Approaches to Analysis of the Green Transport Level

David Staš(✉), Radim Lenort, Pavel Wicher, and David Holman

ŠKODA AUTO University,
Na Karmeli 1457, 293 01 Mladá Boleslav, Czech Republic
{stas,lenort,wicherl,holman}@is.savs.cz

Abstract. The article presents proposals of two approaches for assessing the green transport level in industrial companies and supply chains. As the first approach was designed a methodology for green transport audit, which is suitable for quick view of assessed industrial transport. For more detailed analysis of the green transport level is necessary to use more sophisticated tool then green transport audit. Conceptual framework for assessing the green transport level was designed for this purpose. The framework contains five main phases – preliminary analysis, transport system analysis, selection of assessing parameters, taxonomy development, and evaluation.

Keywords: Green transport · Green transport audit · Green transport level · Assessment

1 Introduction

In recent decades, the performance of economic and non-economic activities has required them to be friendly with the environment. This proactive approach to addressing and eliminating the negative environmental impacts from logistic processes is called green logistics (GL). The potential for an effective implementation of the GL principles can be found in many logistics activities. One of the key areas is the industrial company transport. It is necessary to be able to properly evaluate the green transport level during the implementation of GL and the subsequent process management. The aim of the paper is to summarize results of authors' previous research work in this area. First, green transport audit (GTA) and its methodology will be presented as the starting point for successful implementation of the GL principles. Second, a conceptual framework for measurement, monitoring, and evaluation of an industrial transport will be presented.

2 Methodological Basis

This part presents literature review related to green transport, logistics audit, and recent systems measuring the green transport level as fundamental methodological basis of the proposed methodologies.

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2.1 Green Transport

Movement towards GL starts with green transport (GT) [1]. Transport in the area of logistics processes is one of the areas having considerable potential within the scope of the implementation of the green practices, since it occupies top positions in negative impacts on the environment. At present, the public has been increasingly aware of a number of negative effects transport produces. They include, primarily, the emissions of CO and CO_2 and other exhaust gases, noise, and, last but not least, congested transport infrastructure.

The current goals of GT are now focused on reducing the fuel consumption (which is closely linked to cutting CO_2 and other exhaust gases), reducing noise, reducing the transport costs, reducing traffic jams and, ultimately, on complying with the legislative restrictions. An active and effective solution of the issues of GT must be seen not only as a challenge, but especially as an opportunity offering the possibility of significant competitive advantage, improving the image of the company in the eyes of the customers, region, state and the general public.

2.2 Logistics Audit

For enhancing the performance of the logistics system, it is necessary to take stock of the efficiency and effectiveness status of various sub-systems of the logistic chain. This process is called logistics audit [2].

Logistics audit is conducted to quantify the opportunity for improvement and to prioritize the initiatives in logistics process improvements [3]. Logistics audit is a periodic audit of a firm's logistics system, with the objective of finding an optimal mix of both cost and customer service [4].

Tvrdoň et al. recommend three subsequent parts for logistics audit performance [5]: (1) Descriptive: summarizing and describing all key parameters, measurable values and practice statuses of the logistics corporate system. (2) Diagnostic: the goal is to analyze to what extent corporate logistics systems are optimized or to what extent these systems meet the practical requirements in the specific company environment. (3) Proposal: it is formulated as an action plan, chronologically sorted activities description.

2.3 Recent Systems Measuring the Green Transport Level

On the basis of the literature review in the area of the conceptual frameworks used for measurement, monitoring, and evaluation of GT level, it can be stated: (1) Assessing the GT level is worldwide processed, described and developed topic, but only from a multinational and national prospect, especially for the area of urban or public transport (see e.g. [6, 7]). (2) The GT is usually included in a broader concept of Sustainable transport, which, apart from the environmental aspects, also deals with the economic and social criteria [8–11]. (3) GT field from the viewpoint of industrial companies or supply chains in the available green and sustainable transport conceptual frameworks is addressed only sporadically and marginally (see e.g. [12]). (4) As a result of different importance of green criteria, their measurement, monitoring, and evaluation should use

the principle of weights. Sustainable Highway Self Evaluation Tool using default weights can serve as an example [13].

3 Green Transport Audit

The corner-stone of the proposed methodology is the technique of checklists. Industrial enterprises have two basic practical options how to ensure transport – to have their own car fleet or to use the logistics service providers. A third possibility is the combination of both these options. That is why two types of checklists have been created; taking into account the specific features of both methods of transport. Checklist for the first option is shown in Table 1.

Table 1. Checklist for an industrial company with its own vehicle fleet.

Field	Question
Strategy	1. Are the key suppliers situated near to you?
	2. Is your transport network optimized from the viewpoint of Green indicators?
	3. Do you have a system of monitoring indicators of Green Transport?
	4. Do you have created a partnership platform with all stakeholders?
Management	5. Do you use the concept of fully-loaded direct supplies and milk runs?
	6. Do you use the intermodal transport?
	7. Do your suppliers have an agreement for sharing their warehouses?
	8. Do you plan deliveries with your suppliers /customers?
	9. Do you utilize back rides?
Technology	10. Do you use ICT for transport planning and control?
	11. Do you carry out regular optimization of transport capacity utilization?
	12. Do you use alternative fuels and engines?
	13. Do you innovate your fleet?
	14. Do you use software for route optimization?
	15. Do you use road trains?
	16. Do you use double deck vehicles and other two-level systems?
	17. Do you use one-way pallets or other packages for long transports?
	18. Do you optimize loading /unloading time?
	19. Do you use telematics for efficient transport operations?
	20. Do you carry out careful preventive maintenance of your fleet?
	21. Do you have lighter vehicles?
	22. Do you use engine shutdown during waiting times?
Staff	23. Do you have a motivation system for your drivers to behave green?
	24. Do you carry out green training of your drivers?
	25. Do you select new drivers with regard to the green skills?

The checklists were created on the basis of a detailed research of green best practices used in the area of transport. More than 170 best practices have been analyses altogether. The principal sources of information were [14–19]. Each question in the checklist reflects one best practice. If the question is answered yes, the industrial company uses this best practice.

The questions are divided into four areas, reflecting their essential nature: (1) Strategy – best practices creating the basis of a successful application of other best practices or they have the character of supply chain structural changes. (2) Management – best practices focused on planning and subsequent execution of transport. (3) Technology – technical innovations of the means of transport, equipment, ICT systems and packages. (4) Staff – best practices whose motive power is represented by the people and their skills. The actual checklist evaluation is performed in three levels: (1) Questions – express the level of implementation of a given best practice. (2) Areas – represent the level of implementation of green practices in the individual areas. (3) Overall evaluation – overall level of GT in the evaluated industrial company. An example of the graphical presentation of GTA results is shown in Fig. 1.

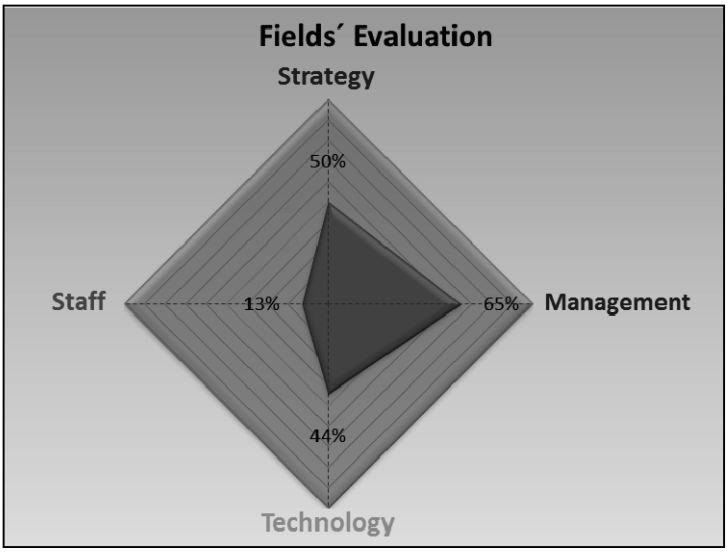

Fig. 1. The evaluation outcome of the audited areas.

4 Conceptual Framework for Assessing the GT Level

For more detailed analysis of the GT level is necessary to use more sophisticated tool then GTA. Conceptual framework for assessing the GT level was designed for this purpose. The main idea of the conceptual framework is based on an assessment of whether and to what extent the given transport system uses the approaches (beast practices) that are generally considered as green. Design conceptual framework includes the stages shown in Fig. 2.

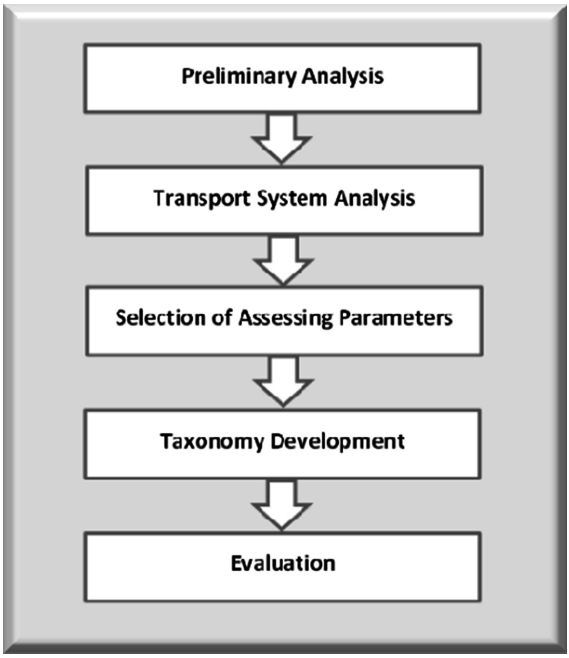

Fig. 2. Conceptual framework for assessing GT level in industrial companies and supply chains.

4.1 Preliminary Analysis

At the beginning, it is necessary to analyze the factors that will determine the manner and focus of the planned evaluation of GT level. The main factors are: (1) Purpose of evaluation – the goal may be to define the current level of GT and the potential for further improvement, to determine the level of GT for the newly designed transport system or the creation of standards for monitoring transport sub-systems within a company or corporation. (2) Scope of evaluation – it defines the part of the industrial company transport system to be evaluated. You can evaluate all transport activities of the company, which, however, requires large resources (especially costs and time). That is why it is preferable to analyze only the mouse negative impacts on the environment. In large industrial companies, the transport system is usually divided into these areas: inbound, internal, and outbound. (3) Availability of information – the method of evaluation will also be affected by the quality and availability of information.

4.2 Transport System Analysis

A good understanding of the transport system is a necessary condition for the evaluation of its green level. Each transport system has certain specific features that need to be taken into account when assessing its green level. The basic examined areas include the transport system structure (type and number of elements, their locations, and mutual links), transport politics (make or buy), transported commodities and their quantity, the

used technologies (modes of transport, kinds of pallets and containers, transport capacities), transport planning and control principles and systems.

4.3 Selection of Assessing Parameters

The task at this stage is the selection of key parameters that will be used to evaluate the level of GT. For this purpose, GTA methodology described above can be used (see Table 1). The selection of key parameters is performed in the following steps: (1) The elimination of the best practices that are not related to the used make or buy transport policy – if the industrial company does not use its own fleet, it usually cannot have a direct impact, for example, on the fleet innovation, the introduction of telematics systems and eco-efficient new drivers selection and vice versa. (2) The elimination of the best practices that cannot be implemented for objective reasons – for example, the use of road trains, which is significantly restricted by the legislation of the individual countries. (3) The selection of strategically important best practices – in strategic management, it is necessary to concentrate on a lower number of crucial factors to avoid the fragmentation of limited company resources. This selection can take advantage of a modified matrix [15], which is presented in Fig. 3.

The company should incorporate the remaining best practices into categories presented in the matrix according to the following criteria: (1) Expected emission reduction after increasing the level or the implementation of a best practice in the given company – low or high. (2) Estimated cost of increasing the level or the implementation of a best practice in the given company – low or high. (3) Responsibility to decide on the increase of the level or the implementation of a best practice in the given company: I. In the responsibility of the implementers or II. Limited responsibility of the implementers (e.g. within the responsibility of another company department or corporation). The result is the inclusion of the remaining best practices into one of four categories: (1) Ideal – high reduction of emissions can be achieved at low costs or even cost savings. (2) Economic – only limited reduction of emissions can be achieved at low costs or even cost savings. (3) Ecological – incurring high costs will achieve a high reduction of emissions. (4) Ineffective – incurring high costs brings only a limited

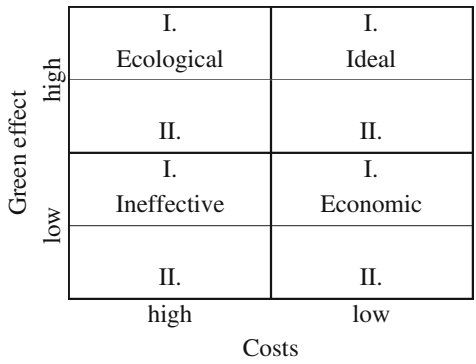

Fig. 3. Matrix for the selection of key parameters.

reduction of emissions. Ideal category should preferably be used to select the key parameters; on the other hand, Ineffective category should not be used at all. At the same time, we prefer the best practices that are within the direct responsibility of the implementers. There are no generally accepted rules for the inclusion of the individual best practices into the matrix, because it is always necessary to consider the individual conditions of the company in question. For one company, the increasing use of transport vehicles can mean relatively large investments in the technological systems with limited emission reduction. In another company, inexpensive organizational measures will lead to significant reduction of emissions.

4.4 Taxonomy Development

The task of taxonomy development is the creation of a system for measuring GT level. It is based on the decomposition of selected parameters into a weighted system of measurable indicators. The indicators may be of qualitative or quantitative nature. It is necessary to assign weight to each indicator. The Analytic Network Process (ANP) designed by Saaty can be used for this purpose. The main procedure of ANP is described in [20]. An example of a network created in Super Decisions software [21] is presented in Appendix.

4.5 Evaluation

The information and the data necessary for determining the indicators are collected during this stage. Using ANP, you can calculate GT level. The evaluation of the results may include: (1) Comparison of the calculated value with the maximum (ideal) and minimum values. (2) Inclusion of the calculated value into the pre-defined categories (low, medium, high GT level). (3) Benchmarking for application of the conceptual framework in other transport systems of the company or in another company. (4) Evaluation of the trend if the GT level evaluation is performed repeatedly. When increasing GT level, it is desirable to focus on the areas and parameters with the highest weight. If these capabilities reach an unsatisfactory level, it is necessary to prepare a plan of actions that will lead to their improvement. If the key parameters reach a sufficient level, it is advisable to prepare a plan of actions in order to maintain them at that level.

5 Conclusion

An efficient management of GT level, however, requires to create a complex conceptual framework, which will include not only the assessing stage, but also execution and control. Thus, the authors of the paper have been dealing with the possible application of the Balanced Scorecard (BSC) approach. Future research activities of the authors will also be focused on extending the presented conceptual framework into the spheres of green logistics and green supply chain.

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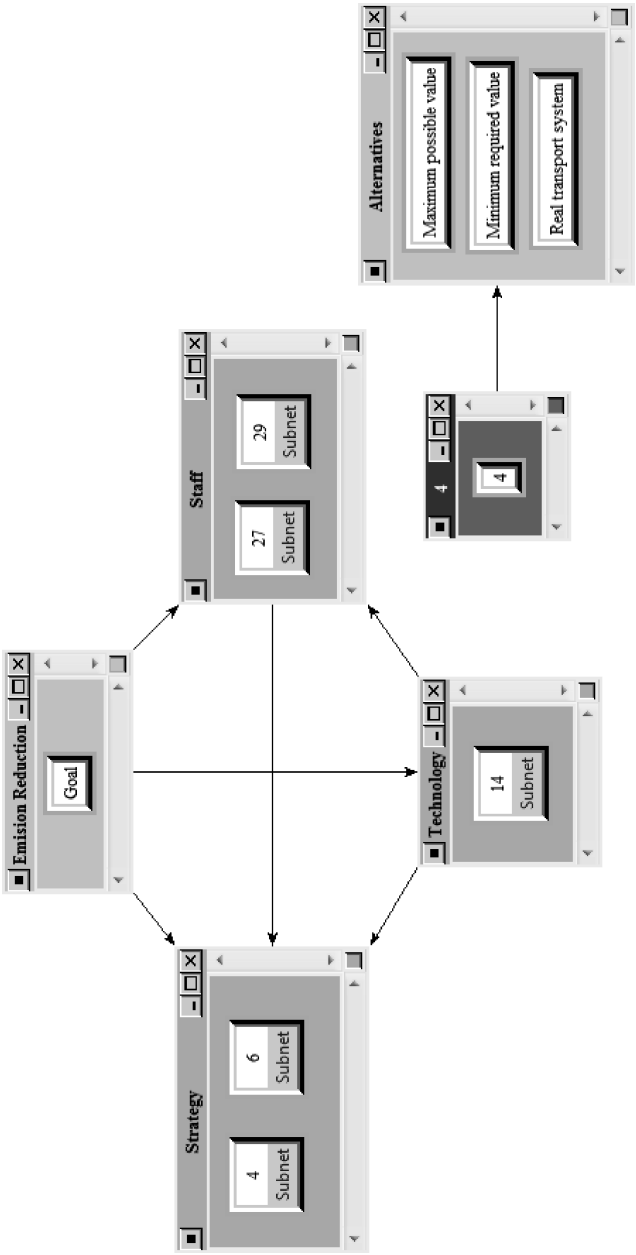
Appendix

Network for application of ANP method created in Super Decisions software.



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