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Environmental Sustainability Standards in Transport Alliances

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In 2012 about 23 percent of worldwide carbon dioxide emissions were caused by transportation. Therefore, it is desirable to improve the environmental sustainability of the transportation sector. In Germany a major part of road transportation is operated by small and medium sized enterprises (SME). They often lack the resources to identify and implement sustainability initiatives. However, to be able to compete with the big players SME tend to establish cooperations, so-called transport alliances. This paper presents an approach supporting the assessment and selection of sustainability measures within transport alliances.

A literature review was conducted investigating measures to improve environmental sustainability as well as their environmental and economic impacts. Based on these findings focus group discussions and interviews were carried out in order to develop a concept that enables a company-specific selection of sets of measures. About 130 measures were identified and rated with respect to their environmental and economic capability. These findings were then used to develop a demonstrator program that supports both selecting measures and reporting the results.

Keywords: Transport, General Cargo Alliances, Sustainable Process Improvements, Environmental Sustainability

1 Introduction

Increasing scarcity of resources and growing pressure from politics and public to reduce carbon dioxide emissions draw more attention to environmental sustainability (Weber, et al., 2011, p. 15; Bretzke and Barkawi, 2012, p. 77). One focus area is the logistics sector (Lochmahr and Boppert, 2014, p. 23): Transport alone causes 23 percent of energy-related carbon dioxide emissions, 75 percent thereof emitted by cars and trucks (International Energy Agency, 2014, p. 54). Additionally, rising commodity prices motivate logistics companies to improve their sustainability standards. In Germany a major part of road transportation is operated by small and medium sized enterprises (SME): According to government figures, more than 95 percent of the companies engaged in freight transport employ less than 50 people (Bundesamt für Güterverkehr, 2012, p. 6). To be able to compete with the big players SME establish transport alliances. These cooperations permit a further reaching transportation network. As a result SME are able to offer a huge number of transport relations and destinations. Moreover, they have the chance to enhance load factors of their transport vehicles by consolidating shipments (Rieck, 2008, p. 115).

A current topic for transport alliances is the optimization of their networks with respect to environmental sustainability. Existing disparities, e.g. with respect to company size and maturity level of sustainability experiences (Hunt and Auster, 1990), inhibit a one size fits all approach. Furthermore, gross profit margins within the general cargo sector are very low (Bollig, 2015) and SME often lack the resources to implement effective sustainability actions.

This publication reports preliminary results of a larger research project with the ultimate goal of developing and enforcing environmental sustainability standards within transport alliances both on strategic and operational level. Therefore, this paper presents an approach that supports the assessment and selection of sustainability measures within transport alliances while considering the specifics of participating companies. The results were used to build a software demonstrator that supports the selection, comparison and performance control of different measures within the transportation network.

2 Method

As it was crucial to gain a deep understanding of strategy development processes and problems occurring during implementation, qualitative research methods were chosen. Accordingly, the results stem from literature reviews, expert interviews, and focus group discussions.

2.1 Literature Review

Before new concepts and ideas are developed it is necessary to gain a profound knowledge about the topic and preceding research (Booth, Papaioannous and Sutton, 2012, p. 3). Different ways of doing a literature review exist. All forms of reviews can be assigned to a continuum mounted between the poles of narrative review and systematic review. While systematic reviews are highly structured and follow rigorous standards, narrative reviews follow no defined method and appear in a variety of styles (Jesson,

Matheson and Lacey, 2011, pp. 10–11). The literature conducted here follows a broad research question: There is no limitation on the amount of processes that should be optimized nor is the kind of measures predetermined. Besides, the appraisal of the results is variable and the synthesis qualitative. Therefore, a narrative review approach is sufficient (Cook, Mulrow and Haynes, 1997, p.378). The research questions are practically oriented. Hence, not only journal contributions but also project reports, handbooks, and practitioner publications were considered. The review results were used as basis for further research and the development of the software demonstrator.

2.2 Expert Interviews

In qualitative research interviews are the primary data collection technique (Cooper and Schindler, 2008, p. 170). Three types of interviews can be distinguished: unstructured, semi-structured and structured interviews (Cooper and Schindler, 2008, p. 171).

In this case semi-structured interviews were conducted. While doing semi-structured interviews the interviewer is supported by a guideline that simplifies focusing on the topic (Mitchell and Jolley, 2010, p. 277). Sustainability is a broad topic with different possible directions of research. The guideline helped to focus only on environmental sustainability aspects. Two in-depth interviews (more than two hours each) were conducted with special focus on the software concept. The questions were formulated openly to give the interviewees the chance to answer independent of any restrictions.

After introducing the topic, the interviewees were asked to specify their requirements with respect to the software demonstrator. The researchers then presented the actual structure of the software and asked for feedback. Next, the underlying data was discussed. The interviewees commented on the catalogue of measures and on the possibilities to categorize them. Afterwards, an early approach to evaluate the measures was discussed. Finally the interviewees were asked to identify dependencies between the different measures. These results were simultaneously noted down on a flipchart and organized as a matrix.

2.3 Focus Group Discussion

Focus Group discussions are used to collect qualitative data through interactions between the participants. The researcher plays an active role through the selection and composition of the group and the moderation of the discussion (Morgan, 1996, p. 130). A focus group typically consists of 6 to 10 participants, who discuss experiences, feelings and ideas on a specific topic (Cooper and Schindler, 2008, p. 178).

For this project four focus group discussions were conducted (n1=8, n2=10, n3=9, n4=6). The majority of participants took part in more than one meeting. Nearly all of the participants represented small and medium enterprises that are doing business in the general cargo sector and participate in at least one transport alliance. All of the participants were familiar with the concept of environmental sustainability and eager to contribute their knowledge to the project. For every session care has been taken that at least two persons from academia attended to record the discussion results.

An initial workshop was conducted to introduce the project as well as the participants to each other. The organizational structure of a typical transport alliance and the decision processes within the organization were discussed to identify potential cooperative environmental optimizations. Within the second focus group session findings from the initial literature review were presented. Subsequently, the attendees were asked to discuss the existing catalogue of measures as well as the classification. Additionally, by using marking points, the participants were asked to rate measures that were most suitable for a transport alliance from their point of view. Both the third and fourth discussion sessions were used to develop and validate a software concept. During the third meeting the moderator focused on the interrelations between the different identified measures. To support the discussion, a matrix of the different groups of measure was used to identify connections between them. Within the fourth session an early version of the software was presented. The focus group attendees were asked to comment on the software concept as well as on the already existing modules of the software.

3 Results

By using the aforementioned research methods different results were generated that were all brought together within a software demonstrator. These results include a catalogue of measures to improve environmental sustainability within transport alliances as well as an evaluation of these measures.

3.1 Catalogue of Measures

A process model of general cargo transport was designed and validated with the focus group (see Figure 1). The model was used to define basic conditions and requirements.

The catalogue of measures should only contain measures that aim at helping logistics companies to improve the execution of these processes. During the literature review more than 100 measures were identified. These measures were grouped into different categories and subcategories. The two main categories used were "transport" and "location/facility", where most of the processes besides transportation take place. A third category, mobility of employees, was built during focus group discussion. Every category contains different sub-categories, like vehicle, information, employees or cooperation (see Figure 2 and Figure 3).

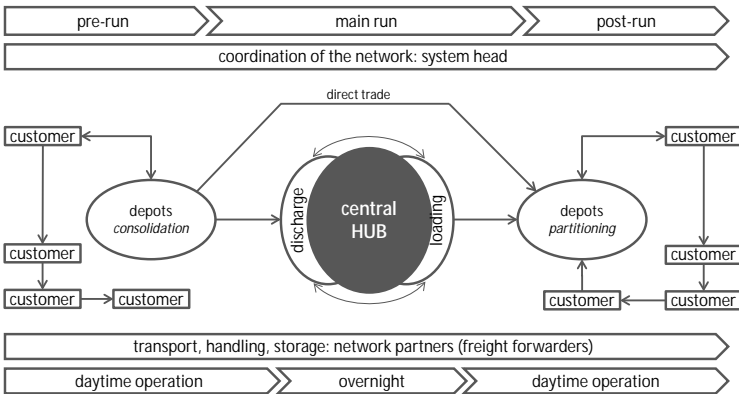


Figure 1 Process model of general cargo transport

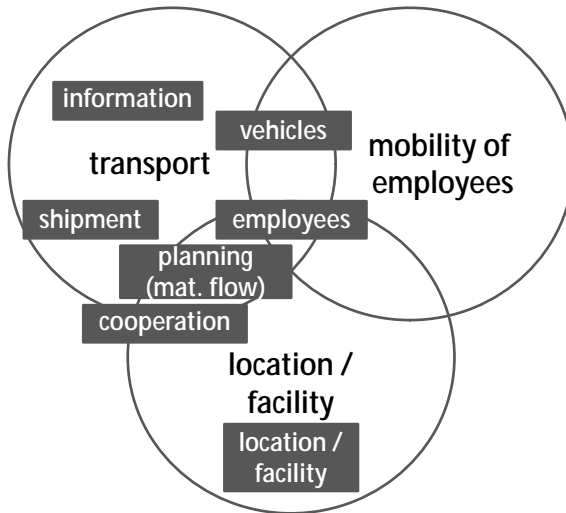


Figure 2 Systems of Categories (1)

During one focus group discussion the catalogue of measures as well as the categorization were reviewed and extended by the practitioners. They also selected most suitable measures by placing marking points on a flipchart. After finalization the catalogue contains 125 measures. All of them are categorized and equipped with a short description. Besides the categorization the measures were matched with key performance indicators from a preliminarily designed catalogue. This catalogue allows users to filter by the indicator they want to optimize. By using key performance indicators the overall reduction of resource consumption and increase of environmental credibility can be measured. The catalogue contains different indicators, for example "total energy used within the network", "water consumption of the network", "paper consumption of the network", "waste production"

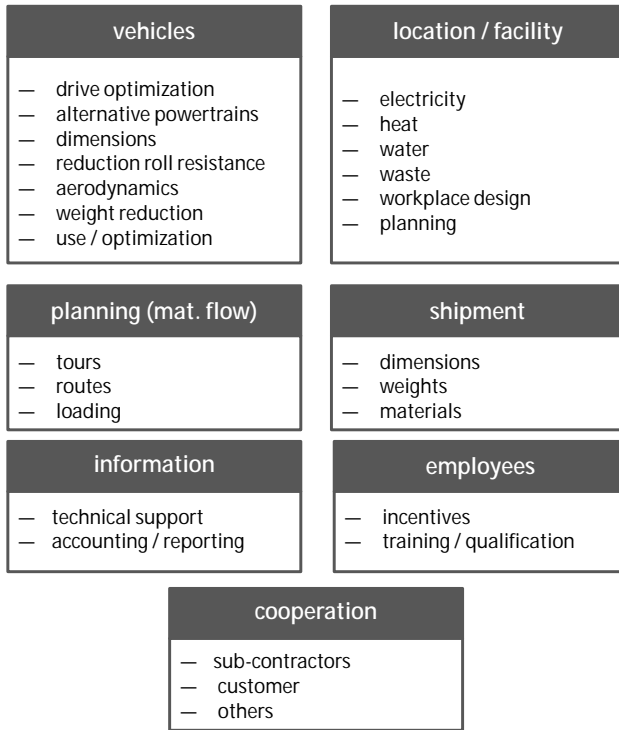


Figure 3 Systems of Categories (2)

and "carbon dioxide emissions". The indicator "total energy used within the network" is further subdivided into "fuel consumption of the commercial vehicle fleet" and "stationary energy use of the whole organization".

3.2 Economical and Ecological Evaluation of Measures

Based on an extensive literature review and the focus group discussions the effects of every method were collected and illustrated by practical examples. In summary, the results are as follows:

Approximately 80% of the measures can be used to directly reduce consumption of resources (input). They help to reduce consumption of fuel, heat or power as well as fresh fiber paper or water. The ecological effects can be measured directly by the savings through reduction of resource consumption. At the same time the output of emissions can be reduced. However, it is more difficult to estimate changes in output than input differences. Additionally, more than 8% of the measures listed don't reduce resource consumption but replace conventional energy sources with renewable energies. Examples are thermal power stations, alternative drives or photovoltaic systems. Measuring ecological effects is possible by calculating the share of renewable energies in comparison to the whole energy consumption. 7% of the measures that were found can't be used to reduce energy consumption, but they are helping the user to find and quantify optimization potentials (for example CO₂-Footprint calculations, environmental certificates, and environmental management systems); for this kind of measures it is not possible to quantify effects. The remaining 5 % of the measures only reduce the output: Particulate filters for vehicles, for example, reduce harmful emissions. The following list shows the economical and the environmental evaluation of the Top 5 ranked measures:

3.2.1 Top 1: Consolidating shipments

Even though, consolidation is – besides the expansion of the network – the main aim for alliances, there is a potential for further optimization. SME can increase utilization rate of their trucks by reorganization of the hub structure or by prolongation of service times. It is even possible to reduce empty runs by consolidating different shipments. In Germany the share of empty runs is approximately 20%. Accordingly, a reduction potential of 2.6 billions of vehicle kilometers and more than 2.2 million tons of carbon dioxide emissions is estimated (VDA, 2008, p. 9).

3.2.2 Top 2: Location planning (HUBs)

During strategic planning of a freight network, the definition of the number and locations of HUBs is essential. In principle hub and spoke structures are more efficient than grid networks, because the average utilization rate of vehicles is higher. On the one hand organizational expenses in hub and spoke structures are lower on the other hand investments in construction and operation of the facilities have to be considered (Wlček, 1998, pp. 31–33). A higher vehicle utilization rate within hub and spoke networks reduces the amount of vehicle-kilometers traveled and greenhouse gases emitted. The level of savings depends on the network structure.

Top 3: Reduction in water consumption

Fresh water is a limited resource and therefore particularly worth protecting. It is estimated that in the middle of the current century in the worst case seven billion people in 60 countries will suffer from shortage of water. In the best case two billion people in 48 countries will not have access to enough fresh water. (Bundeszentrale für politische Bildung, 2010)

Simple activities to reduce water consumption are for example renewal of shower heads or perlators. Additionally, a reduction of the cold water pressure is possible. Both measures don't require high investments. (Bode, et al., 2011, p. 7)

3.2.3 Top 4: Systems for tire pressure monitoring

With an optimal tire pressure a reduction of fuel consumption is possible. Estimates of the reduction potential vary between 3% and 8% (Wittenbrink, 2010, p. 16; VDA, 2008, p. 23). By decreasing consumption of fuel users are able to save 1,000€ on average for each truck (Stuhlmeier, 2014). Investments per truck are around 900€ (Wittenbrink, 2010, p. 16).

3.2.4 Top 5: Auditing processes for subcontractors

By auditing subcontractors problems can be identified. This helps to find solutions and optimization potentials. A comprehensive auditing also includes environmental factors.

The research showed that the possibility to quantify the effects varies: For one part of the measures it was possible to estimate the effects in a generic way. Thus, the transfer to actual implementation scenarios is deemed possible. Examples are measures for vehicle optimization. Most of them result in fuel savings that have a quantifiable impact on the fuel costs as well as the carbon dioxide emissions. For other measures a generic quantification of effects was not possible. However, general statements could be made with respect to the interrelations between those measures and their impacts. One example is the use of special procurement and distribution

strategies like “Vendor Managed Inventory”. There is evidence that by employing such a strategy transport kilometers could be reduced (Lohre, Bernecker and Gotthardt, 2011, pp.48-49). However, the amount of reduction depends on the specific situation and network design. Therefore, the economical and ecological evaluation of measures should only be used as an indication. Practitioners are advised to carry out an individual rating of measures before starting the implementation. It is recommended to utilize cost-benefit-analysis or benefit analysis to evaluate the situation specific benefits and costs.

3.3 Software Demonstrator Design

The final result of the research project is a software demonstrator. On the one hand the software aims at supporting the decision processes of finding suitable optimization measures. On the other hand it will enable transport alliances to monitor sustainability efforts within their network.

For the first goal it was necessary to build a database model to group all the information gathered. The categorization and the links to key figures were used as filters. A listing of adequate measures was displayed. Each method is accompanied by a description as well as the economical and ecological evaluation. Furthermore, users are able to select measures they already applied in practice to track their success. For this purpose the software asks for an overall rating. In addition the user is allowed to write comments on the problems, financial aspects or other related topics. The data is then exchanged within the transport alliance. Based on the information from every participant a best practice database can be built.

The measures are ranked by the individual ratings and their frequency of use. Accordingly, the software enables sharing experiences among the network partners. Furthermore, the network coordinator gets data of the sustainable progress within the alliance.

In addition, users are able to track key performance indicators for the measures in use. By entering the changes of input and output as well as necessary investments they are able to review their own progress. If users are willing to share their data they can even benchmark themselves with other users.

4 Discussion

For making progress in terms of sustainable development it is essential to be aware of the necessity for sustainable actions. Sustainability has to be integrated into the management system. Once there is a change in company culture regarding sustainability, measures can be applied to improve sustainability. Therefore, the overall research project started with implementing sustainability standards on a strategic level. The search for adequate measures on the operational level showed that there are multiple options to improve sustainability by changing behavior. For a comprehensive sustainability concept investments are necessary. In most cases these investments will payback within a short period of time.

It is impossible to find generic solutions that work for every company: In practice transport alliances don't start on the Greenfield but use existent assets of their participants. Accordingly, the initial situation has to be con-

sidered when improving sustainability. Therefore, this research project delivers no rigid procedures but an extensive catalogue of measures. Based on the given information every user should be able to find the solution that best fits his needs. On purpose the catalogue of measures contains possibilities that differ in various aspects. They affect different processes within transport alliances and influence various key performance indicators. Some of the measures can be implemented with low effort while others need more resources.

Especially small and medium enterprises often lack extensive resources. Nevertheless, to ensure progress regarding these sustainable measures transport alliances are able to support their network partners during implementation of these. In most cases the network coordinator functions as consultant or financier. Besides that it is possible to use the power of the network during negotiations with business partners. Truck leasing conditions, for example, are cheaper for the whole network than for individual freight forwarders. Furthermore, the selection of different vehicle variants can be limited to environmental friendly types.

The approach presented above goes beyond other projects in this field of research. In the past several authors developed guidelines and catalogues of measures to improve sustainable logistics (Lohre, Bernecker and Gotthardt, 2011; Bode, et al., 2011). However, they all focused on individual companies and most of them concentrate on only one aspect (e.g. sustainable logistics buildings).

The software developed focuses on the network idea and allows for sustainable improvement within the whole alliance. By building a network-specific best practice database every user can profit from the experience of

the others. Furthermore, the developed software concept functions as fundament for a network wide green controlling and therefore exceeds the idea of providing guidelines and support in choosing the right way of improving sustainability.

5 Conclusion

The discussions with practitioners have revealed a general willingness to improve environmental sustainability as long as investments amortize within a few years. The engagement of top management as well as of network coordinators is essential for a sustainable development. Margins within the logistics sector are very low. As a result economic factors outweigh environmental issues in most cases. Therefore, the approach presented above supports an economic assessment of possible measures. Besides that it provides help for choosing the right action.

This project identifies a lot of opportunities and possibilities to improve environmental sustainability in the logistics sector. However, practitioners – especially small and medium enterprises – often lack personal capacity and financial resources to find the right solution for their own business. A generic solution that works for every company remains elusive. Therefore, the software aids by implementing a best practice catalogue of measures. Based on the information, exchange of experiences should be encouraged and decisions for individual best solutions should be prepared. Furthermore system leaders struggle to align sustainable development of every single partner no matter what size or intention. Using the software it is possible to control and coordinate the partners.

6 Further Research

Based on this research project another issue in the field of environmental sustainability in logistic networks arose. In future, companies are forced to report all emissions that are caused by their value-adding processes, even those, which are caused by subcontractors (known as scope-3-emissions). That means logistics service providers will be responsible for the emissions of their subcontractors, who are often very small (< ten employees). Because of their limited resources and possibilities those subcontractors have to be supported in calculating carbon dioxide emission. Taking this situation into account new research questions arise, such as "How can logistics service providers support their subcontractors in reporting carbon dioxide emissions? How to integrate key performance indicators from subcontractors into the existing reporting? How to ensure data privacy and protection?"

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