A Management Information System (MIS) for ‘Sustainability Networks’

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Abstract
Industrial recycling networks are very effective in minimizing impact on the environment by building up closed loops of material and energy use within the industrial system. These interorganizational recycling activities between various industries can be a starting point for ‘sustainability networks’, i.e. systems of voluntary but organized cooperation among different stakeholders with the common target of sustainable development of society within a certain region. To work well an overall vision of the sustainability network, it needs to be clearly defined and then translated into strategies and strategic objectives. These, in turn, need to be transformed into operational targets that can be measured by a comprehensive set of environmental, social and economic indicators. This procedure is quite similar to the balanced scorecard approach of Kaplan/Norton, which is considered an appropriate management information system not only for industry but also for sustainability networks.

1. Introduction
In the last few decades many industrial organizations have implemented an environmental management system (EMS) to comply with international standards, such as ISO 14000 and EMAS regulations. In addition to these intraorganizational activities the concept of ‘industrial symbiosis’, emphasising similarities between natural and industrial ecosystems, has emerged. The fact that a natural ecosystem tends to recycle all materials biologically, using only energy from the sun to ‘drive’ the system, is used as a metaphor for industrial systems. (Ayres & Ayres 1996, pp 278-279) The main idea of this attractive concept is to design industrial systems in a way that the by-products (“waste”) produced by one company is used as a raw material by another company. The aim is to minimise the industries’ impact on the environment by building up closed loops of material and energy use within the industrial system. The best documented example here is Kalundborg in Denmark, but the industrial recycling network in Styria, Austria has also become a very famous case in the field of

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industrial symbiosis. While in Europe the main focus lies on the waste exchange relationships between existing companies within a certain area, overseas the construction of so-called eco-industrial parks is considered the most effective way to implement the concept. Whatever the case, the protection of the environment as the ultimate goal is achieved through collaboration and inter-company partnering. The totality of the firms involved and the recycling-oriented collaborative relationships between them is often represented in diagrams with vectors for each waste-flow.

Characteristic for recycling networks is the participation of several different industries, since this makes a higher variety of processes available for potential recycling activities. Except for those industries where highly organised markets for recycling residuals are already used, such as in waste paper or scrap iron, recycling within a single industry usually is not inter- but intraorganizational.
2. Sustainability Networks

The aim of this chapter is to show how these interorganizational recycling activities between various industries can be used as starting point for ‘sustainability networks’. For this the currently rather narrow view of recycling cooperation between industries needs to be broadened to include the following:

- Firstly, environmental protection is more than the recycling of material. In fact, recycling is an end-of-pipe-activity and therefore counts only as a second best solution. It does not aim to avoid or reduce the negative outcome of production processes at the origin, but only tries to reduce the negative impact on the environment by reusing the existing by-products. In contrast, Clean Production aims to modify the production processes at a more fundamental level so that no production waste will be produced at all. Or Design for the Environment, a product-oriented approach, suggests dematerialising goods while still retaining their capacity to function.

- Secondly, sustainability is more than environmental protection. According to the famous Brundtland Report of the World Commission on Environment and Development, sustainable development is a “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED 1987, p8). Among the many attempts for more precise definitions the triple bottom line approach of John Elkington stands out: here sustainability implies economic prosperity, environmental quality and social justice – an element which business has largely overlooked. “Those who think that sustainability is only a matter of pollution control are missing the bigger picture.” (Elkington J. 1999, p70-71).

- Thirdly, sustainable development requires the involvement of all actors – not only industry. A major step was undertaken with the move from intraorganizational environmental management to recycling networks. The next necessary step is the move from recycling networks to the so-called sustainability networks integrating all relevant stakeholders in a sustainable regional development.

This leads us to the definition of sustainability networks as ‘systems of voluntary but organized cooperation among different stakeholders with the common target of sustainable development of society within a certain region’. A very important term in this definition is ‘stakeholders’. They are defined here as ‘persons or groups of persons who pursue interests in the context of the regional development or who are affected positively or negatively by the activity under investigation’. This definition differs considerably from the original version of the Stanford Research Institute, according to which stakeholders are defined as ‘those groups without whose support the organization would cease to exist’. It is much closer to the extended definition of Freemann, whereby ‘any group or individual who can affect or is affected by the achievement of the organisation’s objectives’ can be called a stakeholder. (Freemann R.E. 1984, p.31 and 46). However, it needs to be noted that the definition used here...
does not refer to any single organization, but rather to the development of the whole region. Also the question arises whether the term ‘persons or group of persons, whose interests are hurt’ also includes future generations, whose possibilities to meet their own needs may be compromised by the respective project. This generates a link to the definition of sustainability by the WCED, but obviously also leads to the question, who at all would be able to represent them in the sustainability network. In fact, it does not seem to make a lot of sense to include future generations in the definition of stakeholders, since their interests are already implicitly protected by the overall objective of the sustainability network anyway.

Membership in sustainability networks is voluntary. Obviously compulsory membership would be highly counterproductive. But why might private persons or groups, companies or even public or governmental organizations take part in a sustainability network? In general there are two possible motives for membership:

- On the one hand, there can simply be economic reasons whenever activities within the sustainability network also lead to profits. In fact, inter-organizational recycling activities between companies within a recycling network are a good example of environmentally and economically advantageous behaviour. Recycling networks such as those in Styria would never have developed if there had not been clear economic advantages for the firms involved, e.g. lower prices for recycled materials than for raw materials or cheaper/safer disposal of by-products.

- On the other hand, it can’t be denied that economic, environmental and social win-win-win-situations for all stakeholders do not always exist. Hence, the objective of sustainable development does need to be a normative one. In terms of Kant’s categorical imperative it becomes obvious that caring for the future wellbeing is an ethical obligation for the whole of society. That we need to act responsibly towards our descendants is clear, but the extent of this responsibility is still matter of discussion.

Although, in practice, the exchange of by-products for recycling purposes may still count as the most important activity within these sustainability networks, the field of potential cooperation is in fact much larger. For example, common R&D-activities leading to environmentally oriented innovation, continuous improvement, and common knowledge management could all be established. Moreover, infrastructure might be shared, such as in the case of common sewage plants or car sharing activities. To initiate such cooperation between stakeholders and to promote cooperative activity over time the management of sustainability network needs to be supported by an adequate management information system (MIS).

3. Management Information Systems for Sustainability Networks

The management information system for sustainability networks has to be able to cope with the specific objectives of the individual stakeholders involved, as well as
to comply simultaneously with the overall vision of the network. Hence, the starting-point for developing a management information system has to be the definition of a vision that is shared by all members of the sustainability network. While the core mission of an organization is usually strongly determined by the respective business field and historical development of the company, achieving consensus on objectives of a sustainability-network is much more difficult as the experience and attitudes of the persons involved may differ considerably. But the network’s vision is the most important basis, from which the objectives of the network are to be derived. A prerequisite for defining the network’s vision is information about the status quo, e.g. about the environmental impact of the region’s activities or the social situation of the inhabitants.

![Diagram](image)

Fig. 2: Objectives of a sustainability-network

In order to find out the contribution of the specific network to the environmental issues an input-output-balance needs to be provided, at best supported by a series of database-compatible checklists. In general the checklists refer to material and energy flows of the network’s members. The more detailed checklists may also contain quality-oriented data fields about solid waste production, sewage production and treatment, gaseous emissions and highly toxic substances or dangerous processes (see issues above). As any information system is only as good as the data input, it is essential to check data quality even in this early phase. The consistency, plausibility, completeness and immediacy of the data need to be ensured. For example, time periods referred to need to be consistent, the sewage BOD figure (which reflects only easily
degradable compounds of the organic pollutants) needs to be lower than the COD figure (this represents all organic pollutants in the waste water). But the most relevant key figure that indicates the quality of the input-output-analysis is still the quantitative difference between the input- and output-flows.

For strategic environmental management in industry there are several tools available to help focus information gathering activities on the most relevant issues, such as the eco-portfolio developed by Sturm/Mueller. Here, on the basis of given ecological problem areas – from problems relating to primary energy consumption or treatment of dangerous waste or even up to ozone depletion in the atmosphere - this portfolio helps to identify issues in terms of socio-economic/public priority and company contribution – or in our case, the contribution of the network. The higher the socio-economic priority and the greater the network’s contribution, the higher the relevance of the issue for the sustainability network.

It is worth mentioning that the eco-portfolio focuses almost exclusively on external treats or internal weaknesses. However, the management of sustainability networks entails more than mere identification of legal restrictions or the high costs of end-of-pipe-technologies. Building sustainability strategy rather means turning threats into opportunities and weaknesses into strengths as far as possible. Hence, for defining goals and creating strategies of the network it seems to be highly advantageous to undertake something like sustainability-oriented SWOT-analysis, in order to promote proactive sustainability strategies. In general, it is the totality of the institutions and persons involved which needs to be taken into consideration when trying to clarify and translate the network’s vision and mission into concrete strategies and specific strategic objectives. Traditional company objectives emphasize revenue, costs, cash flow or profitability, whereas those of sustainability-networks contain not only monetary but also technical-physical measures like energy consumption or waste production, plus further more complex objectives such as the justice of the income distribution, which do not lend themselves to easy quantification at all.

Further, these strategic objectives must be translated into a sufficient number of relevant and understandable targets, which then need to be communicated throughout the whole network. The single activities of all members ought to be focused on the network’s objectives and targets. It is obvious that the participating companies need to gain profitability, at least to remain competitive in the long term. The compatibility of economic and non-economic goals in a competitive setting has long been subject of discussion in the literature (Mueller-Christ 2000, 12-15). Whatever, only in the case where a company has expressed interest in sustainability and has therefore set itself not only economic but also environmental and social objectives to achieve, does it make sense for the company to play an active role within a sustainability-network. As there is a high probability that there are dependencies between economic and environmental or social objectives in whatever manner and direction, the management system of the sustainability network must not be separated from the traditional core business strategies and management systems of the participating com-
Correspondence between individual and network objectives is essential, since it provides a basic prerequisite for cooperation.

The most critical success factor in developing a management information system is the definition of a comprehensive set of suitable performance measures or indicators. These should closely refer to the targets and thus provide a framework for continual environmental, social and economic evaluation of the activities within the network. While several highly aggregated environmental indicators have been developed to aid continuous monitoring of environmental performance, such methods remain unsatisfactory for two main reasons:

- Firstly, the aggregation of different environmental impacts leads to an immense loss of information. The aggregation algorithm tends to misrepresent the degree of accuracy which can be achieved in practice. There is a definite danger that those basing their decisions on the indicators used may be acting in partial ignorance or at least on the basis of an unfounded faith.
- Secondly, all the environmental evaluation models imply that the value and target system is known, when in fact each evaluation ultimately depends on the unification of factual information with the value or target system. Hence, it makes a big difference whether the evaluation corresponds to the value system of a national or even international community (macro level) or to the target system of a small region with its specific conditions and peculiarities. But the management system of a sustainability network certainly needs to refer to its own target system.

Hence, an approach for creating and monitoring a well-defined system of disaggregated or low aggregated indicators is followed here.

Certainly, the choice of indicators for the environmental, social and economic performance evaluation strongly depends on the nature and scale of the sustainability network and the stakeholders involved. Nevertheless, it is crucial that the set of indi-
cators is not a mere collection of piecemeal measures but should rather be a linked series of critical indicators that are internally consistent and related to the overall vision of sustainable development. In terms of the management approach of Kaplan/Norton, this could be seen as a form of ‘Sustainability Balanced Scorecard’ (Kaplan, R.S. & Norton D.P 1996).

The set of sustainability-performance indicators of a whole network is the basis for the performance indicators of its members. In this way, the network’s objectives and targets are cascaded down to local units of responsibility allowing them to work coherently towards the strategic goals of the sustainability-network. It is thus crucial to combine environmental, social and economic performance measures in a way that provides decision makers with an appropriate set of measures. In future, both benchmarking within the network, and especially benchmarking between networks, will also help to incorporate existing best practice and to verify that the proposed targets do indeed assess network sustainability.

Bibliography