Evaluation of effective barriers and initiatives to cleaner production with focus on light industrial SMEs

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ABSTRACT

For modern societies to continue to sustain themselves there needs to be a dissociation between economic growth and environmental degradation or else economic growth will decline consistently together with deteriorating environmental and social health. Various sustainability methodologies can be applied to mitigate against environmental and social degradation. This includes cleaner production which is a proven sustainability methodology that is supported by the United Nations Industrial Development Organisation and the United Nations Environmental Protection Agency in more than eighty countries worldwide.

However application of cleaner production practices amongst SMEs has been below expectations where such practices should have become the norm. We have surveyed SMEs in South Africa, where assessments have been carried out by the local National Cleaner Production Centre, to assess SMEs' perceptions of a range of barrier typologies. Further the barrier methodologies were evaluated to determine whether social responsibility in itself creates a barrier for successful implementation of sustainable practices.

This research established that the barrier typologies are more equally balanced than findings in many developed regions. Furthermore, some barriers such as institutional challenges are not as prevalent compared to other developing regions. It was recognised that regulation can be used as an incentive that has an effect on two groupings or axis of barriers identified in this research. Lastly, it was reputed that structured and clear institutional support and strategies further provide enhanced frameworks that were more beneficial than solely focusing on economics for SMEs.

KEY WORDS

Cleaner production; Barriers; SMEs; Developing regions; Sustainability economics

DECLARATION

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to perform this research.

Adrian Vroom
Signed:

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CHAPTER 1: INTRODUCTION TO RESEARCH PROBLEM

1.1 Introduction to cleaner production

Cleaner Production is defined as 'the continuous application of an integrated preventative environmental strategy for processes, products and services to increase efficiency and reduce risks to humans and the environment' ("Cleaner Production," 2014). Cleaner Production programmes are seen as a cost effective approach to sustainable development; this applies particularly to existing production or service facilities and is highly effective in industrial applications (Luken & Navratil, 2004). Further cleaner production activities focus on operations that include the maximisation of waste reduction, recycling and reusing at an enterprise level (Khalili, Duecker, Ashton, & Chavez, 2014). Cleaner Production is often publicised as a mutually beneficial solution, albeit slightly compromised, that results in environment and social sustainability whilst helping to enhance a company's profitability (Baas, 2007).

Cleaner production methods have been championed on national levels through National Cleaner Production Centres (NCPC) that have been established through the United Nations Industrial Development Organisation (UNIDO) and United Nations Environmental Protection Agency (UNEP), which launched a joint programme to establish Cleaner Production centres or programmes across the globe (Van Berkel, 2010). Of particular interest is that cleaner production practices are of significant importance not only from producing environmentally and socially sustainable solutions but also from an operating efficiency perspective. However although it would appear that cleaner production is a seemingly winning strategy there are barriers to uptake. These can be variable across regions. Further implementation strategies and incentives have varying success rates and what appears to work in one region may not necessarily work in another (Bonilla, Almeida, Giannetti, & Huisingh, 2010).

It is recognised that the inefficient and at times wasteful use of natural resources, including energy, water and materials, lies at the heart of fundamental environmental challenges, including climate change; hence the development and movement towards combining resource efficiency and cleaner production. Thus UNIDO and UNEP have matured the initial programme towards Resource Efficient and Cleaner Production programmes (RECP). RECP recognises that Cleaner Production methods and practices generate multiple benefits that are relevant to many of today's most pressing global challenges but need to be developed further in terms of environmental and social aspects. The main aims of the RECP programme are to address three dimensions of sustainability namely; economic efficiency, environmental management and human development ("Cleaner Production," 2014).

1.2 The case for cleaner production as a major sustainability initiative

Sustainability traditionally encompasses economic/production efficiency, environmental management and social/human development dimensions (Lozano, 2012). RECP has evolved into a framework that addresses all three basic sustainability dimensions. Particularly, cleaner production also addresses issues from both economic and environmental dimensions through cost savings and reduction of waste and further addresses the origins of environmental pollution.

In a production environment two basic measures are used to mitigate environmental effects, namely cleaner production and end-of-pipe technologies (Frondel, Horbach, & Rennings, 2007). Cleaner production reduces resource used and/or pollution at the source whilst end-of-pipe technologies curb pollution by focusing on add-on measures. Control regulations frequently impose technology standards that can only be met through end–of-pipe reduction measures, which may explain a pertinent issue in terms of the application of cleaner production practices. This is contrary to the evidence that preventative management strategies such as cleaner production increase productive uses of

resources, minimise generation of waste and pollution, foster safe production and ultimately lead to more competitive SMEs (Egler & Sieber, 2011).

1.3 The importance of sustainability aspects of SMEs

Small and Medium-sized Enterprises (SMEs) constitute the vast majority of economic activity of many countries. However in most cases sustainability challenges and particularly environmental aspects are left to voluntary mechanisms such as ISO14001 or other governmental programmes such as the European Eco Management and Audit Scheme (EMAS), which is perceived to be ineffective as a mechanism for advancing sustainability in SMEs (Hillary, 2004). Simultaneously, larger firms tend to have more availability of resources to integrate environmental concerns into their product life cycles and processes; larger firms also tend to be more visible and thus subjected to more public scrutiny and thus have more incentives for the application of sustainability initiatives (Lefebvre, Lefebvre, & Talbot, 2003). SMEs thus form a significant sector in which environmental, economic and social aspects require attention mainly due to their lower profile and also because of their substantial portion of production capacity in the economy. A larger number and greater variety of pollutants are produced in the SME sector. Further studies performed in the European community have demonstrated that SMEs are responsible for 50% of pollution and waste. In the United Kingdom SMEs are responsible for 60% of commercial waste and as much as 80% of pollution (Cassells & Lewis, 2011).

Enhancement of corporate image is often a potential force that encourages firms to adopt environmental policies (Mazzanti & Zoboli, 2009). Inasmuch, it is contended that policy inputs do not necessarily generate implementation of environmental or social practices. There is thus a potential for SMEs to be guided towards application of environmental policies by external forces such as the NCPC as their ability to perform assessments of long-term sustainability of current production methods might embolden companies to adopt more environmentally sound practices.

1.4 SMEs' importance in the economy

There is a particular focus on SMEs due to the major contribution they make in the economic activity of any country. SMEs covers approximately 90% of all business activities in Africa and contributes to over 50% of employment and GDP for Africa (Neneh & Van Zyl, 2013). Cleaner Production methods thus provide an important opportunity for particularly industrial SMEs to improve efficiencies and processes whilst employing sustainable practices.

In respect of supply chain pressure in the African region, there is a concern that inadequate measurement and additional bureaucracy involved with most supply chain measurements result in unsuccessful outputs. This can be mitigated if universal methodologies are consistently applied, rather than customised solutions that are implemented on a bespoke basis (Baden, Harwood, & Woodward, 2009).

1.5 Cleaner production and SMEs

The reason for concentrating on cleaner production is that SMEs should be able to compete in constantly changing environments whilst still creating a model for sustainable development (Klewitz & Hansen, 2014). Particular focus in this research study was placed on identifying barriers that inhibit the application of cleaner production initiatives. It is necessary to determine the impact of these barriers, considering the formal governmental and NGO structures that have been created to support cleaner production methods. Furthermore, the rate and success of overcoming these same barriers must be determined. Research has suggested that the origins of any given barrier be evaluated, and that the implications of one barrier on another are further determined (Klewitz & Hansen, 2014; Trianni & Cagno, 2012).

1.6 Research purpose

The aim of the research study was to evaluate effective barriers for SMEs in which the South African NCPC has performed assessments. Simultaneously, the research study sought to evaluate the effectiveness of incentives to overcome barriers and thus generate a positive relationship with SMEs by creating a positive perception of barriers. It has been established that cleaner production is a particular initiative that can be implemented to motivate success as part of economic and environmental dimensions of sustainability. Further, cleaner production initiatives focus on initial steps of any production activity and thus are powerful in mitigating waste and driving efficiencies.

A large body of research has been consulted regarding the barriers that inhibit the application of sustainability practices and/or cleaner production methods. However insufficient research has been conducted regarding the correlation and cross-effect amongst barriers in developing countries (Mitchell, 2006; Massoud, Fayad, El-Fadel, & Kamleh, 2010; van Hoof & Lyon, 2013). This research aimed to add to the existing body of knowledge and enhance the information regarding institutional barriers and resource efficiency/socially responsible barriers while determining incentives that increase application of sustainability practices.

There are further benefits in terms of the relationship between sustainability and business performance for SMEs and the possibility of opening new market niches. It has been established that SMEs form the majority of economic activity in most countries and are also some of the largest contributors to environmental pollution and wastage. It is thus necessary that a measurable, financially viable and economically beneficial practice is implemented for SMEs in the context of the developing world. In order to do this a more profound understanding and expanded view needs to be taken regarding barriers to application that includes institutional and resource efficiency/social responsibility issues. Simultaneously, public perceptions are changing and the cleaner production methodology has been expanded to include resource efficient cleaner production in order to adjust the programme for social issues.

It is pertinent to consider that a better understanding is required to evaluate whether some of these aspects are indeed either incentives and/or barriers to cleaner production. Some of the aspects of resources include social responsibility and quality standards and regulations that may be considered as barriers to application; these are often referred to as green barriers (Yujing & Huihuang, 2007).

1.7 Conclusion to introduction

To further evaluate barriers and incentives to cleaner production in the African context the research report has been constructed as follows; Chapter 2 will review previous published research and build the case for cleaner production as a sustainability initiative, the importance of SMEs and sustainability and further review research carried out in respect of implementation and barrier issues. In Chapter 3 we will propose research questions to evaluate effective barriers and incentives to cleaner production, with focus on barriers and incentives that are perhaps more pertinent to the African context. Chapter 4 will outline the quantitative research method. Chapter 5 and 6 will review results from the research questions posed and surveys conducted. General information will be provided in respect of research questions defined and specific data will be analysed in the hypotheses tests done to support research questions. In Chapter 7 we will provide an overview of the major findings of this research and provide recommendations to both the NCPC and SMEs in respect of the local context for implementation of cleaner production.

The next chapter will further expand on research conducted in respect of cleaner production as a sustainability initiative, and explains the reason for focus on SMEs. We will review implementation strategies and review the complexity of the program across regions that will explain the complexity of barriers to cleaner production for SMEs.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction to literature review

The literature review will provide an overview of cleaner production as a sustainability initiative and compare to the main alternatives that can be evaluated by an SME when evaluating environmental compliance. We will look at the importance of SMEs and the need for sustainability in this sector including an evaluation in the African context.

Implementation will be evaluated and confirmation of the economic rationale for cleaner production will be presented. Implementation complexity across regions will be evaluated and how this has led to complexity of various barriers to uptake across regions. This will explain the research purpose need to evaluate the effective barriers and implementation incentives in the African region and thus, as conclusion to this research, provide insight into possible implementation focus that will lead to success in terms of uptake by SMEs of cleaner production initiatives. At the same time typologies for barriers and incentives that are evaluated in this research will be defined in this chapter.

2.2 Cleaner production and sustainability

The use of natural resources and levels of pollution and waste continue to grow, despite the emerging trend towards sustainable production practices (Sonnemann, Zacarias, & de Leeuw, 2006). Unless there is dissociation between economic growth and environmental degradation, modern societies will be unable to sustain themselves. Thus in every sector of economic activity there is growing pressure to ensure that practices are implemented that are perceived as being sustainable for the future.

The changes in production processes that result in improved performance in dimensions of environmental, economic and social performance are an important element of any process related to sustainable production (Dvarionienė,

Kruopienė, & Stankevičienė, 2012). It is necessary to analyse innovative process approaches that meet both basic needs and allow for sustainable development; process innovations are positioned to allow for production of a given amount of output with less input (Frondel et al., 2007). Cleaner production is a methodology that concentrates primarily on efficiencies in the production process by utilising various tools. Cleaner production has become the most widely adopted tool amongst various environmental management practices; however the actual application of environmental management practices still remains low (Khalili et al., 2014).

2.2.1 Cleaner production technology

Cleaner production technologies are adopted due to inefficient production processes. Cleaner technologies have three essential effects namely:

- Precision effect; allowing a better application of inputs in terms of quality, quantity and timing.
- Productivity effect; less input is required to achieve the same output.
- Pollution effect; reduced generation of waste, the greater the input effectiveness the lower the quantity of input waste discharged.

All the effects of cleaner technologies connect efficiency to waste reduction (Grimal, 2003).

Technologies used in the African context often focus on optimisation of equipment, optimisation of processes and replacement of heating, cooling and electrical installations with more efficient equipment (Kambani, 2003).

2.2.2 End-of-pipe technologies

Cleaner production processes are often seen to be better than end-of-pipe technology implementation, i.e. end-of-pipe processes result in curbing polluting measures by using pollution control add-on measures (Frondel et al., 2007). There is a clear relation between the stringency of environmental policies and

regulatory measures that use end-of-pipe technologies, whilst costs saving and general management systems tend to favour clean production processes (Frondel et al., 2007), indicating that there is a direct correlation between incentives used and application of a particular environmental management system in a production environment.

Beyond the obvious benefit of fixing a problem at the source, it was promulgated by Grimal (2003) that cleaner production has other benefits that reinforce competitiveness against abatement or end–of-pipe systems; these include:

- Variable unit costs are reduced, owing to precision and pollution effects.
- The whole firm's production process is reorganised, leading to supplementary savings in productivity,
- The cost of pollution control is reduced.
- The quality of newly manufactured goods is better from an ecological perspective.

2.3 Small and Medium-Sized Enterprises

2.3.1 Factors affecting SMEs

In the developing world 90% of all enterprises are categorized as SMEs, as the definition expounds that these organisations employ less than 500 employees. This sector of the economy provide employment and opportunities for millions of people, however it can be considered that SMEs produce higher levels of pollution when compared to larger enterprises operating in the same sector because of their production techniques (Hobbs, 2000).

At SME level there are certain specific determinants or incentives of innovation that can be related to sustainability innovation, as explained by the following points:

- Internal factors normally include a technology push

- External factors are formulated by market pull
- Environmental regulation can be established from either push or pull factors.

(Cuerva, Triguero-Cano, & Córcoles, 2014)

Although examples of internal and external factors are demonstrated as being successful, there remains a concern that regulation that includes subsidies often fail to encourage frugality in resource management (Hobbs, 2000). This may indicate an issue in respect of environmental regulation as a driver of production innovation, as supported by Brown and Stone (2007).

External factors such as market pull appear to have the greatest impact. In the United Kingdom, more than 82% of SME enterprises have indicated that they apply sustainability initiatives due to requirements as a condition for supply (Baden et al., 2009). The very nature of SMEs means that these firms have lean organisational structures and are dominated by their owners/managers, therefore they are more susceptible to being value driven (Klewitz & Hansen, 2014). Inasmuch, only very particular types of firms may be inclined to have internal factors pushing towards sustainable practices.

2.3.2 SMEs local context

The NCPC in South Africa was established in 2002 and it predominantly facilitates the innovation and implementation of technologies that produce the required cleaner production results and the organisation has a vital role to play in the country's socio-economic future (Scholtz, 2008). However it has confirmed that a characteristic of the region is that many institutions are unable to perform effective regulatory and monitoring mandates due to inadequate resources (Kambani, 2003). There has thus been a move to ensure internal control *via* the transfer of technical skills from the South African NCPC to the necessary firms, which has actively been involved in facilitating transfer of skills through their green skills programme.

Comparatively in Brazil it has been found that for small mining companies, they are unable to solve sustainability problems on their own because of poor levels of adoption primarily due to lack of skills transfer; however the programme cannot be seen as a failure (Silvestre & Silva Neto, 2014). Cleaner production technologies can be seen as expanding the scope towards sustainability. A procedure that encompasses managerial and policy changes is suggested as the appropriate methodology to use, as it will create the necessary synergies to drive companies towards sustainability.

2.3.3 Strategy in SMEs

It has been argued that SMEs can become highly efficient suppliers in global supply chains by implementing sustainable practices (Moore & Manring, 2009). Further by ignoring sustainability elements many firms will be missing new opportunities that are presented by a more consciously-sustainable world. Perhaps an issue in particular amongst SMEs is a lack of focus on surrounding factors that must involve analysis regarding regulation, economy, information, location, stakeholders, and trends in the market and government policy. These factors can possibly be regarded as fundamental to allowing SMEs to determine and strategically place themselves in the greater ecosystem in which they operate (Baas, 2007).

Generic technologies such as end-of-pipe technologies often tend to diffuse more rapidly than real clean technology. End-of-pipe technologies are often developed by dedicated equipment's' suppliers who are able to effectively market these products. However it is becoming apparent that these methods are inadequate in significantly compensating for the continuing growth of the global economy and the environmental degradation that is inherent to growth, and that these methods are likely to exacerbate the problem (Moore & Manring, 2009).

There is mention of entrepreneurial resistance to cleaner production technologies and it is often the expectation that government needs to incentivise any processes that are required to be implemented (Silvestre & Silva Neto, 2014). However, incentivised schemes often leads to isolated cases of improvement

amongst companies and it could be argued that companies do not take any ownership and responsibility for ensuring the success of improvement and processes; the ability to create competitive advantage is simply not realised (Moore & Manring, 2009).

It should also be considered that SMEs are able to act more nimbly to fill local, specialised and niche markets compared to large organisations and are ideally positioned to assimilate cleaner production technologies more quickly than their larger competitors (Klewitz & Hansen, 2014).

2.4 Implementation

2.4.1 Methodologies and incentives

Concurrent to the lack of strategic focus from SMEs in implementing cleaner production technologies, a review of literature and implementation methodologies for cleaner production found that there are very fragmented, differing methodologies that can be applied for the successful implementation including; focus on awareness amongst employees (Ribeiro Massote & Moura Santi, 2013), focus on operational change (Rivera, González, Carrillo, & Martínez, 2009), use of quality tools (Lopes Silva, Delai, Soares de Castro, & Ometto, 2013), using theory of inventive problem solving (Kubota & da Rosa, 2013), focus on waste recycling and prevention rather than energy efficiency (van Hoof & Lyon, 2013), using game theory software simulation (Zhao, Neighbour, McGuire, & Deutz, 2013), creating synergies between value management, value analysis and cleaner production (Henriques & Catarino, 2014).

While there are clear success examples of SMEs implementing cleaner production strategies that are available, as indicated by previous research, the application and a consistent framework focusing on cleaner production implementation does not appear to be available. Evaluation of the cleaner programme across 19 different centres has found, particularly, that there is scope for improvement in effectiveness and efficiency and further that clarity on programme performance and success is required (Berkel, 2011). In actual fact

the lack of effectiveness and efficiency appears to prevent programmes from being adapted, thereby hindering success. It is important to determine the barriers of application of cleaner production amongst industrial SMEs and to establish a framework detailing the benefits of cleaner production, which also provides a pathway to achieving results by utilising minimum resources.

There are many examples of successful implementation frameworks and methodologies. The challenge remains to establish success within a particular context. One example of success is a Canadian approach that focused on stakeholder involvement rather than on methods and financial benefits of cleaner production. The stakeholder community consciously drafted regulatory compliance, education, co-funding of incentives and development based programmes (Taylor, 2006). This has created a climate in which cleaner production programmes are well-designed and suited to each firm's individual needs whilst still sharing some common drivers or methods between sectors.

Other more structured examples of implementing cleaner production processes include using a sustainable value methodology though an eight phase working plan (Henriques & Catarino, 2014):

a.) Gathering general data from company

b.) Defining the project

c.) Identifying operations, including outputs and inputs

d.) Promoting a functional analysis

e.) Calculating a problem synthesis

f.) Identifying ideas that can be selected

g.) Performing a viability analysis

h.) Deriving an action plan driven by top management

Based on this working plan it is hoped that economic value though improvement of processes is created. The environmental aspect is controlled through the reduction of waste and the social aspect is addressed through improved communication and changed behaviours.

In the case of the quality tools approach, a 12 phase working plan is implemented as follows (Lopes Silva et al., 2013):

a.) Top management commitment

b.) Employee engagement

c.) Organise cleaner production team

d.) Presentation of methodology to the team

e.) Company assessment

f.) Data collection

g.) Creating performance indicators

h.) Data evaluation

i.) Identification of options for improvement

j.) Implementation

k.) Evaluation

l.) Programme continuity

Lopes and Silva's (2013) assessment has a strong case in that many methodologies rather rely on assessment and data collection with little focus on the structure of the programme, the team responsible for the programme and the definition of the goal that seeks to be achieved. By focussing on analysis and synthesis without concentrating on top management and employee commitment, it often results in delegating authority to middle management levels in order to

drive a cost effective solution, which has frequently proven to be unsuccessful (Khan, 2008).

2.4.2 Implementation business performance

In two separate studies conducted in China and the Netherlands, a positive correlation was found to exist between cleaner production methods and business performance for SMEs (Gombault & Versteege, 1999; Zeng, Meng, Yin, Tam, & Sun, 2010). Yet as previously discussed, application of cleaner production has been low in spite of proven economic performance (Hillary, 2004). It is difficult to establish current verified statistics that indicate the current application levels.

End-of-pipe technologies have traditionally been expensive and uneconomical to install and provide no real improvement in the efficiency of materials that are used. Cleaner production has a dual function of both economic and environmental benefits and thus provides a direct connection to improved business performance (Lin, Kun, & Dejuan, 2011).

2.4.3 Complexity through evolution of the programme

It becomes imperative to emphasise that the cleaner production programme has evolved into a complex system that uses differing methods of encouraging and implementing cleaner production across different nations. Further, cleaner production centres each have very differing structures. This results in complexity as barriers vary across regions due to stages of development of industry and the governmental programmes or organisational initiatives that implement cleaner production.

As an example, Chile has implemented a system of voluntary cleaner production agreements between private companies in the same production sector and public bodies that have an interest in the agreement. The aim was to create coordination between the various governmental institutions involved and industries within that particular sector to ensure that aims of productive and environmental enhancement are achieved (Bezama, Valeria, Correa, & Szarka, 2012).

In the case of New Zealand, cleaner production is promoted through industry self-management without the establishment of any formal cleaner production centres. Funding for programmes has been channelled through a 'sustainable management fund' and the preference is to avoid a rule-based regime that may have a less positive environmental outcome (Brown & Stone, 2007b). This may be successful, particularly in New Zealand, where environmental impact is perhaps less obvious and also where a strong community NGO oversight is commonplace.

On the other extreme China has suffered far-reaching impacts from industrial pollution and thus has implemented the Cleaner Production Promotion Law, which has been in effect from 2003. The aim has been to transfer government's tendencies towards addressing end–of-pipe pollution treatment towards pollution prevention, and specifically aimed at strategic enterprises that deal with either hazardous substances and or are viewed as heavy polluters (Shi, Peng, Liu, & Zhong, 2008). Provincial structures run the programme and there is varying success amongst the provinces that are dependent on drivers of economic growth and pollution within a particular province (Dan et al., 2013).

Furthermore van Berkel (2010) has delineated how the NCPC's arrangement in developing countries were completed in near-identical ways; however over time these have evolved in response to internal factors and country-specific factors (Van Berkel, 2010). Generally the NCPCs can be categorised according to their focus on either audit and training, specialist services or networking services.

2.5 Barriers to cleaner production uptake

2.5.1 Barrier typologies

A barrier can be defined as a "a postulated mechanism that inhibits investments in technologies that are energy and economically efficient" (Trianni & Cagno, 2012). Any single barrier can then be classified according to a particular typology. Weber (1997) has hypothesised that there are four distinct typologies of barriers to cleaner production, namely:

a) Institutional barriers i.e. those caused by government and regulations.

b) Obstacles conditioned by the market, market barriers or market failure.

c) Organisation barriers.

d) Behavioural barriers.

Further, Sorrell, Schleich, Scott, O'Malley, Trace, Boede and Radgen (2000) developed a comprehensive taxonomy that failed to consider institutional barriers (see Appendix A). A general criticism of these typologies is that they are somewhat generic in applicability to larger corporate organisations and not relevant to SMEs, particularly those in developing nations. Shi, Peng, Liu and Zhong (2008) have slightly amended these typologies to better suit the Chinese situation as follows:

a.) Policy and market barriers that include lack of regulatory enforcement, absence of incentive policies, weak public awareness and barriers.

b.) Financial and economic barriers; these include high cost of capital, poor performance of cleaner production and lack of effective performance measurements for cleaner production.

c.) Technical and information barriers that include limited capability and lack of access to external technical support, additional infrastructure requirements and lack of technical training on the workshop floor.

d.) Managerial and organisational barriers; management resistance to change, higher priorities to product expansion and market share.

These typologies have again been supported by applicability to Brazilian SMEs (Lopes Silva et al., 2013). Furthermore, these typologies provide an effective way to categorise barriers and thus formulate policy and methods to deal with these barriers. However, barriers can be derived from other issues in the developing world. Simple policy formation and action does not adequately address these issues. In research carried out in Vietnam, Mitchell (2006) has found some systemic root causes of inaction:

a.) Policy environment; lack of funds and absence of trained personnel to perform policy objectives.

b.) Dependence on outside assistance; it has been argued that lack of training is in reality an issue, as whether training is carried out particularly when this is from outside involvement, remains to be measured.

c.) Traditional corporate culture; an overly bureaucratic culture and low responsiveness to incentives, as found in Vietnam, have an impact on application.

d.) Weak internal auditing and accounting; this impacts data that can be used in calculating volumes of waste and further at determining which points in the production process waste is produced.

e.) Relevance of cleaner production; there is an absence of consensus regarding whether the methodologies employed in the developed world are applicable for the developing world.

It has been also established that environmental and human development dimensions formulate a barrier in the form of strict regulation and technical standards commonly known as green barriers (Yujing & Huihuang, 2007). In this research, barrier typologies have been expanded to include green barriers that focus on environmental and social responsibility principles. In principle, these are the same to the expansion of the cleaner production programme to RECP methodology. Research on a corporate level has found that these types of programmes that include socially responsible and environmental management aspects have shown significant positive economic return (Ortas, Burritt, & Moneva, 2013).

It is evident that there is some variation concerning the pertinent barriers and their typologies towards the application of cleaner production depending on the whether the business is located in the developed or developing world, and then further based on the stage of development of free enterprise within the country

and the general norms and behaviours that manifest themselves in the management of these companies.

In terms of relevance of cleaner production it has been found that command control structures (Thollander, Danestig, & Rohdin, 2007) developed during the 1980s and 1990s for developed countries in implementing cleaner production have not worked. Rather, practices are stimulated by a transformation in environmental governance that are pioneered mainly by private entities and other governance structures that are participatory, consensual and cooperative (Er, Mol, & van Koppen, 2012). The stimulation of environmental governance often takes the form of a customer organisation imposing environmental requirements on their suppliers.

2.5.2 Cross effects of barriers

There is also evidence that supports the case for more profound understanding of barriers to ensure that company managers are able to make investment decisions, and that policymakers are empowered to make appropriate policy decisions (Cagno & Trianni, 2014).

Trianni and Cagno (2012) have found some correlations amongst barriers that affect SMEs. However, these appear to be weak causal relationships. For example, people without sufficient technical skills would find that they had insufficient information to make decisions (Trianni & Cagno, 2012). The major conclusion from their study is that the correlations that were analysed indicated that there is a high variability of correlation between barriers regarding the sizes of organisations within the SME sector, and further with regard to the sector of operation. This reinforces the need to develop effective comprehension of the barriers to gain comprehension of the dynamics and effects on and between barriers.

Further, Massoud, Fayed, El-Fadel and Kamleh (2010) performed a study that ranked barriers for the application of cleaner production processes for SMEs. There initially appeared to be a correlation of issues because of obvious causal relationships such as unknown financial benefits related to lack of knowledge and

failure by regulators to promote cleaner production and thus reduce costs (Massoud et al., 2010). However, it has been emphasised that perspectives amongst various stakeholders can vary and there is no correlation between a hierarchy or ranking of barriers between different stakeholders, such as government, enterprise and practitioners (Shi et al., 2008).

2.5.3 Policies affecting barriers

Low prices of inputs have often not been conducive to the diffusion of cleaner production. However taxation, subsidies, liability and permits all tend to be more favourable to cleaner production, although regulation is still not seen as a primary incentive for application thereof (Reijnders, 2003). In recent times, escalating energy costs have led to the emerging trend of applying cleaner production as a tool in demand side of management (Thollander & Ottosson, 2010). Many countries have adopted a combination of both regulatory drivers and incentive programmes to advance cleaner production (Taylor, 2006). These policies form a set of tools that can be used to mitigate the effects of some barriers. Taylor (2006) specified that a co-funding model to support SMEs has been particularly effective where resources are not always available. Taylor (2006) further mentioned that absolute measures such as waste per tonnage should be used rather than any relative measures such as percentage reduction measures.

Specifically in the South African context, it has also been found that financial, poor and weak enforcement of environmental laws and lack of knowledge/awareness as well as technical incompetence contribute to the challenges of implementing cleaner production processes (Siaminwe, Chinsembu, & Syakalima, 2005).

2.6 Conclusion and summary of literature review

In summary, the argument for the necessity of cleaner production has been developed, as an essential element of sustainability. Furthermore, the literature reviewed has provided confirmation that the use of cleaner production is more effective than abatement or end-of-pipe processes.

Further, reasons have been established for the selection of SMEs as the focus of the research study, mainly because these enterprises are the predominant economic activity driver. Moreover the local African context has been analysed in terms of implementation of cleaner production amongst SMEs and the need for cleaner production as an essential part of African firms' strategies has been established.

In terms of implementation, the literature reviewed provided a description of the methodologies and incentives currently used. These have been connected to improved business performance, while there has been an increased account of cleaner production implementation being regarded as complex, culminating in the development and augmentation of programmes across the many countries that have implemented these cleaner production processes.

Lastly, the problems of cleaner production, namely barriers to application, were analysed. It was noted that much research was developed that resulted in clear and consistent typologies for barriers. However, these need to be adjusted for the local context. The cross effects or correlation amongst barriers were also explained, in the hope to illuminate methods to mitigate barriers. As such, a barrier was defined as either a financial, behavioural, organisation, institutional or resource efficiency/social responsibility obstruction.

A factor that affected application was defined as either internal incentive, external incentive or environmental regulation incentive.

Table 1: Research Matrix

Research question	Authors	Findings
1.) What are the effective barriers to entry for light industrial SMEs to cleaner production?	Weber (1997)	First to define financial, behavioural, organisation and institutional barrier typologies. Acknowledged that barrier approach helped decision makers overcome problems. however indicated that this will often lead to technical solutions
	Sorrell et al (2000)	General typologies are broken down into 12 categories with the exception of institutional typology Arguably the most comprehensive study done on barriers however solely based in Europe. Argued for greater policy mix and policy intervention.
	Shi, Peng, Liu, & Zhong, (2008)	Twenty barriers identified and grouped into four categories. Indicated that Chinese firms predominantly faced economic and poor regulation as barriers to uptake.
	Lopes Silva, Delai, Soares de Castro, & Ometto, (2013)	Twenty one barriers were identified in Brazil. Results were inconclusive though as only partial results received.
	Mitchell (2006)	Examined root causes affecting cleaner production implementation in Vietnam and introduced institutional barriers.
2.) Is there a significant relationship between barriers?	Cagno & Trianni, (2014)	Stressed the need to properly evaluate barriers, particularly from viewpoint of different dimensions such as company level and technology level. Suggested behavioural and organisational barriers will always be linked. There further distinction done between internal and external drivers of barriers.
	Massoud, Fayad, El-Fadel, & Kamleh, (2010)	Government support and stakeholder demand are significant barriers affecting perception around economic barrier.
	Shi, Peng, Liu, & Zhong, (2008)	There should be a focus on external policy and economic barriers rather than internal and managerial barriers.
	Trianni & Cagno, (2012)	Research conducted in SMEs that confirmed no relationship between institutional and organisational/behavioural barriers.

3.) Is there a significant relationship between factors for uptake and barriers to uptake	Cuerva, Triguero-Cano, & Córcoles, (2014)	Research looks at identifying key incentives for green innovation. This is then linked to overcoming some barriers such as economic barriers.
	Brown & Stone, (2007)	Highlights that a wide range of incentives have proven successful in overcoming barriers to energy efficiency
	Taylor (2006)	Links incentive programmes based on identified barriers in Canada.
	Baden (2009)	Majority of SMEs based on study in the UK are considering taking up sustainability initiatives primarily because of external incentives, specifically customer requirements.
	Reijnders (2003)	Established regulation as a primary incentive in the European region.

CHAPTER 3: KEY OBJECTIVES, RESEARCH QUESTIONS AND HYPOTHESIS

3.1 Introduction to research questions

The research question and hypothesis follow on from the literature reviewed in Chapter 2. This research study aimed to establish and identify barriers that inhibit the application of cleaner production and further sought to relate the application of cleaner production to incentives. The research problem evaluates the true effective barriers that inhibit the application of cleaner production, their relationships with and the effects on each other and determines the relationship between incentives and barriers. This analysis was performed based on a survey of organisations where assessments were carried out by the South African NCPC.

Extensive research has been conducted concerning cleaner production processes implemented by SMEs in the South African context. However it has been affirmed by the absence of research that this particular research is required in order to gain a more profound understanding of barriers and incentives particularly in the African context. This research aimed to add to the existing body of knowledge and update as required by adding additional variables to barriers of institutional and resource efficiency/social responsibility and to further enhance the understanding of the roles that incentives play in increasing application of cleaner production. The effective barriers that firms have experienced are evaluated, and the relationship, if any, between barriers and between barriers and incentives is determined.

3.2 Research questions and hypotheses

3.2.1 Effective barriers to application of cleaner production

Both Mitchell (2006) and Shi *et al.* (2008) emphasised that further research is required regarding the determination of barriers and to understand the particular

variability of barriers that are evident across the developing world. The cleaner production programme has also evolved over time to now include resource efficiency in order to provide a more comprehensive system that includes social and environmental aspects. These issues have been included as a barrier to ascertain whether the requirements, for example a health and safety programme in the workplace, would be viewed as a barrier. In common research these barriers are described as green barriers or barriers related to social responsibility (Ortas et al., 2013). Particularly due to the applicability of institutional barriers to the developed world and due to introduction of resource efficiency/social responsibility barriers, this research study's hypothesis examined the effectiveness for these two barriers.

Research question 1:

What are the effective barriers to entry for light industrial SMEs to cleaner production?

The following hypotheses have been stated:

H1a: There is a positive relationship between cleaner production application and positive perception of institutional barriers.

H1b: There is a positive relationship between cleaner production application and positive perception of resource efficiency/social responsibility barriers.

3.2.2 Determining a significant relationship between barriers to cleaner production

Regional differences were noticeable when the literature was reviewed. Shi *et al*. (2008) emphasised that in the Chinese setting regulation and economic barriers had to be related in order to make the programme effective. Cagno and Trianni (2012) felt that organisational and behavioural barriers are always related. The study aimed to add to this research by identifying additional relationships. The focus was on barriers that are of possible applicability in the region, and it was

measured whether these barriers have any relation to economic barriers due to the requirement that cleaner production needs to make economic sense.

Research question 2:

Is there a significant relationship between barriers?

The following hypotheses have been stated:

H2a: There is a positive relationship between the perception of economic barriers and positive perception of institutional barriers.

H2b: There is a positive relationship between perception of economic barriers and positive perception of resource efficiency/social responsibility barriers.

3.2.3 Relationship between incentives for application and barriers to cleaner production

Regional differences were apparent during the literature review. According to Taylor (1996), incentives were established and functional in both Canada and New Zealand, where the New Zealand programmes are predominantly voluntary and different from incentives found in the developing world. China, as a case study for the developing world, has many regulations and legal requirements in place, as discussed by Shi *et al*. (2008) Cuerva *et al.* (2014) identified economic barriers as predominant barriers. The perception of incentives and their relationship in particular to economic barriers are also analysed.

Research question 3:

Is there a significant relationship between factors that induce application and barriers to application?

The following hypotheses have been stated:

H3a There is a positive relationship between positive perception of internal incentives and positive perception of economic barriers.

H3b There is a positive relationship between positive perception of external incentives and positive perception of economic barriers.

H3c There is a positive relationship between positive perception of regulatory incentives and positive perception of economic barriers.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 Introduction to research methodology

This chapter will define the research process followed in order to collect and analyse the data used in the analysis and conclusions for the previously defined research questions and hypotheses to be tested. The focus is on collecting data from SMEs in which evaluations from the NCPC have been carried out, to analyse both barriers and incentives to cleaner production.

4.2 Research design

The research approach that has been taken is a deductive, causal, quantitative study that describes the relationship between application of cleaner production, companies' perceptions of barriers and perception of incentives for application of cleaner production. The study was constructed on a cross-sectional basis and primary data was collected for all variables by means of a survey conducted online.

A quantitative approach was selected in order to accurately describe the current perceptions within the region, pertinent to cleaner production initiatives and barriers. The research study sought to create a statistically significant conclusion in respect of the sample being surveyed. Particularly, the research study pursued the confirmation and assessment of relationships between barriers, and the relationship between barriers and incentives. The quantitative approach enabled the researcher to use precise statistical measurements to confirm and evaluate these relationships. A quantitative approach further makes use of a sample that is selected in a manner that is representative of the population. Thus the aim of the research design was to develop a research approach that provided conclusive results and findings.

4.3 Scope of research

The research made use of proven barrier typologies to cleaner production, as developed by Sorrell *et al.* (2000) and Weber (1997) discussed previously in the literature review. These barriers were further expanded on and additional barriers were included and subsequently categorised as institutional and resource efficiency/social responsibility based were added, consistent with Mitchell's (2006) recommendations. However, any other form of research regarding barrier typologies was excluded to account for complexities arising due to typologies being developed for specific regions. Essentially, a qualitative study would have been better suited to establish additional barrier typologies that may be specific to a particular region. This research study was restricted to companies in which cleaner production assessments have been conducted. It must be noted that this research study selected respondents, of which the majority were organisations that have successfully implemented cleaner production due to their positive perception regarding the initiative.

The decision to restrict the scope of research to known barrier typologies and known incentive typologies ensured a clear response that identified perceptions of known barriers and their relationship to each other. This is an area had been identified for further research and as such, it was required that the focus of this study was to add to the knowledge of known barrier typologies. By limiting the research to include only companies in which the NCPC had performed assessments was based on the companies surveyed, as these had knowledge of cleaner production and further understood the concepts and benefits involved.

4.4 Population

The population of this research included companies where the NCPC performed assessments since 1 January 2011 to 30 June 2014, irrespective of whether these companies implemented any cleaner production initiatives or not. The companies are in the industrial sector and predominant activity is manufacturing and/or processing of goods and are classified in the SME sector. The listing of

the respective companies' contact details were provided by the South African NCPC. This list was verified according to the definition of SME companies to ensure that companies that did not prescribe to the relevant criteria were removed from the population surveyed.

The research study expanded the definition used for SMEs to accommodate the South African context. The SME definition has varied widely in relation to the Cleaner Production field. In the Chinese case study examined by Shi *et al*. (2008) their definition of a SME was a company that employed less than 2000 employees. In the South African context, the National Small Business Act of 1996 places a limitation of between 100 and 200 employees on the SME, depending on the sector of operation, and included certain other financial restrictions that were incorporated into the definition of a SME. However most developed countries define an SME as any company with less than 500 employees (Monks, 2011). A large body of research was analysed regarding Cleaner Production practices in SMEs, and these studies have used the limitation of 500 employees for the definition of a SME (Trianni & Cagno, 2012). For the sake of consistency and international relevance, this research study used a definition that included organisations with a maximum number of 500 employees in order to match other research within the field.

4.5 Unit of analysis

The unit of analysis for this research study were companies. This allowed for the testing of all variables on a company level, including barriers and incentives. Cleaner production methodology is based on a companywide assessment and has multiple tools for effect throughout a company, affecting all dimensions of sustainability including economic, social and environmental aspects and may cut across functional departments that include but are not limited to operations, financial and quality.

4.6 Sampling technique

Sampling was based on a non-probability technique. Total population purposive sampling was used whereby the entire population was surveyed where NCPC had performed assessments (Levy & Lemeshow, 2013). The listing of the companies' details was verified based on demographic data collected for the companies in the research survey to verify compliance with the research study's definition of a SME company. There was a requirement in respect of validity of responses that represented a valid cross-section of companies across all industrial sectors and across all regions that were surveyed.

Sampling was done by means of an online survey, where a hyperlink was emailed to all recipients and they were subsequently invited to complete the survey. This was considered to be the most efficient way in allowing busy SME owners and employees to complete the survey in their own time. Internet-based surveys are considered to have reached a matured status and their usage is now standardised by various companies offering online survey programmes.

The targeted sample size was based on a calculated figure in accordance with Cochran's sample size formula for continuous data. In this research the T-value is selected for alpha level of 0.05. Standard deviation is calculated for a five point Likert-type scale at 1,02 (includes 98% of all values in the range). The margin for error is estimated at 0, 0625. The resultant minimum sample size is calculated at 60. Based on a final calculation of population size, Cochran's correction formula was applied to arrive at the final sample size. The initial listing provided by the NCPC consisted of 216 companies, this number was then narrowed to include 131 companies after excluding companies that did not prescribe to the SME definition or for which contact details no longer existed. The final corrected sample size was calculated as 41. The corrected number of companies from Cochran's formula was then evaluated against the *rule of thumb* (30 sample size required for statistical significance) (t distribution approximate normal distribution at this point) (Kotrlik & Higgins, 2001) to ensure that the returned sample was statistically valid.

Incidence rates within this research were of no consequence as the population consisted of companies in which cleaner production surveys were performed.

Research seems to indicate that the response rate with online surveys can be expected at the 20% mark (Deutskens, De Ruyter, Wetzels, & Oosterveld, 2004). Many of the articles reviewed for this research study indicated response rates of up to 40%. Completion rates of surveys are a further concern with expected completion rates of online surveys established at 50% (Hansen & Smith, 2012). It was thus recognised that responses were required to be motivated in order to ensure that the adequate sample size was achieved from responses. A regime of multiple follow-ups, that involved both emails and telephone calls were used. Other methods of surveys included email- and telephone-based surveys, but these methods are no longer considered feasible in terms of driving higher response rates due to the longer time periods that are required by respondents to complete.

The concern existed that sampling may produce bias in results, particularly if all regions and industrial sectors are not represented proportionally to the population. Of particular concern was the potential for low response, leading to non-response bias. Non-response bias is related to differences between respondent and non-respondent survey scores. As previously mentioned it is recognised that most respondents who completed the survey have probably successfully implemented cleaner production techniques. Further it needs to be noted that additional barriers that may be peculiar to the region were not identified in this study; however this research did not intend to identify these barriers and it was aimed at adding to the body of research concerning existing identified barriers.

4.7 Research instruments

The research was conducted using an online survey. The instruments were classified into three sections and were constructed in order to modify the study, depending on survey response rates to allow for more detailed analysis of

additional qualitative and quantitative data if survey response rate was sufficient. The first section dealt with collecting demographic data of the firms, namely location, size and whether cleaner production methodologies were actually implemented.

The second section evaluated incentives based on internal, external and regulation factors as postulated by Cuerva *et al*. (2014). Data collected for incentives was based on an ordinal scale. Primarily this research did not evaluate differences between incentives but rather established opinions and ranked the effect these had on decisions to proceed with or decide against Cleaner Production. Thus a ranking scale was used to grade the ten incentive questions to establish the predominant incentives that drove the application of cleaner production.

The third section was categorised to evaluate barriers to application (Weber, 1997; Sorrell et al 2000) including institutional and resource efficiency barriers, as postulated by Mitchell (2006) and Yujing *et al*. (2007). Questions were phrased in a particularly positive manner to measure positive perceptions in overcoming barriers, taking into consideration that most respondents are likely to have been companies that implemented Cleaner Production initiatives. In this section a five point Likert-type scale was used and 24 individual statements were posed for evaluation. Questions were directly related to Sorrell ***et al's*** (2000) and Mitchell's (2006) typologies and were used to evaluate the five different barriers that form the basis of this study.

4.7.1 Reliability and validity

The research instrument sought to provide consistent findings. To that extent, reliability relates to the consistency of the research hence affirms the use of a consistent methodology of barriers. Cronbach's alpha was used to test the reliability of the instruments as measure of internal consistency (Carmines, 1979).

Validity is concerned whether the instruments actually measures what they are meant to measure. All questions were phrase in respect of Sorrell ***et al's*** (2000) taxonomy that classified the main barriers into 14 distinct segments. Mitchell

(2006) further categorised institutional barriers into five distinct segments. Resource efficiency was delineated into two distinct segments. All questions in the survey were phrased in respect of these distinct segments that then form the individual barriers. The same approach was taken with evaluating incentives, where standard segments were each incorporated into question, constituting the three individual incentive categories as described by Cuerva *et al* (2014).

4.7.2 Pre testing

The questionnaire was evaluated by three different project managers from the South African NCPC to assess whether questions were consistent with barrier and incentive segments and that they were easily understood by anyone with knowledge of cleaner production methodologies.

Further tests were completed by the researcher's supervisor and family members to investigate that the instrument actually worked in terms of logic and capturing of data.

4.8 Data analysis

Data analysis exported the relevant data from the online survey system and imported into IBM SPSS statistics software. Data was already coded and the variables were defined.

Univariate-type analysis was first performed to present descriptive statistics concerning the sample and to address details in respect of the research questions. Hypothesis testing was then done by using bivariate methods, particularly using Spearman Rank Order correlation measures, which is suitable for non-parametric measurements and suitable for categorical and non-normal distributions.

4.9 Limitations

Limitations of this research study were recorded as follows:

Non-response bias; as previously explained there is a concern about the limitations of the research in that predominantly, the respondents were companies in which cleaner production methodologies have been effective. Further the study limited itself to companies which had assessments performed and it can be assumed that their perceptions of application of cleaner production is different from those of firms in which surveys and assessments have not been carried out. Further, results may be skewed by region and thus measurement could have been skewed towards particular region's sentiments.

Measurement bias may have been evident if insufficient sample size was attained. The sample was not representative of the population, making the study inconclusive in its findings. This limitation was evident in many of the prior studies concerned with cleaner production, such as Silvestre and Neto's (2014) study in small-scale mining, which focused on only one specific region and that concluded that many respondents were unable to articulate some of their answers, therefore the study proved to be inconclusive.

Sampling bias is the deviation from the true traits and characteristics of the population. In theory this is mitigated by sampling the entire population. However response and completion rates could have made sampling bias apparent once the survey was completed.

4.10 Conclusion to research methodology

The research methodology process has been defined that will address collection and analysis of data for our research questions. The next chapter will address the statistical analysis of the data collected.

CHAPTER 5: RESULTS

5.1 Introduction to results

The results chapter provides firstly a description of the characteristics of the sample and some of the characteristics are compared to the population. Details regarding scale reliability, distribution of scores and the suitability of bivariate analysis are stated and the resultant data cleaning that is implemented based on the analysis of both scale reliability and distribution of scores is described. General results pertaining to each research question is stated and results from each hypotheses test is stated afterwards.

5.2 Characteristics of sample

All variables providing demographics for the sample are categorical and are thus presented by way of frequencies to describe the characteristics of the sample.

In terms of business location, the predominantly returned sample is from the Cape (Western and Eastern) region of South Africa:

Table 2: Region where business located, returned sample

	Frequency	Percent	Valid Percent
Cape	31	57,4	57,4
Gauteng	14	25,9	25,9
Natal	9	16.7	16.7
Total	54	100,0	100,0

This can be compared to the defined study population which shows region distribution as follows:

Table 3: Region where business located population, all companies where assessments carried out

	Frequency	Percent	Valid Percent
Cape	73	55,7	55,7
Gauteng	43	32,8	32,8
Natal	15	11,5	11,5
Total	131	100,0	100,0

It is thus evident that the Gauteng region is under-represented in the sample and the Cape and Natal regions are approximating within 5% the population distribution.

Further, in terms of the size of organisation, predominantly firms are in the categories of below 50 employees or between 200 and 500 employees:

Table 4: Number of employees in organisation

	Frequency	Percent	Valid Percent
<50	14	25,9	25,9
<100	11	20,4	20,4
<200	10	18,5	18,5
<500	19	35,2	35,2
Total	54	100,0	100,0

By industrial type, the sample is predominantly from the agricultural and manufacturing industries and then other processing and food/beverage industries.

Table 5: Industrial sector

	Frequency	Percent	Valid Percent
Agriculture	13	24,1	24,1
Automotive	5	9,3	9,3
Construction, Machinery, and Real Estate	1	1,9	1,9
Food & Beverages	8	14,8	14,8
Manufacturing	20	37,0	37,0
Other manufacturing and processing	7	13,0	13,0
Total	54	100,0	100,0

Both the number of employees and industrial sector are difficult to compare to the population as no readily public information is available for SME companies involved in order to gain an awareness of the distribution between sectors and number of employees in the population. Further, it is imperative that it is considered that the findings of this study might be particular to the dominant sectors and organisations' size groupings.

As a further note most of the companies surveyed predominantly implemented cleaner production techniques, which was recognised as concern when the study methodology was developed.

Table 6: Have implemented Cleaner Production

	Frequency	Percent	Valid Percent
Yes	39	72,2	72,2
No	15	27,8	27,8
Total	54	100,0	100,0

An equal proportion of yes/no answers would have allowed a more thorough statistical analysis of the drivers of the yes/no decision in terms of implementation.

5.3 Response rate

The initial population and sample size surveyed was defined at 131 companies. Fifty-four companies were included in the total returned response, thus resulting in a response rate of 41%. The total valid responses, whereby the survey was fully completed in all sections, included 34 responses. The survey completion rate was thus 63%.

In order to improve the response rate each survey collector was left open for three weeks. In the first week all non-respondents and respondents that did not opt-out of the mailing list were sent reminder emails every second day, after which another three emails were sent over next two weeks. A total of six reminder emails were sent to respondents to complete the survey.

In order to further enhance completion rates, respondents who did not fully complete the survey were contacted telephonically in order to provide help to complete the survey. New emails were sent to these respondents, however the campaign proved unsuccessful and none of these respondents subsequently completed the survey; all duplicate responses were removed from the sample.

Contact details for many of the companies were further double-checked by an intern from the South African NCPC by comparing the physical documentation for assessment and these details were updated to reflect the corrections, if applicable. This increased the population size from 105 companies to 131 companies after duplicate entries were removed from the listing. The result was that three separate collectors were used in the survey system, as further updated contact details were received during the course of the research.

5.4 Scale reliability

Scale reliability is tested by means of a Cronbach's alpha calculation which is a measure of internal consistency. These scores are summarised in the tables below by categories of barriers and incentives.

Table 7: Barrier questions, Cronbach's alpha

Barrier	Cronbach's Alpha	N of Items
Economic	,827	8
Behavioural	,759	5
Organisational	,608	2
Institutional	,759	5
Resource Efficiency	,601	4

Further inter-item correlation matrixes were examined to ensure that there were no negative correlations. Organisational barrier and resource efficiency barrier had a Cronbach's alpha lower than 0, 7. However when reviewing the correlation between the two items that constitute the organisational barrier scale, there was a medium strength relationship of 0,452. The decision was made to maintain the organisational barrier scale due to their apparent relationship (Pallant, 2007). In terms of resource efficiency/social responsibility a decision was made to delete the management culture question and social responsibility questions with a resultant Cronbach's alpha of 0,803 and a mean inter-correlation of 0,671. The results after this adjustment are as follows:

Table 8: Barrier questions adjusted, Cronbach's alpha

Barrier	Cronbach's alpha	N of Items
Economic	,827	8
Behavioural	,759	5
Organisational	,608	2
Institutional	,759	5
Resource Efficiency	,803	2

The incentive question results are stated below:

Table 9: Incentive questions, Cronbach's alpha

Incentive	Cronbach's Alpha	N of Items
External	,818	3
Internal	,784	4

Regulatory incentive was based on one question of regulation and no Cronbach's alpha measurement was necessary.

5.5 Definition of variables

A detailed list of all variables measured in the survey is provided in Appendix B. However most analyses discussed in this research were based on calculated variables, which were indicated with labels commencing with a capital “T”. Scores for the sub-variables were simply added together and divided by the number of sub-variables that comprised the barrier or incentive in order to produce scores that are numerically consistent with the variables measurements. Further, the implementation of cleaner production initiatives was recoded in order to provide a positive score that is higher than the negative score. The listing of calculated variables is shown in the table below:

Table 10: Research variable codes

Variable	Namecode data	Type	Measure
Calculated Variables Barrier	TEconomicBarrier	Numeric	Scale
	TBehaviourialBarrier	Numeric	Scale
	TOrganisationBarrier	Numeric	Scale
	TInstBarrier	Numeric	Scale
	TReBarrier	Numeric	Scale
Recoded Demographic	NImplementation	Numeric	Nominal
Calculated Variables Incentive	TIncentiveInternal	Numeric	Ordinal
	TIncentiveExternal	Numeric	Ordinal

5.6 Distribution of scores

In the case of barrier variables, distribution of scores was tested for normality of distribution. However most scores were distributed towards the highest score or positive side whilst some distributions demonstrated very sharply peaked distributions and other cases flat distributions were evident:

Table 11: Scores distribution evaluation

	N	Skewness		Kurtosis	
	Statistic	Statistic	Std. Error	Statistic	Std. Error
TEconomicBarrier	34	-2,638	,403	11,888	,788
TBehaviourialBarrier	34	-,968	,403	1,091	,788
TOrganisationBarrier	34	-,085	,403	-,444	,788
TInstBarrier	34	-,979	,403	,820	,788
TReBarrier	34	-1,199	,403	5,313	,788
Valid N (listwise)	34				

Further analysis of the data revealed an outlier case whereby one respondent completed the same score for all questions. This case was removed and distribution normality was re-evaluated.

Table 12: Score distribution after correction

	N	Skewness		Kurtosis	
	Statistic	Statistic	Std. Error	Statistic	Std. Error
TEconomicBarrier	33	,326	,409	,499	,798
TBehaviourialBarrier	33	-1,060	,409	1,816	,798
TOrganisationBarrier	33	,055	,409	-,560	,798
TInstBarrier	33	-,995	,409	1,312	,798
TReBarrier	33	,859	,409	-,610	,798
Valid N (listwise)	33				

Some improvement was noted; however many of variables still demonstrated a non-normal distribution. Thus only non-parametric analysis was used in statistical analysis of the variables.

5.7 Bivariate analysis

For the bivariate analysis a significance level of 5% was used throughout all tests. A p-value below 0, 05 would be a statistically significant result. All correlations were measured using the Spearman rho calculation, which is suited to the non-normal distribution of the data and further suitable for some of the categorical variables used in the tests (Pallant, 2007). The following approach was used in all tests: the null hypothesis was stated and then Spearman rho calculation

results were stated. On the basis of significance levels and resultant correlation figures, the null hypothesis was either accepted or rejected. In some cases a covariance figure was included, which may also be seen as an indicator of practical relationship between the two variables and was seen as an additional indicator of strength of relationship. Where possible, scatterplots were reviewed to evaluate the directional and strength of relationship between the two variables.

5.8 Research Question 1

In this question effective barriers to cleaner production initiatives for SMEs were measured. Descriptive statistics give an indication by way of mean values that indicate perhaps a more effective barrier. A lower mean value indicates a low positive perception of the barrier and thus possibly indicates that the barrier is more difficult to handle in implementation:

Table 13: Descriptive statistic barriers

	N	Minimum	Maximum	Mean	Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Statistic
TEconomicBarrier	33	2,88	4,63	3,7121	,36642
TBehaviourialBarrier	33	1,40	4,20	3,3273	,60996
TOrganisationBarrier	33	2,50	5,00	3,5303	,66072
TInstBarrier	33	1,80	4,20	3,3697	,53179
TReBarrier	33	3,50	5,00	4,2576	,43519
Valid N (listwise)	33				

5.8.1 Hypothesis H1a

H1a: There is a positive relationship between cleaner production application and positive perception of institutional barriers.

For this test the dependent variable is cleaner production implementation and the independent variable is institutional barrier. Statistical significance is set at $p<0,05$. The null hypotheses can be stated as follows:

Ho: There is no positive relationship between cleaner production application and positive perception of institutional barriers.

Table 14: Spearman rho result H1a

		NImplementation	TInstBarrier
NImplementation	Correlation Coefficient	1,000	,004
	Sig. (1-tailed)		,491
	N	53	33
TInstBarrier	Correlation Coefficient	,004	1,000
	Sig. (1-tailed)	,491	
	N	33	33

No correlation was found between the two variables at 0,004. Due to the significance level of 0,491 and no correlation, there is insufficient evidence to reject the null hypothesis.

5.8.2 Hypothesis H1b

H1b: There is a positive relationship between cleaner production application and positive perception of resource efficiency barriers.

For this test the dependent variable is cleaner production implementation and the independent variable is resource efficiency/social responsibility barrier. Statistical significance is set at p<0,05. The null hypotheses can be stated as follows:

Ho: There is no positive relationship between cleaner production implementation and positive perception of resource efficiency/social responsibility barriers.

Table 15: Spearman rho result H1b

		NImplementation	TReBarrier
NImplementation	Correlation Coefficient	1,000	-,123
	Sig. (1-tailed)		,248
	N	53	33
TReBarrier	Correlation Coefficient	-,123	1,000
	Sig. (1-tailed)	,248	
	N	33	33

A very small negative correlation was found between the two variables at -0, 123. Some 1,5 percent of variance in the scores between the two variables was explained by their correlation. Due to the significance level at 0 ,248 and the small negative correlation, there is insufficient evidence to reject the null hypothesis.

5.9 Research Question 2

In this question the additional relationships between barriers were identified. The findings are summarised in a global picture from the Spearman rho correlation amongst the five barriers. It was apparent that there are some significant relationships between economic, behavioural, organisational and institutional barriers:

Table 16: Total correlation barriers

	TReBarrier	TEconomicBarrier	TBehaviourialBarrier	TOrganisationBarrier	TInstBarrier
TReBarrier		-,060	,008	,243	-,086
TEconomicBarrier	-,060		.518**	.413*	.602**
TBehaviourialBarrier	,008	.518**		.612**	.481**
TOrganisationBarrier	,243	.413*	.612**		.487**
TInstBarrier	-,086	.602**	.481**	.487**	
**. Correlation is significant at the 0.01 level (2-tailed).					
*. Correlation is significant at the 0.05 level (2-tailed).					

5.9.1 Hypothesis H2a

H2a: There is a positive relationship between perception of economic barriers and positive perception of institutional barriers.

The dependent variable is an economic barrier and the independent variable is an institutional barrier. Statistical significance is set at p<0,05. The alternative hypothesis can be stated as follows:

Ho There is no positive relationship between perceptions of economic barriers and positive perception of institutional barriers.

Table 17: Spearman rho results H2a

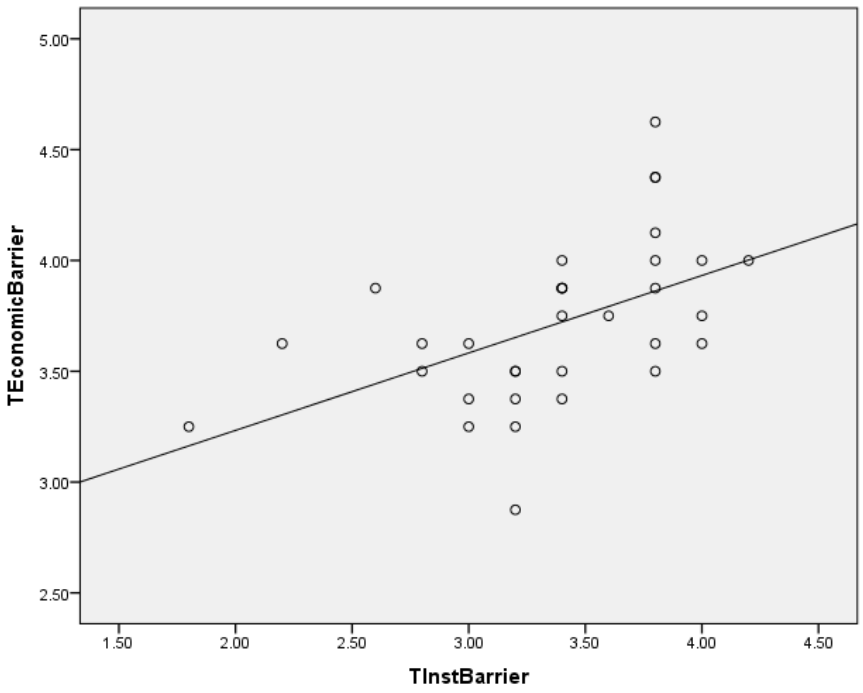
		TEconomicBarrier	TInstBarrier
TEconomicBarrier	Correlation Coefficient	1,000	.602**
	Sig. (1-tailed)		,000
	N	33	33
TInstBarrier	Correlation Coefficient	.602**	1,000
	Sig. (1-tailed)	,000	
	N	33	33

**. Correlation is significant at the 0.01 level (1-tailed).

A strong positive correlation coefficient exists between positive perception of economic barriers and institutional barriers. Some 36% of variance within these barriers was explained by their correlation. Due to significance level of 0,000 and large positive correlation, the null hypothesis is rejected and the alternate hypothesis is accepted.

It is important to realise that when checking the scatterplot for the two variables, the presence of some outliers is shown that affected the correlation statistic. The decision was made not to exclude the outliers in order to maintain validity in the statistical analysis.

Figure 1 Scatterplot economic and institutional barriers



5.9.2 Hypothesis H2b

H2b: There is a positive relationship between perception of economic barriers and positive perception of resource efficiency/social responsibility barriers.

For this case the dependent variable is the economic barrier and the independent variable is resource efficiency/social responsibility barrier. Statistical significance is set at $p<0,05$. The alternative hypothesis can be stated as follows:

Ho: There is no positive relationship between positive perception of economic barriers and positive perception of resource efficiency/social responsibility barriers.

Table 18: Spearman rho results H2b

		TEconomicBarrier	TReBarrier
TEconomicBarrier	Correlation Coefficient	1,000	-,060
	Sig. (1-tailed)		,370
	N	33	33
TReBarrier	Correlation Coefficient	-,060	1,000
	Sig. (1-tailed)	,370	
	N	33	33

There is no correlation between resource efficiency/social responsibility and economic barriers. Due to significance level of 0,370 and there being no correlation, there is insufficient evidence to reject the null hypothesis.

5.10 Research Question 3

It remained to be identified whether any of the relationships emphasised in research question 2 were explained by incentives for application of cleaner production. The perception is always that economic barriers are often the most limiting factor. A global view of incentives was analysed against the standardised barrier variables.

A Spearman rho calculation was used for evaluating relationships between incentives and barriers. The only immediate significant relationship is demonstrated between regulatory compliance incentive and organisational barrier:

Table 19: Correlation incentives and barriers

	TIncentiveInternal	TIncentiveExternal	IncentRegCompliance
TEconomicBarrier	,239	,070	,305
TBehaviourialBarrier	,096	-,038	,303
TOrganisationBarrier	,180	,020	.437*
TInstBarrier	,224	-,240	,283
TReBarrier	,173	,322	,218

*. Correlation is significant at the 0.05 level (2-tailed).

5.10.1 Hypothesis H3a

H3a: There is a positive relationship between perceptions of internal incentives and positive perceptions of economic barriers.

The dependent variable is the economic barrier and independent variable is the internal incentive. Statistical significance is set at p<0,05. The null hypothesis can be stated as follows:

Ho: There is no positive relationship between perceptions of internal incentives and positive perceptions of economic barriers.

Table 20: Spearman rho results H3a

		TIncentiveInternal	TEconomicBarrier
TIncentiveInternal	Correlation Coefficient	1,000	,239
	Sig. (1-tailed)		,098
	N	32	31
TEconomicBarrier	Correlation Coefficient	,239	1,000
	Sig. (1-tailed)	,098	
	N	31	33

There is a small correlation between internal incentives and economic barriers. Only some 5,7% of variance is explained by their correlation. Due to the weak correlation and significant level at 0,098, there was insufficient evidence to reject the null hypothesis.

5.10.2 Hypothesis H3b

H3b: There is a positive relationship between positive perceptions of external incentives and positive perceptions of economic barriers.

The dependent variable is economic barriers economic barriers and the independent variable is economic barriers. Statistical significance is set at p<0,05 The null hypothesis can be stated as follows:

Ho: There is no positive relationship between positive perceptions of external incentives and positive perceptions of economic barriers.

Table 21: Spearman rho results H3b

		TIncentiveExternal	TEconomicBarrier
TIncentiveExternal	Correlation Coefficient	1,000	,070
	Sig. (1-tailed)		,357
	N	31	30
TEconomicBarrier	Correlation Coefficient	,070	1,000
	Sig. (1-tailed)	,357	
	N	30	33

There is a no correlation between external incentives and economic barriers. Due to no relationship and statistical significance at 0,357, there is insufficient evidence to reject the null hypothesis.

5.10.3 Hypothesis H3c

H3c: There is a positive relationship between positive perceptions of regulatory incentives and positive perceptions of economic barriers.

The dependent variable is economic barriers and the independent variable is regulatory incentives. Statistical significance is set at p<0,05. The null hypotheses can be stated as follows:

Ho: There is no positive relationship between positive perceptions of regulatory incentives and positive perceptions of economic barriers.

Table 22: Spearman rho results H3c

		TIncentiveReg	TEconomicBarrier
TIncentiveReg	Correlation Coefficient	1,000	.305*
	Sig. (1-tailed)		,047
	N	32	31
TEconomicBarrier	Correlation Coefficient	.305*	1,000
	Sig. (1-tailed)	,047	
	N	31	33

*. Correlation is significant at the 0.05 level (1-tailed).

There is a medium strength correlation between positive perceptions of economic barriers and regulatory incentives. Some 9,3% of variance in positive relationship between the variables is explained by their correlation. With the positive correlation between the two variables and a significance level at 0,047, there is sufficient evidence to reject the null hypothesis and to accept the alternate hypothesis.

5.11 Summary of hypotheses tests

The below table provides a summary of all hypothesis results for this research:

Table 23: Hypothesis results summary

Research hypothesis	Accepted
H1a: There is a positive relationship between cleaner production uptake and positive perception of institutional barriers	No
H1b: There is a positive relationship between cleaner production uptake and positive perception of resource efficiency barriers.	No
H2a: There is a positive relationship between perception of economic barriers and positive perception of institutional barriers.	Yes
H2b: There is a positive relationship between perception of economic barriers and positive perception of resource efficiency barriers	No
H3a: There is a positive relationship between perception of internal incentives and positive perception of economic barriers	No
H3b: There is a positive relationship between positive perception of external incentives and positive perception of economic barriers.	No
H3c: There is a positive relationship between positive perception of regulatory incentive and positive perception of economic barriers	Yes

CHAPTER 6: DISCUSSION OF RESEARCH RESULTS

6.1 Research results introduction

The main objective of this research study was to evaluate the effective barriers and incentives to cleaner production for SMEs in the local context. It was emphasised that there is some variability in barriers depending on region and level of economic development within a country. This has led to the scope of cleaner production methodologies being variable across NCPC's, thus having an impact on perceived barriers and incentives and the approaches that need to be taken to overcome the same barriers (Van Berkel, 2010).

Although the results did not identify clear or predominant barriers and incentives, the first research question identified certain barriers that are slightly more predominant, namely institutional and behavioural barriers. In the second research question that sought to measure the relationships between barriers, two clear axis were noted, namely an external orientation of economic and institutional barriers and internal orientation of organisational and behavioural barriers. In the third research question, the only incentive with any positive-with-positive perception of barriers is between regulation incentives and economic barriers. It was also noted that there appears to be a relationship between regulatory incentives and organisational barriers.

A crucial limitation of the research that has become apparent on review of results is that barriers have not been evaluated on a technology level. Of the 25 respondents who provided details of the types of cleaner production implementation carried out, some 23 of these were focused on energy improvements with only two respondents who focused on waste improvements. Most installations included a simple optimisation improvement including changes to lighting, improving motors, compressed air management and so forth. This supported Kambani's (2003) findings that in the African context most improvements are from an equipment optimization perspective. The improvements may be particularly relevant to SMEs in terms of the smaller scale

of plants, however a more comprehensive methodology should be applied that focuses on energy efficiencies, waste reduction and the resource efficiency dimension of human development and environmental management for the programme to be truly effective. The analysis of barriers and their relationships may thus vary when analysing a more comprehensive implementation structure.

6.2 Discussion of research question 1

Both Weber (1997) and Sorrell *et al* (2000) had developed and researched barriers and defined the pivotal role these play in the application of sustainability practices and/or cleaner production applications. Sorrell *et al* (2000) carried out comprehensive research at the turn of the century that further classified the categories into 12 distinct typologies, as shown in Appendix A. On the basis of this study, Sorrell *at al* (2000) had recommended greater policy mix and policy intervention to overcome these barriers. A consistent policy and intervention has been established by way of the cleaner production programme through UNIDO and UNEP. However, as van Berkel (2010) delineated, the programme has evolved very specifically in each country due to internal and external factors. It is thus important to determine what has possibly brought some of those changes about, particularly in the developing world.

The study in China, performed by Shi *et al*. (2008), identified economic and regulation barriers as significant amongst some twenty odd barriers identified. This research study supported the findings of Shi *et al.* (2008) in terms of identifying regulations and the policy environment as part of institutional barriers that are perceived to be an obstacle. This is indicated by the mean score of 3.37 for institutional barriers that encompasses weak internal and external auditing and accounting, poor policy environment and poor organisational and management skill sets. This research study similarly supported the conclusions of Lopes *et al*. (2013) regarding the Brazilian SME environment. Further, the findings of this research study in terms of institutional barriers support Mitchell's (2006) study in Vietnam in relation to institutional barriers being of consequence.

An additional significant barrier to cleaner production application was identified as the behavioural barrier. A study supporting this research study's finding was performed in Hungary and in particular it was found that internal incentives were the largest factor driving behavioural issues (Zilahy, 2004). At the same time professional competence was viewed as a major driver to overcome this barrier. As suggested by Trianni and Cagno (2014), organisational and behavioural barriers are often related and it can be deduced that organisational barrier issues relate to behavioural barrier issues. Organisational attitude drives the professionalism required to overcome some of the behavioural barriers.

Anecdotal evidence suggests that in the SME environment the economic barrier is the most significant to overcome. In the survey, additional comments for improving the programme were made; some 16 different comments were provided and these mainly included institutional and financial barriers. Of the 16 comments made, 12 of these were concerned with financial issues. This may be a result that the constant focus of an SME is the bottom line. However the results from this question indicated that a broader focus should be placed on overcoming institutional, economic, behavioural and organisational barriers to together as a set. What is apparent is that resource efficiency aspects such as implementing more social responsibility and quality management have no significant impact on application of cleaner production processes.

6.2.1 Research hypothesis H1a findings

Hypothesis H1a examined the relationship between cleaner production application and positive perceptions of institutional barriers. It was emphasised by Mitchell (2006) that particularly in developing countries, a more common barrier to cleaner production application is institutional and thus there is the need to evaluate this barrier in the South African context. As discussed in this literature reviewed in Chapter 2, institutional barriers are significant. It was found though that there is no significant relationship between cleaner production application and institutional barriers. The possibility exists of Type II error, this can be due to both sample size and bias evident in terms of the division between returned sample of people that have implemented cleaner production initiatives and those

companies that have not. The research hypothesis would thus suggest an inconclusive result.

6.2.2 Research hypothesis H1b findings

In Hypothesis H1b cleaner production application was evaluated against resource efficiency/social responsibility barriers. There was a very weak negative correlation, although this was not statistically significant. Again, there is a concern that Type II error is applicable and that this is due to small sample size and bias inherent within the sample. A continuous result shown in this research is that organisations that are focused on social and environmental aspects are more concentrated on these two aspects. All results for resource efficiency/social responsibility barriers are distinct from the other barriers; it can thus be possibly speculated that priority for other sustainability techniques such as cleaner production techniques is somewhat lower and that the two can perhaps be seen as two separate and distinctive initiatives i.e. there is a distinction between cleaner production and resource efficiency.

Another particular consideration in SME environments is the limitation of resources. Many SMEs cannot attend to all three dimensions of sustainability namely; economic efficiency, environmental management and human development (Lozano, 2012). Resource efficiency barrier is focused in the dimension of human development and environmental management and is comparable to the term eco-efficiency (Glavič & Lukman, 2007). It can thus be speculated that SMEs either focus on producing eco-efficiency results, predominantly in the social and environmental dimensions, or focus purely on cleaner production and that these two systems are mutually exclusive.

6.2.3 Conclusion to research question 1

The aim of this question was to establish the effective barriers to cleaner production. The hypothesis tests were focussed on barriers that are outside of Weber (1997) and Sorrell *et al*. (2000) original typologies and that are perhaps more pertinent to the context of developing countries, to evaluate whether these

barriers carry any significance. This study was inconclusive in whether these barriers carry any significance. It was however apparent that institutional and behavioural barriers carry some weight, based on the lowest mean scores in descriptive statistics in Table 12. However when analysing the descriptive statistics in Table 12 in respect of the barriers, mean scores are all in the range of between 3,3 and 3,8, which indicate a standard deviation from 0,4 to 0,7; this indicates that all barriers carry very similar weightings and that there is no clearer or stronger barriers to cleaner production with the exception of resource efficiency/social responsibility, which appears to be ineffectual as a barrier.

6.3 Discussion of research question 2

In this question the relationships between barriers were determined and evaluated. These relationships were of interest in terms of ensuring whether organisations are able to overcome the barriers; a comprehensive strategy can be developed that addresses all significant barriers simultaneously, and further allow the ability to evaluate whether any other variables motivate these results. In this research study it was apparent that there was a positive relationship between organisation and behavioural barriers, thereby supporting the research done by Cagno and Trianni (2014). Organisational barriers are often driven by management behaviour and this has a direct impact on behavioural issues within the organisation.

Further there are statistically significant relationships shown in this study amongst economic, organisational, behavioural and institutional barriers. Shi *et al*. (2008) proposed that there should be a focus on economic and institutional barriers rather than internal and managerial barriers. However, the results from this research study suggested that all four barriers need focus in order to succeed and that policy direction needs to be as comprehensive as possible.

In the results it was evident that institutional and economic barriers are strongly correlated (0,602) and that organisational and behavioural barriers are also strongly correlated at (0,612). This indicated that there is internal and external

barrier orientation and that policy can perhaps take a two-pronged approach to focus separately on internal and external barriers and that these cannot be seen as mutually exclusive in order to succeed; both areas need to be addressed in order to drive success in the cleaner production programme.

Of interest here is that although there is a statistically significant relationship between institutional barriers and/or organisational and behavioural barriers this is not as significant as a relationship when compared to that of internal/external barriers axis and the relationship between barriers in these groupings. An assumption would have been that there would be a large positive relationship between institutional and behavioural/organisational barriers, better information and guidance should lead to better perceptions regarding the behavioural/organisational level. Trianni and Cagno (2012) came to the same conclusion in their study and ascribed this to underestimating awareness and that the result is driven by limitations of their research. This may have the same effect in this research study due to the small sample size and perhaps due to the need for a stronger institutional regime (Trianni & Cagno, 2012).

Resource efficiency/social responsibility barriers appeared to be insignificant in their relationship to other barriers of cleaner production. This supports Massoud *et al.'s* (2010) observation that certain firms are more likely to focus on resource efficiency aspects rather than cleaner production aspects and that barriers facing resource efficiency will not necessarily reflect in cleaner production implementation (Massoud et al., 2010). Further, this research supports Massoud *et al.'s* (2010) finding regarding relationships between institutional and economic barriers and that these external factors are seen as a significant entity.

6.3.1 Research hypothesis H2a findings

Hypotheses H2a tested whether there is a positive relationship of positive perceptions between economic barriers and institutional barriers. The results are significant and the hypothesis that there is a positive relationship was accepted. This is of significance, as Mitchell (2006) described that in the developing world

institutional barriers are of major consequence. As the institutional barrier has a positive relationship to economic barriers this has large impact in terms of controlling the economic rationale for implementing cleaner production.

However caution needs to be demonstrated in terms of institutional support. Mitchell (2006) emphasised an issue in Vietnam of over reliance on outside financial and technical assistance which in itself then becomes a barrier. Thus it is imperative that institutional support is well-managed and does not foster an over-reliance on support.

6.3.2 Research hypothesis H2b findings

Hypotheses H2b evaluated the relationship between economic and resource efficiency/social responsibility barriers. There is no correlation between these two barriers. It appeared that resource efficiency/social responsibility barriers and economic barriers are in no way related to each other and need to be managed separately. Again Type II errors may be present due to sample size.

However, considering that no relationship can be established with cleaner production application and no relationship exists with any other barrier, further consideration needs to be given to taking into account that resource efficiency elements of the programme are mutually exclusive from cleaner production for SMEs. This may be due to the SMEs in the sample operations being in sectors where no significant standards are in place that effectively form the commonly known green barriers (Yujing & Huihuang, 2007). These standards are not driven by any governing body or measured in a consistent way. The result also supports Ortas *et al.'s* (2013) findings that perhaps resource efficiency/socially responsible barriers can be seen as somewhat weak.

6.3.3 Conclusion to research question 2

It is vital to note that all barriers can still be seen as somewhat effective as shown by a relative narrow band of scores and large degree of correlation, with the exception of the resource efficiency/social responsibility barrier. However when developing any policy or practical tools, focus needs to be on combining initiatives

that address both institutional/economic barriers together and organisation/behavioural barriers together. It has been speculated that an institutional barrier approach would have an effect on organizational and behavioural barriers, however it would seem that specific measures need to be formulated that address organisational/behavioural barriers separately.

6.4 Discussion of research question 3

In this question incentive variables and whether these have any impact on or can possibly explain the relationship identified in research question two were evaluated. The relationship of incentives specifically against economic barrier were evaluated, as identified as the predominant barrier by the study of Cuerva *et al.* (2014). The predominant rationale with any SME is undoubtedly an economic one in terms of making the implementation decision and thus the research study sought to identify whether any particular incentive has an impact on this barrier.

The only significant apparent relationship however shown by the overview of matrix of correlations in Table 17 is apparent between regulatory incentive and organisational barriers. This is probably somewhat significant in that regulatory measures have an effect on organisational and primarily managerial levels within an organisation. However it appeared that the typologies of incentives as proposed by Cuerva *et al* (2014) are not particularly suited in overcoming the issues involved in making an economic decision.

Cuerva *et al* (2014) had found that certain internal incentives were the largest drivers, including quality management systems, in a reduction in financial constraints for SMEs. Brown and Stone (2007) and Taylor (2006) in separate studies suggested incentives on public dissemination of information; however this may only be applicable in more developed countries where arguably public participation and non-governmental organisations are more effective in applying pressure. However this research study indicated that external incentives do not play a significant role in the region.

A growing trend has been for customers to put in place corporate social responsibility scores as part of a procurement decision. A study performed by Baden (2009) in the United Kingdom has indicated that more than 82% of SMEs in the study implemented sustainability initiatives as a requirement for being selected. However the indication from this research study is that no external pressure is apparent and therefore provides the necessary incentive. This may be that SMEs consider the time and costs of implementing a sustainability initiative such as cleaner production as not being worthwhile in terms of gaining a purchase order or that sustainability scoring has not yet become a significant fact in procurement decisions in the region.

Reijnders (2003) argued for greater regulation including permit schemes and emissions trading to enforce application of cleaner production. The study was completed in 2003; however regulation appears to still be ineffectual in many regions more than ten years later. A primary concern is that it develops uncompetitive industries and indicates that sustainability initiatives do not really make economic sense and thus these actions continue to require some sort of incentives (Ahner & Meeus, 2011).

6.4.1 Research hypothesis H3a findings

Hypotheses H3a evaluated internal incentives relationships with economic barriers. The result was insignificant and no relationship shown. Thus a positive view of internal incentives such as technology improvements do not necessarily lead to an improvement in positive perceptions of economic barriers and seemingly indicated that internal incentives do not overcome economic barrier.

A note would be that positive economic return when analysing descriptive statistics is the most significant incentive with a mean score of 6.51. A strong positive economic return indicated that economic barriers can be overcome, however there appears to be some incongruence in that the economic incentive is not sufficient to overcome the economic barrier. There is no significant positive correlation with any of the questions that constitute the total economic barrier scale.

6.4.2 Research hypothesis H3b findings

Hypothesis H3b evaluated external incentives positive relationship with positive perceptions of economic barrier. There was no relationship between the incentive and barrier. To compare to studies from Brown and Stone (2007) and Taylor (2006) where external pressure and incentives were effective, this study indicated that any self-regulation and external information would not be successful in incentivising cleaner production. Again the results are inclined to Type II errors from the small sample size.

When analysing descriptive statistics for the individual incentives it was noted that current trends are a significant incentive, with the second highest mean score at 6.21. However this is not significant enough in overcoming the economic barrier and indicated that the trend does not carry significant economic superiority in the region.

6.4.3 Research hypothesis H3c findings

Hypotheses 3c evaluated regulatory incentives against economic barriers and there was a significant relationship found in one tail. There is a concern of Type I error, whereby there exists a small sample and medium strength correlation of 0,410. This is of interest, as it contradicts Ahner and Meeus (2011) conclusion that regulations can often make industries uncompetitive when compared to other regions.

It can be possible that regulation does level the playing field amongst SMEs in the local context and region, which then drives overcoming the regulatory barrier.

6.4.4 Conclusion to research question 3

This study appeared to contradict some previous studies, particularly in the developed world where it was indicated that external incentives on their own are often successful in driving cleaner production uptake; these external incentives can be public pressure and trends, customer requirements and so forth. However these appear to be ineffectual in South Africa’s context of development.

Congruently, this research study contradicts Cuerva *et al.'s* (2014) study in Italy amongst SMEs that indicated internal incentives are effective in overcoming economic barriers. This can be due to higher capital costs in the region of study, and can also be attributed to difficulties in actually measuring the results.

Of interest through is that regulation incentive has a relationship with a positive view of economic barriers. It has been speculated that part of the responses could be a levelling of the playing field whereby all SME suppliers in the economy can compete on the basis of the same sustainability principles.

6.5 Conclusion to research results

In research question one we established that there are no clear and distinct barriers that are of a major impact on their own with the exception of resource efficiency/social responsibility barrier which is ineffectual. This is contradictory to other research in developing regions such as Shi *et al* (2008) Lopes *et al* (2013) and Mitchell (2006) who were able to define predominant barriers for their respective regions in which research was conducted.

In research question two we were able to identify two clear axis of barriers with internal and external alignment. This supports Cagno and Trianni (2014) research in respect of organisational/behavioural barriers but contradicts research done by Massoud *et al* (2010) and Shi *et al* (2008) that supported differing alignments between the barriers.

In research question three the research has defined that regulation has a relationship with regulation and economic barriers. External incentives appear to be ineffectual and thus contradicts studies done in developed regions by Brown and Stone (2007), Taylor (2006), Baden *et al* (2009) and for internal incentives contradicts the study done by Cuerva *et al* (2014). However for regulation as a primary incentive this research is supported in its findings by Reijnders (2003) but contradicts more recently Ahner and Meeus (2011) findings that regulation is ineffectual.

CHAPTER 7: CONCLUSION

7.1 Introduction to conclusion

A significant point of this research study has revolved around the importance of implementing and supporting sustainability initiatives for SMEs. It is important for SMEs to be able to compete on an equal footing with many of their larger counterparts whilst employing sustainability practices that will ensure their future and ensure more environmentally and social aware practices. Simultaneously, it is recognised that in most countries, SMEs form the bulk of economic activity and are in aggregation some of the largest sources of inefficiencies and waste, leading to environmental and social harm. Thus the study has attempted to contribute to the body of research by identifying barriers to application of a sustainability initiative, namely cleaner production; and possibly gaining a more profound understanding of which incentives have proven effective in overcoming the same barriers.

7.2 Main findings

The study used generic barrier typologies identified in previous research by Weber (1997) Sorrell *et al* (2000) Mitchell (2006) and Yujing *et al* (2007). These broad typologies were classified into taxonomy of factors that constituted individual barriers. Additional barriers that had also been defined in prior research in studies performed in the developing world were added, such as institutional barriers (Mitchell, 2006). A further additional source of barrier has been identified with the expansion of the programme to include and be known as resource efficiency and cleaner production; in this study resource efficiency/socially responsible was identified as a barrier (Yujing & Huihuang, 2007). Congruently, generic typologies of incentives as described by Cuerva *et al* (2014) were measured to evaluate their effectiveness in enabling companies to overcome barriers.

Institutional barriers were found to be relevant in the current research study, however not significantly more so than any other barrier. A pertinent finding from the research study was that the expansion of the programme to resource efficiency and concerns of a resource efficiency/social responsibility barrier are not significant. The barrier did not appear to be significant in any analysis and further no relation was found with other barriers that may connect it to a specific grouping of internal or external barriers. However caution needs to be applied with these results in that resource efficiency or social responsible aspects are not seemingly widely implemented at the SME level as part of the programme. This may affect the perception of the barrier because no assessment or implementation is performed that targets these dimensions of sustainability.

When reviewing the results from the study in relation to barriers, it became apparent that a two-pronged approach is required that focuses on an external and internal type axes of barrier. Within these axes that were identified, each axis had the predominant barrier which can be used as a lever to manage the two axis.

The focus of policy and strategy for the external barrier axis should be overcoming institutional barriers whilst regulatory incentives can be used as a tool to control the economic barriers. The regulatory incentive can be pursued as a leveller to equalise the economic playing field, particularly between larger corporates and SMEs.

The focus of policy and strategy for the internal barrier axis should be in terms of overcoming behavioural barriers whilst again the regulatory incentives can be used as a tool to control the organisation barriers.

Both these explanations in terms of overcoming the axis of barriers defined in this research study suggested that strong regulatory and policy frameworks are required. This supported Sorrell *et al* (2000) original study findings and would be contradictory compared to more recent studies Brown and Stone (2007) Taylor (2006) Baden *et al* (2009), which focus on external incentives in the developed world. The research study also established that a focus on institutional barriers,

as in other parts of the developing world, is not as imperative in the local context and that all barriers can be taken into consideration on more equal footing.

In general internal and external incentives were found to not have a significant relationship with any of the barriers evaluated in this research; it appeared that having a positive viewpoint in respect of one of these incentives would not necessarily lead to a positive viewpoint in terms of one of the barriers that were evaluated. This appear to be a regional context issue and may vary significantly when explained in other studies.

7.3 Recommendations to NCPC

A pertinent issue is often seen as the need to overcome economic barriers in terms of allowing SMEs to implement cleaner production. However it was apparent from this research that both internal and external axis barriers play a role. Of particular importance is the recommendation to focus on a strong regulatory and strategic-policy environment that can positively influence the two axis of barriers:

- Accurate measurements of projects need to be implemented and a consistent methodology needs to be applied. This can take some different forms, including the formulation of a national monitoring and accreditation body that evaluate SMEs on a consistent level. Thus, for companies not wanting to implement ISO standards this allows an alternative and hopefully lowers the costs of implementing approaches to receive ratings.

- Regulation needs to be done in such way that it levels the playing field between large corporates and SMEs. Furthermore, SMEs that employ sustainability practices should gain further procurement incentives that further encourage sustainability initiatives. Regulation must also steer the focus away from end-of-pipe technologies and more towards initial production processes.

- Policy and strategy should focus on creating more general public awareness; particular focus should be placed on employees during the assessment phase to ensure that behavioural barrier issues are addressed.

- Comprehensive assessment and implementation methodologies that are adjusted as required for each particular SME. Project managers from the NCPC need to manage assessment and implementation each step of the way; they need to be able to create the time for SME owners and managers to allow the project to be implemented.

In terms of incentives it is apparent that what works in one region does not necessarily work elsewhere. In particular it is noted that the developed world's external incentives often are the most effective particularly regarding public engagement (Brown & Stone, 2007) (Taylor, 2006) (Baden et al., 2009). From this study it became apparent that external incentives are not necessarily effective in the region. This may however change as public interest in sustainability grows and thus recognition needs to be made that over a short period of time the effectiveness of some of the incentives typologies may change.

Further the research has steered clear from recommending economic incentives, even when most companies surveyed have predominantly made suggestions that better economic incentives would be beneficial, avoidance of economic incentives is supported by Moore and Manring (2009) and Hobbs (2000). Rather, economic incentives has appear to be a quick fix and sustainability on its own within a sound regulatory framework is suggested to drive the profitability of the same initiatives. Perhaps the only economic incentive that should be provided is to allow easier access to funding; SMEs already struggle in a highly risk averse banking environment to access funding and thus the capital involved with any implementation may be very difficult to source.

7.4 Recommendations to SMEs

Acknowledgment needs to be made that sustainability practices are becoming an integral part of the landscape for SMEs. Buying-companies are becoming more aware of being accountable towards sustainability in their decisions, and by forcing their suppliers to follow sustainability practices (Baden et al., 2009). It is thus imperative that SMEs start considering sustainability practices not only to ensure future sales but also as part of their responsibility towards the communities in which they are situated. Further as reviewed in the literature in Chapter 2, it is important that SMEs implement practices that attend to the root cause of the problem rather than on end-of-pipe technologies that are often inefficient as supported by Grimal (2003) and Frondel *et al* (2007).

In terms of barriers, it is important to form an ecosystem of companies which can share experiences, benefits and so forth and to avoid pitfalls that may be very unique and not necessarily taken in to consideration by NCPC assessment. From the respondents in the survey, some 58% did not know of any other companies that had implemented cleaner production. This may indicate a low penetration within the SME sector but also indicated that many SMEs are on their own during implementation and do not rely on a network of companies that can assist with guidance.

7.5 Recommendations for future research

Some observations that have come forth in terms of this research and are based on the views of the respondents' answers are as follows:

- It is apparent that implementation in the region is extensively focused on energy resource efficiencies and minimally on other methodologies in the RECP framework. A greater emphasis should be placed on a more comprehensive assessment and evaluation in accordance with RECP principles. It would appear that there is a barrier or barriers, not assessed

in this research, which is preventing a more comprehensive solution to be formulated and thus further research is required to identify the barrier/s.

- It is apparent that there are many differences across regions in the world and that the perception of barriers will vary. It will also vary over time as economic situations and institutional development changes. It is thus important to understand the dynamics of change and particularly in predicting these and understanding how to then respond to change perceptions of barriers as the developing world changes. This is important from an NCPC perspective, as it remains to be determined how quickly policy changes needs to be done.

- It would appear that cleaner production and resource efficiency aspects are seen as mutually exclusive. Thus further research is required in determining the drivers of SME behaviour towards selecting one aspect over another, for example selecting social responsibility over and above production efficiencies and what the differences are across different regions.

7.6 Concluding statement

Sustainability initiatives are identified as an important factor in doing business in the future. The reasons why SMEs need to be focused has also been identified, namely due to their high contribution towards the economy of any country and their contribution towards environmental and social degradation. Cleaner production methodology has been emphasised as an important sustainability initiative that is championed across the developing world by UNIDO and UNEP and thus provides a platform for a consistent initiative that can be best supported by a wide range of resources. However it has been emphasised that the programmes face differing barriers and effective incentives across different regions are required. Thus each country NCPC has to cater for its own unique set of constraints.

Based on this research it is apparent that a multi-prong approach is required to overcome barriers. Further it is apparent that internal/external incentives are ineffective, including public pressure and sentiment. It is thus important that public message is conveyed and that there is more awareness created in respect of sustainability. Further a sound institutional and regulatory framework needs to be developed that will assist in overcoming both internal and external axis barriers.

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Appendix A: Sorrell's Taxonomy of barriers

Typology	Barrier	Explanation
Economic	Heterogeneity	While a particular technology or measure may be cost effective on average, it may not be so in all cases.
	Hidden cost	Examples of hidden costs include overhead costs for management, disruption, inconvenience, staff replacement and training, and the costs associated with gathering, analysing and applying information.
	Access to capital	companies may be reluctant borrow due to concerns about the risk of increased gearing
	Risk	short paybacks required for energy efficiency investments may represent a rational response to risk
	Imperfect information	Lack of information may lead to cost effective energy efficiency opportunities being missed
	Split incentives	individual departments in an organisation may not be accountable for their energy use and therefore have no incentive to improve efficiency
	Adverse selection	Suppliers know more about the energy performance of a good than purchasers
	Principal-agent relationships	Monitoring and control problems
Behavioural	Bounded rationality	constraints on time, attention, and the ability to process information leads to reliance on imprecise routines and rules of thumb
	Form of information	To be effective, information must be specific, personalised, vivid and simple
	Credibility and trust	Trust is particularly encouraged through interpersonal contacts
	Inertia	individuals to favour the status quo
	Values	Individuals motivated by environmental values may therefore give a higher priority to efficiency

		improvements than those that are not
Organisation theory	Power	It is commonly the case that energy management has a relatively low status and is viewed as a peripheral issue by top management
	Culture	Organisations may encourage efficiency investment by developing a culture (values, norms and routines) that emphasises environmental improvement.

Appendix B: Variable table

Variable	Namecode data	Description	Type	Measure
Demographic	RespondentID	Unique identifier for each respondent	Numeric	Nominal
	CollectorID	Identifier for collector that was used	Numeric	Nominal
	IPAddress	Demographic data for organisation	String	Nominal
	EmailAddress		String	Nominal
	FirstName		String	Nominal
	LastName		String	Nominal
	Region		Numeric	Nominal
	Numberofemployees		Numeric	Nominal
	IndustryType		Numeric	Nominal
	Implementation	Had cleaner production initiatives been implemented	Numeric	Nominal
	InitiativeDetail	Details of initiatives been implemented	String	Nominal
Incentive Regulatory	IncentRegGovernmental	Government enforced rules and regulations	Numeric	Ordinal
	IncentRegCompliance	Voluntary regulations compliance	Numeric	Ordinal
Incentive Internal	IncentIntProcessEfficiency	Need for internal process change	Numeric	Ordinal
	IncentIntEnergyEfficiency	Requirement for energy efficiencies	Numeric	Ordinal
	IncentIntWasteReduction	Requirement for waste reduction	Numeric	Ordinal
	IncentIntEconomicReturn	Requirement for improved economic return	Numeric	Ordinal
Incetive External	IncentExtTrend	Requirement to meet	Numeric	Ordinal

		external market trends		
	IncentExtCustomer	Customer imposed requirement	Numeric	Ordinal
	IncentExtCompetitor	Competitive requirement	Numeric	Ordinal
Barrier Economic	EconBusinessModelB	Does cleaner production initiatives provide consistent methodology across business models	Numeric	Scale
	EconHiddenCostB	Are there any hidden costs	Numeric	Scale
	EconAccessCapB	Is access to capital for implementation available	Numeric	Scale
	EconRiskB	Is payback quick	Numeric	Scale
	EconImperfectInfoB	Are all possible initiatives evaluated	Numeric	Scale
	EconSplitIncentiveB	Do all departments have the same goal	Numeric	Scale
	EconAdverseSelectionB	Is there symmetry in information between suppliers and used	Numeric	Scale
	EconPrincipalAgentB	IS monitoring and compliance transparent	Numeric	Scale
Barrier Behaviour	BehBoundedRationalityB	Does time allow for rational decisions	Numeric	Scale
	BehFormInformationB	Is information clearly understandable	Numeric	Scale
	BehCredibilityB	IS interpersonal	Numeric	Scale

		information disseminated		
	BehInertiaB	Are individuals prepared to change	Numeric	Scale
	BehValuesB	What are individuals motives and values	Numeric	Scale
Barrier Organisation	OrgManagmentCommitmentB	Are sustainability initiatives a priority for management	Numeric	Scale
	OrgCultureB	Does the company culture encourage sustainability	Numeric	Scale
Barrier Institutional	InstPolicyB	Are personnel available to carry out policy objectives	Numeric	Scale
	InstDependenceB	Is there a dependency on outside assistance, no internal training	Numeric	Scale
	InstTechSupportB	Is there sufficient technical know-how and support	Numeric	Scale
	InstRegulatoryB	Is the regulatory environment weak or strong	Numeric	Scale
	InstRelevanceB	Is cleaner production relevant to the region	Numeric	Scale
Barrier Resource Efficiency/Social Responsibility	ReEnvManagementProdB	Are products of a nature that minimise impact on the environment	Numeric	Scale
	ReEnvManagementCultureB	IS there environmental awareness	Numeric	Scale

		culture in the organisation		
	ReSocialResponsibilityB	IS social responsibility viewed as important	Numeric	Scale
	ReSocialSafetyB	Is workplace health and safety viewed as important	Numeric	Scale
General comments	GeneralCommentInitiative	General comment note	String	Nominal
	OtherIncentiveDetail	Are any other incentives viewed as important	String	Nominal
	FurtherImplmentation	Would further measures be implemented	Numeric	Nominal
	OtherbussinessImplementation	Does the organisation know other that have implemented cleaner production	Numeric	Nominal
Calculated Variables Barrier	TEconomicBarrier	Total calculated economic barrier	Numeric	Scale
	TBehaviourialBarrier	Total calculated behavioural barrier	Numeric	Scale
	TOrganisationBarrier	Total calculated organisational barrier	Numeric	Scale
	TInstBarrier	Total calculated institutional barrier	Numeric	Scale
	TReBarrier	Total calculated resource efficiency barrier	Numeric	Scale
Recoded Demographic	NImplementation	Recoded implementation answer	Numeric	Nominal

Calculated Variables Incentive	TIncentiveInternal	Total calculated internal incentive	Numeric	Ordinal
	TIncentiveExternal	Total calculated external incentive	Numeric	Ordinal

Appendix C: Survey Questionnaire

National Cleaner Production

Please note that this survey is used to collect data in respect of research on uptake of resource efficiency and cleaner production methods in SME companies, the aim is to find out more about the success factors to uptake of cleaner production methods. All information will be kept confidential. If you have any concerns please contact the National Cleaner Production Centre Tel no 021 658 2776 Alfred Hartzenberg or alternately 083 659 0868 Adrian Vroom.

1. Region where business located?

2. Number of employees in the business?

3. Which of the following best describes the industry sector of your business?

4. Have you implemented any Cleaner Production initiatives in your business?

If cleaner production methods were implemented

5. Please detail what Cleaner Production initiatives were implemented

6. Which of the following had an impact on your decision

Ranking:

Sufficient governmental incentives

Process efficiency gains

Energy efficiency gains

Waste reduction

Current trend to implement sustainable practices

Customer requirement to have sustainable practices

Competitors implementing

Compliance with regulatory and/or ISO requirements

Positive economic return

Other

7. Would you consider implementing Cleaner Production initiatives in the future?

8. Do you know of other businesses that have implemented Cleaner Production initiatives?

If no cleaner production methods were implemented

9. Please detail reasons for not implementing any Cleaner Production initiatives

10. Which of the following had an impact on your decision

Ranking:

Sufficient governmental incentives

Process efficiency gains

Energy efficiency gains

Waste reduction

Current trend to implement sustainable practices

Customer requirement to have sustainable practices

Competitors implementing

Compliance with regulatory and/or ISO requirements

Positive economic return

Other

11. Would you consider implementing Cleaner Production initiatives in the future?

12. Do you know of other businesses that have implemented Cleaner Production initiatives?

Evaluation of barriers (5 point Likert scale)

13. Evaluate the following financial statements.

Cleaner production initiatives suits our business model

There is or can be possible additional costs apparent only after implementation

Implementation is easily financed

Payback will be immediate

All employees can easily be made knowledgeable on cleaner production initiatives implemented

Benefits are easily measurable

Selection of processes and/or equipment for initiatives is clear

Monitoring of initiatives is achievable

14. Evaluate the following behavioural statements.

We have human resource capability in-house to implement cleaner production initiatives

General information is readily available to train employees in respect of initiatives implemented

Colleagues highly recommend cleaner production initiatives

Employees are readily willing to embrace changes from cleaner production initiatives

Cleaner production methods were or can be easily accepted by employees

15. Evaluate the following organisation statements.

Amount of management time and commitment is justifiable

Environmental and sustainability concerns are a priority amongst employees

16. Evaluate the following institutional statements.

Training is readily available and easily understood

Further support after initiatives implementation is necessary

There is adequate technical support

There is a suitable amount of regulatory enforcement for sustainable practices

Economic targets from implementation are achievable

17. Evaluate the following resource efficiency statements.

Would like to produce products or services that minimize impact on the environment

Making sustainable products/services is possible with current business plan

Would place priority on spending on socially valuable projects over cleaner production initiatives

Priority should be placed on reducing environmental risks to employees

General comments

18. Please comment on what may make cleaner production initiatives more attractive for SME's.

Many thanks for your time and patience in completing the questionnaire.

Please note that all research findings will be kept confidential