Redefining environmental management system boundaries through stakeholder management across product life-cycle

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Abstract: The paper makes an attempt to show that integration of life-cycle thinking into EMS can certainly address environmental issues, external to the organisation. New emphasis must be placed on product life-cycle thinking, to achieve business performance consistent with sustainability principles. In effect, the paper calls for redesigning the EMS through life-cycle environmental review (LCER) capable of addressing

- environmental issues across the life-cycle of its products
- institutionalising diffusion of continual improvement across the product life-cycle
- stakeholder concerns across the product life-cycle
- relating to the relevant global environmental issues.

Keywords: life-cycle environmental review; product life-cycle; environmental management system; continual improvement; stakeholder management; green supply chain; green consumers.

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1 Introduction

The last few years have seen attention to environment by business moving beyond the factories' four walls and covering the entire life-cycle of products they manufacture. It has been interesting to see how many companies have accepted their responsibility to improve their business performance across the life-cycle of products and services. Especially, in many European countries, legislators are beginning to include such concepts as extended producer responsibility and take-back regulation in the environmental policy agenda (Ehrenfeld, 1997). In these approaches, the producer must

also consider the eventual reuse of, or recycling opportunities for, its products, which relate to the latter steps of product's life. The dominant approach to managing environmental issues in most large companies has been the construction of EMS, often certified to ISO 14001, associated with a cycle of continuous improvement (Welford, 1998). For many companies this has brought about tangible benefits in terms of cost reduction, improvements in working practices, and enhancement to reputation and image. On the business and environmental front, competitive advantage is possible to be obtained, not only by corporations strategically positioning their products and services in the marketplace, but also through the character of their organisational processes (Orsatto, 2001). Academicians and practitioners have recently suggested that management of industrial risks through EMS have the potential to become a source of competitive advantage (Berry and Rondinelli, 1998; Forest, 1998). Petroni (2000) has illustrated three major benefits from EMS as perceived by customers. These are

- product related
- image and reputation
- assurance of compliance with regulations.

The product related benefits are price reduction, reduction of defective products, by eliminating use of hazardous materials and environmentally unsafe processes (Gupta and Sharma, 1996), and increased use of recycled and/or recycling of materials. The image related benefits are improved reputation with regulators/government; effective communication of environmental friendliness to customer base may improve the perceptional quality of product and operations (Strachan, 1999); and certified EMS of a large and important suppliers may have a beneficial impact on firm's relationship with its shareholders and other investors (Buckens and Hinton, 1998; Coulson and Monks, 1999). Similarly, ISO 14000 certification can become the basis of deciding lending and liability (Samdani et al., 1995).

However, Welford (2003) rightly raised few question regarding the effectiveness of EMS in today's context. He points out that even in companies where EMS approach has worked well, the systems approach has now led to a degree of inertia whereby the company complies with its stated policies and goes no further. Further, he argues that in the globalised economy, no company can see itself in isolation and take a purely internal view of its environmental impacts. According to him, globalisation has led to outsourcing of production activities of many companies and, therefore, one must question whether an internally oriented tool, such as an EMS, is capable of dealing with what are essentially now external impacts. According to Giddens and Hutton (2000), companies are increasingly 'weightless' with more and more of their production activities outsourced and their assets are increasingly based on knowledge, brand, and reputation. Therefore, companies can be certified to ISO 14001, and the organisation, while still creating huge environmental impacts further down the supply chain goes unmonitored and not addressed. Similarly, environmental impacts along the demand chain are also not addressed. Welford (2003) raised the following questions highlighting the limitation of EMS in today's global economy:

- Systems approach used in EMS is prone to degree of inertia whereby the company complies with its stated policies and goes no further, i.e., it may not be related to global environmental impacts.
- An internally oriented tool, such as an EMS, is not capable of dealing with impacts beyond the factory gate. Especially, if the organisation has outsourced its production activities.

Similarly, van der Vorst et al. (1999) has also highlighted limitations of EMS given below:

- the practices in vogue EMS do not adequately related to global impacts, viz., energy usage and associated CO_2 emissions are to be controlled in the light of global environmental impact, rather than that of its own target setting process for cost reduction and efficiency
- EMS do not necessarily harness opportunities for continual improvement across the product cycle
- EMS should also recognise that environmental impacts of any product or service are spread across its entire life-cycle.

Besides, EMS must be integrated with the overall management system-financial, environmental, personal/social especially, interface between business and its financial partners on environmental grounds (EU Commission, 1997a, 1997b; ISAR-UNCTAD, 1997; Schaltegger and Figge, 1998; Schmidheiny and Zorraquin, 1996; Skillius and Wennberg, 1998).

EMS procedures and objectives need to be adapted to incorporate the wider and growing demands of civil society, business partners, and government in a more democratic decision making process (Kruth and Gleckman, 1998). Further, others (Sangle and Nema 2002, Sangle, 2002; Sangle and Ram Babu, 2002) have also suggested internalising the environmental concerns of stakeholder groups across product life-cycle. In this backdrop, EMS implementation needs to be more comprehensive and demanding in new approach in line with above points that are critical from sustainability viewpoint also. Key pointers for redesign of EMS include:

- relating relevant significant global environmental issues
- institutionalisation of diffusing continual improvement process across product life-cycle based on the principles of industrial ecology
- addressing environmental issues across the entire life-cycle of product or service
- internalisation of stakeholders' concerns.

The paper proposes a new framework for designing an EMS that is capable of addressing all the above issues. It is argued here that while designing EMS, organisations must look at the entire life-cycle of its products and services. Entire life-cycle assessment may not be required in all cases, only life-cycle approach alone will suffice to address the deficiencies listed earlier in existing EMS, as pointed above. The life-cycle approach can be adopted as a management tool, as life-cycle oriented environmental management (Sinding, 2000). However, now the question arises, whether such an integration of life-cycle assessment and environmental management system is possible or not. Life-cycle assessment, in its present form, is capable of identifying and assessing

environmental impacts at global and regional level. In other words, it does not identify all the environmental issues especially local environmental impacts (Potting and Blok, 1994; Roeleveld et al., 1997; Sangle et al., 1999, Sangle and Ram Babu, 2004). Similarly, current EMS implementation practices do not necessarily relate to environmental issues at global and regional level. At the best it is used to address environmental issues at firm level. Therefore, both LCA and EMS, in their present form, are both complementary to each other, and the proposed integration will facilitate addressing new decision making, in line with sustainability agenda, which is not possible when both the tools are used separately. Further, both LCA and EMS are chain management tools; hence integration of the two is theoretically possible. EMS can be defined as all the people, at all the level, at all the time contribute in achieving environmental objectives and targets derived from the environmental policy of the firm. Similarly, LCA is all about assessing all environmental impacts of a product at all the product life-cycle stages. Current EMS practices do not ensure continual improvement across the entire life-cycle stages; hence, life-cycle view may help an organisation to trigger continual improvement, along both upstream and downstream. This is very critical, as opportunities for continual improvement might be present all along the life-cycle and not restricted to manufacturing stage alone. Similarly, if one incorporates life-cycle view at design stage of EMS, it can perhaps address all the environmental life-cycle impacts. EMS will be responsive to all environmental impacts spread across the life-cycle stages of products and services. Finally, the current EMS identifies stakeholders who are at manufacturing stage, ignoring stakeholders at other stages of product life-cycle. Hence, inclusion of life-cycle view in the EMS will ensure that concerns of all the stakeholder groups, at all the stages of production, are reflected in the EMS.

2 EMS based on ISO 14001

EMS designate a set of tools and techniques developed to perform a management function in organisations by developing, implementing, and reviewing environmental policies. Based on initial environmental review, EMS tools have been established to evaluate and continuously improve the organisation's environmental performance. van der Vorst et al. (1999) has highlighted the following principles on which EMS based on ISO 14001 is established:

- an EMS is *systematic* in providing the corporate management with stable system elements to increase the protection of the environment
- an EMS is *priority* driven, as the system and objectives it implements are based on those aspects and impacts considered as significant
- it is *procedural* in the systematic, objective and periodic evaluation of performance of EMS
- it is *cyclical*, as the audit enables an evaluation of achievements against objectives and imposes corrective actions in a continuous improvement process
- it is *informational*, both for management decisions (internal) and external through publicity of environmental policy
- it is also *third party* reliant, as accredited independent certifiers check the validity of system and the reliability of generated data.

So an EMS is an organised strategy that enables an organisation to achieve: focused, intentional development of environmental policy; monitoring and recording of environmental performance; and identification of needs and opportunities for improvement. An EMS strives to put in place the policy tools, incentives, and routines needed to make environmental improvements an integral part of part of company's way of doing business. EMS is an extension of total quality management (TQM) and related to continuous improvement systems revolutionised modern manufacturing characterised by quality. In other words, TQM advocates that quality is much more efficiently built into product, rather than through an inspection. Similarly, TQM focuses on continuous improvement by regularly working through PDCA cycle. Likewise, a properly developed EMS ensures continual improvement in the environmental performance of its operations and achieving better environmental performance help improve its business performance. In such an approach, wastes and emissions are considered to be non-value added by-products that are to be minimised to the possible extent because any form of waste is an economic waste.

2.1 Capturing the opportunities and benefits of product life-cycle

Although most existing EMSs, address site operations, LCA is a systematic way to incorporate environmental impacts across the product life-cycle. LCA has a potential to generate significant environmental benefits. In particular, it avoids problem shifting from (UNEP, 1996):

- One stage of the product to other stages. For example, in case of battery driven car, the pollution is shifted from use phase to manufacturing stage.
- One location to other locations. For example, polluting activities from developed world are shifted to developing world.
- One media to other environmental media.
- Allow company to understand dominant stallholders across the life-cycle stages of product.

Product life-cycle view may also leverage other business goals such as product differentiation, cost reduction and redefining markets. For example, environmental product differentiation creates products or employ processes that offer greater environmental benefits or improve smaller environmental costs than those of competitors. Such efforts may raise business costs, but they have the potential to command higher prices, to capture additional market share, or both (Forest, 1998). Similarly, by reducing materials and energy consumption, DFE can be highly profitable. Let us consider Xerox Corporation's Asset Recovery Management (ARM) program, which uses leased Xerox copiers as a source of high quality, low-cost parts and components for new machines. A well developed, infrastructure for taking back leased copiers combined with sophisticated remanufacturing process allows parts and components to be reconditioned, tested, and then reassembled into 'new machines'. Xerox estimated that ARM savings in raw materials, labour, and waste disposal in 1995 alone were in the $300 million to $400 million range (Hart, 1997). Also, Dell computers attempted to redefine its business model after realising higher lifecycle environmental impacts while selling PCs. Rather than simply selling the PC, it retains the responsibility

for PC's disposal and takes back products from customers when they are superseded by new technology or higher performing PCs. The machines are then disassembled, remanufactured to incorporate new technology, and again leased as new machines. This practice enables Dell to reduce its overall costs and also to make entirely new lease market for itself. The lease markets in 1999 was believed to be growing at phenomenal 149% (Fishbein et al., 2000). Customers also benefit because they no longer have to worry about the disposal of machine and have access to latest technology. Besides, product life-cycle view can also help designer improve product costs and time-to-markets by evaluating the environmental attributes of their products (Eagan and Pferdehirt, 1998). Time-to-markets can be improved by eliminating hazardous materials that would normally require time and resources to obtain necessary permits. Beyond the business decision-making, product life-cycle view promises to guide business decisions making towards a more sustainable production-consumption chain.

2.2 Broadening the decision making horizon through integration of product life-cycle and EMS

Today, environmental concerns go beyond merely focusing on individual projects or issues, or environmental impacts within individual company boundaries. They, instead, highlight the systemic nature of the environment and the need to focus more on aspects of global sustainability, and also the need to provide new–often multi-disciplinary–information for decision-making. Often, we expecttools to perform beyond their original purposes, i.e., to inform us in making broad sustainability decisions rather than simply providing data on specific and individual environmental impacts.

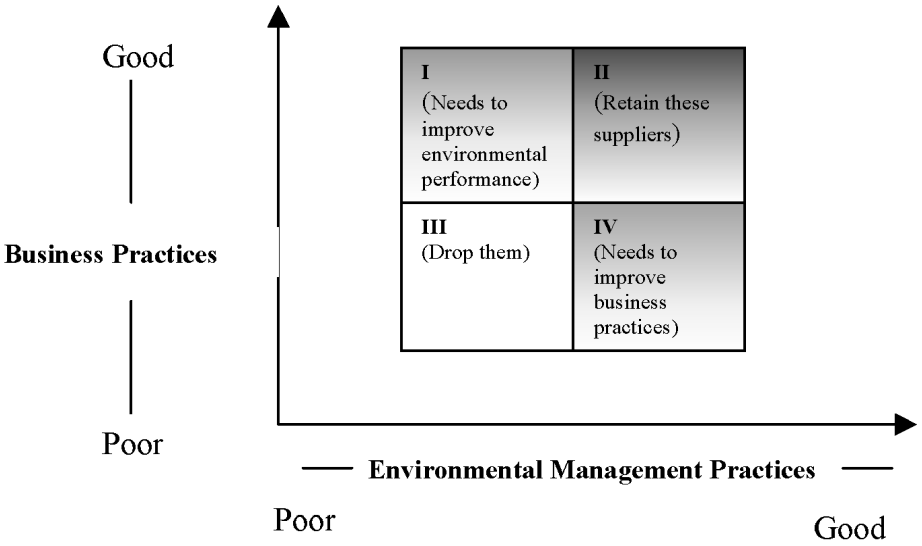
While EMS and LCA have evolved with specific applications in mind, together, they provide a framework for assessment and management of environmental impacts and for the provision of information needed in response to increasing environmental awareness and needs. The question often posed is whether the tools we have are sufficient, or if there is a need for new tools or approaches that are specifically designed to address sustainability. This question is itself too simplistic since it implies mutual exclusivity, whereas in reality there is a need for both existing tools used in a new context and new tools per se.

Internalisation of product life-cycle view in an EMS can reveal how different economic actors in the entire value chain are critical for better environmental performance of the focal organisation. Thus, one can draw a framework to make the production-consumption chain more sustainable with the help of suppliers, distributors, consumers, and other actors in the production system. This approach can help an organisation to derive both the supply and the demand side sustainability strategies for the organisation. For example, strategic decisions on greening efforts along the supply chain can be drawn. Let us say, if an organisation has large number of suppliers, then should the organisation have one common strategy for all suppliers, or should it have different strategies for different clusters of suppliers depending on their environmental and general business performance. Obviously, dealing with individual cluster is desirable and is explained in the following paragraph.

In Figure 1, suppliers coming in Quadrant I are those whose business practices are good, but have poor environmental management practices. Therefore, obviously they become candidates who need to improve their environmental performance, perhaps with some support from focal organisation. Similarly, suppliers coming in Quadrant IV have

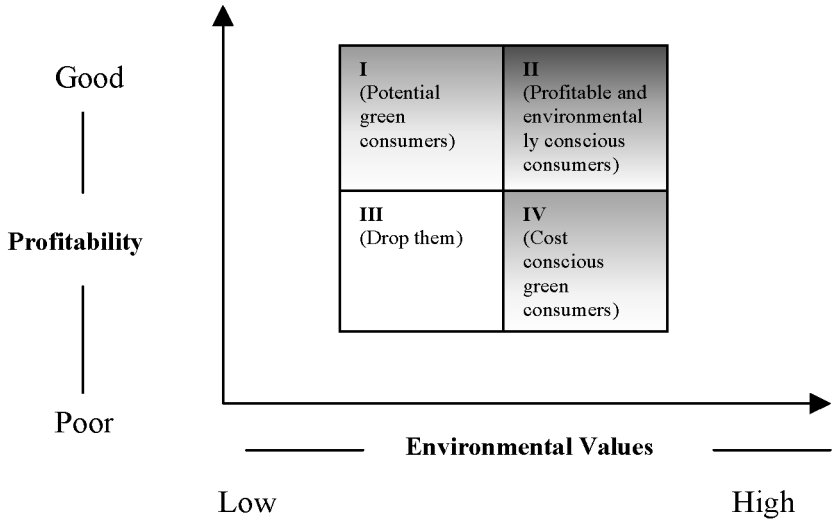
good environmental performance, but poor business practices; hence they need support from focal organisation to uplift their business performance. Suppliers in Quadrant III are not doing well in both business and environmental area; hence focal organisation might like to stop doing business with them. Finally, suppliers in Quadrant II are really good in term of environmental and business performance; hence focal organisation should make effort to retain these suppliers.

Figure 1 Green shades of suppliers



Similarly, one can take strategic decision based on clusters of green customers, and also derive appropriate sustainability strategies to improve environmental performance in the downstream. In Figure 2, Quadrant I has profitable customers, but with poor environmental values, i.e., their consumption related decisions are not influenced by environmental impacts of the product and services they consume. Therefore, organisation may have to educate these customers and need to spread awareness regarding environmental impacts of the products that they buy. Similarly, consumers coming in Quadrant IV are environmentally conscious, however they are not willing to pay more for environmentally better products. Majority of consumers, at least in developing countries, are in this quadrant; hence organisations will have to deliver the product and its benefits at a competitive price. Consumers in Quadrant III are neither very profitable, nor do they have high environmental value, and it may be very difficult for organisation to make them profitable and inspire them to take environmentally informed decision making, hence organisation might like to have such consumers. Finally, customers in Quadrant II are profitable and environmentally conscious; hence organisation should make efforts to retain these consumers.

Figure 2 Green shades of consumers



The stakeholder management literature can be traced back to the pioneering work of Freeman (1984), who articulated a 'stakeholder model' to replace 'managerial model' of the firm. Traditional stakeholder management literature (Brener and Cochran, 1991; Brener, 1993) has focused on classification of stakeholders, viz., primary and secondary, and also on stakeholder's approach to obtain overview of threats and opportunity (Madsen and Ulhoi, 2001) offered by stakeholders within the factory four walls. However, additional emphasis should be placed on stakeholder groups present along the product life-cycle. Since product has environmental consequences throughout its life-cycle stages and there are stakeholder groups at all the product life-cycle stages, the focus of this approach is to facilitate identification of stakeholders and their concerns at each stage of product, to enable company address concerns of all stakeholder groups. This is also in line with principle of extended producer's responsibility, which requires producer to deal with monetary and physical disposal of product after being discarded by the customer. Further, product life-cycle view is of potentially great importance, as this will help company to manage competing and conflicting interests of stakeholder groups.

3 Framework for redefining EMS through stakeholder management across product life-cycle

This section delineates a framework for redefining the development of EMS.

The redesigning of EMS has the following three steps:

- need assessment
- system development and performance
- result monitoring and continual improvement.

3.1 Need assessment

Here, a life-cycle environmental review, which is a walk through product(s) life-cycle audit of the organisation intending to develop EMS, is conducted. The LCER will include all the life-cycle stages of products that the organisation manufactures. Further, it needs to identify salient stakeholder groups at each life-cycle stage of product. This step will involve:

- identification of salient life-cycle stages of product
- identification of salient stakeholders and elicitation of their environmental concerns at above identified product life-cycle stages
- identification of applicable environmental laws across the above life-cycle stages of product
- identification of pollution prevention opportunities across the above life-cycle stages of product
- identification of opportunities for continual improvement across the above life-cycle stages of product.

Identification of stakeholders along product life-cycle of products and eliciting their expectations are two salient tasks in this step. Assessment of stakeholders' expectations involves establishment of communicative linkage with the stakeholders to identify both implicit and explicit ones.

The salient elements of the assessment process are detailed further:

3.1.1 Identification of salient life-cycle stages of product

Determining which life-cycle stage to be included or considered can be a daunting task. In principle, all the stages of product in question should be considered. However, some stages can be omitted if the environmental impacts /aspects are not significant. A thumb rule to choose life-cycle stages is to identify stages:

- where legal requirements have to be met
- whose environmental impacts are significant (emissions are high/exceeding standards or limits, scarce resources are used)
- where key environmental stakeholders are affected
- which are under the direct influence of product manufacturer
- which are not under the direct control of product manufacture, but are critical to the overall environmental performance across the life-cycle of a product in question.

After identifying the salient stages of product for the evaluation of stakeholder satisfaction, the next step is to seek stakeholders' prioritisation of salient stages, i.e., to know preferences of all stakeholders from the viewpoint of environment. This could be based on the following criteria:

- potential impacts of emission/wastes/discharges/resources use
- past occurrences of non-compliances and incidences of conflict
- cost-effectiveness of environmental performance improvement possibilities.

3.1.2 Identification of key stakeholders

Determining who the environmental stakeholders are for an organisation is a critical for evaluation of stakeholder satisfaction. Stakeholders may be formal, readily identifiable groups, or they may be people who have been inadvertently pulled into an issue-such as parents of children at a school located in the neighbourhood of a contaminated site. Failure to identify, or include groups or persons that have an interest in an issue, can have grave consequences. Thus, identification of stakeholders and gaining insights into their attitudes and agenda is an important task in the development of EMS.

Generally key stakeholders:

- can affect the operations of factory, site or project, i.e., regulators
- are directly involved because of their proximity to a facility, site, or project, such as neighbours
- use the products and services of the organisation
- have financial stake in the organisation such as banks, insurance organisations and investors, shareholders
- have an interest in an environmental issue because of the positions they hold, such as elected and appointed officials and other local government staff
- want to be part of the dialogue concerning the issue.

Organisations can have their own set of criteria to prioritise stakeholders or preferences. However, the following considerations would aid the ranking process

- statutory or legal authorities with powers to close/penalise industry for not meeting legal requirements
- population directly affected by the operations of the industry (who are in the vicinity or factory, site, project)
- employees affected by working conditions (health and safety) in the organisation
- institutions and individuals with financial stake in the organisation
- environmental and consumer groups in the neighbourhood, region or anywhere in the globe
- consumers or users of the product or service
- suppliers of goods and services to the organisation
- national government and other public interest organisations advocating and / or concerned about sustainable development.

The first three stakeholder groups have direct linkages and their satisfaction is of the paramount concern. The next four stakeholder groups have indirect interest with the environmental performance of the organisation and are not covered by the regulations in many countries. While the last stakeholder group is important for the environmentally committed organisations preparing for future. The suitable and relevant criteria to internalise organisation's sustainable business concerns are context specific.

3.1.3 Identification of expectations of stakeholders

One of the most important questions that must be answered about environmental stakeholders is, what are the explicit and implicit expectations of stakeholders with regard to the environmental performance of the organisation and the state of the environment in the region? Understanding the environmental needs holds the key for a successful evaluation of environmental expectations of diversified stakeholders, and is as challenging as the:

- misinformation or lack of information or understanding about a situation, substance or process
- difference of opinion or belief as to for example, the way facility should be operated, the risk posed by activities or the way natural resources should be used
- incidents, such as spills, adverse effects or threats (or perceived incidents, adverse effects, or threats) to human health and environment
- lack of information, ignorance about environmental issues.

To understand the stakeholder' expectations, one may need to provide adequate information and knowledge to them on environmental problems in the region and their severity, feasibility and cost of control, effect on health, and eco system restoration costs, etc., without introducing bias and influence. A feasible way to map environmental expectations is a questionnaire survey.

3.2 System development and performance

Environmental policy

As it is known environmental policy is the expression of intention of a company towards the environment. Considering the LCER and the findings of need assessment, the environmental policy can be framed on the following four points:

- harnessing pollution prevention opportunities across the life-cycle
- commitment to compliance with laws of land across the life-cycle
- harnessing opportunities for continual improvement across the life-cycle
- commitment to meet the expectations of all stakeholders at all stages of life-cycle of product.

Identification of environmental improvement programmes

Once the environmental expectations are known/prioritised, the organisation needs to select environmental programmes that can meet the concerns of each stakeholder group.

The environmental improvement programmes are identified through a comprehensive environmental audit and are based on the environmental objectives and targets of the corporation. However, these may not be related to the stakeholders' satisfaction. The extension of TQM principles of conforming to customer satisfaction to environmental sector ensures that the process of TQEM improves stakeholder satisfaction, and subsequently improves this continuously through total employee involvement. Hence, the basis to select a set of environmental programmes should be to improve total environmental stakeholder satisfaction in an economic manner.

The evaluation of alternative environmental programmes involves the considerations of legal, social, image, competition, market forces, economic, and environmental factors, and it is a multi-judge, multi-objective, and multi-criteria decision making problem.

3.3 Monitoring the results and continual improvement

The third phase of monitoring results and striving continual improvement is preceded by output-and-requirement resolution and provision of output. Since measurements are vital, establishment of the key factors to reflect the system suitability or fitness mechanism to satisfy the stakeholders' needs is essential.

When measurement is driven by stakeholder needs, tremendous opportunities for improving corporate environmental performance may be found. Too often, measurements have been established to provide well-intended compliance references, but without giving regard to satisfactory fulfilment of the stakeholders' needs. For example, obtaining the permit to discharge wastes into a river reveals nothing about whether or not the local community was satisfied. The most cost-effective measurement should reorganise, to ensure satisfaction of stakeholders' expectations in the beginning, to minimise liability in the future.

Measuring against own performance and striving to improve on it will provide a meaningful reward: in fact, studying competitors may attain even greater achievement. Often linkages can be formed, where measurement data are exchanged, not for the sake of simply comparing numbers to numbers, but more importantly, to identify those who may not be performing better than you. Once identified, the challenge is to determine why or how their system suitability mechanism is different. From this analysis, improvement strategies in meeting the needs of stakeholders could be formulated.

It is important to keep the organisational focus on the stakeholder satisfaction process–needs assessment, delivery of needs, issues and resolution, measurement, and continued improvement.

4 Discussion

Because the scope of an EMS is linked to firm's environmental policy, its objective, and targets, the firm may have difficulty in implementing and benefiting from product life-cycle, if those policies, objective, and targets do not support or encourage the use of life-cycle concepts. Given the historic distinctions and separation of environmental management and product life-cycle management, it is not surprising that relationships, communications, and effective management can be problematic. Generally, environmental management is based in operations and has been responsible for compliance, and reducing energy and material usage. Thus, objectives may not address product life-cycle and issues of stakeholders at other product life-cycle stages. Product life-cycle, on the other hand, relates to entire life-cycle stages of product and may not be organisationally accessible to the environmental management personnel.

An EMS can and should provide the organisational underpinnings and framework for managing all stakeholders across product life-cycle. To a firm that is intent and deliberate in seeking opportunities for reducing environmental impacts across the value chain, product life-cycle is the only tool that provides most promising opportunities for nipping non-value-added materials and process from the entire product system. Truly, product

life-cycle is highly effective opportunity to identify and improve environmental performance across entire product system, and not just at one or few production stages. Still rare, unfortunately, is the EMS that extends its reach far enough upstream and downstream to understand and embrace opportunities for achieving EMS environmental quality objectives. To make this happen, it is essential that firm's environmental policy create a business framework that accommodates and encourages product life-cycle view.

5 Conclusion

EMS, despite its popularity amongst the many companies that are now engaged in environmental management activities, has attracted criticism from many scholars who questioned its effectiveness in the globalised world. In particular, systems that emphasise control within an organisation may not be effective when that organisation out-sources its production activities. The paper has suggested how:

- EMS can be redesigned to capture product life-cycle
- EMS can play an important role not only is greening the supply chain, but it also has the potential to make improvements along downstream. This is important particularly for firms manufacturing product having significant environmental impacts at use and disposal stage.

Thus, EMS has potential to improve environmental performance along the entire production-consumption chain.

The paper also suggests that existing EMS can be further strengthened by internalising environmental concerns of stakeholder groups present across the entire product life-cycle stages, thereby leading to better satisfaction amongst them. However, the suggested framework pre-supposes that improvement in the EMS performance depends heavily on stakeholder pressure. Particularly, if the improvements are not expected to bring financial benefits in short-term, and if they are not legally mandated. This also implies that environmental issues along the product life-cycle can perhaps be best handled by collective efforts by all the actors involved in the chain, and it would be interesting to see how EMS can help in developing such a network, which needs to be investigated in future.

References

Berry, M.A. and Rondinelli, D.A. (1998) 'Proactive corporate environmental management: a new industrial revolution', *Academy of Management Executive*, Vol. 12, No. 2, pp.38–50.

Brener, S.N. (1993) 'The stakeholder theory of firm and organizational decision-making: some propositions and a model', in Pasquero, J. and Collins, D. (Eds), *Proceedings of the Fourth Annual Meeting of the International Association for Business and Society*, San Diego pp.205–210. .

Brener, S.N. and Cochran, P.L. (1991) 'The stakeholder theory of firms: Implications for business and society theory and research', in Mahon, J.F. (Ed.), *Proceedings of the Second Annual Meeting of the International Association for Business and Society*, San Diego pp.449–467.

Buckens, A.G. and Hinton, A.F. (1998) 'Engaging the stakeholders: corporate views and current trends', *Business Strategy and the Environment*, Vol. 7, No. 3, pp.124–133.

Coulson, A.B. and Monks, V. (1999) 'Corporate environmental performance: considerations within bank lending decisions', *Eco-management and Auditing*, Vol. 6, No. 1, pp.1–6.

Eagan, P.D.and Pferdehirt, W. (1998) 'Expanding the benefits of environmental management systems through DFE', *Environmental Quality Management*, Summer , pp.71–79.

Ehrenfeld, J. (1997), 'Industrial ecology: a framework for product and process design', *Journal of Cleaner Production*, Vol. 5, Nos. 1–2, pp.87–96.

EU Commission (1997a) *FEEMAS Report*, European commission DGXI, Brussels.

EU Commission (1997b) *The Role of Financial Institutions in Achieving Sustainable Development*, prepared for the EU commission DGXI by Delphi International Ltd., in association with Ecologic GMBH, Brussels.

Fishbein, B, Lorraine, M, and Dillon, P. (2000) *Leasing: A Step Toward Producer Responsibility*, Inform, Inc. NY, USA.

Forest, R. (1998) 'Bringing the environmental down to earth', *Harvard Business Review*, July–August, pp.149–157.

Freeman, R.E. (1984) *Strategic Management: A Stakeholder Approach*, Boston, USA.

Giddens, A. and Hutton, W. (2000) 'On the edge: living with global capitalism', London, Vantage.

Gupta, M. and Sharma, K. (1996) 'Environmental operations management: an opportunity for improvement', *Production and Inventory Management Journal*, Vol. 37, No. 3, pp.40–46.

Hart, S. (1997) 'Beyond greening strategies for a sustainable world', *Harvard Business Review*, January–February, pp.66–76.

ISAR-UNCTAD (1997) 'An environmental reporting framework for the annual report', *Proposed in Linking Environmental and Financial Performance: A Survey of the Best Practice Techniques*, prepared by ACCA for ISAR-UNCTAD. An update of 1994, Conclusions on accounting and reporting by trans-national corporation, Geneva.

Kruth, R. and Gleckman, H. (1998) 'ISO 14001', *A Missed Opportunity*, Earthscan, London.

Madsen, H. and Ulhoi, J.P. (2001) 'Integrating environmental and stakeholder management', *Business Strategy and the Environment*, Vol. 10, No. 2, pp.77–88.

Orsatto, R.J. (2001) 'Market advantage and environmental strategies of firms: competitive rationales for proactive environmental management', paper presented at *The Ninth Greening of Industry Conference*, Bangkok, Thailand.

Petroni, A. (2000) 'The analysis of customer-satisfaction-related elements of ISO 14000 implementation: evidence from the food machinery industry', *Eco-Management and Auditing*, Vol. 7, pp.1–10.

Potting, J. and Blok, K. (1994) 'Emissions and Life cycle impact assessment', *Integrating Impact Assessment Into Life Cycle Assessment*, Brussels, SETAC.

Roeleveld, P.J., Klapwijk, A., Eggles, P.G., Rulkens, W.H. and Strakenburg van, W. (1997) 'Sustainability and municipal wastewater treatment', *Water Science and Technology*, Vol. 35, No. 10, pp.221–228.

Samdani, G.S., Moore, S. and Ondrey, G. (1995) 'ISO 14000: new passport to world markets', *Chemical Engineering*, Vol. 102, No. 6, pp.41–49.

Sangle, S. (2002) 'Corporate environmental governance: from shareholders to stakeholders', in Göteborg (Ed.): *Presented in 10th International Conference of Greening the Industry Network: Corporate Social Responsibility-Governance for Sustainability*, Sweden during June 23–26, The abstract and the full paper is available at http:/ /www.gin2002.miljo.chalmers.se.

Sangle, S. and Nema, A. (2002) 'Maximizing benefits of environmental management system through life cycle assessment', *Presented On-line in International E-conference 'InLCA/LCM 2002 Life Cycle Assessment and Life Cycle Management*' organised by American Center of Life Cycle Assessment and Institute of Environmental Research and Education (IERE), USA during May 20–25, 2002. Paper is available at www.lcacenter.org/lca-lcm/session-lcm.html.

Sangle, S. and Ram Babu, P. (2002) 'Framework for assessing stakeholder satisfaction for better corporate environmental governance', *Proceedings of International Conference of Corporate Social Responsibility and Environmental Management at University of Leeds*, UK during July 1–2, pp.229–238.

Sangle, S. and Ram Babu, P. (2004) 'Evaluation of life cycle impacts using elicited societal weights-a case study', *International Journal of Ecology and Environmental Sciences*, Vol. 30, No. 4, pp.333–340.

Sangle, S., Ram Babu, P. and Khanna, P. (1999) 'Evaluation of life cycle impacts: identification of societal weights of environmental issues', *International Journal of Life Cycle Assessment*, Vol. 4, No. 4, pp.221–228.

Schalteger, S. and Figge, F. (1998) *Environmental shareholder value* WWZ/Sarasin Basic Report.

Schmidheiny, S. and Zorraquin (1996) *Financing Change*, MIT Press/WBCSD, London.

Sinding, K. (2000) 'Environmental management beyond the boundaries of the firm: definition and constraints', *Business Strategy and the Environment*, Vol. 9, No. 2, pp.79–91.

Skillius, A. and Wennberg, U. (1998) *Continuity, Credibility and Comparability, IIIEE at Lund University*, on behalf of the European Environmental Agency, Copenhagen.

Strachan, P.A. (1999) 'Is the eco-management and audit scheme (EMAS) regulations an effective strategic marketing tool for implementing industrial organizations?', *Eco-Management and Auditing*, Vol. 6, No. 1, pp.42–51.

UNEP (1996) *Life Cycle Assessment: What it is and How to do it*? Paris, France.

van der Vorst, R., Grafe-Buckens, A. and Sheate, W.R. (1999) 'A systematic framework for environmental decision making', *Journal of Environmental Assessment Policy and Management*, Vol. 1, No. 1, pp.1–26.

Welford, R. (1998) *Corporate Environmental Management: Systems and Strategies*, *Earthscan*, London.

Welford, R. (2003) 'Beyond systems: a vision for corporate environmental management for the future', *International Journal of Environment and Sustainable Development*, Vol. 2, No. 2, pp.162–173.