

Perspectives of Inter-Industrial Recycling Networks

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Abstract

From the theoretical background of Industrial Ecology it is asked in what way networks – especially Inter-Industrial Recycling Networks – can be seen as sustainable oriented. A retrospective evaluation with qualitative and quantitative indicators is regarded to be an adequate instrument to give an insight into the current orientation of a network. On this basis, lacks of sustainable orientation can be corrected.

To clarify the whole issue, the idea of sustainability will first be discussed. Then, the term Inter-Industrial Recycling Networks will be explained, embedded in the concept of Material Flow Management and the theoretical framework of Industrial Ecology. This will also illuminate the relationship to sustainable development. Problems of network evaluation are then considered. On this foundation, hypotheses and indicators for an evaluation are collected. Finally, the idea of evaluation is illustrated by the development of the “Heidelberg-Pfaffengrund”, a regional Inter-Industrial Recycling Network in the North-West of Baden-Wuerttemberg, Germany. Unfortunately, so far it is only founded on literature research.

Introduction

In the German-speaking area the concept of Inter-Industrial Recycling Networks is well established by Strebel and Schwarz (1998; Schwarz 1994). Prominent empirical examples in Europe are the Industrial Symbiosis Kalundborg (see, e.g., Christensen, 1998) and the Styrian Material Flow Management Network (see, e.g., Schwarz, 1994).

But are they sustainable oriented as the Industrial Ecology suggests (Lifset/Graedel 2002: 10)? Or do they just represent economic networks focussed on economies of scale while neglecting ecological and social issues?

To answer these questions, first, the theoretical framework will be discussed. Then, to compare the empirical evidence with the theoretical claim, an evaluation approach is suggested. Third, the idea of evaluation will be shown with literature research for one example.

The role of sustainable development for Inter-Industrial Recycling Networks

The next two sections deal with the theoretical foundation of this paper: first, the use of the terms sustainability and sustainable development is examined. Then, the relationship between sustainable development, Material Flow Management and Industrial Ecology is presented with a focus on Inter-Industrial Recycling Networks.

Defining and operationalising sustainability and sustainable development

“For what is sustainable development? Who can readily and briefly explain this? But what in discourse do we mention more familiarly and knowingly, than sustainable development. And, we understand, when we speak of it; we understand also, when we hear it spoken by another.

What then is sustainable development? I know well enough what it is, provided that nobody asks me; but if I am asked what it is and try to explain it, I am baffled.“ (Faber et al. 1996: 75)¹.

This quotation captures the present debate of defining and operationalising sustainable development quite well. So where are the difficulties?

The common issue of various definitions is to preserve certain characteristics of a system to make it available for future human generations as intergenerational justice (Klauer 1999:87). According to Constanza and Patten (1995:193) this leads to three questions:

- Which (parts of a) system shall be preserved?
- For how long shall it be preserved?
- When can one state that the preservation was successful?

As these questions are not answered yet, the aim of defining sustainability precisely remains unsolved.

Nevertheless, Faber et al. (1996: 78) think of two ways to operationalise sustainable development. The first way is to turn scientific results and

insights on ecological and economic systems into a framework that allows gaining political advises on how to act. Inherent problems of this way such as the uncertainty of the future and the task of constructing applicable laws to which the majority needs to conform themselves lead to a second, ethical approach: “[Sustainable development] presupposes that human norms and forms of behaviour must fundamentally change in the long-run in our present Western economies, in order for humans to live and to be able to act in an economic manner on the earth over a long period.” (Faber et al. 1996: 78).

Sustainability is thus a regulative idea (Ott 2001: 56), which needs a discussion and a broad agreement on the developmental path to be followed in national societies. But a common definition and a concept of how to operationalise sustainable development are not given ex ante.

In Germany the following aspects in table 1 are part of the political and scientific understanding of sustainable development.

Table 1: The overall concept of sustainable development in Germany (after Voss 1997: 28)

Working definition	Management rules	Dimensions
Brundlandt-Report - 1987	Ecological economics	Agenda 21- 1992 in Rio
Development that meets the needs and aspirations of the current generation without compromising the ability to meet those of future generations.	<p>“to limit the human scale (throughput) to a level which, if not optimal, is at least within carrying capacity” (Daly 1991: 44)</p> <p>“Technological progress for sustainable development should be efficiency-increasing rather than throughput-increasing.” (Daly 1991: 44)</p> <p>“Renewable resources ... should be exploited on a profit-maximizing sustained yield basis and in general not driven to extinction ...” (Daly 1991: 45)</p> <p>“Nonrenewable resources should be exploited, but at a rate equal to the creation of renewable substitutes.” (Daly 1991: 45)</p>	<p>Economical</p> <p>Ecological</p> <p>Social</p>

The three dimensions of the Agenda 21 process can be explained as follows on national basis: The economic dimension implies a sensitive economic growth, which will provide future generations with necessary goods and services. The ecological dimension aims at securing a solid natural basis for future needs. The social dimension is concerned with intragenerational justice within a society as well as between societies in order to shift towards an ecologically sound economy (Enquete-Kommission 1994: 54). These three dimensions cannot be aimed at independently².

In this context, to speak of sustainable development at the enterprise level, all three dimensions need to be taken into consideration and need to be dealt with but given different weights. Still, the normative claim is that there shall be a constant improvement on all dimensions over time (Henseling, Eberle, Griebhammer 1999: 7).

The relationship between Material Flow Management, Industrial Ecology and sustainable development

In Germany since the mid-1990s the term Material Flow Management is used for “the management of material flows by stakeholders (to be) the goal-orientated, responsible, integrated, and efficient manipulation of material flows. Set targets derive from the ecological and economic realm, under consideration of social aspects. Goals are set on the level of the single firm, within the supply chain of actors, or on the public policy level.” (Seuring 2003). Hence, the conventional management perspective is broadened by the sustainability dimensions as well as by stakeholders to be involved. The term “under consideration” suggests that an economic-ecological win-win-, win-zero- or zero-win-situation shall not imply a trade-off in the third dimension. Stakeholders are all internal and external individuals or groups who have a material or intangible claim towards a system (Kim 2002:

5). They can influence the establishment of goals, their achievement and the conditions under which the system operates in many different ways. They can also be influenced themselves.

The definition of Material Flow Management distinguishes between three levels: within firms, among firms and on a regional or national level. Industrial Ecology as a scientific framework for Material Flow Management predominantly focuses on the second level. The idea of Industrial Ecology is “first to understand how the industrial system works, how it is regulated, and its interaction with the biosphere; then, on the basis of what we know about ecosystems, to determine how it could be restructured to make it compatible with the way natural ecosystems function” (Erkman 1997:1) since the conventional way of production has led to an unsustainable development so far. The most obvious feature of ecological systems to be applied in the industry is seen in the transformation of a quasi-linear throughput of material “from virgin material, to finished material, to component, to product, to waste product, and to ultimate disposal” (Jelinski et al 1992: 793) towards a quasi-cyclic material flow to reduce the resource and energy input.

Despite certain weaknesses of the biological metaphor (Boons, Baas 1997: 80), one can state that “the use of this metaphor rightly emphasises the fact that industrial processes are interrelated. Reducing the environmental effects of these processes should take these relations as a starting point. This requires the establishment of a system boundary.” (Boons, Baas 1997: 80). Moreover since the development can only be achieved by intentional action, Boons and Baas (1997) think that actors need to be taken into consideration.

This leads to the question of relationship between Industrial Ecology and sustainability. As figure 1 shows Industrial Ecology sees itself obligated to the regulative idea of sustainability.

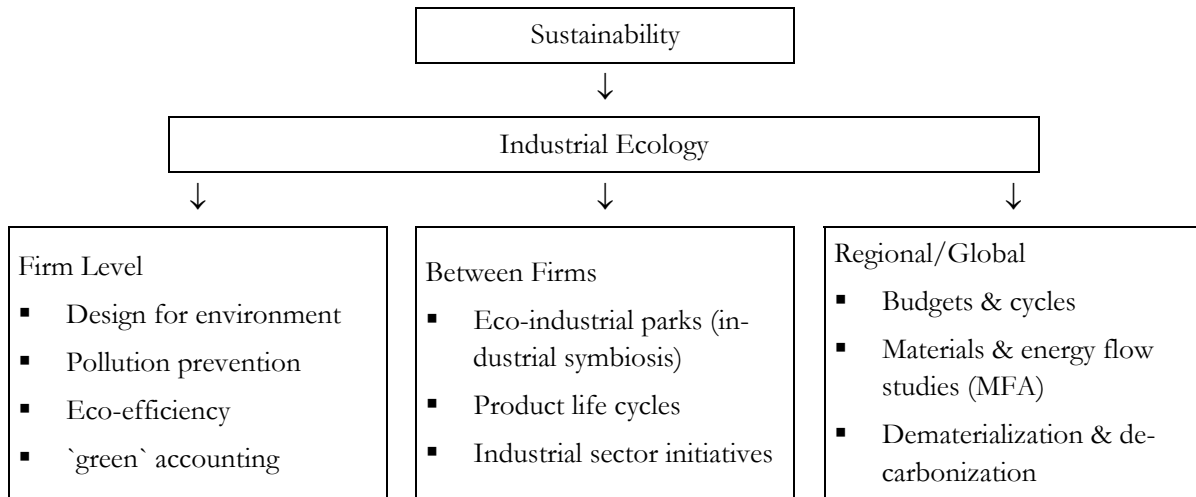


Figure 1: The elements of industrial ecology seen as operating at different levels (Lifeset, Graedel 2002: 10)

Nevertheless, there is a controversy as to whether social, political and economic questions are part of the research of Industrial Ecology (Lifeset, Graedel 2002: 14). Opponents point out that the issue of ‘how to implement different strategies’ is a subject of the social sciences, although most of them regard such knowledge as crucial. Supporters ask whether the “questions that industrial ecology seeks to answer (need to) be pursued on an interdisciplinary basis” (Lifeset, Graedel 2002: 15) rather than on a modular foundation in order to produce reliable scientific outcomes.

The point is that in theoretical discussions material flows are at the centre of attention and thus the predominant emphasis is on ecological factors. But in practice, by enlarging the focus on management aspects, attention also needs to be “paid to the analysis of the actors influencing the material flows and the interconnections between them” (Seuring, 2003). This normative statement

results from an understanding of sustainability in terms of integrated dimensions as described above. For example, Schwarz and Steiniger (1997: 52) point out that the “most common cause for the failure of cooperation negotiations or existing cooperation is problems in human relations”.

Coming to the boundaries of complex industrial systems, Korhonen (2002) identifies two major streams: the product-based and the geographical approach. In the former, the boundaries enclose the economic actors who are connected with a product during its lifetime. The latter draws the boundaries around economic actors in the same region who build a network of material flow. Examples are Inter-Industrial Recycling Networks.

As shown in table 2, networks in general can be characterised by different facts:

Table 2: Network Characteristics (after Wallner 1999:54)

Characteristics	Occurrence
Functional area of effect and objective of the networks	Ecological, economic, social
Actors involved	Industry, trade, manual, institutions, farming, local authorities, individuals etc.
Exchange variables	Information, matter, energy, capital, people, culture etc.
Intensity of the connection	Loose connection to contractual arrangement, mobile means of transport to pipelines, switched lines to dedicated lines etc.
Temporal development	Activity by demand to permanently active networks
Structure and organisation	Linear to fractal, hierarchical to equal, winners and/or losers, horizontal – complementary – vertical
Spatial area of effect	Local to global

According to Hippe (1996: 25) one speaks of an enterprise network when there is a co-ordinated co-operation between several legally independent and to a large extent formally autonomous enterprises aiming at interorganisational common goals. In this context typical features of Inter-Industrial Recycling Networks are “the cooperative efforts of independent companies from diverse branches with one common goal: to reemploy waste derived from the production and consumption areas within the regional industry as a replacement for raw materials and also as a substitute for primary energy sources” (Schwarz 1996: 359). Because of these characteristics, hierarchical forms of networks with a central dominant enterprise are explicitly excluded. Nevertheless, an interorganisational agency or a scientific project team taking over co-ordination, consultation and mediation services is regarded as helpful (Schwarz 1994: 164).

Common advantages are seen in the reduction of waste disposal, energy costs and raw material costs as well as in the reduction of associated risks. Obstacles are set by technological, environmental and economic constraints (Schwarz, Steiniger 1997: 48) and by social transaction costs because networks have to be built up, the

information flow needs to be co-ordinated and intraorganisational arrangements need to be altered.

Concerning sustainable development this type of network is of interest for two reasons: first, the theoretical framework suggests that these networks are interested in a sustainable orientation. Second, it is assumed to be easier to enhance the ecological and social orientation of an existing network than to build up a new one.

Orientation towards sustainability in Inter-Industrial Recycling Networks – illusion or reality?

In an overview of material flow management in Germany Henseling et al. (2000: 29) state that there is a significant gap between academic claims to have made a contribution to sustainable development and practical approaches. Most approaches restrict themselves to a consideration of the ecological factors under the premise of economic success. Wallner (1999: 54) declares that the example of industrial recycling networks only “shows a network with a primarily ecological area of effect, followed secondarily by an economic effect”. On the basis of other

examples for the isolated existence of networks in terms of their area of effect he calls for new forms of integrated networks to address all dimensions of sustainability.

One method for improving the sustainable orientation of a given network is to evaluate the current state of the network. In the following, first, problems of evaluation are described. Then, hypotheses and indicators are proposed

for identifying the sustainable orientation of a network and finally, it is tried out on a network by literature research.

Problems of evaluating networks

Sydow and Goebel (2001: 80) give an overview of the elements of network evaluation. Parts of it are presented in table 3.

Table 3: Aspects of evaluation of networks – potential components of an evaluation (after Sydow, Goebel 2001: 80)³

Evaluation subject	Criteria of evaluation	Time horizon	Evaluation cause
Network	Criteria of	Short-term	entrance or exit of
Network partners	... efficiency	Medium term	partners
Parts of a network (e.g. dyadic relationships)	... effectiveness	Long term	getting a credit
Portfolio of relationships from the point or view of a central organisation or core business unit	... justice		reengineering of a process
Network effect	Risk		development of a network
	Indicators (e.g. organisational distance, gain of reputation or competence, strategic flexibility)		takeover or entrance into a stock market of a network partner

The evaluation subject is the one being evaluated. The evaluator can be a person or a group from inside or outside the network. Criteria of evaluation depend on the aim. In this paper, various quantitative and qualitative indicators are regarded dealing with aspects of sustainable orientation in networks. Evaluation causes are numerous. Here, it is used for potentially fostering the development of a network⁴. It has to be taken into account that results are at best valid for the examined cases and cannot be generalized because of different preconditions and regional peculiarities.

An obvious problem is the selection of indicators related to the research question⁵, the network goals and the area of influence of a network. Various efforts are made to operationalise the measurement of sustainable orientation on

enterprise level. Guidelines from international organisations such as the OECD or World Business Council for Sustainable Development as well as financial services or ISO standards provide criteria for various aspects of sustainable orientation (Fichter, Loew 2002: 21). But small and medium enterprises (SMEs) have difficulties in adopting these guidelines on a one-to-one scale (Loew 2002: 3).

The choice of indicators influences the method of inquiry. Social indicators are especially difficult to quantify. Because of certain characteristics of the expression `social` Empacher and Wehling (1999: 21) suggest choosing subjective respective individual and qualitative, and objective respective quantitative indicators for evaluation.

Second, it has to be questioned whether and how indicators at the enterprise level can be transferred to the network level. Networks are primarily seen as hybrid forms between market and hierarchical elements (Gerum 2001). In this context, Fürst (2002: 5) lists some details regarding networks that are possible limitations on the transferability of enterprise approaches:

- Normal institutional controls are missing for the enterprise. Instead, social norms, negotiated rules and role models function as control mechanisms. This is successful on the basis of direct contact between individuals also very dependent upon personal characteristics.
- Institutional structures between enterprises are minimised so that no company has a dominant influence over any other one. This implies that there is no central authority for dealing with conflicts and decisions must be made by consensus.
- Hence, communication and negotiation are central elements in networks since membership is voluntary. Social capital in the form of trust, affection and the willingness to cooperate plays a vital role (Fürst 2002: 7).
- All individuals in a network are simultaneously members of their organisation and additionally have other external relationships. This results in the facts that various interests beyond the network have to be taken into consideration and that every member has to co-ordinate his vote in a network with organisational interests.

These limitations suggest altering indicator systems for sustainable orientation of enterprises.

Third, it has to be asked how one draws boundaries (Wolff, 2001) for evaluation: parts of the network efforts are performed in enterprises; parts are carried out on interorganisational basis. This leads to the issue of how much a network can influence individual enterprise decisions, which surely differs from network to network.

Hypotheses and Indicators

To get an overview whether an Inter-Industrial Recycling Network is sustainable oriented, in the tables 4 – 6 below hypotheses and indicators are set up for evaluation. Some limitations need to be mentioned: First, economic criteria are not listed as it is assumed that sustainable oriented concepts will only be realised in the long term if they provide advantages for each decision maker in the traditional sense of business management (Sterr 1998: 13). One problem is that, especially in the social dimension, the economic effects often cannot be quantified. To reduce this problem, only those social aspects are listed which can be directly influenced by the network and concern the network members. For instance, this excludes gender issues because employment questions are strictly confined to the purview of the enterprises. Social problems in developing countries are likewise excluded. This is based on the fact that most companies are small and medium sized enterprises. The hypothesis is that they do not have many contacts with developing countries let alone as a network. Underlying all of these considerations is the assumption that the overall degree of fulfilment of the following indicators is compatible with the economic stability of the firms.

The following collection of hypotheses and indicators does not claim to be complete. They are selected from various literature, which deals with sustainability in enterprises under the premise that the hypotheses are also suitable for a network evaluation. The set results in three tables: table 4 comprises hypotheses that equally concern all dimensions. This table is twofold: The first set of hypotheses concentrates on those elements which are necessary for a network to function and which therefore need to be built up in the emerging of a network. They partly determine the extent of system features such as the ability to develop, or being flexible but still stable. If they are given, a network is not necessarily

oriented towards sustainability but they are needed as a prerequisite. The second set lists some of the hypotheses, which, together with the necessary elements listed above, are sufficient to support the conclusion that the network is oriented towards sustainability. Table 5 covers hypotheses, which mainly focus on the social dimension. Table 6 shows hypotheses for the ecological dimension. Although, Inter-Industrial Recycling Networks are the starting point, in both tables co-operation in other fields than material flow are also listed since contacts have

now been established. With these indicators, it is asked whether additional efforts are already made to consider other activities than recycling related ones, which would be a surplus.

How is the relationship between the hypotheses in table 4 to 6 to speak of sustainable orientation? They are thought to be a guidance line for checking networks. The overall impression gained then shall lead to a judgement.

Table 4: Selected hypotheses and indicators concerning all dimensions

All dimensions	Hypotheses A network has a good basis for an orientation towards sustainability ...	Subjective and Intersubjective Indicators
Prerequisites The individual in his home organisation	... if most members have significant influence on the strategic decisions in their home organisations ... if most members bring along specific qualifications and knowledge (de Man and Claus 1998: 73)	Position in home hierarchy, authority, informal relations in home organisation
Quality of internal communication	... if the internal communication and information structures are functioning as a prerequisite for substantial work. ... if instruments for constructive conflict management are implemented and used	Social network analysis - to answer questions such as Who makes suggestions? What are the decision making processes? How often does communication lead to co-ordinated action?
Motivation and trust Milchrahm and Hasler (2002: 549) distinguish between three types of trust: calculus-based trust in the beginning of a business relationship, information-based trust grown over repeated communication between network members and transference based trust while working on a common task considering joint goals.	... if participants are motivated ... if they trust each other enough to work on a common task	Time spent for network activities Individual statements of the participants
Additional features Plan-do-check-act-orientation	A network is oriented towards sustainability if network visions are ambitious in terms of covering all dimensions of sustainability and members set goals oriented toward visions and check their success regularly to alter goals and specific actions	Knowledge of the sustainability dimensions and the feeling of responsibility to drive the process A declaration signed by members (and the heads of their organisations) Knowledge of the environmental and social impact of material flow and processes Set priorities: specific actions and responsibilities written down for a defined period of time An interorganisational controlling system for environmental and social issues A management review after a certain period of time similar to those proposed in environmental management systems
External stakeholder orientation: According to Wallner (1999: 55) "The more actors participate in the regional economy, i.e. not only commercial enterprises but also interest groups... the more likely the network is to achieve regional significance and the more likely it is to be sustainable."	... if it is in dialogue with all its stakeholders about all dimensions of sustainability and their interest in the networks on different communication channels quite regularly and if it has a procedure for handling information from stakeholders	Questions directed towards the network and stakeholders e.g. personal, meetings, blackboard, newsletter, phone, fax, email, a written report, an update system for applicable laws e.g. a documentation of contacts, specific actions taken and a feedback system
innovation activities (These can only be conducted on a general basis because the network members are not from the same branch)	... if single members increase the amount of environmental benign products due to network activities ... if the network enhance regional taking back systems	

Table 5: Selected hypotheses and indicators concerning the social dimension

Social dimension	Hypotheses A network is oriented towards sustainability ...	Subjective and intersubjective Indicators
<p>Internal actor orientation: Boons and Baas (1997: 80), for example, think that since development can only be achieved by intentional action, actors need to be taken into consideration as well.</p>	<p>... if internal actors are enabled to practice key social qualifications. For them to be enabled means to have an adequate framework for practicing such qualifications to possess key social qualifications</p>	<p>Key social qualifications are, for example democratic participation in decision making in the network communication techniques conflict management creativity techniques</p>
<p>Value and identity orientation Fürst (2002: 14) states that networks work much more than enterprises with paradigmatic control: By influencing each other's ways of thinking similarities in their ways of acting will be increased.</p>	<p>... if the participants of the network create a shared value system following the sustainability dimensions over time (Fürst 2002: 14) that strengthens the intrinsic motivation. This might result in a common identity and a common image communicated to external stakeholders (Strebel 1998: 9)</p>	
<p>Knowledge transfer Milchrahm and Hasler (2002: 555) postulate that "knowledge transfer in recycling networks (with a network institution as central co-ordination, recycling agency) decreases the subjectively perceived high degree of uncertainty" among participants.</p>	<p>... if individuals get additional qualifications in their fields and enhance their specialised knowledge share their knowledge in periodic meetings move "knowledge ... to a tangible company asset through the implementation of technology-based tools and techniques" (Milchrahm, Hasler 2002: 547)</p>	<p>"bringing the recycling experts together in meetings initiated by the {co-ordination} agents in order to exchange experience about their recycling {and other environmental benign and social} practices, transforming this knowledge in a formal and explicit form, amalgamating the explicit knowledge about various aspects (organizational, technical, etc.) of inter-company recycling systems for specific kinds of waste ... transferring the explicit knowledge back to" participants. (Milchrahm, Hasler (2002: 549)) education in working conditions and health care</p>
<p>Co-operation in other fields regional activities</p>	<p>... if the network is engaged in the local Agenda 21 process or similar regional activities e.g. with expertise ... if the network enhances regional marketing activities.</p>	
<p>Common use facilities</p>	<p>... if it builds up common use facilities for network enterprises within comfortable reach for most of the employees</p>	<p>e.g. a canteen, a kinder garden, sport facilities, meeting points</p>

Table 6: Selected hypotheses and indicators concerning the ecological dimension

Ecological dimension	Hypotheses A network is oriented towards sustainability ...	Subjective and Intersubjective Indicators
Efficiency of material use	... if, due to network activities, there are continuous efforts to reduce raw material, waste, packing material and dangerous substances in the organisations ... enhance the relation of recycling material to waste ... if there are Intraorganisational controlling systems for all dimensions which can be connected towards an interorganisational controlling system (Sterr 1998: 25)	--- numerous ---
Co-operation in other fields Efficiency of energy	... if, due to network activities, there are continuous efforts to reduce energy in organisations ... enhance the relation of regenerative energy to conventional energy due to network activities ... enhance the regaining of energy	--- numerous ---
Efficiency of water use and emissions	... if, due to network activities, there are continuous efforts to reduce water and emissions in organisations ... reduce water per employee in sanitary facilities	--- numerous ---
transportation	... if it agitates on the market as a single virtual enterprise to bundle transportation aspects	a better use of transportation capacity due to co-operation in the fields of raw material, goods and waste a change from trucks towards trains or ships an arrangement for providing tickets for the public transportation system for all employees
space	...if the network reduces the amount of space used or invests in compensation activities	Bundling of potential common use facilities Compensation activities
buying activities	... if it bundles buying activities according to social and ecological criteria	

Heidelberg-Pfaffengrund

The network development at Heidelberg-Pfaffengrund is taken as an example. Due to time restrictions and methodological aspects, this presentation is limited towards literature research with some comments from Thomas Sterr. First, the aim of the project is depicted. Then, the starting point is described. Third, according to the tables above, the results are presented and because sustainable development is also a question of time horizon, it is partly asked how the situation looks like today.

In the local industrial area of Heidelberg-Pfaffengrund, between August 1996 and January 1998 fourteen small and medium sized enterprises (SMEs) took part in a project⁶ organised by the Institut für Umweltwirtschaftsanalysen (IUWA) Heidelberg e.V. in order to examine potentials of an Inter-Industrial Recycling Network. The idea was to connect waste producers with potential receivers of waste as secondary raw material. An additional hypothesis was that a bundle of small and medium enterprises could simulate a virtual big enterprise on the waste market to get some of its economic and ecological advantages such as avoiding cost explosions due to various alternatives of action and enlarging the knowledge of the person responsible for environmental management (Sterr 1998: 15). Moreover, due to larger amounts of waste a big enterprise can realise economy of scale effects.

The starting point was as follows: the enterprises of Heidelberg-Pfaffengrund had their origins in different branches with no customer-supplier relations between them. None of them was agitating as a waste processing company. Contacts between them had only partly existed on an informal personal level due to the splitting of enterprises. Most of them did not produce for the end-consumer. Thus, the pressure from this stakeholder group to gain an environmental benign image was small. Also, no decision maker

distinguished himself from the others with proactive environmental management policy. (Sterr 2003: 379 - 383)

At the opening of the project, the local heads of the organisations needed to sign an agreement – a kind of vision with the IUWA (Sterr 1998: 27). But the communicated vision only implicated goals in the areas economy and environment. Hence, from the beginning onwards, social improvement could only be expected indirectly. Concerning the other parts of a plan-do-check-act orientation, the economic and ecological effects were continuously checked, and modifications of action took place due to the fact that it was partly a sponsored project with a limited time horizon.

Regarding the explicit aims of this project it was a success: first, the IUWA as network manager and consultant concentrated on improving intraorganisational waste management and on building up information systems for waste (Sterr 1998: 25). This sometimes resulted in changes of processes, which can be seen as organisational innovation. Nevertheless, the innovation activities did not include the supply chain or products. All in all, building up trust and the willingness of enterprises to communicate was essential. So, the IUWA could organize an interorganisational information pooling, a prerequisite for knowledge transfer.

The results were the following: First, information pooling activities were the foundation for three potential ecological benign material cycles of which two were stable in practiced during project time and afterwards (Sterr 1998: 46). Whether they still function today is not known to the author. Second, the project installed a cyclic way to repair old wooden pallets. Today, because of economic reasons the way changed at least partly: Old pallets are collected and burned in one of the firms as heating material - also still an ecological benign solution. Third, the network partly co-ordinated its waste selling activi-

ties in the sense of virtually bundling its waste for waste processing companies with the purpose of gaining economies of scale like big companies. As the waste processing enterprises partly adapted their transportation activities, it also had ecological effects. Unfortunately, the economic and ecological effects are confidential and cannot be published out of contract reasons (Sterr 2003: 394).

Due to the signed vision at the beginning, the overall values were common. The economic interest dominated but in some cases the firms felt free to choose a ecological more benign alternative. A positive effect was that this project created another image and another, common identity for the firm members in Pfaffengrund through press articles, the invitation of a lot of people at the end of the project (Sterr 1998: 68) and speeches held at conferences about that network (Sterr 1998: 70). The awareness of the employees for ecological benign actions and solutions was heightened. But the network did not appear in public as a local actor in local Agenda 21 processes or other activities for the benefit of the society. Also, it did not create a surplus effect for the employees in form of common use facilities.

Coming to the positions of the individuals in their home organisations the network members were mostly part-time environmental or waste manager in their firms without staff and a limited power. Moreover, it was an obstacle to overcome that in nine out of fourteen firms, the headquarters and so the primary decision making power were not situated in Pfaffengrund but somewhere else, partly in foreign countries (Sterr 1998: 7).

Concerning the internal communication as well as information collecting and processing or introducing new ideas the IUWA was the driving force. It implemented a software especially for waste management for automatic exchange of information and organised five project meetings

within the last six months in order to reinforce the know-how transfer (Sterr 1998: 66). Additionally, the IUWA held contact through different channels with the firms, the firms themselves had partly contact to each other independently (Sterr 1998: 14). The communication often led to co-ordinated action. But the dominance of the IUWA could not be seen as a sole top-down approach as suggestions and reporting were welcome and required. During project time and afterwards, the network was open for new ideas and members, given that there was a consensus within the network, as well as for co-operations with other networks in the southern part of Germany. Whether it got new members is not known.

Since the project was finished successfully with a sufficient information flow one can state that the trust between network members and the IUWA was high enough for common activities (Sterr 1998: 25). But obviously some of them could not transfer this motivation towards the employees: one recycling cycle with film boxes was instable because firm member also threw other waste in the container. There were two reasons for it: first, due to cost aspects, the enterprise was not willing to put up a second container (Sterr 2003: 403). Second, the enterprise employees were not trained in separating waste from recyclable products (Sterr 1998: 46). In the sense of internal actor orientation a network idea would have been to study tools with the network participants on how to awake the awareness in their home organisations. In this case it was not done. In general it can be concluded that the framework for practicing social key qualifications was given but the qualifications were not subject themselves.

The stakeholder orientation was partly given: before the project started, the IUWA was in dialogue with officials of the city of Heidelberg, of the chamber of industry and commerce Rhine-Neckar and with other organisations be-

sides the SMEs in Pfaffengrund (Sterr 1998: 27). At the end of the project, all associated were invited for the party. The communication efforts with the stakeholders during project time are not documented in literature.

Summarising it can be said, that the economic effects were dominating, followed by ecological aspects according to the aims of the project. Also, the consideration of some social aspects can be identified as necessary prerequisite for successful network activities. But the network is not sustainable oriented in the sense of integrating all three dimensions. Certainly, there is a potential to enhance the promotion of social aspects within this context. The most obvious example is the support of the network members to motivate the employees in their home organisations. Also, once the contact is established a potential is seen in broadening the network activities towards other fields of co-operation such as taking part in the local Agenda 21 process. But before the consensus of the involved enterprises would have been needed depending on the economic consequences as restriction.

Yet, there is a development towards a sustainable oriented network: after the local project Pfaffengrund was finished, from January 1999 until December 2001 a regional follow-up was installed: the material flow management network Rhine-Neckar with a formal network called AGUM e.V.⁷ as communication platform. This network had 20 members with four of them being bigger enterprises from Pfaffengrund. It also aimed at economic and ecological effects while mostly blending out social aspects (Wetzchewald 2000). Nevertheless, a progress was made towards a sustainable orientation as stake-

holders from politics and science were involved (Sterr 2000: 63).

From July 2002 till January 2006 a third project is undertaken: an interregional material flow management network with the explicit communicated aim of sustainable orientation. In the region Rhine-Neckar the IUWA has built up a working group of 10 members up to now, mainly specialized on (inter industrial) material flow management including recycling activities. The idea is to also broaden the perspective towards social aspects as well as to open it for other fields of co-operation. The interregional aspect is expressed in the co-operation with two partner organisations in Ulm, Germany: one is an informal working group “waste” from the local chamber of industry and commerce and the second one is a formal network in that region called unw – Ulmer Initiativkreis nachhaltige Wirtschaftsentwicklung e.V., which already deals with social aspects in different working groups.

Results of the effort to foster an integrated perspective are not known yet for this project. But as a general conclusion it can be said that in a network focussing on material flows, especially on Inter-Industrial Recycling activities there is the potential in practice to enhance the spotlight on other fields of co-operation including social issues. The hope is to get an example of how to stabilise the network under economic conditions and simultaneously to live up the expectations of both the scientists and practitioners in ecological and social sense. A periodical evaluation with network indicators oriented on the sustainability concept as well as on the concrete aims of the network can contribute to a successful development.

Notes

- ¹ Initially, A. Augustine (1961: 264, *Confessions*, Middlesex: Penguin) wrote these sentences on the difficulties of understanding `time`. Faber et al. modified this statement.
- ² The question is whether they need to be equally ranked in different contexts to speak of sustainability. There are at least two reflections for an answer. First, from cybernetic and decision theory it is known that a multidimensional optimisation of independent variables usually leads to a bundle of options for actions that fulfil the criteria of sustainability with different manifestations (Spangenberg 2002: 25). Second, improving three variables to the same degree simultaneously may result in synergy effects but could also end in conflicts.
- ³ Translation: the author; the underlined words have been modified for this text. Contrary to this table, Sydow and Goebel defined evaluation subject as the person who evaluates something or someone whereas in their context evaluation object characterises the element to be examined.
- ⁴ Sydow and Goebel (2001: 78) express that so far the scientific literature does not pay great attention towards the network management task of evaluation.
- ⁵ In this context it is also interesting to generate and measure hypotheses and indicators about possible hindrances in networks in order to promote the idea of sustainability more effectively afterwards.
- ⁶ This project was financed by Deutsche Bundesstiftung Umwelt.
- ⁷ Arbeitsgemeinschaft Umweltmanagement e.V. – working group environmental management

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