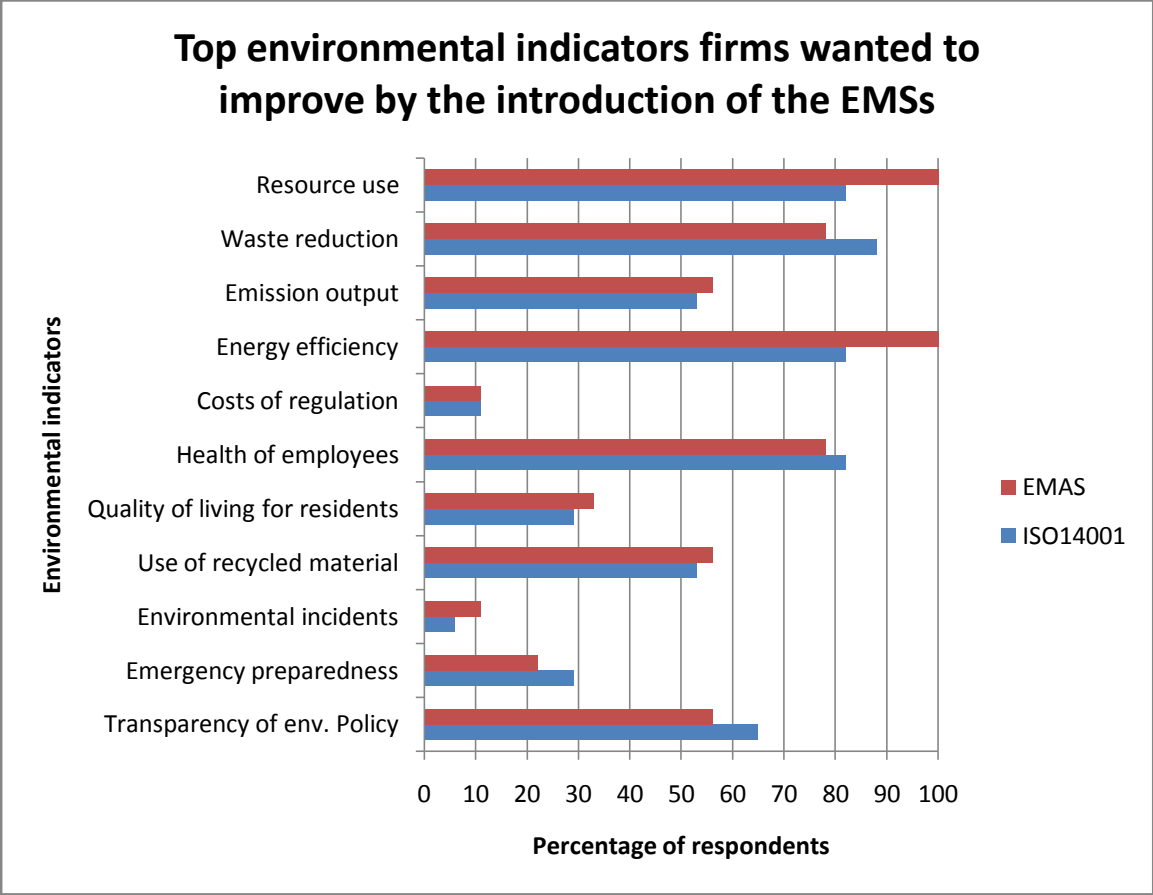


Figure 5. Top environmental indicators firms wanted to improve by the introduction of the EMSs.

The results of the environmental indicators are less clear than the ones for the business indicators. ISO14001 and EMAS CC performed almost equally well, although some results like transparency and energy efficiency seemed unusual and require further research complemented by in-depth interviews. To conclude, stricter regulation does not lead to greater changes in environmental performance than less strict regulation, which can attribute much to the current discussions about policy design. However, this result can also be due to different pre-conditions: EMAS certified firms might have had a better environmental status quo already before the introduction of EMAS, since it is possible to be ISO14001 certified before. But according to the survey, only one respondent of the EMAS sample had introduced ISO14001 before the company chose to introduce EMAS.

To conclude, the environmental performance presents mixed results for both EMSs with a tendency to prefer ISO14001 over EMAS. Although EMAS slightly outperformed ISO14001 when comparing the indicators after the introduction in Table 2, and both EMSs improved the same number of variables, EMAS might also be the reason for the worsening of two indicators. Furthermore, ISO14001 satisfied more improvement goals than EMAS did.

### 6.3 The external Business Environment

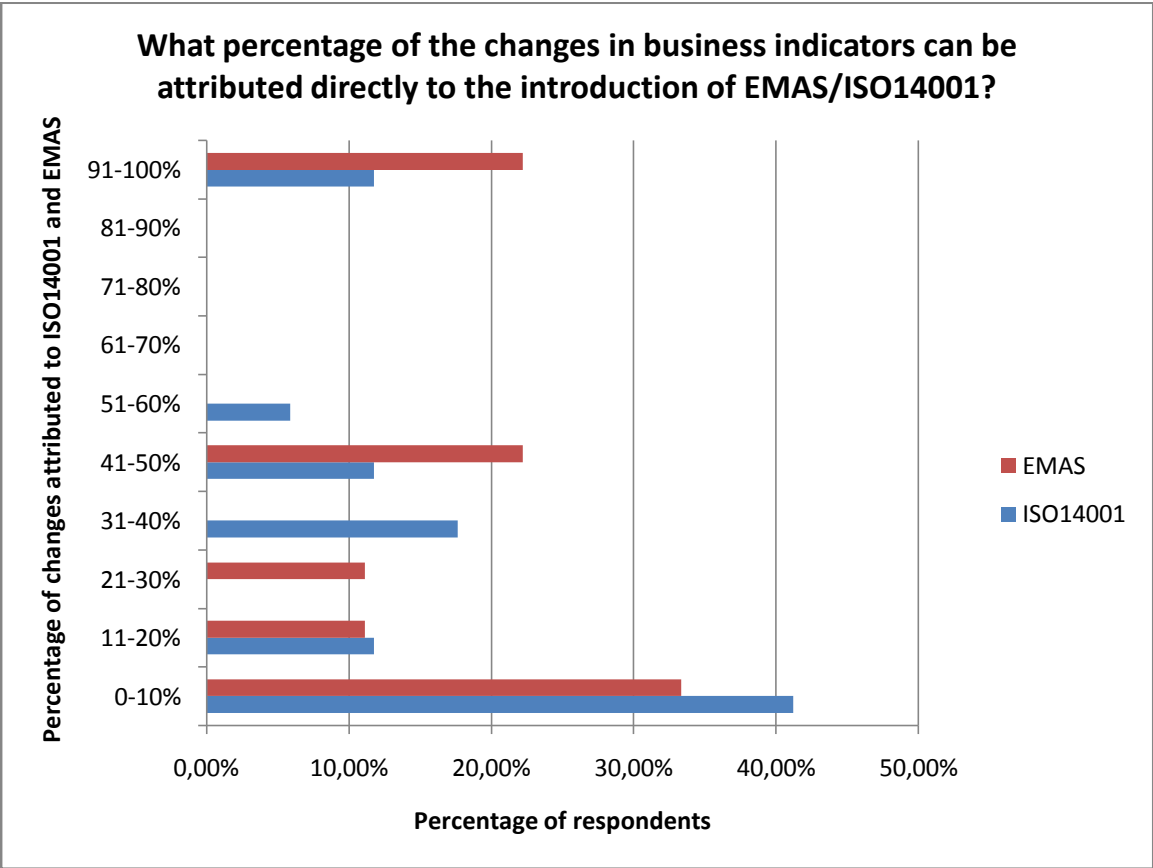


Figure 6. Responses to the question: "What percentage of the changes in business indicators can be attributed directly to the introduction of EMAS/ISO14001?".

As can be seen in Figure 6, most of the respondents for EMAS and for ISO14001 stated that the actual implementation of the EMS plays only a very small role when considering the changes in business indicators. Although there are some respondents who stated that 90-100% of the changes were due to the EMS, the median is quite low with 21-30% for EMAS CC and 11-20% for ISO14001 CC. This shows that the validity of the measure is quiet low, which does not necessarily apply only to the indicators used in the survey but also to the ones used firm-internally to measure these changes. Therefore, the changes in business indicators are mostly due to the external environment. The

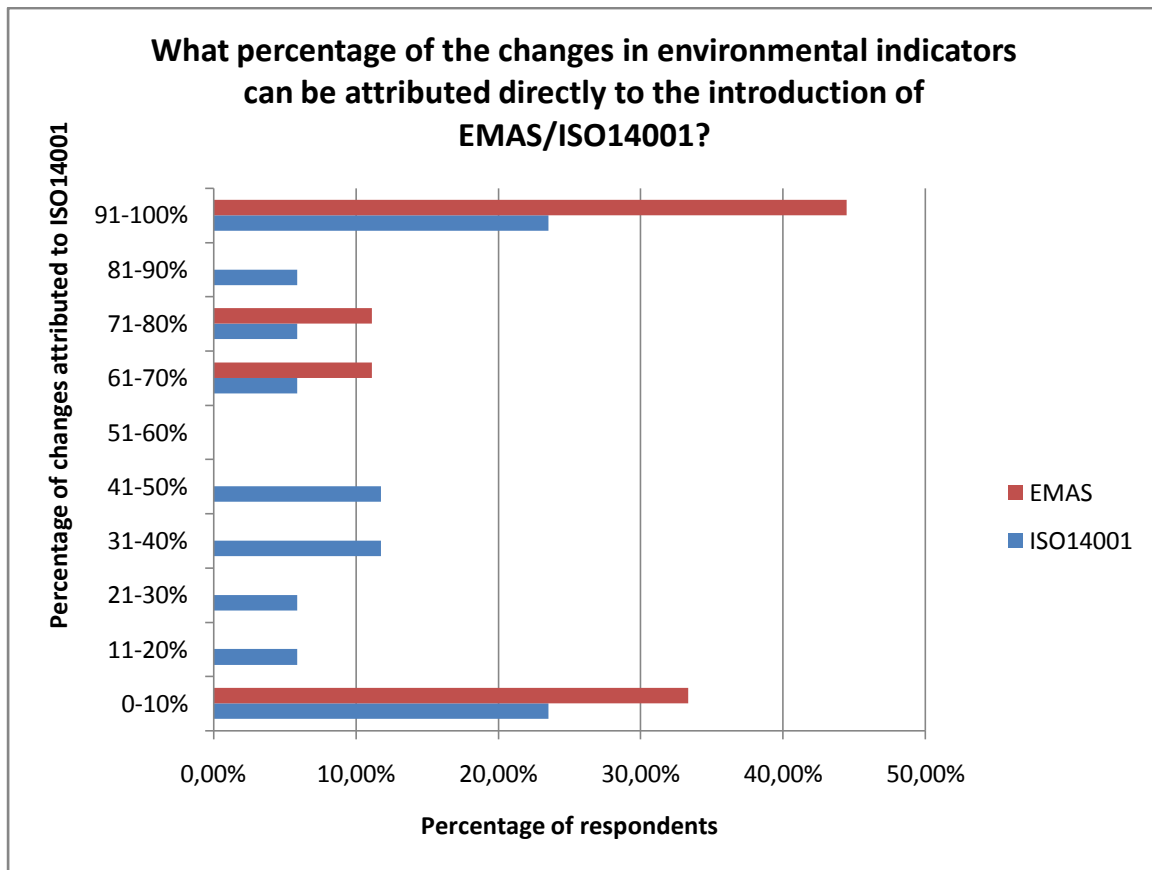
following causes were provided in the comments and include task environmental factors as well as general environmental factors:

- General economic situation (sector, country etc.)
- Restructuring of firms and new managing directors who focus on sustainability
- Competition in Asian markets and cost pressure of global players
- Higher sales due to an increased quantity of orders

Within the scope of the thesis there was no possibility to extract data that excludes external influences. What I could account for, was that firms of one sector are mostly similarly affected by e.g. foreign competition, economic downturn etc., which is why I concentrated on the metal production and basic metals and fabricated metal products sector. Furthermore, I tried to account for a stimulating environment with regard to the uptake of new technologies, which was attempted to achieve by the choice of BW as my research site.

None of the EMSs possesses official business core indicators. That signifies that the definite *composition* of each indicator cannot be determined, e.g., which percentage of the revenues is due to the employee morale that was improved by the EMS and which percentage is due to fiercer competition. That poses not only an obstacle to cross-sector benchmarking but also hinders transparency and thus the communication of the real potential of the EMSs.

As for the business indicators, the influence of the EMSs on the changes in environmental indicators has been assessed:



**Figure 7. Responses to the question: “What percentage of the changes in environmental indicators can be attributed directly to the introduction of EMAS/ISO14001?”.**

As can be seen in Figure 7, over 40% of EMAS respondents and over 20% of ISO14001 respondents voted for the category 90-100%, which may be due to the environmental indicators being less influenced by the external environment. In general, the distribution has changed towards more indicator changes being explained by the introduction of the EMSs, than was the case for the business indicators (Appendix 18). Furthermore, the better results for EMAS could be explained by the environmental core indicators that facilitate the monitoring of environment related developments (EMAS, 2010a). However, some uncertainty remains and the high variance, in particular for ISO14001 CC, adverts to individual company conditions as explained in the comments, when asked why the EMS does not account for 90-100% of the changes:

- Environmental measures were only introduced step-by-step due to high costs
- The company had already a distinct environmental consciousness before the introduction of the EMS

Growth was stated as a general influence and one respondent indicated the necessity to calculate with relative figures, supporting my assumption in Chapter 2.4.

I would like to remind the interested reader that the obtained results present only the *change in performance* an EMS can bring about after its introduction, not the *status quo* of the firm. Because of that, I feel obliged to note that an ISO14001 certified company can nevertheless have a better business performance than an EMAS certified firm although its changes in performance were lower. And even though the results for the business indicators in EMAS certified SMEs were more distinctive, this might only point to EMAS CC starting from a lower business base level than ISO14001 CC and thus having more to revise. If, however, the companies have approximately the same status quo before the introduction of an EMS and they implement EMAS and ISO14001 respectively, then the probability of an EMAS certified firm to have better business-related results and thus in general a better business performance within three years after the certification is much higher. My research was directed at the question which EMS enhances the competitiveness of a small and medium sized enterprise (SME) best, not which SME is the most competitive. This depends on the individual starting point of the SMEs.

To assess the overall competitiveness of the EMSs, consisting mainly of the business and environmental indicators, all relevant survey responses will be connected to PsD in the following chapter.

#### **6.4 Evaluation of Competitiveness**

In the following, the third SQ will be answered:

*SQ 3: Which EMS enhances the competitiveness of the SMEs best and what are the implications for EM and the transition to a greener economic paradigm?*

First, I will evaluate how ISO14001 and EMAS influence the competitiveness of the chosen SMEs by listing the six categories Porter gives in his Diamond framework and allocate the questions of the survey accordingly. The majority of the values compared are the means of the business and environmental indicators.<sup>14</sup> The cells that are highlighted in green determine which EMS enhances the competitiveness of the firm best with regard to the according variable. Second, a discussion will follow about the potential these EMSs have, to pave the way for a transition to a greener economic paradigm.

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<sup>14</sup> I have chosen to use the mean since it presents a more objective measure than the weighed performance. However, I have compared the results I would get with the mean with the results that I would get with the weighed values and they were the same.

### 6.4.1 Factor Conditions

As can be seen from the sums at the bottom of each resource in Table 3, ISO14001 outperforms EMAS in *Natural resources*, which has been already observed in Table 2. However, with 12 of 19 variables, EMAS increased the probability of a firm gaining a competitive edge in this category most.

**Table 3. Factor conditions.**

Determinant	ISO14001	EMAS
<i>1. Human and knowledge resources</i>		
When EMS introduced? <sup>15</sup>	Mean: 2008	Mean: 2003
Qualified graduates	ISO14001 is predominantly taught system.	Do often not deal with EMAS in apprenticeships.
Employee morale	2.235	1.889
Health of employees	2.882	2.667
Existence of supported partner programmes with other certified firms.	-	+
	1/5	4/5
<i>2. Natural resources</i>		
Waste reduction	3.118	4.111
Use of recycled material	2.588	2.556
Resource use	3.941	3.889
Emission output	3.118	3.778
Energy efficiency	2.529 Median: 2 (very high variance)	3.000 Median: 4 (very high variance)
	3/5	2/5
<i>3. Capital resources</i>		
Revenues	2.824	2.444
Revenues per customer	2.824	2.778
Profit	2.824	2.444
ROI	3.059	2.778
Costs	2.882 Median: 3 (very high variance)	2.778 Median: 3 (very high variance)
Prevented costs of regulation	3.118	3.000
Sales volume	2.882	2.667
Return on sales	2.882	2.667
Has the break-even-point been reached?	Yes: 53% No: 47%	Yes: 50% No: 50%
	3/9	6/9
	<b>7/19</b>	<b>12/19</b>

<sup>15</sup> The longer the EMS has been introduced, the greater the knowledge of certain procedures as e.g. reporting and the better the experience with the system.

### 6.4.2 Demand Conditions

As can be seen in Table 4, ISO14001 obtains the competitive edge in this category, which might be due to better marketing strategies since more customers noticed the certification, which was observed in the survey. Due to the clients also placing a greater value on this certification, the combination of these factors is favourable for ISO14001. This furthermore leads to a higher acquisition of new customers.

**Table 4. Demand conditions.**

Determinant	ISO14001	EMAS
Did your customers take notice of your certification?	Yes: 94% No: 6%	Yes: 78% No: 22%
Customers are indifferent to a certification	Agree and agree fully: 33% Don't agree and don't agree at all: 67%	Agree and agree fully: 50% Don't agree and don't agree at all: 50%
Acquisition of new customers	2.647	2.667
Awareness of company/products	2.588	2.556
Do you use the certification actively for your marketing?	Yes: 88% No: 12%	Yes: 89% No: 11%
Transparency of environmental policy	1.588	1.778
Quality of living for residents	2.882	2.778
	<b>4/7</b>	<b>3/7</b>

### 6.4.3 Firm Strategy, Structure and Rivalry

ISO14001 CC seem to have more influential rivals than EMAS CC as observed in Table 5. According to Porter, competition is essential to stimulate the competitiveness of a firm and thus rather an advantage than a disadvantage when responded to in the right way (Porter, 1991). However, for the overall category, EMAS clearly increases the probability of a competitive edge.

**Table 5. Firm Strategy, Structure and Rivalry.**

Determinant	ISO14001	EMAS
Product quality	2.706	2.000
Process and time efficiency	2.765	1.889
Environmental incidents	3.765	3.889
Emergency preparedness	2.471	2.444
Has the business performance in total improved? <sup>16</sup>	Yes: 35% No: 24% Stayed the same: 41%	Yes: 50% <sup>17</sup> No: 0% Stayed the same: 50%

<sup>16</sup> Business performance here consists only of the comparison of business indicators.

<sup>17</sup> Half of these 50% are responses that were given as comments and not as a clear "yes", "no", or "stayed the same". I chose to interpret these two answers as "yes" since there were improvements in the business performance visible for the two firms that commented.



Has the environmental performance in total improved? <sup>18</sup>	Yes: 88% No: 0% Stayed the same: 12%	Yes: 89% No: 0% Stayed the same: 11%
How important was the fact that a competitor got certified for your decision to implement an EMS?	Important and very important: 59% Neutral: 29% Not important and not important at all: 12%	Important and very important: 22% Neutral: 44% Not important and not important at all: 33% <sup>19</sup>
To which extend did the introduction of the EMS lead to innovations? <sup>20</sup>	Mean: 3.5	Mean: 3.0
	<b>1/8</b>	<b>7/8</b>

#### 6.4.4 Related and Supported Industries

Being situated in cluster regions or even participating in founding a cluster does not necessarily mean that the certification has an influence on the formation of clusters but these companies certainly have a greater competitive advantage. This is the case for EMAS CC as presented in Table 6.

**Table 6. Related and Supported Industries.**

Determinant	ISO14001	EMAS
Is your company situated in a cluster region?	Mean: 3 <sup>21</sup>	Mean: 1.521
	<b>0/1</b>	<b>1/1</b>

#### 6.4.5 Chance

*Chance* allows for a greater exclusion of unknown variables and eventually leads to better monitoring and thus to a competitive advantage, which in this case is claimed by EMAS and displayed in Table 7.

**Table 7. Chance.**

Determinant	ISO14001	EMAS
Percentage of change in business indicators caused by the EMS	Median: 11-20%	Median: 21-30%
Percentage of change in environmental indicators caused by the EMS	Median: 41-50%	Median: 71-80%
	<b>0/2</b>	<b>2/2</b>

<sup>18</sup> Environmental performance here consists only of the comparison of environmental indicators.

<sup>19</sup> Due to rounding the figures, the sum of the values in this cell is 101.

<sup>20</sup> Innovation was assessed by asking for new products, new markets, new processes, new marketing strategies etc. which is the "working definition 1" of innovation by Hauschildt and Salomo (2007), stating that innovations are defined as all these products and processes that are introduced in a company for the first time. It was furthermore part of a follow-up of the survey, so not all of the original respondents replied.

<sup>21</sup> Cluster formation was also part of the follow-up of the survey, so not all of the original respondents replied.

### 6.4.6 Government

A direct link between financial support and competitiveness is likely since the higher capital allows for additional investments and encourages risk-taking because the capital reserves of the firms are not threatened. Currently, there are no subsidies in whatever form for ISO14001 certifications because EMAS was considered the better alternative and it was hence attempted to make EMAS certifications more popular (Representative of the Ministry for Environment in BW, 2013). 88.88% of EMAS CC reported they were either supported with the introduction of the EMS or are part of a subsidy programme, which was mostly *EMAS im Konvoi* (EMAS in convoy). Furthermore, the possibility to execute a re-audit only every four years, reduces the effort and time that is put into this elaborate procedure and directs the focus back to the core business, which is only possible with EMAS. In this last category of PsD, displayed in Table 8, EMAS surpasses ISO14001, again, and increases the probability of an SME to have a competitive advantage in this category.

**Table 8. Government.**

Determinant	ISO14001	EMAS
Support from the county of BW	Yes: 0% No: 100%	Yes: 78% No: 22%
Costs of regulation:	Mean: 3.118	Mean: 3.000
Re-audit for SMEs:	Every 3 years	Every 4 years
	<b>1/3</b>	<b>2/3</b>

Thus, EMAS outscores ISO14001 in five of six categories and consequently enhances the competitiveness of SMEs more than ISO14001.

### 6.5 The Potential of EMSs as Tools for a Transition

EMSs, as representatives of many technologies introduced in the era of EM, are testimonies to the political modernisation in EM, which is characterised by “. . . new forms of political interventions” as the design of voluntary regulations (Spaargaren, 1997, p. 15 as cited in Fisher & Freudenburg, 2001). By decreasing the use of resources and by adhering to environmental standards, the enterprises were promised environmental improvements and also an increased profitability after the introduction of the EMS (EMAS, n.d.-a; ISO, n.d.; NQA, n.d.). This win-win situation has been advertised by EM supporters and is said to be achieved by decoupling economic growth from environmental exploitation (Mol & Sonnenfeld, 2000).

The eligibility of a transition tool in general depends (1) on the design of the instrument, which is context specific, (2) on the cross-influence of certain variables, (3) on the adjustment of frameworks,

and (4) on the influence of the current paradigm. With regard to the context specific design, EMSs need to provide economic incentives to the company owners and at the same time improve the environmental impact of the company. Furthermore, these instruments are supposed to promote a form of competitiveness where environmental sustainability is the key.

EMAS fulfils the first design requirement: by promoting business and environmental interests, the EMS creates a win-win situation and thus could be eligible as a transition tool. EMAS leads to an improvement of five business indicators and of five environmental indicators. Although the goal should be to improve at least 80% of the indicators in each set, EMAS seems to perform well in business and environmental matters. Nevertheless, it also worsened the development of two environmental variables, which has implications for the cross-influence of variables. ISO14001 failed to improve the companies' business indicators, which takes away the incentive for business owners to install such a system.

On first sight, EMAS also seems to fulfil the second design requirement: it surpasses ISO14001 in five of six categories of PsD and thus enhances the competitiveness of the SMEs better. However, this is only the case when competitiveness is considered in conventional terms. According to the principles of EM, competitiveness has to include environmental sustainability as the key, which points to it being a crucial element for gaining a competitive edge. ISO14001, not fulfilling the competitiveness criteria in the first place, cannot be assessed for the key criterion. EMAS, in contrast, improved the same number of variables in both performance sets and outperformed ISO14001 in competitiveness matters. However, an improvement of less than 50% of the variables and a worsening of two environmental variables does not indicate that environmental sustainability was the *key* for the gained competitive advantage. This might imply that environmental sustainability is still not a part of the competitiveness of a firm as proclaimed by EM.

Although ISO14001 presented not a good business performance, it improved five environmental variables without impeding any indicators in their development. Consequently, the decrease of *Waste reduction* and *Energy efficiency* under EMAS could point to a cross-influence of variables, which is the second eligibility aspect. There might be a negative correlation between business and environmental indicators in the course of an EMS implementation. If this outcome was proved, it would disqualify either EMAS or EMSs in general as transition tools, since it would not be possible to align business and environmental interests by the use of these mechanisms. However, due to some sample errors, the negative wording of *Waste reduction*, and the assessment of only two EMSs, this final conclusion cannot be drawn here.

That EMAS was superior in competitiveness matters is also likely to be due to the framework itself, which points towards an insufficient adjustment of the framework, which refers to the third eligibility aspect. Although environmental indicators have been part of PsD, it still possesses the structure of a conventional, business centred competitiveness framework. That explains furthermore, why ISO14001 outscored EMAS only in one competitiveness category, although its environmental performance was equally good. Thus, the focus of PsD seems to be on the business performance, which is a critique to the framework itself, leading to the recommendation of adjusting the framework for sustainability before using it for further consultations (Appendix 8). Thus, PsD does not seem to be suited for assessing the potential for transition tools under a competitiveness standpoint adhering to EM principles.

Finally, the influence of the current paradigm of capitalism should not be underestimated. EM provides the basis for the creation of EMSs but simultaneously poses obstacles to them, originating in the short-term and profit-driven thinking. This might lead to the rejection of an EMS if it is combined with an uncertain costs-benefit ratio. This disqualifies EMSs as a transition tools, because the acceptance of the system is too low to create a movement big enough to launch a transition.

## **7 Conclusion**

This study examined whether the EMSs ISO14001 and EMAS enhance the competitiveness of SMEs within three years after the introduction of the according EMS, and which EMS enhances the competitiveness best. Therefore, competitiveness has been divided into business and environmental performance, which have been assessed separately first with regard to three different aspects and have been combined in PsD afterwards. It has been found that EMAS outperformed ISO14001 in 10 of 12 business variables, improved five variables and satisfied two of three improvement goals. ISO14001 outperformed EMAS in two of 12 business variables, improved one variable and reached one of three improvement goals. Thus, the business performance has been better for companies that chose a stricter certification standard with EMAS. For the environmental variables, EMAS performed better in six of 11 variables, improved five and impaired two indicators and satisfied one of four improvement goals. The two impaired variables were *Waste reduction* and *Energy efficiency*, whereby the results for *Waste reduction* have to be interpreted with caution due to its negative wording (see Chapter 2.4). ISO14001 performed better in five of 11 environmental variables, also improved five indicators and reached two of four improvement goals. Thus, the results were mixed for the environmental indicators: EMAS performed slightly better in an indicator comparison with

ISO14001, but ISO14001 did not impair any variables and satisfied more environmental goals than EMAS. With regard to the competitiveness measured by the use of PsD on basis of the means, EMAS scored in five of six categories and thus enhanced the competitiveness of SMEs significantly more than ISO14001 did. However, there are several obstacles which render these results less clear and have a significant influence on their interpretation.

The direct influences on the results are the external business environment and research limitations. The various aspects of the external business environment influencing the business and the environmental performance increase the uncertainty and render it more difficult to attribute changes in indicators directly to the introduction of the EMSs. Thus, the potential of the EMSs is difficult to assess and this lack in transparency has implications for the marketing of these instruments. The second direct challenges are the before mentioned research limitations as poor wording of indicators or the restrictions of the chosen sampling method, influencing the outcomes. A probable negative correlation between indicators and the short-term profit maximising mindset have been found to be indirect influences on the results. If there is a negative correlation between the business and the environmental indicators, the introduction of the EMSs did not only influence the indicators separately, but also cross-influenced the environmental performance by triggering changes in the business performance. This is a dynamic I did not account for, which might change the outcomes. The second indirect influence is situated on a macroeconomic level. Since it takes EMSs on average 15 months to reach their break-even-point, respondents might evaluate the introduction of such a system under capitalist standards. This might present EMSs worse than if viewed from an EM or even a sustainability perspective, which might influence the results, as well. Consequently, the results show only *tendencies* of how both EMSs influence the performances and the competitiveness.

To face the challenge of overcoming this short-term mindset, which has been found significant in the course of this research, companies need to be convinced by (1) the profitability of the investment, supported by shorter amortisation periods and high desired changes in indicators compared to alternative technologies; (2) the value of the investment, supported by the improvement of business and environmental variables and the fulfilment of desired goals, and (3) environmental sustainability being the key of competitiveness, which will provide a competitive advantage when incorporated into daily processes as well as into the strategy. Although these are aspects a well-designed EMS can tackle, the majority of companies still seem to be in a modernity lock-in. The reason therefore might be found in the capitalist paradigm that hinders an emphasis on environmental sustainability. It seems that, in the course of this transition, eventually the capitalist system itself will be challenged, thereby going back to the demands of the Green Revolution.

Based on these reflections there have been mixed results for the eligibility of EMSs as tools of transition. Thus, no clear statement about their potential could be provided: (1) With regard to the design, EMAS is favoured over ISO14001 due to creating a win-win situation and outperforming ISO14001 in competitiveness matters but EMAS does not include environmental sustainability as the key; (2) furthermore, if there is a negative correlation between indicators, EMAS or EMSs in general are not suited as transition tools; (3) PsD as competitiveness framework seems to be too business centred in its inherent structure, and (4) the capitalist mindset may lead to the rejection of an EMS, which disqualifies these as transition tools, as well.

The observations of this thesis apply only to this specific sector in the county of BW in Germany. Further research should aim for studies in other counties of Germany, and for an evaluation of the correlation between environmental and business indicators for an EMS introduction. Furthermore, it is crucial to assess how much of the competitiveness is still determined by business aspects and how environmental sustainability can play a greater role in achieving a sustainable competitive edge. The results might furthermore implicate that a stricter regulation is not necessarily better for fostering environmental protection. Thus, the matter of strictness has to be researched further, in particular in association with voluntary regulations.

Although the eligibility for being a tool of transition depends upon the ability to align business and environmental interests, there will be a point in time when the coupling of interests is not possible anymore. Then, companies will have to make the decision to sacrifice some of their business variables in favour of their environmental variables. The first step, however, is to account for both interests to incorporate a sustainable mindset into the firms, so it will be part of the revolution from within and thus less disruptive and more accepted. It has been stressed in this thesis that this incremental transformation has a higher probability to succeed than an abrupt change of behaviour and thinking, but this timeframe will not be open infinitely. Economics as they are taught today have not changed much since the last revolution in economics about 100 years ago, which signifies a pace that is too slow to react to changes and decisions in the era of globalisation (Gowdy & Erickson, 2005). Not only the speed but also the tools, on a national, as well as international level, will have to be reconsidered: is it a self-motivated few or a strictly regulated lot that make the first step towards a sustainable future? Above all, economists and environmentalists have to recognise that they are both standing on the same side (Collier, 2011). Both parties have to be willing to make compromises for this transition to work in time - they are greatly urged to find a common ground.



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## Appendix

### Appendix 1. Most important differences between ISO14001 and EMAS. Adapted from Zippel, 2011.

ISO14001	EMAS
Improvement of Management System	<b>Continuous</b> improvement of <b>environmental performance</b>
Publication of Environmental Policy	<b>Intense communication with the public and more transparency</b> through <ul style="list-style-type: none"> <li>• Environmental Policy</li> <li>• Detailed Environmental Report</li> <li>• Online Register of certified firms</li> <li>• EMAS Logo for marketing</li> </ul>
Enquiry into prevailing legal norms and authorisations	<b>Evidence of the firm's compliance</b> with prevailing legal norms and authorisations
Only involvement of the employees that deal directly with the EMS	<b>Involvement of all employees</b> in the environmental management of the company and active information transfer to the entire personnel

For a further overview about the differences between ISO14001 and EMAS, please refer to *Systematisches Umweltmanagement: Mit EMAS Mehrwert schaffen* (German) or *EMAS – Factsheet* (English) (European Commission, 2008; Zippel, 2011).

### Appendix 2. Blank survey questions.

#### Welcome to my survey

Dear Sir or Madam,

my name is Cecilia Fischer and I am studying “Environmental Studies and Sustainability Science” at the University of Lund, Sweden. I have done my Bachelor in international business in Paderborn and try to combine these two fields in the course of my Master programme.

Currently I am in the last semester of my studies, which is why I am involved in writing my Master thesis. Within the scope of this thesis I plan on researching which implications the introduction of the EMSs ISO14001 and EMAS has for the business and environmental performance of small and medium enterprises in Baden-Württemberg. Furthermore, I will assess which obstacles exist that hinder or impede the introduction of an EMS and how these can be prevented.

In a detailed selection process, I have chosen your enterprise to participate in this survey. You can contribute to improve the introduction and support of EMSs. I would greatly appreciate it if you could take 10-15 minutes to participate in the following online survey.

Link

All information that you provide will be treated confidentially and will only be used in anonymised form in my Master thesis. I will not, under any circumstances, mention the name of your company or pass on confidential information, which includes all responses in this survey, to third parties. However, it would be very helpful if you provided your company details in the end of the survey, so I can allocate the survey directly and can come back to you in case I have any questions.

In case you have any questions, please e-mail me under [cecilia.fischer.624@student.lu.se](mailto:cecilia.fischer.624@student.lu.se). I will furthermore contact you within the next 2-3 days by phone. Thus, you will have the chance to get familiar with the survey and to talk to me in person to ask me any questions that arise about my research. The survey is open for your reply until 04 June 2013.<sup>22</sup>

Thank you very much in advance and have a successful week!

Best regards,

Cecilia Fischer

1	Did you implement an EMS? <ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
2	YES: Which EMS are you officially certified with? <ul style="list-style-type: none"> <li>• ISO14001</li> <li>• EMAS</li> <li>• ISO14001 and EMAS</li> </ul>
	NO: Forwarded to question 62.
	ISO14001: Forwarded to question 3.
	EMAS: Forwarded to question 60.
	IOS14001 and EMAS: Forwarded to question 61.
3	Which economic sector do you belong to? (EA key of your main industry) → Drop-down menu of EA-Scopes <sup>23</sup>

<sup>22</sup> I decided later to close the survey on 07 June 2013.

<sup>23</sup> For simplicity reasons, please refer to <http://iso-certification-scope-ea-code.blogspot.se/2011/08/iso-certification-scope-ea-code.html> for a listing of the EA-Scopes. For a better comparison, the EA-Scopes were

4	<p>How many employees does your company have?</p> <ul style="list-style-type: none"> <li>• 1-10</li> <li>• 11-50</li> <li>• 51-100</li> <li>• 101-150</li> <li>• 151-200</li> <li>• 201-249</li> <li>• 250+<sup>24</sup></li> </ul>
5	<p>What were your revenues in 2011?</p> <ul style="list-style-type: none"> <li>• 0 - 2 million €</li> <li>• &gt; 2 – 10 million €</li> <li>• &gt; 10 – 20 million €</li> <li>• &gt; 20 – 30 million €</li> <li>• &gt; 30 – 40 million €</li> <li>• &gt; 40 – 50 million €</li> <li>• &gt; 50 million €</li> </ul>
6	<p>What were your total assets in 2011?</p> <ul style="list-style-type: none"> <li>• 0 - 2 million €</li> <li>• &gt; 2 – 10 million €</li> <li>• &gt; 10 – 20 million €</li> <li>• &gt; 20 – 30 million €</li> <li>• &gt; 30 – 40 million €</li> <li>• &gt; 40 – 43 million €</li> <li>• &gt; 43 million €</li> </ul>
7	<p>Please state your approximate net profits (EBIT) for 2011 (in €) (question does not have to be answered if this information is confidential<sup>25</sup>).</p>
8	<p>Under which ISO14001 regulation did you implement the EMS?</p> <ul style="list-style-type: none"> <li>• ISO14001:1996</li> <li>• ISO14001:2004</li> <li>• ISO14001:2009</li> <li>• Other, please specify</li> </ul>
9	<p>In which year were you certified? → Drop-down menu of the years 1996-2013</p>
10	<p>Which were your reasons to implement ISO14001? Please state how important the following reasons were for your decision:<sup>26</sup></p> <ul style="list-style-type: none"> <li>• Competitors in the same sector introduced an EMS</li> <li>• Business partners in the same sector introduced EMS</li> <li>• Products from certified firms are preferred by customers</li> <li>• More profit possible when EMS is introduced (less energy consumption, waste etc.)</li> <li>• Legislative pressure (avoidance of fines, etc.)</li> <li>• Competitive advantage</li> <li>• Environmental concern</li> <li>• Employees spoke out in favour for an EMS or a “greener”</li> <li>• To attract more customers</li> <li>• Interest to improve the working conditions or other socially-related reasons</li> </ul>
11	<p>Were there other reasons than the afore mentioned ones that were pivotal for your decision to implement ISO14001?</p>
12	<p>Please indicate which of the following business indicators you hoped to substantially improve through</p>

also given for EMAS, although there the NACE Scopes are common, which can be accessed here: [http://ec.europa.eu/environment/emas/pdf/general/nacecodes\\_en.pdf](http://ec.europa.eu/environment/emas/pdf/general/nacecodes_en.pdf). An according note was provided for the respondents.

<sup>24</sup> If 250+ was chosen, the respondent was forwarded to question 63 and disqualified from the survey.

<sup>25</sup> I added this statement later since some companies did not take the survey due to confidentiality reasons.

<sup>26</sup> 5-point Likert scale: very important, important, neutral, not important, not important at all

	<p>the introduction of ISO14001:</p> <ul style="list-style-type: none"> <li>• Acquisition of new customers</li> <li>• Revenues</li> <li>• Revenue per customer</li> <li>• Awareness of company/products</li> <li>• Profit</li> <li>• Return on investment</li> <li>• Product quality</li> <li>• Costs</li> <li>• Sales volume</li> <li>• Return on sales</li> <li>• Process and time efficiency</li> <li>• Employee morale</li> </ul>
13	Were there other business indicators you hoped to improve through the introduction of ISO14001?
14	<p>Please indicate which of the following environmental indicators you hoped to substantially improve through the introduction of ISO14001:</p> <ul style="list-style-type: none"> <li>• Resource use</li> <li>• Waste reduction</li> <li>• Emission output</li> <li>• Energy efficiency</li> <li>• Costs of regulation</li> <li>• Health of employees</li> <li>• Quality of living for residents</li> <li>• Use of recycled material</li> <li>• Occurrence of an environmentally relevant incident (contamination etc.)</li> <li>• Emergency preparedness if environmentally relevant incident should occur</li> <li>• Transparency of environmental policy</li> </ul>
15	Were there other environmental indicators you hoped to improve through the introduction of ISO14001?
16	<p>Do you think that it is particularly important for your sector to introduce an EMS?</p> <ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
	YES: Forwarded to question 17.
	NO: Forwarded to question 17.
17	<p>Why did you prefer an ISO14001 certification and decided against an EMAS certification?</p> <ul style="list-style-type: none"> <li>• Heard about ISO14001 earlier</li> <li>• Better information material/better online presentation</li> <li>• Is worldwide approved</li> <li>• Seems more trustworthy than EMAS</li> <li>• Is easier to implement into the company</li> <li>• The guidelines are easier to comply with</li> <li>• Was financially supported</li> <li>• Is more adapted to the needs of SMEs</li> <li>• Has a greater positive impact on the already mentioned business indicators</li> <li>• Has a greater positive impact on the already mentioned environmental indicators</li> </ul>
18	Were there other reasons for a preference of ISO14001 over EMAS?
19	<p>Did you believe that one of the two EMS, ISO14001 or EMAS, possesses stricter guidelines?</p> <ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
20	<p>YES: Which EMS do you perceive as stricter?</p> <ul style="list-style-type: none"> <li>• ISO14001</li> <li>• EMAS</li> </ul>
	NO: Forwarded to question 23.
21	ISO14001: Please state briefly why you consider ISO14001 to be stricter (in which fields, personal experience etc.) and why you decided for the perceived stricter EMS, ISO14001.

22	EMAS: Please state briefly why you think this EMS is stricter (in which fields, personal experience etc.) and why you decided for the perceived weaker EMS, ISO14001.
23	Did you encounter any obstacles or difficulties BEFORE the introduction of ISO14001, which impeded or hindered the implementation of the EMS? <ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
24	YES: Please select, which kind of challenges/complications you encountered: <ul style="list-style-type: none"> <li>• Insufficient liquidity</li> <li>• Costly investments into other technologies already took place (sunk costs)</li> <li>• Cost-benefit ratio unclear</li> <li>• The introduction was not supported by every employee/manager of the firm</li> <li>• Time and staff related constraints with regard to the project ISO14001</li> <li>• Uncertainty if environmental pollution is sufficiently significant to introduce ISO14001</li> <li>• None of the above mentioned reasons</li> </ul>
	NO: Forwarded to question 26.
25	Were there other reasons, which impeded or hindered the decision for ISO14001?
26	Do you believe that there are obstacles with regard to the introduction of ISO14001 that are predominantly or exclusively relevant for SMEs in Germany? <ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
27	YES: To what extent do you agree with the following statements, which denominate several disadvantages SMEs could encounter when introducing ISO14001 in comparison to big companies? <sup>27</sup> <ul style="list-style-type: none"> <li>• Not enough personnel to support the introduction of ISO14001</li> <li>• Limited financial means</li> <li>• Insufficient availability of capital (raising of credit)</li> <li>• Low risk disposition</li> <li>• Clients are indifferent towards an environmental certification</li> </ul>
	NO: Forwarded to question 29.
28	Are there in your opinion further disadvantages SMEs encounter when introducing ISO14001?
29	Did you encounter any obstacles or difficulties DURING the introduction of ISO14001, which impeded or hindered the implementation of the EMS? <ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
30	YES: Please select, which kind of challenges/complications you encountered: <ul style="list-style-type: none"> <li>• No sufficient support during the implementation (information, consulting etc.)</li> <li>• Difficulties with the design of new processes</li> <li>• No staff training possible (because of time, financial etc. constraints)</li> <li>• Greater financial effort than expected</li> <li>• Greater time exposure than expected</li> <li>• None of the above mentioned reasons</li> </ul>
	NO: Forwarded to question 32.
31	Were there other reasons that posed an obstacle DURING the implementation of ISO14001?
32	Were you supported by the ministry of BW in the introduction of ISO14001, do you participate in a subsidy programme or are there miscellaneous discharges for you as ISO14001 certified enterprise? <ul style="list-style-type: none"> <li>• Supported in the introduction</li> <li>• I am participating in a subsidy programme</li> <li>• No support</li> <li>• Other discharges, please specify</li> </ul>
33	Please briefly explain, if applicable, in which programme you participate or which kind of support you receive.
34	Did you encounter any obstacles or difficulties AFTER the introduction of ISO14001, which impeded or hindered the implementation of the EMS? <ul style="list-style-type: none"> <li>• Yes</li> </ul>

<sup>27</sup>5-point Likert scale: agree fully, agree, neutral, disagree, disagree fully

	<ul style="list-style-type: none"> <li>No</li> </ul>
35	<p>YES: Please select, which kind of challenges/complications you encountered:</p> <ul style="list-style-type: none"> <li>The introduction of the EMS did not have the desired impact on the stakeholders (clients, investors, etc.)</li> <li>The introduction of the EMS did not or not sufficiently solve the environmental issues</li> <li>The introduction of the EMS did not have desired effect on the business indicators of the firm</li> <li>The reporting in the years to follow the introduction is too much effort</li> <li>It is difficult to adhere to the guidelines over a longer time period</li> <li>It requires a lot of time and effort to educate and train new employees in the guidelines of ISO14001</li> <li>None of the above mentioned reasons</li> </ul>
	NO: Forwarded to question 37.
36	Were there other reasons that posed an obstacle AFTER the implementation of ISO14001?
37	<p>How would you rate the changes of the following business indicators within the first three years after the introduction of ISO14001? (If you are certified with ISO14001 less than three years, please state your experiences until now.)<sup>28</sup></p> <ul style="list-style-type: none"> <li>Acquisition of new customers</li> <li>Revenues</li> <li>Revenue per customer</li> <li>Awareness of company/products</li> <li>Profit</li> <li>Return on investment</li> <li>Product quality</li> <li>Costs</li> <li>Sales volume</li> <li>Return on sales</li> <li>Process and time efficiency</li> <li>Employee morale</li> </ul>
38	<p>Which percentage of these changes in performance is in your opinion due to the introduction of ISO14001? (Hence, exclusion of other influencing factors as financial crisis, resource prices or scarcity, etc.)</p> <ul style="list-style-type: none"> <li>0-10%</li> <li>11-20%</li> <li>21-30%</li> <li>31-40%</li> <li>41-50%</li> <li>51-60%</li> <li>61-70%</li> <li>71-80%</li> <li>81-90%</li> <li>91-100%</li> </ul>
39	In case you did not select 91-100%, which other factors were crucial for the changes of your business indicators?
40	<p>Would you say that your business performance in total improved (measured by the stated business indicators like revenues, ROI, sales volume etc.)?</p> <ul style="list-style-type: none"> <li>Yes</li> <li>No</li> <li>Stayed the same</li> <li>Further commentary</li> </ul>
41	<p>Have you already reached the break-even point of the investment ISO14001? (Note: break-even point is defined here as profit threshold that is reached as soon as the profit surpasses the costs.)</p> <ul style="list-style-type: none"> <li>Yes</li> </ul>

<sup>28</sup>5-point Likert scale: significantly increased, slightly increased, no changes, slightly decreased, significantly decreased

	<ul style="list-style-type: none"> <li>• No</li> </ul>
42	<p>YES: How much time did your company require to reach the break-even point for the investment ISO14001?</p> <ul style="list-style-type: none"> <li>• Less than one year</li> <li>• 1 year</li> <li>• 2 years</li> <li>• 3 years</li> <li>• 4 years</li> <li>• 5 years</li> <li>• More than 5 years</li> </ul>
43	<p>NO: How much time, in your opinion, will your company require to reach the break-even point for the investment ISO14001?</p> <ul style="list-style-type: none"> <li>• Less than one year</li> <li>• 1 year</li> <li>• 2 years</li> <li>• 3 years</li> <li>• 4 years</li> <li>• 5 years</li> <li>• More than 5 years</li> <li>• Not sure</li> </ul>
44	<p>How would you rate the changes of the following environmental indicators within the first three years after the introduction of ISO14001? (If you are certified with ISO14001 less than three years, please state your experiences until the current point in time.)<sup>28</sup></p> <ul style="list-style-type: none"> <li>• Resource use</li> <li>• Waste reduction</li> <li>• Emission output</li> <li>• Energy efficiency</li> <li>• Costs of regulation</li> <li>• Health of employees</li> <li>• Quality of living for residents</li> <li>• Use of recycled material</li> <li>• Occurrence of an environmentally relevant incident (contamination etc.)</li> <li>• Emergency preparedness if environmentally relevant incident should occur</li> <li>• Transparency of environmental policy</li> </ul>
45	<p>Which percentage of these changes in performance is in your opinion due to the introduction of ISO14001? (Hence, exclusion of other influencing factors as financial crisis, resource prices or scarcity, etc.)</p> <ul style="list-style-type: none"> <li>• 0-10%</li> <li>• 11-20%</li> <li>• 21-30%</li> <li>• 31-40%</li> <li>• 41-50%</li> <li>• 51-60%</li> <li>• 61-70%</li> <li>• 71-80%</li> <li>• 81-90%</li> <li>• 91-100%</li> </ul>
46	<p>In case you did not select 91-100%, which other factors were crucial for the changes of your environmental indicators?</p>
47	<p>Would you say that your environmental performance in total improved (measured by the stated environmental indicators like energy efficiency, resource use, etc.)?</p> <ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> <li>• Stayed the same</li> <li>• Further comments, please state:</li> </ul>



48	<p>How important are in your opinion the environmental indicators (resource use, etc.), which were changed by the implementation, for the development of your business indicators (profits, ROI, etc.)?</p> <ul style="list-style-type: none"> <li>• Very important</li> <li>• Important</li> <li>• Neutral</li> <li>• Not important</li> <li>• Not important at all</li> <li>• Not sure</li> </ul>
49	<p>Which of the environmental indicators have/had the greatest influence on your business indicators after the implementation? Please select the three most important ones:</p> <ul style="list-style-type: none"> <li>• Resource use</li> <li>• Waste reduction</li> <li>• Emission output</li> <li>• Energy efficiency</li> <li>• Costs of regulation</li> <li>• Health of employees</li> <li>• Quality of living for residents</li> <li>• Use of recycled material</li> <li>• Occurrence of an environmentally relevant incident (contamination etc.)</li> <li>• Emergency preparedness if environmentally relevant incident should occur</li> <li>• Transparency of environmental policy</li> </ul>
50	<p>Do you actively use your certification with ISO14001 in your marketing?</p> <ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
	YES: Forwarded to question 51.
	NO: Forwarded to question 51.
51	<p>Did your customers notice that you are certified (and, if applicable, approached you on this topic)?</p> <ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
	YES: Forwarded to question 52.
	NO: Forwarded to question 52.
52	<p>Would you consider getting certified with EMAS?</p> <ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
	YES: Forwarded to question 53.
	NO: Forwarded to question 53.
53	<p>Can you imagine introducing another EMS, except ISO14001 and EMAS, or have you already introduced another EMS?</p> <ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
54	If you decided for "Yes", please state which other EMS you favour.
55	<p>Please state if you plan on introducing this EMS, already introduced it or if you are only interested in the EMS:</p> <ul style="list-style-type: none"> <li>• Planning to introduce it</li> <li>• Already introduced it</li> <li>• Only interested</li> </ul>
56	<p>Do you believe that the introduction of an EMS is the right way to motivate companies to take on more responsibility for the environment?</p> <ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
57	YES and NO: Please briefly explain why you selected this response.
58	<p>In the end of the survey I would like to ask you to provide me with your company details, so I can clearly allocate this survey and so I can contact you in case questions should arise.</p> <ul style="list-style-type: none"> <li>• Name of the firm</li> <li>• Street</li> </ul>

	<ul style="list-style-type: none"> <li>• Postal code</li> <li>• City</li> <li>• Telephone</li> <li>• E-mail</li> <li>• Responsible Person for certifications</li> </ul>
59	Please select "Complete survey" when you have responded to all questions and with "Next" your entries will be sent.
60	<p>Please copy the following URL into the address bar of your browser and press enter. This URL will then lead you to the EMAS-related survey.</p> <p><a href="http://www.surveymethods.com/EndUser.aspx?DAFE928BDF908F80DA">http://www.surveymethods.com/EndUser.aspx?DAFE928BDF908F80DA</a></p> <p>Please select the box "Complete survey" after you opened the above given link, and to finish this survey, click on "Next". Afterwards, please start the EMAS-related survey. Thank you very much.</p>
61	<p>Although you implemented both EMS, I am in the following interested in your experiences with the EMS EMAS, since that includes the ISO14001 guidelines. Please copy the following URL into the address bar of your browser and press enter. This URL will then lead you to the EMAS-related survey.</p> <p><a href="http://www.surveymethods.com/EndUser.aspx?DAFE928BDF908F80DA">http://www.surveymethods.com/EndUser.aspx?DAFE928BDF908F80DA</a></p> <p>Please select the box "Complete survey" after you opened the above given link, and to finish this survey, click on "Next". Afterwards, please start the EMAS-related survey. Thank you very much.</p>
62	<p>Please copy the following URL into the address bar of your browser and press enter. This URL will then lead you to the survey that attends to "no certification".</p> <p><a href="http://www.surveymethods.com/EndUser.aspx?E6C2AEB7E3ACB3BCE0">http://www.surveymethods.com/EndUser.aspx?E6C2AEB7E3ACB3BCE0</a></p> <p>Please select the box "Complete survey" after you opened the above given link, and to finish this survey, click on "Next". Afterwards, please start the survey that attends to "no certification". Thank you very much.<sup>29</sup></p>
63	<p>Unfortunately, your enterprise has too many employees to be regarded as SME. Since I can only include SMEs in my research, this survey will be terminated.</p> <p>Please select the box "Complete survey", so the questionnaire can be completed with a click on "Next". Thank you very much.</p>

Thank you very much!

This is the end of the survey. I would like to thank you sincerely for your participation and your time. Your responses are of great importance for my Master thesis and for the future design of EMS. In case you have questions and you would like to contact me, here, again, my e-mail address:

cecilia.fischer.624@student.lu.se

Thank you very much and good luck for your company in the future.

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<sup>29</sup>This survey differed from the ISO14001 and EMAS survey and was designed in case I wrongly allocated a certification to a company. To not miss out on valuable data I created a "no certification" survey. However, every company was certified, thus this survey was not used and is not provided in the thesis.

Best regards,

Cecilia Fischer

Note: The questions that differ in their context from the ISO14001 survey are given in the table below. For the remaining survey, the term ISO14001 only has to be replaced by EMAS and vice versa.

3	Which EMS did you implement first? <ul style="list-style-type: none"> <li>• ISO14001</li> <li>• EMAS</li> </ul>
8 ISO = 9 EMAS	Under which EMAS regulation did you implement the EMS? <ul style="list-style-type: none"> <li>• EMAS I (Nr. 1836/93 – since 1993)</li> <li>• EMAS II (Nr. 761/2001 – since 2001)</li> <li>• EMAS III (Nr. 1221/2009 – since 2010)</li> <li>• Other, please specify</li> </ul>
9 ISO = 10 EMAS	In which year were you certified? → Drop-down menu of the years 1993-2013
17 ISO = 18 EMAS	Why did you prefer an EMAS certification and decided against a (sole) ISO14001 certification? <ul style="list-style-type: none"> <li>• Heard about EMAS earlier</li> <li>• Better information material/better online presentation</li> <li>• Seems more trustworthy than ISO14001</li> <li>• Is easier to communicate (EMAS register, logo, etc.)</li> <li>• Is easier to implement into the company</li> <li>• The guidelines are easier to comply with</li> <li>• Was financially supported</li> <li>• Is more adapted to the needs of SMEs</li> <li>• EMAS includes the guidelines of ISO14001 – double certification possible</li> <li>• Has a greater positive impact on the already mentioned business indicators</li> <li>• Has a greater positive impact on the already mentioned environmental indicators</li> <li>• Presents the continuous improvement of the environmental performance of the company</li> <li>• Greater transparency than ISO14001</li> <li>• Better inclusion of employees into environmental management processes</li> </ul>
21 ISO = 22 EMAS	ISO14001: Please state briefly why you consider ISO14001 to be stricter (in which fields, personal experience etc.) and why you decided for the perceived weaker EMS, EMAS.
22 ISO = 23 EMAS	EMAS: Please state briefly why you think this EMS is stricter (in which fields, personal experience etc.) and why you decided for the perceived stricter EMS, EMAS.
32 ISO = 33 EMAS	Were you supported by the ministry of BW in the introduction of ISO14001, do you participate in a subsidy programme like “EMAS im Konvoi” or are there miscellaneous discharges for you as ISO14001 certified enterprise? <ul style="list-style-type: none"> <li>• Supported in the introduction</li> <li>• I am participating in a subsidy programme</li> <li>• No support</li> <li>• Other discharges, please specify</li> </ul>

### **Appendix 3. Certification procedure for ISO14001.**

The first step during an ISO certification is an Environmental Impact Assessment where “. . . objectives and targets for the management system. . .” are set (United States Environmental Protection Agency, 2012). The implementation of the EMS follows, which requires the transformation of harmful processes, training of responsible personnel and the set up of metrics to measure the outcomes periodically in an audit (United States Environmental Protection Agency, 2012). After the company has implemented these modifications, the environmental standards are examined by an independent professional who issues a certificate upon successful completion (BIO Intelligence Service & Adelphi Consult, 2009). The adherence to the norm is examined by the means of annual surveillance visits to verify the adherence to the 14001 guidelines (Field, n.d.). Every three years a re-audit for the entire system is necessary to renew the status of the EMS (Field, n.d.).

### **Appendix 4. Certification procedure for EMAS.**

The PDCA cycle is almost equal to the ISO14001 procedure but requires some more dedication and effort since the firm is not only required to adopt an environmental policy like ISO14001 but also has to publish an environmental report (European Commission, n.d.). The company is then registered in an online database and can make use of the EMAS logo (European Commission, n.d.). The re-audit for the EMS in the “Act-step” “. . . must be conducted within an audit cycle of no longer than three years”, which was extended for SMEs under EMAS III (European Commission, n.d.).

### **Appendix 5. Challenges and opportunities of SMEs and the implications for EMSs.**

#### 2.2.1 Challenges for SMEs and their introduction of EMSs

(1) SMEs often experience a lack of access to finance when compared to large multinational firms, whereby access implies “. . . providing financial products or supplying financial services” (Angela, 2011, p. 432). The National Council of Small and Medium Sized Private Enterprises in Romania (CNIPMMR) conducted a survey in 2010 and amongst others, “. . . banks’ lack of transparency . . ., no real negotiation . . ., and unjustified and abusive contractual terms practiced by banks . . .” strain the SME-bank relationship (CNIPMMR, 2010 as cited in Angela, 2011, p. 435, in italic letters in the original). Resulting from that, are operational thinking and a “. . . [l]ack of long-term strategic focus . . .” (Bist, 2007, p. 5). The implementation of an EMS is costly and the benefits of an EMS implementation are not visible immediately, which poses a hindrance to an EMS-favourable decision (Bist, 2007).

(2) Closely related to that are institutional and regulatory frameworks that are not supportive of SMEs' needs as sufficient funding (Angela, 2011). External uncertainty has been identified by Westhead and Storey (1996) as one of the major obstacles for SMEs, rendering the firms powerless and leaving them vulnerable to changes of the external business environment (Sarah bt. Omar, Arokiasamy, & Ismail, 2009). Whereas EMAS has been adopted partly to the needs of SMEs with its revision in 2010, the ISO14001 revision that was passed in 2004 still fails to ". . . account for the needs of SMEs and thus would not foster increased acceptance" (ISO/TC207/SC1/ Strategic SME Group, 2005).

(3) SMEs experience limited access to information about EMSs. Especially the unawareness of governmental support is an obstacle to the introduction of an EMS: 50% of the SMEs evaluated in the executive report of the ISO-TC207 working group (2005) stated that they ". . . did not know whether their government provided assistance . . ." (p. 9). Uncertainty over the political support and the financial benefits leads to risk aversion, resulting in SMEs considering EMS as less attractive ". . . than firms that are large enough to diversify their investments . . ." (Stoeckl, 2004 as cited in Bist, 2007, p. 7, in italic letters in the original).

(4) Since SMEs in particular need to strive for an efficient allocation of their resources, they often experience time and staff constraints. As Beaver and Hutchings (2005) state, this is aggravated by the fact that SMEs rarely support or even neglect managerial development and employee trainings conducted by external professionals, which leads to a decreasing moral and motivation of the staff. A consequence of this is that many SMEs feel they lack the expertise and knowledge to implement an EMS unaided in the first place (ISO/TC207/SC1/ Strategic SME Group, 2005). This lack of expertise and motivation can hinder the introduction of an EMS: the managers do not know how to measure the environmental impacts of the firm and consider their pollution level as insignificant due to the small size of the firm (Bist, 2007). Time constraints can lead to the preference of an informal quality system over a formal one that requires certification and quite often entails bureaucracy (Bist, 2007).

(5) SMEs furthermore display a very narrow customer base, making them extraordinarily dependent on their clients (Bist, 2007). This can pose an obstacle to the introduction of EMSs in case the customers do not explicitly demand more environmentally friendly practices, are indifferent or even oppose such a development (ISO/TC207/SC1/ Strategic SME Group, 2005).

### 2.2.2 Opportunities for SMEs and their introduction of EMSs

(1) Employees of smaller firms are higher committed to the company and are more supportive in implementing changes (Bist, 2007). EMSs can benefit from such firm loyalty, especially EMAS that builds on the participation of all employees.

(2) SMEs are very flexible, allowing them to adapt to changing environments quite quickly although uncertainty remains (Bist, 2007). SMEs incorporate the new guidelines faster into their routine work without having the obstacle of rigid structures. However, I would dispute this argument since SMEs are mostly specialised due to their limited size and staff. The amount of sunk costs is thus relatively higher than for larger firms, making drastic changes costly and unlikely.

(3) A flat management structure in SMEs allows for short decision paths and a more transparent communication (Bist, 2007). That increases the process and time efficiency and can probably offset some of the time constraints set by EMSs' bureaucracy. It also leads to less misunderstandings and consequently to a decreased rate of errors in production, implementation etc.

As can be seen, the challenges outnumber the opportunities quite significantly. This is why SMEs still have a difficult stance when it comes to the introduction of an EMS. Despite their size, SMEs have a considerable impact on the environment, which is why the combination EMS-SME has to be strengthened. In the report *SMEs and the environment in the European Union (2010)*, the authors estimate that in the EU27 SMEs are responsible for approximately 64% of the environmental impact (Constantinos, Sørensen, Larsen, & Alexopoulou et al., 2010). With 55%, Germany is below the average but compared with Slovakia (51%) and the United Kingdom (53%) there is still room for improvement (Constantinos et al., 2010).

### **Appendix 6. Privileging of EMAS certified enterprises by the ministry of BW. Adapted from Lodigiani, 2010, p. 8.**

A privileging of EMAS CC is reflected by the following decrees:

- An abatement of 30% of the fees for financial assistance from public funds that are provided by governmental agencies situated within the Ministry for the Environment - [http://www.gaa.baden-wuerttemberg.de/servlet/is/16499/2\\_2\\_3.pdf](http://www.gaa.baden-wuerttemberg.de/servlet/is/16499/2_2_3.pdf)
- Administrative regulation for administrative facilitation for EMAS sites (Emission protection law, waste law and water law) - [http://www.gewerbeaufsicht.baden-wuerttemberg.de/servlet/is/16492/4\\_4.pdf](http://www.gewerbeaufsicht.baden-wuerttemberg.de/servlet/is/16492/4_4.pdf)

Further privileges:

- Federal state waste law (§ 21) - [http://www.gaa.baden-wuerttemberg.de/servlet/is/16033/1\\_3\\_1.pdf](http://www.gaa.baden-wuerttemberg.de/servlet/is/16033/1_3_1.pdf)
- Federal state water law (§§ 82, 95a, 100) - [http://www.gaa.baden-wuerttemberg.de/servlet/is/16491/1\\_3\\_1.pdf](http://www.gaa.baden-wuerttemberg.de/servlet/is/16491/1_3_1.pdf)
- Ordinance on substances hazardous to water – VawS (§ 23) - [http://www.gaa.baden-wuerttemberg.de/servlet/is/16491/2\\_3\\_05.pdf](http://www.gaa.baden-wuerttemberg.de/servlet/is/16491/2_3_05.pdf)
- Self-control regulation (§ 2) - [http://www.gaa.baden-wuerttemberg.de/servlet/is/16491/2\\_3\\_03.pdf](http://www.gaa.baden-wuerttemberg.de/servlet/is/16491/2_3_03.pdf)
- IVU-regulation on water (§ 3) - [http://www.gaa.baden-wuerttemberg.de/servlet/is/16492/2\\_3.pdf](http://www.gaa.baden-wuerttemberg.de/servlet/is/16492/2_3.pdf)

#### **Appendix 7. The external business environment.**

Hitt, Black and Porter (2005) define the external business environment as “. . . a set of forces and conditions outside the organization [sic!] that potentially can influence its performance” (2005, p. 77). They divide this into the task environment, influencing the company on an immediate basis and the general environment, which affects the firm’s task environment and eventually the firm itself (Hitt et al., 2005). The authors cite the following factors as part of the task environment and decisively influencing the organisation and thus its competitive and strategic position:

- Customers
- Competitors
- Suppliers
- Labour
- Regulators
- Strategic Partner

Relating back to PsD, Porter stated that if the industry structure stayed constant, competitiveness depended on an attractive relative position (Porter, 1991). This positioning can be achieved by responding actively to changes in the task environment (Hitt et al., 2005). For further information about task environmental dynamics, please refer to Porter’s essay on *How competitive forces shape strategy* where he introduces his Five Forces framework (Porter, 1979).

The general environment consists according to Hitt et al. (2005) of the following forces:

- Socio-Cultural Forces
- Economic Forces
- Technological Forces
- Political-Legal Forces
- Global Forces

These are factors on a macro level, which determine the general framework a company does business in. Demographics and economic cycles are only two examples of influencing variables. What is crucial for the path into a greener economic paradigm, is the general external factor of structural change, belonging to Economic forces, which represents longer-term changes (Hitt et al., 2005). Managerial decisions must be very anticipatory in nature and directed parallel to current changes to use the transformation as an opportunity. To channel the view and the actions of the managers into the desired direction, the introduction of EMSs can be considered as being part of the steering wheel. However, even with the introduction of these systems, the company leaders cannot predict the development of every single external factor mentioned. Likewise, it is not possible to account for that in my research due to its complexity.

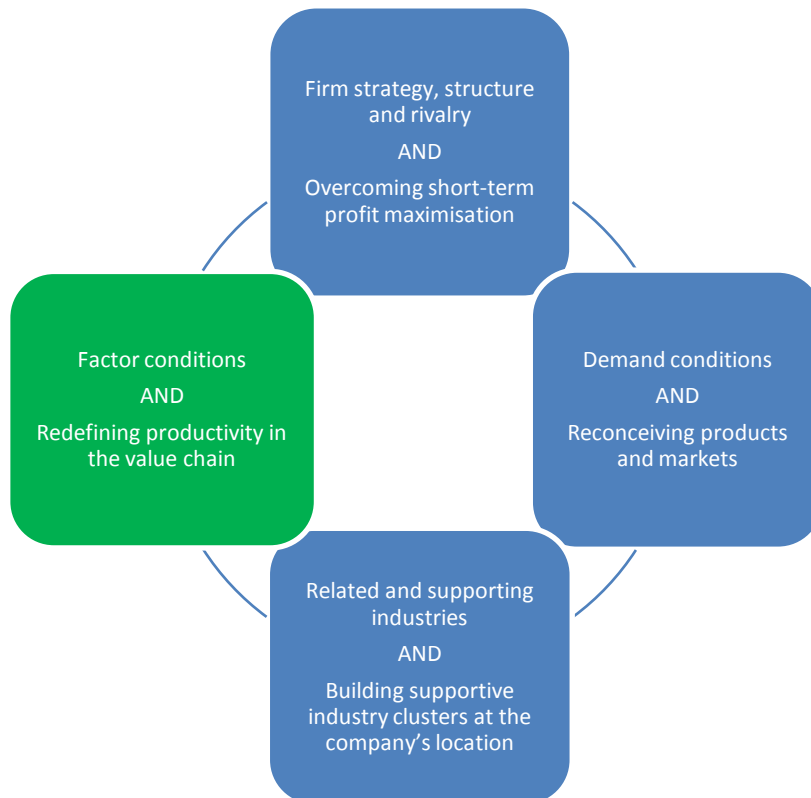
#### **Appendix 8. Porter and Kramer's framework of Shared Value.**

Porter and Kramer (2011) took notice of the debates about one-sided business practices neglecting societal and environmental needs and identified a big part of the problem being “. . . an outdated approach to value creation” (p. 64). Their proposed solution is the introduction of Shared Value into corporate strategy, being characterised by simultaneously creating economic value and value for society (Porter & Kramer, 2011).<sup>30</sup> As the reason why this opportunity has not been seized until today, the authors provide the often still prevalent neoclassical mindset that associates providing social benefits with a decrease in company profits (Porter & Kramer, 2011). The principle of Shared Value is not redistribution but improving the situation as a whole, which can be achieved in three ways: “by reconceiving products and markets, redefining productivity in the value chain, and building supportive industry clusters at the company’s location” (Porter & Kramer, 2011, p. 67). These three activities can be fit to the categories of PsD as presented by Figure 8:

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<sup>30</sup> By writing about value for society, Porter and Kramer seem to include environmental challenges into the realm of societal ones.





**Figure 8. The combined Diamond-Shared Value framework. Highlighted is the field that applies best to how EMSs create Shared Value. Adapted from Porter (1991) and Porter & Kramer (2011).**

EMSs create Shared Value especially by redefining productivity in the value chain by scrutinising its very elements and re-designing them more efficiently. Configuring the value chain and re-positioning the firm is how competitive advantage will be gained and how the response to societal needs becomes an integral part in the corporate agenda (Porter & Kramer, 2011). Since there was no Shared Value attribute that could be allocated to *Firm strategy, structure and rivalry* I chose *Overcoming short-term profit maximisation* due to its relevance in sustainability debates. Porter and Kramer (2011) mention this outdated mindset several times in their article and establish that “[s]hortening investor time horizons began to narrow thinking about appropriate investments”, which lead to a contracted strategic thinking (Porter & Kramer, 2011, p. 66). They declare this mindset to be the reason for missing far greater opportunities (Porter & Kramer, 2011).

#### **Appendix 9. Single steps realised by multi-level purposive sampling.**

1. County: I decided to choose only one county to increase the comparability of the firms, since the support of EMSs and the legal conditions vary for the different counties in Germany. The choice of Baden-Württemberg as my research site was mainly due to it being one of the leading economic regions within Germany and Europe where thousands of SMEs are situated

and innovation hubs have been created (Baden-Württemberg.de, n.d.). This does not justify generalising, but these conditions provided a good framework for my study since motivation and willingness to implement an EMS are likely to be higher in a region that identifies with progress and new technologies.

2. ISO14001 companies: There is no official list where ISO14001 CC are registered, which is the reason I wrote to the German Environmental Protection Agency, the German Institute for standardisation (DIN) and the Swiss ISO Central Secretariat and the main certifiers in Germany. One of the certifiers, TÜV Süd, was willing to provide the requested data of firms certified with ISO14001, presented in an excel table containing all the companies that TÜV Süd had certified up to March 25<sup>th</sup>, 2013. By using only companies from one certifier I again increased the comparability.
3. ISO14001 table editing: To be able to work with the data provided I had to edit the Excel table and sorted first by country, post code and chose only companies in BW. Furthermore, I sorted by sector, which was given by the so called EA-scope, which is allocated by the European Accreditation of Certification. The underlined scope was the main sector I chose whereby I eliminated companies with several underlined scopes, since there could be no unequivocal allocation of a sector. The most common sectors certified with ISO14001 were sector 17.2 with 108 certified companies, followed by sector 18 and 19. To increase my level of response, I decided to concentrate on sector 17.2, which represented basic metals and fabricated metal products, and 17.1 representing metal production, both belonging to sector 17 (Deutsche Akkreditierungsstelle, 2012). Following these considerations, I had to determine how many of these companies were eligible as SMEs according to the EU's definition. However, it was only possible to verify the number of employees, since SMEs are not obliged to publish any data or annual reports. Finally, I decided to eliminate certified sites other than the headquarters to avoid redundancy. After this selection process the sample size for ISO14001-certified enterprises amounted to 44 firms.
4. EMAS CC: To obtain data about EMAS CC was a relatively straightforward process since these data are recorded in online registers. I used the EMAS database to select EMAS-certified companies already sorted by sector (EMAS, n.d.-b). It should be noted, that EMAS uses a different numbering system, the so called NACE-scopes, and does not adhere to the conventional EA-Scope system. For EMAS CC I received a sample size of 27 SMEs.

**Appendix 10. Business indicators. Partly based on Best (2004).**

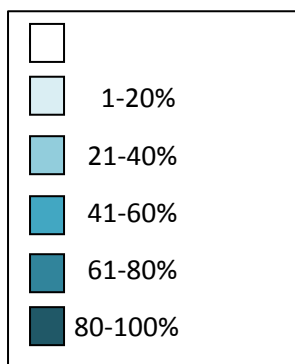
- Acquisition of new customers
- Revenues
- Revenue per customer
- Awareness of company/products
- Profit
- Return on investment
- Product quality
- Costs
- Sales volume
- Return on sales
- Process and time efficiency
- Employee morale

**Appendix 11. Environmental indicators. Partly based on Yin and Schmeidler (2009).**

- Resource use
- Waste reduction
- Emission output
- Energy efficiency
- Costs of regulation
- Health of employees
- Quality of living for residents
- Use of recycled material
- Environmental incidents
- Emergency Preparedness
- Transparency of environmental policy

**Appendix 12. Changes in business indicators within the first three years of the introduction of ISO14001. Displayed by rounded figures.**

	Increased significantly	Increased slightly	Not changed	Decreased slightly	Decreased significantly
Acquisition of new customers		35%	65%		
Revenues		18%	82%		
Revenue per customer		18%	82%		
Awareness of company/ products		41%	59%		
Profit		24%	71%	6% <sup>31</sup>	
ROI		6%	82%	12%	
Product quality		29%	71%		
Costs	6%	35%	29%	24%	6%
Sales volume		12%	88%		
Return on sales		18%	76%	6%	
Process and time efficiency		41%	41%	18%	
Employee morale		76%	24%		

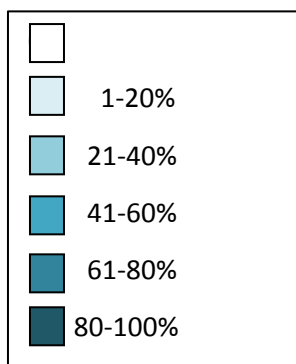


Note: Most of the variables are evenly distributed with variances below 0.3. The variance is highest for the variable *Costs* with 1.11 and thus renders a clear comparison with EMAS difficult due to the 100% of respondents being almost evenly distributed between the five categories.

<sup>31</sup>Due to rounding the figures the total sum for this row is 101%.

**Appendix 13. Changes in business indicators within the first three years of the introduction of EMAS. Displayed by rounded figures.**

	Increased significantly	Increased slightly	Not changed	Decreased slightly	Decreased significantly
Acquisition of new customers		33%	67%		
Revenues		56%	44%		
Revenue per customer		33%	56%	11%	
Awareness of company/ products		44%	56%		
Profit		56%	44%		
ROI		22%	78%		
Product quality	11%	78%	11%		
Costs		44%	33%	22% <sup>32</sup>	
Sales volume		33%	67%		
Return on sales		33%	67%		
Process and time efficiency	22%	67%	11%		
Employee morale	33%	44%	22% <sup>32</sup>		





Note: The highest variances for the variables of EMAS respondents are *Revenue per customer*, *Costs* and *Employee morale*, although these values stay below 0.7 and do not reach such a high spread as *Costs* for ISO14001.

<sup>32</sup>Due to rounding the figures the total sum for this row is 99%.

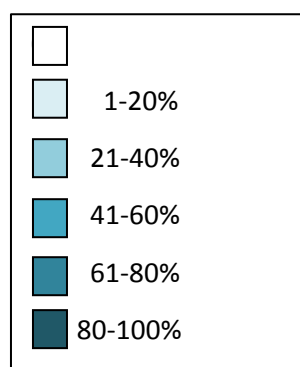
**Appendix 14. Differences in percentage points between ISO14001 and EMAS responses for business indicators. Presented in absolute values (not weighed). “I” represents an increase and “D” a decrease as the desired direction of change of the indicator.**

	Increased significantly	Increased slightly	Decreased slightly	Decreased significantly
Acquisition of new customers - I		2		
Revenues - I		38		
Revenue per customer - I		15	11	
Awareness of company/products - I		3		
Profit - I		32	6	
ROI - I		16	12	
Product quality - I	11	49		
Costs - D	6	9	2	6
Sales volume - I		21		
Return on sales - I		15	6	
Process and time efficiency - I	22	26	18	
Employee moral - I	33	32		

	Better results for ISO14001
	Better results for EMAS

**Appendix 15. Changes in environmental indicators within the first three years of the introduction of ISO14001. Displayed by rounded figures.**

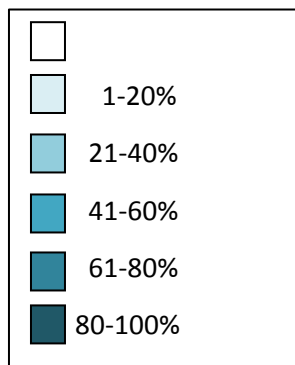
	Increased significantly	Increased slightly	Not changed	Decreased slightly	Decreased significantly
Resource use			12%	82%	6%
Waste reduction <sup>33</sup>	6%	24%	24%	47% <sup>31</sup>	
Emission output	6%		71%	24% <sup>31</sup>	
Energy efficiency		59%	29%	12%	
Costs of regulation			94%		6%
Health of employees		24%	71%		6% <sup>31</sup>
Quality of living for residents		12%	88%		
Use of recycled material	6%	41%	47%		6%
Environmental incidents			41%	41%	18%
Emergency Preparedness	6%	53%	35%		6%
Transparency of env. policy	41%	59%			



<sup>33</sup> Since this variable was formulated inconveniently in the survey (already in negated form), I contacted the respondents, again. The SMEs which replied, however, displayed the same response tendencies as seen above (one exception). Because of that I will include the results of this variable in this study.

**Appendix 16. Changes in environmental indicators within the first three years of the introduction of EMAS. Displayed by rounded figures.**

	Increased significantly	Increased slightly	Not changed	Decreased slightly	Decreased significantly
Resource use		11%		78%	11%
Waste reduction <sup>33</sup>			33%	22%	44%
Emission output		11%	22%	44%	22%
Energy efficiency	22%	11%	11%	56%	
Costs of regulation			100%		
Health of employees		33%	67%		
Quality of living for residents		22%	78%		
Use of recycled material	11%	33%	44%	11%	
Environmental incidents			44%	22%	33%
Emergency Preparedness	11%	44%	33%	11%	
Transparency of env. policy	44%	33%	22%		

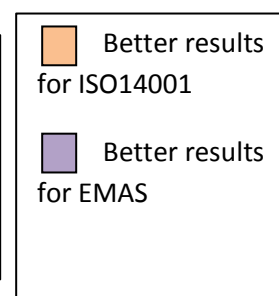


Note: The environmental variables display for the majority of variables a greater variance than the business variables. This is true for ISO14001 and EMAS certified enterprises but may be attributed to outliers. For ISO14001 certified enterprises, the highest variance is the one for *Waste reduction* with a value of 0.985. The highest variance for the variables of EMAS respondents is *Energy efficiency* with a variance of 1.75.



**Appendix 17. Differences in percentage points between ISO14001 and EMAS responses for environmental indicators. Presented in absolute values (not weighed). “I” represents an increase and “D” a decrease as the desired direction of change of the indicator.**

	Increased significantly	Increased slightly	Decreased slightly	Decreased significantly
Resource use - D		11	4	5
Waste reduction <sup>33</sup> - I	6	24	25	44
Emission output - D	6	11	20	22
Energy efficiency - I	22	48	44	
Costs of regulation - D				6
Health of employees - I		9		6
Quality of living for residents -I		10		
Use of recycled material - I	5	8	11	6
Environmental incidents - D			19	15
Emergency Preparedness - I	5	9	11	6
Transparency of env. Policy - I	3	26		



**Appendix 18. Percentages of change in business and environmental indicators that can be directly attributed to the EMSs.**

	Category	ISO14001	EMAS
Percentage of changes in business indicators that can be directly attributed to the EMSs	0-10%	41.18%	33.33%
	91-100%	11.76%	22.22%
Percentage of changes in environmental indicators that can be directly attributed to the EMSs	0-10%	23.53%	33.33%
	91-100%	23.53%	44.44%