

## ENVIRONMENTAL MANAGEMENT SYSTEMS IN THE AUTOMOTIVE SUPPLY CHAIN IN SOUTH AFRICA: A PILOT STUDY

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### ABSTRACT

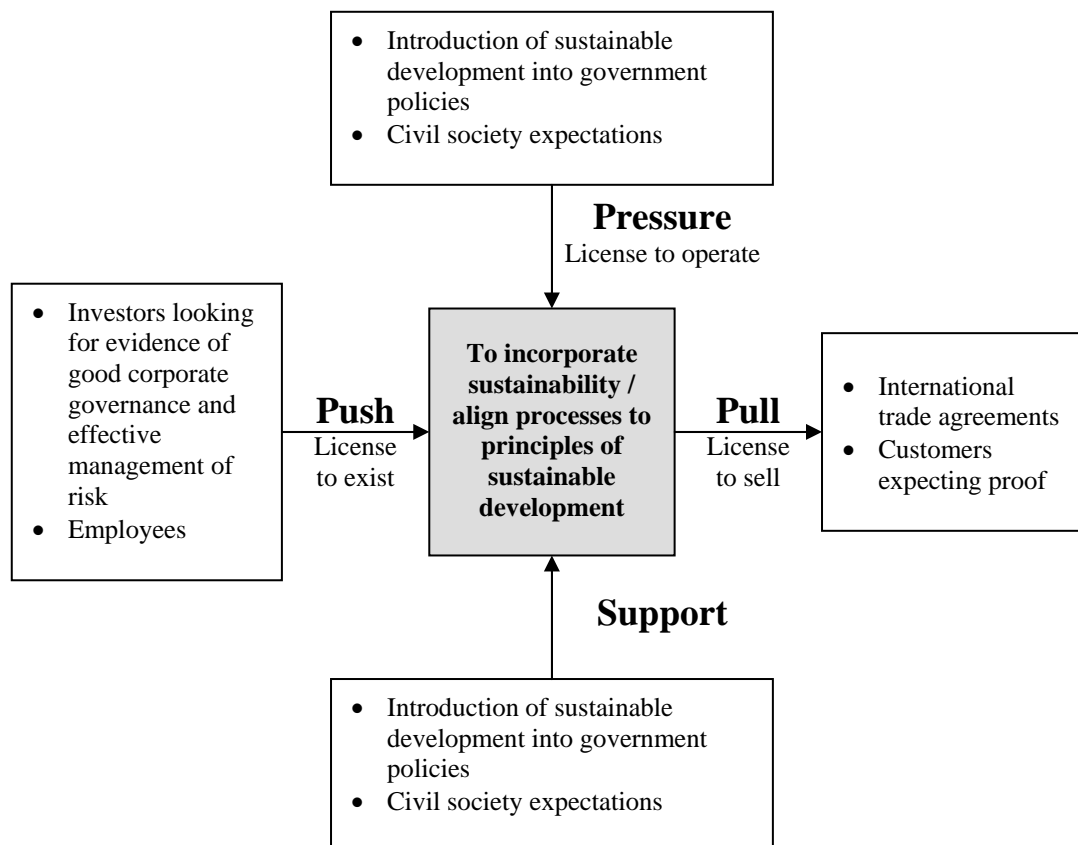
Automobile Original Equipment Manufacturers (OEMs) have implemented formal Environmental Management Systems (EMSs) globally that require the OEMs to consider the environmental performance and potential liabilities in the supply chain. However, in South Africa, OEMs typically experience resistance from suppliers to focus on environmental issues, compliance with regulations, and OEM requirements. Although the responses from many OEMs have been an attempt to enforce the formal EMS certification and accreditation of suppliers, a case study reveals that such certification and accreditation does not necessarily imply good environmental performance, nor indeed environmental compliance with the national legislation. Apart from general environmental management and compliance information, basic cleaner production process parameters, i.e. water and energy usage, and waste generated, were used to compare the environmental performances of different sized suppliers, with and without formal EMSs, and with variance of financial dependency on an OEM. In order to improve the environmental performance of the entire supply chain, a conceptual model is introduced, which is currently under investigation in the automotive sector of South Africa.

### OPSOMMING

Oorspronklike Toerusting Vervaardigers (OTVs) in die motorbedryf het internasionaal formele Omgewingsbestuursisteme (OBS) geïmplementeer wat vereis dat die omgewingsprestasie en potensiele aanspreeklikhede van die verskaffingsketting in ag geneem moet word. Nieteenstaande ondervind OTVs in Suid-Afrika weerstand van verskaffers wanneer gefokus word op omgewingsaspekte, voldoening aan regulasies en OTV-verwagtinge. Alhoewel die meerderheid OTVs formele OBS akkreditering probeer afdwing, toon 'n gevallestudie dat dit nie noodwendig omgewingsprestasie, en voldoening aan nasionale omgewingswetgewing, impliseer nie. Afgesien van algemene omgewingsbestuur en regsvooldoening, was produksieprosesparameters, soos water- en energieverbruik, en afvalgenerering, gebruik om die omgewingsprestasie van verskillende verskaffers, met of sonder OBS, en met variasie in finansiële afhanklikheid van 'n OTV, te vergelyk. Om die omgewingsprestasie van die verskaffingsketting te verbeter, word 'n konsepsuele model wat tans in the motorvervaardigingsektor van Suid-Afrika ondersoek word, voorgestel.

## 1. INTRODUCTION

Internationally, industry has experienced mounting pressure to align operational processes with the objectives of sustainable development [1]. Apart from pressure drivers, push, pull, and support drivers have also been identified for the incorporation of sustainability into business practices (see Figure 1) [2]. The consequence is the concept of “business helping business improve environmental, health and safety performance, shareholder value, and corporate citizenship” [3]. Such initiatives have assisted many larger companies to adopt good environmental practices through formal Environmental Management Systems (EMSs), but it is often found that the suppliers of these companies have few or no environmental programmes, and little or no awareness or legal compliance [4, 5]. Although it is often true that small and medium enterprises (SMEs) have lower environmental impacts than the larger companies they supply, it has been estimated that they collectively contribute between 70% and 95% of environmental impacts worldwide [5]. Therefore, it is imperative that industry understands that sound EMSs imply that good environmental performances and compliance of the entire supply chain, including SMEs, must be ensured [6, 7]. Furthermore, a good link between an EMS and the supply chain, if properly integrated with other business practices, could result in increased profitability (and quality) together with reduced environmental liabilities [8, 9].



**Figure 1: Drivers for the incorporation of sustainable development into business practices [2]**

The automotive sector of South Africa faces problems in that suppliers find it difficult to comply with the multitude of requirements of the multinational Original Equipment Manufacturers (OEMs). For example, it is a requirement for first tier suppliers to be TS 16949 accredited, and it is a further requirement from OEMs and TS 16949 that the suppliers have or are in the process of having ISO 14000 accreditation in addition to being ISO 9000 accredited. For products entering the European Union marketplace, it is also a requirement to register materials on the Substance of Concern (SOC) website. These are just a few of the requirements placed on suppliers in the last five years or so, and the strain on suppliers, typically medium and small companies, is manifesting itself in some companies either ceasing to trade completely, or ceasing to trade in the automotive sector specifically.

With respect to EMS implementation many suppliers, especially SMEs, lack the skills and knowledge to address the integration of an EMS with normal internal management practices. There is also very little assistance for suppliers in the form of tools, programmes, and policies to evaluate operations, to determine the extent of potential environmental impacts, and to identify possible solutions, which are typically available in developed and transition economies [10]. Although suppliers may be aware that their current business practices have certain impacts on the environment, and changes in operational practices are subsequently necessary, the perception is that these changes of practices would be costly and difficult to implement. Such barriers to SMEs adopting formal EMSs have even been highlighted in developed countries [11]:

- Internal barriers that are grouped into resources, understanding and perception, implementation, and attitudes and company culture.
- External barriers that are grouped into certifiers or verifiers, economics, institutional weaknesses, and support and guidance.

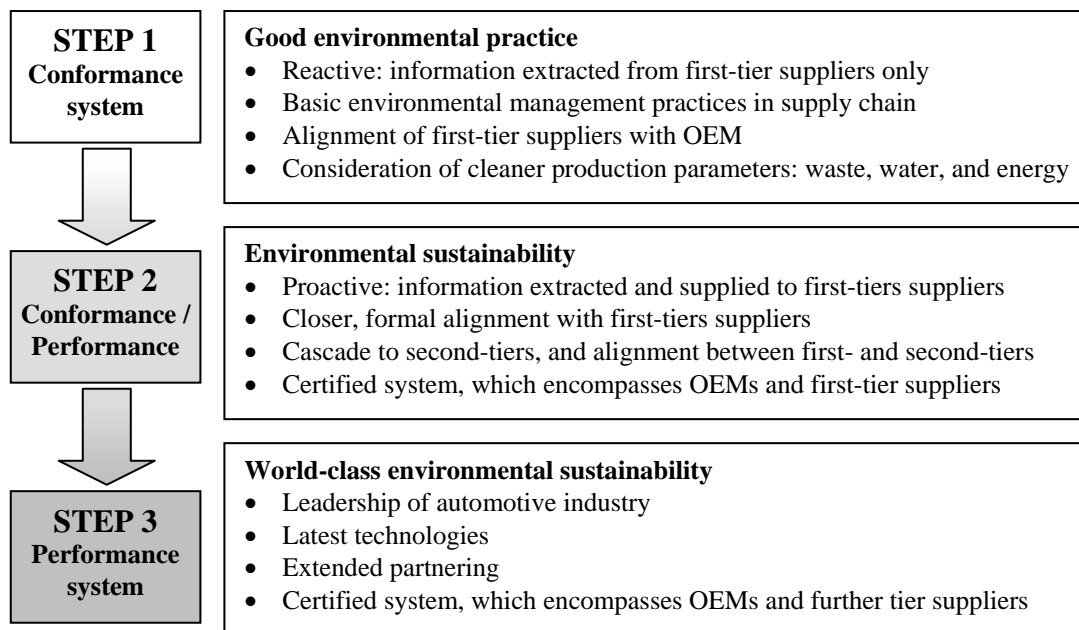
A comprehensive study conducted in the value chain of the manufacturing sector of the United States [12] further emphasised the following issues pertaining to the implementation of formal EMSs:

- EMSs are, in general, perceived as having a strong negative impact on the major strategic dimensions of performance, e.g. lead-time, cost, and quality, and EMSs do not enhance a company's competitive position in the marketplace.
- The implementation of an EMS is influenced by several factors: company size (larger companies more readily implement EMSs); nature of ownership (foreign-owned companies are more likely to implement EMSs); past success with the implementation of Total Quality Management (TQM) systems; and the degree to which cross-functional programmes and teams are used.
- Formal EMSs do lead to improved environmental performances, i.e. manufacturing plants can be both clean, or more environmentally responsible, and more efficient.

These findings have been confirmed in Europe [13]. Most notably, EMSs are more readily accepted where environmental improvements are complemented by cost-

savings, although EMSs rarely fulfil the expectations of cost reduction potentials within companies [13]. The overall cost benefits associated with environmental management in the supply chain are therefore not recognised or integrated into the internal management practices of supplying companies.

There are supply chain models that attempt to ensure more effective supply chain management to reduce cost, lead-times, and improve product quality, e.g. the Supply Chain Operation Reference (SCOR) model of the Supply Chain Council [14]. This is a process reference model that improves the communication within and between organisations. It allows the management of companies, e.g. OEMs, to align goals and targets with supply chains to provide more effective planning and efficient operations [15]. Furthermore, SCOR can be used to measure and evaluate supply chain performance against set targets and business goals, thereby supporting the transfer of best practice and strategy planning. However, the type of models and tools that are available for automotive supply chain management have very little or no integration with EMSs, and therefore do not address the environmental concerns and business goals of OEMs.



**Figure 2: Supply chain environmental performance achievement goal**

### 1.1 Objectives of this paper

This paper summarises the first phase of ongoing research work that has been undertaken in the automotive sector of South Africa. The primary objective of the paper is to evaluate and establish a preliminary baseline of the current automotive supply chain situation in South Africa with respect to the implementation of EMSs and environmental performances. For the preliminary baseline, only first-tier suppliers are considered. Sound EMSs of an OEM and all of its first-tier suppliers are viewed to be good environmental practice and the first step towards a world-class

supply chain environmental performance achievement goal (see Figure 2). A rating procedure is introduced to evaluate the environmental performances of suppliers, and to prioritise where the emphasis must be placed in terms of supplier assistance to improve the overall environmental performance of the value chain. The rating procedure, based on Cleaner Production principles [16], is used to compare the environmental performances of different size suppliers, with and without formal EMSs, and with variance of financial dependency on an OEM.

Finally, a model is proposed, based on the findings, which could facilitate the implementation of EMSs and potentially lead to continuous environmental improvements in the whole supply chain.

## 2. RESEARCH METHODOLOGY

One Original Equipment Manufacturer (OEM), located in the Gauteng Province of South Africa, was considered as a case study. The OEM had forty-eight first-tier main component suppliers with manufacturing facilities inside South Africa. A simple electronic survey was designed to obtain the minimum environmental performance information from the first-tiers, which required little effort on the part of the companies. The information of the survey was verified with telephonic interviews and site visits. The survey required the following information:

- Products that are supplied to the OEM.
- Size of the company [17], i.e. small (fewer than 50 employees), medium (fewer than 500 employees), and large (more than 500 employees).
- Percentage of production allocated to the specific OEM, i.e. small dependency on OEM (less than 10% of production), medium dependency (less than 50%), and large dependency (more than 50%).
- Accreditation of the company with respect to environmental, safety, and quality management.
- Cleaner production process parameters and management practices, i.e. water usage and effluent releases, energy usage, and general and hazardous waste generation.

For the cleaner production (CP) factors – i.e., process parameters and management practices – scoring scales were developed from 1 to 5. A score of 1 indicates no or bad practices pertaining to the factor, and a score of 5 indicates best practices. The scoring guidelines are summarised in Tables 1 to 3. The authors conducted the scoring initially; the scores were then verified with an environmental management practitioner in the OEM. An overall environmental performance rating for each company was calculated as follows:

$$R_{EP} = S_{water} \times S_{energy} \times S_{waste} \quad 1.$$

A multiplicative model was used instead of an additive model to highlight small discrepancies between companies; the overall results would not be affected by the choice of either model. The environmental performance rating value ( $R_{EP}$ ) can therefore range from 1, with no measurement or monitoring system and/or no

compliance or evidence of compliance for any of the CP factors, to 125, with world-class management practices for all the CP factors.

Score	Company practices for the cleaner production factor
1	No measurement / monitoring system AND/OR No compliance / evidence of compliance.
2	No reduction of water usage programmes. No effluent reduction programme (if applicable).
3	Fair water management practices. Water usage monitored and some reduction programmes considered. Effluent monitoring and treatment/minimisation programmes considered.
4	Sound water management practices. Internal water usages measured and monitored per process/equipment. Some water usage reduction programs in place. If applicable, effluent measured and monitored per process/equipment. Some treatment/minimisation programmes in place.
5	Excellent world-class water management practices. Internal water usage monitored and reduction programmes implemented. Internal effluents monitored and treatment/minimisation programmes implemented.

**Table 1: Score scale for the water usage and effluent release process parameters and management practices**

Score	Company practices for the cleaner production factor
1	No measurement / monitoring system.
2	No reduction of energy usage programmes.
3	Fair energy management practices. Energy usage monitored and some reduction programmes considered.
4	Sound energy management practices. Internal energy usages measured and monitored per process/equipment. Some reduction programmes in place.
5	Excellent world-class energy management practices. Internal energy usage monitored and reduction programmes implemented.

**Table 2: Score scale for the energy usage process parameters and management practices**

Score	Company practices for the cleaner production factor
1	No measurement / monitoring system AND/OR No compliance / evidence of compliance.
2	No waste reduction systems / policies / poor practices.
3	Fair waste management practices. Waste streams identified but not all measured / quantified.
4	Sound waste management practices. Waste streams measured with some recycling / external collaboration programmes where possible.
5	Excellent world-class waste management systems with total recycling / external collaboration programmes implement. Fully compliant in terms of international legislation.

**Table 3: Score scale for the waste generation process parameters and management practices**

The overall rating was then used to analyse and compare the environmental performances with:

- Company sizes;
- Financial dependencies on the specific OEM; and
- The status of formal EMS implementation, i.e. ISO 14000.

The OEM was selected as it is highly proactive on environmental issues, like other OEMs in South Africa. Twenty of the first-tier suppliers participated in the survey, representing over 40% of the total South African based suppliers of the OEM, and about 10% of the total registered automotive supplying companies in South Africa [18]. The majority of these (80%) also supply other OEMs in the country and/or export. The twenty participating companies may represent the typical first-tier automotive supplying companies of South Africa (see Table 4).

Company size	Number	Percentage of total	Percentage with ISO 14000
Large	25	13	52
Medium	131	66	33
Small	42	21	10

**Table 4: Summary of the company profiles in the South African automotive component supply chain [18]**

### 3. RESULTS

The company profiles, with the scores for the Cleaner Production factors, and the calculated rating values, are summarised in Table 5. No company had an environmental performance rating value ( $R_{EP}$ ) of more than 48 (of the possible 125). This highlights that much needs to be done in the South African automotive supply sector in terms of Cleaner Production, which is also reflected in the poor accreditation of the companies in terms of formal EMSs (see Table 4). With respect to the company sizes:

- 3 were large in size, with more than 500 employees;
- 14 were medium in size, with between 50 and 500 employees; and
- 3 were small in size, with fewer than 50 employees.

Therefore, about two-thirds represent medium-sized companies, which corresponds to the profile of the 218 South African registered automotive supplying companies (see Table 4) [18]. The financial dependencies of the companies on the OEM were as follows:

- 3 had little dependency, with 10% or less of the production associated with the OEM; all are medium in size;
- 9 had a medium dependency, with between 10% and 50% of the production associated with the OEM; of these, 1 is large, 7 are medium, and 1 is small in size; and
- 8 had a high dependency, with 50% or more of the production associated with the OEM; of these, 2 are large, 4 are medium, and 2 are small in size.

All of the companies had certified quality management systems (ISO 9000), while only the two medium-sized glass manufacturing companies had certified safety management systems (OSHAS 18001 or NOSA). Three-quarters of the companies had accredited EMSs (ISO 14000), of which 12 were medium in size and 3 were the large-sized companies. All of the large-sized companies were foreign-owned, whilst the medium-sized companies were a mixture of foreign- and locally-owned. None of the small-sized companies, all locally owned, had EMSs, which was also true of the locally-owned medium fuel tank and interior trim plastics parts manufacturers.

### 4. DISCUSSION

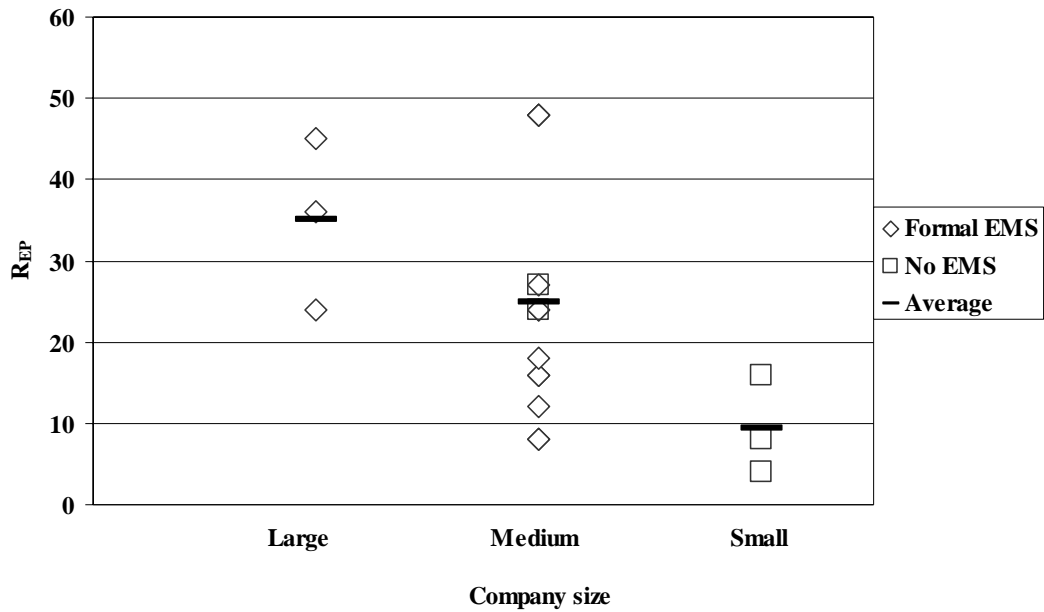
Figure 3 illustrates the relationship between the calculated  $R_{EP}$  values of the suppliers (y-axis), the size of the companies (x-axis), and the status of implemented formal EMSs (data markers). Although an effective EMS can improve the environmental performance of a company, it is by no means a guarantee. Considering the medium-sized companies only, those with no formal EMS did, on average, have a good environmental performance compared with those with implemented formal EMSs. Rather, from the average  $R_{EP}$  value line in Figure 3, it appears that company size is more important for overall environmental performance and compliance.



No.	Component/s supplied	Company size <sup>a</sup>	% of production <sup>b</sup>	Accreditation <sup>c</sup>			CP factor			R <sub>EP</sub>
				Env.	Saf.	Qual.	S <sub>Water</sub>	S <sub>Energy</sub>	S <sub>Water</sub>	
S1	Hand brake assembly	Medium	5	Y	N	Y	4	3	4	48
S2	Fuel tank	Medium	40	N	N	Y	3	3	3	27
S3	Air conditioner hoses	Medium	70	Y	N	Y	3	2	2	12
S4	Paint	Medium	20	Y	N	Y	2	1	4	8
S5	Interior trim parts	Medium	100	N	N	Y	3	2	4	24
S6	Pressed metal parts	Large	50	Y	N	Y	2	3	4	24
S7	Seatbelts bowden cable	Small	90	N	N	Y	2	1	2	4
S8	Sunroofs	Small	90	N	N	Y	2	2	4	16
S9	Wiring Harnesses	Large	100	Y	N	Y	3	3	4	36
S10	Axle assembly	Medium	100	Y	N	Y	3	2	3	18
S11	Assorted components (wiper, alternator, etc.)	Large	20	Y	N	Y	5	3	3	45
S12	Rear-view mirrors	Medium	40	Y	N	Y	2	2	4	16
S13	Glass	Medium	5	Y	Y	Y	2	2	4	16
S14	electronic modules	Medium	40	Y	N	Y	3	3	3	27
S15	Stickers	Small	20	N	N	Y	2	2	2	8
S16	Window winders	Medium	90	Y	N	Y	2	2	2	8
S17	Air con unit / (h/e)	Medium	10	Y	N	Y	3	4	4	48
S18	Air con unit / (h/e)	Medium	30	Y	N	Y	2	3	4	24
S19	Phosphating chemicals / seals	Medium	20	Y	N	Y	2	3	4	24
S20	Glass	Medium	20	Y	Y	Y	3	4	4	48

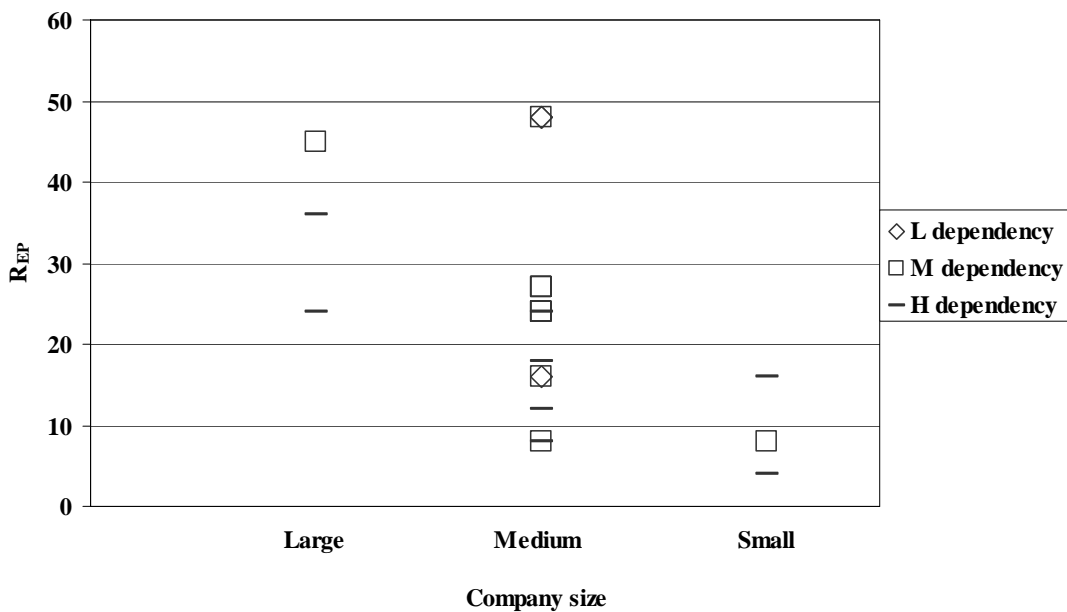
- a Large (more than 500 employees); Medium (between 50 and 500 employees); and Small (fewer than 50 employees).
- b Percentage of production income that is attributable to the one OEM.
- c Formal accreditation in terms of ISO 14000 (environmental), OSHAS 18001 or NOSA (safety), and ISO 9000 (quality).

**Table 5: Summary of the company profiles, scores for the cleaner production factors, and calculated environmental performances ratings**



**Figure 3: Environmental performance rating relating to implemented EMSs and company sizes**

The abovementioned result is emphasised in Figure 4, which illustrates the relationship between the calculated  $R_{EP}$  values of the suppliers (y-axis), the size of the companies (x-axis), and the financial dependency of the companies on the OEM (data markers). The dependency of the production output of a company on a single OEM customer does not imply good environmental performance. In fact, a higher dependency leans towards lower environmental performance. Again, company size determines the trends in environmental performances.

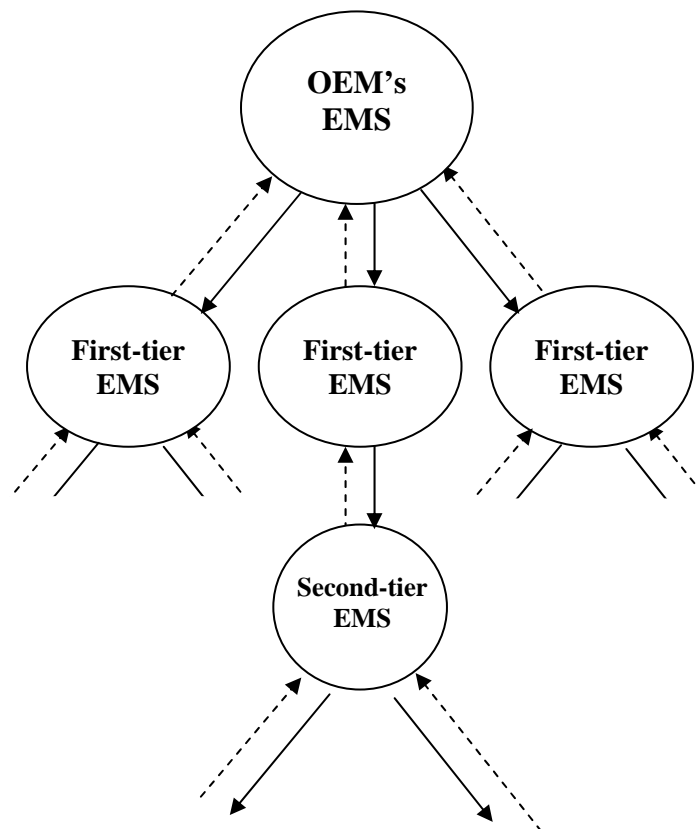


**Figure 4: Environmental performance rating to financial dependency on one OEM and company sizes**

## 5. CONCLUSIONS AND WAY FORWARD

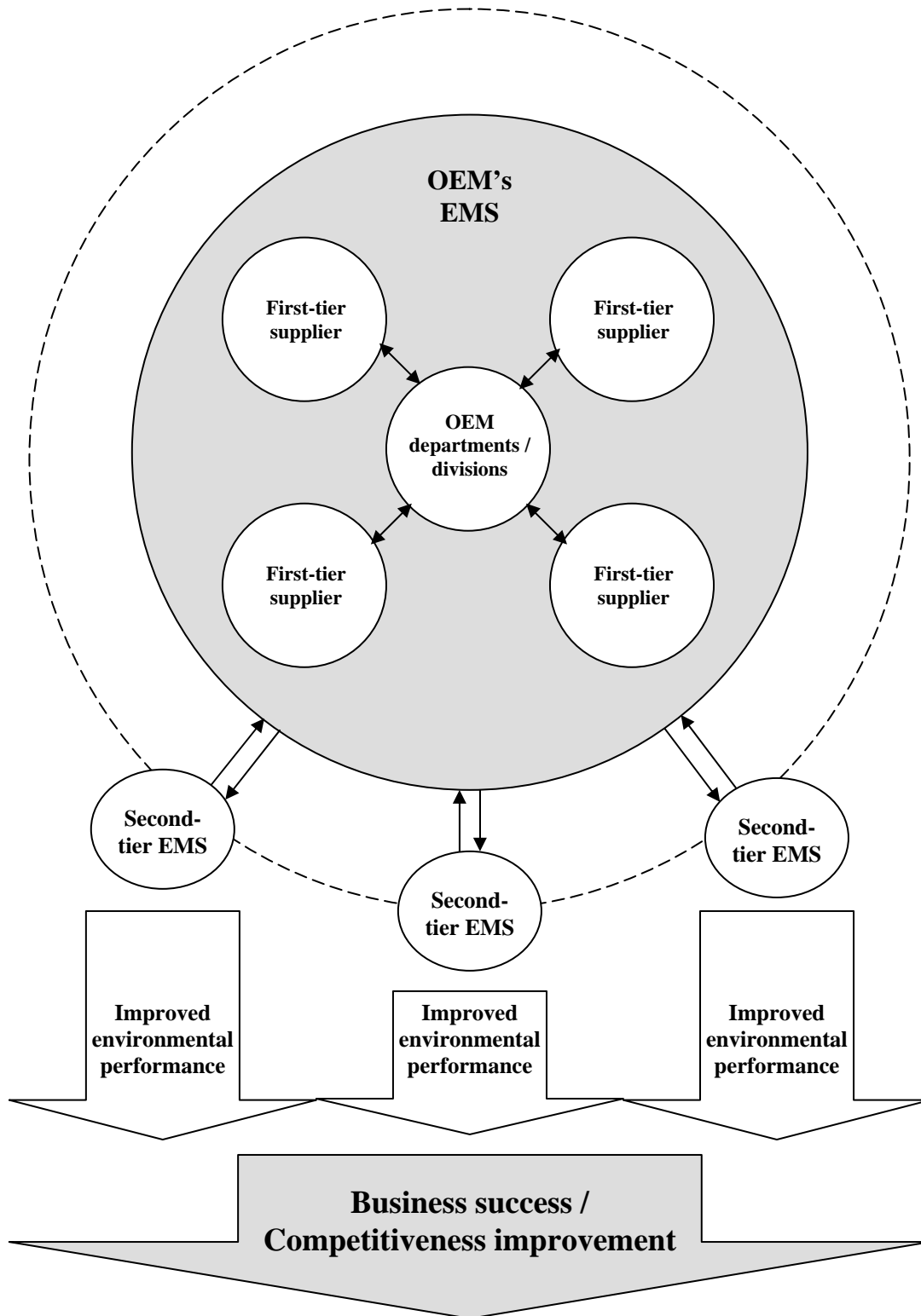
This paper has evaluated the implementation of Environmental Management Systems (EMSs) and the corresponding environmental performances of some first-tier companies in the current automotive supply chain of South Africa. This preliminary work focused on one OEM only, which makes the generalisation of the results problematic. For example, when compared with other countries, specific conditions pertaining to South Africa may or may not influence the outcomes observed.

From this pilot study, the most important factor that influences environmental performances appears to be the company size. The degree of financial dependency on an OEM is of lesser importance. Formal EMSs may lead to improved environmental performances if they are implemented effectively; what constitutes an effective implementation has yet to be resolved. Barriers to implementation have been documented in literature (see Section 1) [11]. To overcome these barriers it is subsequently proposed to modify the conventional EMS approach in the supply chain (see Figure 5). Rather than implementing separate EMSs, the concepts of existing supply chain models [14] are incorporated, whereby a more effective EMS can be developed for OEMs that integrates the external supply chain into the internal EMS (see Figure 6).



Solid lines depict the filtering of information down the supply chain between EMSs.  
Dashed lines depict the limited feedback of information up the supply chain between EMSs.

**Figure 5: Conventional EMS interaction in the supply chain**



**Figure 6: Proposed extension of OEM EMSs to include first-tier and subsequent suppliers**

The potential advantages of such a conceptual model are that:

- Communication between OEMs and the different parties in the supply chain is improved;
- Skills and knowledge from the OEMs to their supply chains are transferred, ensuring sound EMS compliance and cost effective systems;
- Partnering between OEMs and suppliers is closer, which results in the identification of additional opportunities, such as logistics and cost optimisation;
- An overall environmental performance improvement of the supply chain EMS can be achieved;
- Greener products at the end of the value chain can be delivered; and
- Investor confidence and company perception can subsequently be improved.

The disadvantage of such an EMS model is that suppliers may refuse to participate if, initially, there appear to be benefits, but the arrangement is later perceived to be a control mechanism of OEMs over suppliers. Similar cause-and-effects have been observed with previous supply chain models, and the concept therefore needs much analysis from more than a technical perspective, especially where first-tiers have lesser financial dependencies on single OEMs. The advantages and disadvantages of such a model are currently being investigated in the South African industry to develop a model that can be generalised outside the automotive sector.

## 6. ACKNOWLEDGEMENTS

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