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ISO 14001 - Some international perspectives

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ABSTRACT The aim of this paper is to discuss a number of issues related to ISO 14001, the international standard for environmental management systems (EMS). The standard is a process standard that leaves room for interpretation at company level as well as among lead auditors from certifying bodies. The paper questions whether the interpretation of the standard is uniform both at national and international levels. The paper also suggests changes of ISO 14001 in order to formulate more clear demands of environmental improvements, to include demand for publication of an environmental report and to include product focus more clearly. Secondly the paper briefly presents a cases study of four companies in the automotive industry in South Africa, related to the discussions of ISO 14001 and compliance with environmental regulation.

(Environmental Management System, ISO 14001, continuous improvements, regulation, product focus)

INTRODUCTION

The possible solutions to the environmental problems related to industrial production have moved to the companies' production processes. This implies new ways of managing environmental effects, where EMS is central and strategic planning necessary to secure continuous improvements of the environmental performance. The existing consumer patterns in the industrialised parts of the world, the global character of today's environmental problems and the expansion and increasing complexity of the global marketplace demand a response from all countries and from all levels of society. Through the 1990s and up until today, this development has resulted in an increasing pressure on industry, especially in the most developed countries. This pressure derives from the demand that companies should take responsibility for the environmental damage which they create and thus approach their way of managing the environment in a more systematic and proactive way [1].

Environmental concerns are being incorporated in an increasing number of business strategies in order to meet the environmental demands from the different stakeholders or to create a market demand for greener products. Many companies have integrated the responsibility for pollution prevention in their management system, where actions have to take place in order to reduce the environmental impacts. The increasing interest among companies for self-regulation in relation

to their environmental impacts has resulted in a need for methods and tools to support reliability and the process of change towards systematic development of cleaner production processes and products. Since the middle of the 1990s, with the publication of ISO 14001 [2], almost 50,000 companies covering 118 countries have obtained a certified EMS [3]. ISO 14001 is an international standard which could have a number of opportunities for an organisation [4]:

- a. A structured approach to addressing the environmental bottom line
- b. To manage the impact of their activities on the environment better and to demonstrate sound environmental management
- c. Improved environmental performance
- d. Addresses not only environmental aspects of the production processes but also those of its products and services.
- e. Can improve environmental management and enables equal access to a growing "green" market place.

Internationally the implementation of environmental management systems is shown great interest. The number of ISO 14001 certificates increased with 60% from 2000 to 2001, and with 35% from 2001 to 2002 [3]. Figure 1 shows the development in the number of issued certifications, which points at a continued interest in the next years.

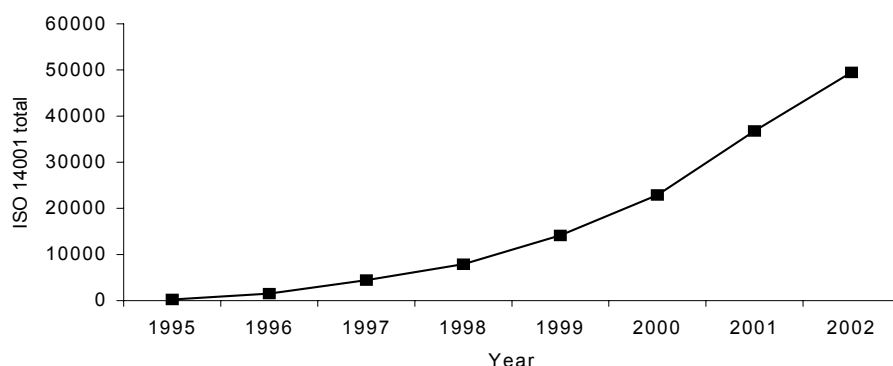


Figure 1. Total number of issued ISO 14001 certificates in the world, 31st Dec. 1995 to 31st Dec. 2002 [3].

APPROPRIATION OF ISO 14001

ISO 14001 is an international standard with the purpose of use in many different types of organisations. The standard does not, and is not intended to contain many specific requirements [5]. ISO 14001 is a framework that companies are obliged to adopt in their organisation. However, the standard does not specify how the requirements should be met and they do not provide an indication of what goals it should strive to achieve [6]. ISO 14001 is a process standard not a performance standard which means the standard does not set up specific demands of environmental improvements. ISO 14001 is flexible with room for interpretations, such as implementation strategies, definition of scope, environmental improvements, internal and external dialogues and co-operation.

An EMS according to ISO 14001 can be considered as a travelling concept both at national and international levels and appropriated to different contexts. The concept of environmental management is shaped due to conditions, such as interests and demands of different stakeholders, the regulatory framework, market structure, organisational identity, educational systems, accreditation bodies, available equipment and production facilities. In the appropriation process, the interpretation of the surrounding environment shapes problem definitions and problem solving strategies. Not only ISO 14001 is translated from one language to another, when travelling, the whole concept

and understanding of the environment is translated and transformed in order to perform in a new context.

ISO 14001 – SURVEYS

Several case studies show that organisations certified according to ISO 14001 result in environmental improvements and cost savings for the majority of the organisations. For instance in a case study with about 1,000 respondents it is concluded that *“Basically, a formal EMS does play a role in improving overall performance; it also affects the frequency with which various environmentally related options are used. Furthermore, certification of these systems does have a significant incremental impact on performance and on the reactive options the plants involved in the study considered”* [7].

Though case studies of ISO 14001 certified companies in Thailand have shown examples of poor environmental management and acceptance of non-regulatory compliance among external auditors [8]. In an article from 2001 it is also stated that complying with regulation is not a necessary precondition for an ISO 14001 certification [9, p.39]. In Denmark companies must comply with environmental regulation when they are certified [10]. In the next years many companies in developing countries must obtain an ISO 14001 certificate in order to enter the international market. In this respect it is of great importance that the certificate has credibility.

Still more large-scale studies of the effects of ISO 14001, which should bring more general applicable results, need to be carried out in order to achieve a better insight in the benefits of EMS at international level and differences between countries [11, 7, 12]. The validity of most existing quantitative studies measuring environmental performance in ISO 14001 certified companies can be questioned. First of all the number of certified companies that do not reply on questionnaires used in research are often high, and we do not know why these companies did not reply and what impact they would have made on the results if they had participated. Secondly it must be investigated how companies that are not certified act and perform compared with certified companies. Thirdly it is of importance in a study to know how long the companies have been certified. It can take some time to generate effects but the first years after certification organisations often achieve a number of environmental improvements, “the low hanging fruits”, and over time improvements become smaller or are made in connection with technological jumps like investments in new technology [11, 7].

THE ROLE OF STAKEHOLDERS

A interesting question is how quickly and to what extent the environmental impacts from industry are reduced in order to move towards a more sustainable production. This will depend on the development in demands from stakeholders, the responsiveness of industry and the internal dynamic in the companies in relation to their wish to be one step ahead and to have a reliable environmental image towards the stakeholders [10].

An important stakeholder in this regard could be the environmental authorities. Regarding environmental pressure from authorities, a common problem of several developing countries is weak administrative and institutional capacities, poor regulatory enforcement and centralised systems. In countries with weak environmental enforcement of authorities, ISO 14001 is a system that could take the role of securing compliance with the environmental regulation for certified companies in the specific country. A country like South Africa is said to have one of the best environmental laws in the world, but the enforcement is low. Here ISO 14001 ensures that certified companies comply.

Another question to be raised here is “what is the differences in regulatory demands of the environmental law in different countries?” In some countries both environmental law and enforcement is weak. For a company with a certified EMS in such a country it might be rather easy to comply with environmental regulation contrary to companies in other countries with more strict environmental regulation with more environmental demands and more control from authorities. As a consequence of this some parent companies have formulated their own environmental standards which all subsidiary companies must comply with no matter where they are situated in the world [10]. I will not go further into this question but point out that customers with suppliers certified according to ISO 14001 do not necessarily know anything about how strict environmental regulation is formulated in these countries. This means that customers to a certain extent should obtain knowledge about environmental demands in the countries of their suppliers in order to assess whether it is satisfactory.

Developing countries with limited resources for enforcement of environmental regulation could consider to concentrate on formulation of clear and appropriate environmental law and regulation towards industry and at the same time demand the most polluting companies to become certified according to ISO 14001. In this way it is the lead auditors from the certifying bodies who control and secure that these companies comply with the law.

PUBLIC ASSESS TO ENVIRONMENTAL PERFORMANCE IN INDUSTRY NEEDED

The fact that a company is certified according to ISO 14001 does not automatically inform stakeholders about how polluting the production is compared to other companies. With ISO 14001 the company is only committed to publish their environmental policy and that is most often not sufficient in order to assess and compare the environmental performance of for instance two different companies. EMAS registered companies in EU have to publish an environmental statement which gives stakeholders a better opportunity to assess and compare environmental performances. With the increasing number of stakeholders concerned about the environmental impact and performance of industry, ISO 14001 could respond to this concern by integrating

demand for environmental statements in the next edition of ISO 14001. Another way of providing public assess is practised in Denmark since 1995 with a demand for the most polluting companies to deliver an environmental report no matter if they are certified or not.

Public assess to environmental information about performance in the individual company through environmental statements/reports would probably motivate some companies to make an extra effort in order to comply with environmental legislation and conduct continuous improvements of their environmental performance.

ENVIRONMENTAL IMPROVEMENTS

Ananother issue of relevance to discuss is the demand for environmental improvements. What specific environmental improvements the company must live up to is a question of interpretation. ISO 14001 do not provide an indication of what goals the company should strive to achieve. Besides, with an ISO 14001 certification stakeholders do not know if the specific company is among the least polluting companies at national/international level or among the worst.

In relation to the specific formulation of aims companies often set up goals with environmental impacts per produced unit. But what happens when the production increases? If for instance a dairy cleans the pipes twice daily with detergents, and then production increases and they still clean twice daily then the result is that used detergent per produced unit or per amount of raw milk is decreasing. In practise the dairy has not made any environmental improvements, they have just increased production. Is this an environmental improvement? You could say no with the argument that the total use of detergents in the company has not decreased, on the other hand you could argue that it is an improvement because you produce more products with less environmental impact per unit. Another example could be that the dairy uses more energy in total when increasing production, but the energy consumption per ton raw milk might be the same or even decreasing. This means that environmental improvements can be reached in spite of the fact that the total environmental impacts have increased. When this is the reason for the environmental improvements, it should be stated in the environmental statement/report of

the company in question, in order to inform the public about the preconditions of the improvements. Companies do expand their production, economic growth is the basis of most businesses. Therefore ISO 14001 should be clearer in the definition of environmental improvements and it should be discussed what kind of goals are most appropriate in order to reduce environmental impacts from industry.

THE ROLE OF THE AUDITORS

The certifying bodies and especially the individual auditors who certify and audit companies' compliance with ISO 14001 play an important role interpreting the standard. As mentioned earlier in this paper ISO 14001 leaves room for interpretation. Both at national and international levels studies show that auditors have different attitudes and opinions of the interpretation. In a comparative analysis of EMAS and ISO 14001 it is indicated that not all auditors demand continuous improvements with an ISO 14001 certificate [13]. A Danish auditor has personally experienced differences in the interpretation of continuous improvements between Denmark and Thailand. He thinks that culture has an influence on the demands placed at companies in different contexts.

Another example of differences is given earlier in this paper regarding the interpretation of (non-) conformance with regulatory requirements. In the next years many companies in developing countries must obtain an ISO 14001 certificate in order to enter the international markets. In this respect it is of great importance that the certificate has credibility and is not something you can pull in a vending machine [10, 14].

At national level differences in interpretation between certifying organisations and between auditors in the same certifying body also seems to vary. Smink followed the certification of three car-dismantling companies, which were certified by two different certifying bodies. The auditor in the first company certified the company in only two hours and allowed a consultant of the dismantling company to answer some of the questions (which they are not allowed to do). The auditor from another certifying body spent two days on each of the other car-dismantling companies [15].

From interviews with one lead auditor from each of the three biggest certifying organisations in Denmark, it can be concluded that two of the three interviewees do not place demands regarding the environmental impacts of the products on their clients regarding ISO 14001. The third lead auditor demands/requires that the companies have conducted life cycle considerations [10].

Interviews with 13 auditors from the same certifying body (SWEDAC in Sweden) also show differences in their interpretation of ISO 14001 [16]. On the question *"How do you control that the requirement regarding continual improvement is fulfilled?"* the answers varied:

- a. I focus on the environmental targets (8 auditors)
- b. I try to make a comprehensive judgement, where environmental targets constitute one part (4 auditors)
- c. I focus on procedures for handling non-conformance (1 auditor)

On another question: *"Which criteria are approved for inclusion in the assessment of environmental aspects when determining the significant environmental aspects?"* the answers were:

- a. Only criteria related to environmental impact are approved (8 auditors)
- b. Criteria regarding economy, technical possibilities, legal demands, etc. are also approved in the assessment process (5 auditors).

The discussion in the above paragraph indicates that the interpretation of ISO 14001 vary more than the certifying bodies imply. ISO 14001 could be more clear regarding continuous improvements and regarding the assessment of the environmental aspects. As Georg points out: *"auditing is the key to making the organisation transparent, but an important prerequisite for auditing is, however, that things have in some way been made audible"* [17].

MORE PRODUCT FOCUS NEEDED IN ISO 14001

Companies complying with EMAS/ISO 14001 have recognised the responsibility for their own production, but not yet for the whole product

chain [18]. In the mean-time consumers, wholesalers and authorities are increasingly considering producers as responsible for the whole life cycle of their products. In other words they put pressure on industries concerning increased product responsibility with a basis in life cycle thinking [19]. A Danish study of 107 companies complying with EMAS/ISO 14001 shows that EMS has proved to be a good basis for technological innovation and environmental improvements. In nearly half the cases EMS has resulted in cost savings, but the companies also stress the importance of improved image. Although half of the companies have a few aspects of life cycle thinking in the environmental review, the environmental focus is site-specific.

A more product-oriented approach is necessary because the most significant environmental impacts frequently appear in other life cycle stages. This is certainly the case for many food products, as the hot spot is often the primary production, where the demand for energy and land (space) is significant [20]. For products with energy consumption during use, such as electronics, the usage stage will often be very important [21]. The latter is also the case for a series of other products such as cars, textiles, chemicals, etc. Other groups of products may cause the largest problems in the disposal stage, such as PVC, products containing large quantities of heavy metals, e.g. some batteries, and various kinds of electronics, etc.

Only 28% of the ISO 14001/EMAS certified companies in Denmark place demands on suppliers and other network collaborations in order to have an EMS certification or other kinds of EMS. In general the formal EMS is not diffused up- and down stream the product chain. This indicates that life cycle thinking and demands for improvements by the suppliers are still not very common [13]. Concerning the possibility for substituting suppliers or customers to obtain environmental improvements there are also other barriers: price and quality are almost always more important than environmental considerations [19].

An increasing demand for greener products should be promoted both with pressure from stakeholders, regulatory incentives and with initiatives from the individual companies. The companies more often ought to consider taking

initiatives to inform and educate their market about their green products [22].

To promote implementation of life cycle based management in industries, demands for product focus should be incorporated strongly in ISO 14001. In principle ISO 14001 holds demands for life cycle thinking in certified companies as the scope for the standard, among other things, states that: *"It applies to those environmental aspects, which the organization can control and over which it can be expected, to have an influence."* [2]. For instance, companies producing energy consuming products to households must be considered to have an influence on the energy consumption of the products. Therefore use of these products must be an environmental aspect the company should include in their EMS. In practise this is not often the case.

CASE STUDY OF AUTOMOTIVE INDUSTRY IN SOUTH AFRICA

Case studies were conducted November 2002 in four companies in the automobile industry in South Africa. Two assembling companies (BMW in Pretoria and Delta Motor corporation in Port Elizabeth) and two tyre producers (Bridgestone Firestone and Continental, both situated in Port Elizabeth). Of the four companies only Delta Motor is yet not certified according to ISO 14001. The main purpose of the case studies was to answer the following questions:

- a. What are the incentives for becoming certified according to ISO 14001?
- b. What organizational changes have the companies gone through?
- c. Has the EMS promoted environmental improvements and greening of knowledge?
- d. How are the relations with stakeholders, and have they been strengthened?

These findings, will be further elaborated in [23] and [24]. Looking at the share of ISO 14001 certificates in different parts of the world it shows, that Europe (47%) and the Far East (36%) together hold 83% of the certificates. Other regions in the world have had a slower and/or a later start. In regions characterised by developing countries the share is very little and seems to stay low: Africa/West Asia (2,7%) and Central/South America (2,9%) [3].

South Africa has been chosen because it belongs to a part of the world, where ISO 14001 is not widely spread at the moment. Today South Africa has by far the most ISO 14001 certificates in Africa (264 certificates by 31st December 2002) [3]. The incentives and barriers for ISO 14001 certification are viewed from the point of the industry in South Africa. It has been chosen to investigate transnational companies in the automobile industry, the supplier relations to the parent company and a business with increasing international environmental regulation, for instance to proper environmental dismantling of automobiles. In this paper it is chosen to discuss findings regarding environmental regulation.

The most difficult part of complying with ISO 14001 has been the environmental legislation. It takes a great amount of time for the companies to gain an overview of the legislation to comply with. They find the law very extensive and incomprehensive. Bridgestone Firestone has made an agreement with a lawyer to interpret the laws and express the essence in a few pages and in an easy language. The environmental manager has a close relationship with the head of the local environmental authorities and stays in direct contact with him to discuss environmental matters. At Continental they also have external assistance. They get a monthly update on any changes in laws in South Africa, including environmental legislation. At BMW they have joined a number of courses to achieve the necessary knowledge about the environmental regulation in South Africa.

In South Africa there are three levels of legislation: national, provincial and local/municipal. On the national level legislation is fragmented between various governmental departments. In absence of South African legislation it sometimes happens that the EPA guidelines for air pollution are used. As for smoke and water pollution, the Dutch intervention guidelines are often used. The enforcement of regulations is weak because of limited government resources [25]. *"They (the municipality eds.) do not actually enforce anything, if we did not want to improve the environment we could do some nasty and horrible things"..."Basically it is entirely up to the company to ensure that they run according to strict regulations"* [26]. For instance the companies have to contact the authorities themselves in order to ask for specific pollution

permits. The companies also take their own water samples; the municipality does not have the resources to do it.

BMW has taken the initiative to a waste club including the major industries in the area. They discuss and inform about environmental issues. Next step for BMW is to get a government representative and local environmental authorities to participate. BMW wants to give companies guidance for improvements of environmental performance. For instance it is difficult for individual companies to have access to every new law, and BMW are willing to share their knowledge about it. They do not want to be a company with high environmental performance while the neighbours still dump stuff into the road and so on [27]. It is interesting that BMW, a transnational company, has put their own resources into organising the waste group caused by lack of enforcement from the environmental authorities.

The case studies show that the companies with a certified EMS have difficulties obtaining an overview of what to comply with and spend a lot of resources in order to secure compliance with legislation. They complain about the complexity of legislation and the lack of enforcement of legislation.

CONCLUSION

This paper has discussed a number of issues related to the use of certified EMS according to ISO 14001. Some of the issues of concern have their basis in unclearness of the standard, the interpretation of the standard at company level and among auditors from certifying bodies.

First of all more large-scale studies need to be conducted in order to achieve a better insight in the benefits of certified EMS at international level and differences between countries. Such studies need to be aware if the actual number of respondents compared to the number of questionnaires sent out is satisfactory. It must also be investigated how non-certified companies perform compared to certified companies. It also has an impact on surveys for how many years the companies have been certified which might differ significantly between different trades of businesses and between countries.

When certified according to ISO 14001 companies must comply with environmental legislation, but it is important to bear in mind that national legislation and enforcement can differ significantly between countries. Customers who want their suppliers to be certified must gain knowledge about environmental regulation in the specific countries in order to assess whether it is satisfactory. Especially in developing countries with limited resources for enforcement of environmental regulation it is suggested that the authorities concentrate on formulating a clear regulation of high quality and at the same time demand the most polluting companies to become certified according to ISO 14001. This way the individual company must take responsibility of documenting compliance and authorities could let the auditors from the certifying bodies control that the companies comply. It is also suggested that ISO 14001 integrate a demand for publication of environmental reports in order to provide public access to environmental information about performance. Alternatively environmental reports could be considered as a legal requirement from authorities.

Regarding environmental performance companies often set up goals of impact per produced units. If the company increases production this might result in a reduced impact per unit, even though the total impact is not decreased. It is suggested that ISO 14001 should be clearer in the definition of how to measure and report environmental improvements.

The auditors from the certifying bodies interpret ISO 14001 and assess companies' compliance with the standard. Different surveys show that neither at national nor at international levels do the auditors make the same assessments of issues like continuous improvement and environmental aspects. ISO 14001 should make these issues easier to audit homogeneously among auditors.

The final suggestion is to incorporate life cycle considerations more strongly in ISO 14001. A more product-oriented approach is necessary because the most significant environmental impacts frequently appear in other life cycle stages than in the certified company in question.

REFERENCES

1. Welford, Richard. (1998). *Corporate Environmental Management – systems and*

- Strategies. Second edition 1999. Earthscan Publications Ltd. London.
2. ISO. (1996). *EN ISO 14001; Environmental management systems – Specification with guidance for use*. Danske standard. 1. Edition.
3. ISO. (2003). *The ISO Survey of ISO 9000 and ISO 14000 Certificates. Twelfth cycle: up to and including 31 December 2002*. Viewed on homepage 28 July 2003: <http://www.iso.ch/iso/en/commcentre/pressreleases/2003/Ref864.html>
4. ISO. (2002). *Benefits of the ISO 14000 family of international standards*. Viewed 19th February 2003: <http://www.iso.ch/iso/en/prods-services/otherpubs/iso14000/benefits.pdf>
5. Bell, C. L. (1997) The ISO 14001 Environmental Management Systems Standard – One American's View. *ISO 14001 and Beyond – Environmental Management Systems in the Real World*. Ed. Hillary, R. UK. Greenleaf Publishing.
6. Schaltegger, S., Burritt, R. and Petersen, H. (2003). *An Introduction to Corporate Environmental Management. Striving for sustainability*. Greenleaf Publishing.
7. Melnyk, S.A., Stroufe, R.P. and Calantone, R. (2003). Assessing the impact of environmental management systems on corporate and environmental performance. *Journal of Operations Management*, 21 pp. 329-351.
8. Lauridsen, E. H. and Jørgensen, U. (2003). Changing settings-changing roles. The different conditions of EMS in Thailand and Europe. *Submitted to the 11th Greening of Industry Conference*, San Francisco October.
9. Wätzold et al. (2001). EMAS and regulatory relief in Europe: Lessons from national experience. *European Environment. The Journal of European Environmental Policy*. Vol. 11, no. 1 pp. 39.
10. Jørgensen, Tine Herreborg (2001). *Miljøledelse – systemer, standarder og praksis* [Environmental Management – Systems, Standards and Practice]. Skriftserie 277. Department of Development and Planning, Aalborg University, Denmark.
11. Ammenberg, Jonas (2001). *How do standardised environmental management systems affect environmental performance and business?* Institute of Technology, Linköpings Universitet. Sweden.
12. Morrow, D. and Rondinelli, D. (2002). Adopting Corporate Environmental Management Systems: Motivations and Results of ISO 14001 and EMAS Certification. *European Management Journal* Vol. 20, No2, pp.159-171. Elsevier Science Ltd.
13. Kvistgaard, Morten et al. (2001). *Miljøstyring og miljørevision i danske virksomheder* [Environmental Management and Environmental Review in Danish Companies] Kvistgaard Consult ApS. *Miljønyt* Nr. 62. Erhvervsfremme Styrelsen og Miljøstyrelsen, Copenhagen.
14. Lead auditor (2001). Bureau Veritas, telephone interview, Denmark June.
15. Smink, C. (2002). *Modernisation of environmental regulations. End-of-life Vehicle regulations in the Netherlands and Denmark*. Ph.D.-thesis, Aalborg University.
16. Ammenberg, J, Wik, G. and Hjelm, O. (2001). Auditing External Environmental Auditors – Investigating How ISO 14001 is Interpreted and Applied in Reality. *Eco-Management and Auditing*, vol.8.
17. Georg, S. (2003). Environmental Management Standards –Traveling Ideas for providing transparency and Trust? *Position paper for the DUCED-EMP Research Workshop*. Chulalongkorn University. Bangkok, March.
18. Christensen, P. et al. (1999). *Erfaringer med miljøledelse i danske virksomheder* [Experiences with environmental management in Danish companies], Miljøprojekt nr. 486, Miljøstyrelsen, København.
19. Thrane, M. et al. (2000). *Innovation, miljø og kvalitet i fiskeindustrien* [Innovation, environment and quality in the fishing industry], POET's projektserie om fødevaresektoren, Aalborg Universitet, Aalborg.
20. SIK. (2001). *International Conference on LCA in Foods*, Proceedings, SIK Dokument 143, Organised by the Swedish Institute for Food and Biotechnology, 26 – 27 April, Gothenburg.
21. Wenzel, H. et al. (1997). *Environmental Assessment of products*, Volume 1, The Danish Technical University, Chapman & Hall, London.
22. Jørgensen, T. H. and Thrane, M. (2002). Life Cycle Based Environmental Approach in the Industry. *Proceedings of the Corporate*

- Social Responsibility and Environment Conference*. Leeds.
23. Smink, C., Nielsen, E. and Jørgensen, T. H. (2003). Process and Product-oriented Environmental Policy in the Car Chain. *Proceedings of the Greening of Industry Conference*, San Francisco October.
 24. Jørgensen, T. H. and Smink, C. (2003). EMS in the Automobile Industry in South Africa – a case study. *Proceedings of the Greening of Industry Conference*, San Francisco October.
 25. Williams, B. (2002). Interview with an environmental consultant. Port Elizabeth, South Africa. November.
 26. Continental (2002). Interview with Mrs. Alison spence, Health, safety and environmental manager Port Elizabeth, South Africa. 19 November.
 27. BMW (2002). Interview with Mrs. M. Boscho, environmental advisor. Preoria, South Africa. 26 November.

