Sustainable Supply Chains – a framework for best practice assessment Results of the pilot study, BestLog project

WOJCIECH PIOTROWICZ, RICHARD CUTHBERTSON, GERD ISLEI
Said Business School
University of Oxford
OX1 1HP, Park End Street, Oxford
UNITED KINGDOM

www.sbs.ox.ac.uk, www.bestlog.org

Abstract: This paper presents results of a pilot study completed as part of the BestLog (Best Practices in Logistics) project. BestLog (www.bestlog.org) is a research project initiated by the European Commission (EC) and financed from the 6th Framework Programme. One of the project goals is to identify and promote best sustainable practices in logistics and supply chain management. This paper focuses on the development of a framework for assessment.
The research methodology is presented first, followed by an overview of the collected cases. The overview includes information related to best practice characteristics, such as: industry and sector, supply chain area and relationships, country coverage and contextual aspects. The next section reviews EC policies on sustainability in transport and logistics. The main part of the analysis concentrates on the metrics and benefits reported in the case studies. Identified benefits are listed and compared with the EC policies as well as existing literature related to performance measurement and supply chains benchmarking. To reflect the requirement for a sustainable supply chain, the proposed framework is composed of three dimensions: economic, social and environmental. Each dimension is further subdivided into categories of metrics that could be used to assess the supply chain performance. These metrics represent a mixture of both hard (quantitative) and soft (qualitative) measures. Hard metrics such as costs, utilisation or number of accidents are relatively easy to measure, while the soft metrics will require judgment to determine their relative value. The case study analysis confirmed the domination of purely economic benefits - while social and environmental aspects are often ignored. The final part of the paper provides a working version of the framework for best practice assessment, as well as conclusions and recommendations for future research. Results of the analysis are being employed in field work (based on the multi-case study design), running simultaneously in 9 European countries.

Key-Words: Supply Chain, Logistics, Transport, Sustainability, Sustainable Development, Performance Measurement, European Union, Benchmarking, Metrics, Best Practice

1 Introduction

Results of the analysis presented in this paper are part of the BestLog (Best Practices in Logistics) project. BestLog (www.bestlog.org) is a research project initiated by the European Commission (EC) and financed from the 6th Framework Programme. The BestLog project started in 2006 and will continue until 2010. BestLog aims are to:

- Improve logistics and supply chain practice
- Develop logistics and supply chain education
- Reduce differences in logistics and supply chain practice across Europe
- Set quality standards for logistics and supply chain education and practice
- Achieve a better match between EC policy and logistics and supply chain management decision-making

The project aims are achieved through: the collection and dissemination of logistics and supply chain best practices, the development of a certificate for European best practice in logistics and supply chain management, the regular publication of a report on the state-of-the-art in logistics education, as well as the development of training programmes. A platform for an ongoing exchange on logistics and supply chain best practices is planned beyond the project duration.
The BestLog project is split into a number of Work Packages. Work Packages 4-6, coordinated by the Saïd Business School, University of Oxford, are focused on creating a framework for the assessment

of sustainable best practices. To achieve that goal, the first steps were to review the existing frameworks and models for performance measurement and benchmarking used in supply chain management. These results are then used to establish a set of criteria for assessing existing best practice. The starting point for this analysis is a framework developed during a "brainstorming" workshop at an earlier stage in the project. This framework, the "BestLog Pyramid", originally comprised of four dimensions: economic, social, environmental and technology. However, the initial review of the literature and case study material confirmed that there is no need to include "technology" as an independent dimension. Technology is an enabler and is used to improve the other dimensions, so it is not necessary to separate it. The BestLog best practice pyramid dimensions are presented in Figure 1. This approach is also supported by the EC policy documents, where only three dimensions: economic, social and environmental, are seen as fundamental.

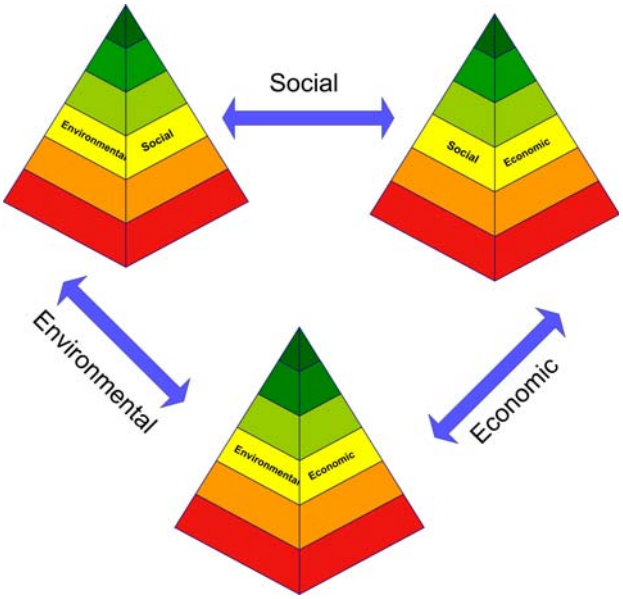

Figure 1 BestLog Best Practice Pyramid

In the analysis existing case studies of best practice collected by the project partners are used, in an iterative triangulation [1] approach to build a structured framework.

The main goals of the analysis are:

- To identify the main performance measurements and benefits of best practice.
- To detail the main metrics that underpin each dimension.
- To analyse how well practices, which are referred to as "good", or "best", reflect sustainability issues.
- To propose a framework for assessment, combining the initial framework with results of the literature review, EC policies and the results of the case study analyses.

This paper is composed as follows: the research methodology is briefly presented, followed by an overview of the collected cases. The overview includes information related to the best practice characteristics, such as: industry and sector, supply chain area and relationships, country coverage and contextual aspects and is based on input from the BestLog partners. The next section reviews EC policies relating to sustainability in transport and logistics. The main part of the analysis concentrates on the benefits and metrics reported in the case studies supplied by the partners. The benefits are listed and compared with the EC policies, as well as existing literature related to performance measurement and benchmarking in the supply chain. The final part includes a working version of the framework for best practice assessment, as well as conclusions and recommendations for future research on the project.

2 Methodology

Iterative triangulation [1] is used as a structured framework to build theories from existing case studies. Instead of data collected directly from organisations, selected case studies are analysed to develop or modify theories. The analysis of existing case studies involves searching for common patterns across studies that were prepared using different data collection methods and in different organisational contexts. Iterative triangulation is recommended in situations where the research topic is novel and underdeveloped, but at the same time a body of relevant literature exists [1]. BestLog project partners searched for existing case studies of supply chain practices that could be defined as "good" or "best" practice. The requirements for this pilot case collection were unrestricted to encourage a wide perspective on "best practice", with the only major caveat being that they must not be older than 6 years. Therefore, case studies could be published or unpublished, created for academic or teaching purposes, written as part of other EC funded projects, or examples from industry, related to issues in any country (not European cases only), and written in English, or any other language (translated by BestLog partners if required). The resulting collection of pilot case studies provides views from different industries and sectors, as well as different points of the supply chain (manufacturers,

forwarders, customers etc.). For each case study, the relevant BestLog partner filled a pre-defined table identifying key characteristics.

Altogether 33 cases were collected, the majority, 21 are practically oriented, 6 are academically focused and 6 classified by BestLog research project partners as "other". The majority of the cases collected (21 out of 33) have not been published to date, though seven of them are already published, and additionally four cases represent ongoing research. The majority of cases are classified by partners as logistics services (18 cases), while the second largest group of cases were from the retail sector (7 cases), there were three cases from each of the following sectors – chemicals, automotive and consumer goods. Only 6 cases were actually related to an extended supply chain, the remaining concentrate on internal issues (single company), or relationships between one organisation and their business partners (one-to-one or one-to-many). Around half of cases were declared as "best practice" by the authors of the cases or BestLog partners. This confirms that in many cases "best practice" is postulated by their authors, with little or no confirmation as to how the presented practice improved performance [2]. Most of the collected cases relate to practices in the UK (10 cases), followed by Germany (7 cases). Some European Union (EU) countries were not represented, while from most countries only single cases have been collected. Three non-EU countries were represented: Norway, Switzerland and Turkey. While the internal contextual aspects related to the case company, such as history, structure, turnover and size, are presented to varying levels of detail, the external market and country-related elements are less common. Indeed, some of the cases do not include any details related to the specific market, product or industry. Only one case [3] provides a comparison with competitors. The pilot cases collected reflect the findings from the literature review that in "best" or "good" practice papers, the context is often missing. An additional aspect presented in the case studies relates to the timing involved. Some cases describe the planning process and focus on the selection of a best option [4-6]. However, it is unknown whether the option selected resulted in the expected performance improvement or not. Similarly, some cases present pilot implementations only [7, 8], and so, as a consequence, do not consider any issues arising from a full implementation. However, the majority of collected pilot cases present completed initiatives.

3 Sustainable transport and logistics

The following section discusses the results of the pilot case study collection in relation to EC policies. At the beginning of the section, the relevant EC polices are presented. The main goals set by the EC are extracted from the white paper – *Transport Policy for 2010: time to decide* [9], as well as from a key working paper [10] and its appendix [11] relating to freight logistics - *Commission staff working document: Freight transport logistics in Europe - the key to sustainable mobility*.

This analysis resulted in confirming the modified underlying framework for assessment (BestLog Pyramid) built upon three key dimensions: economic, social and environmental; while each of the dimensions is divided further into relevant categories. Within each category, examples of the metrics are included, based on EC documents and the pilot case study collection.

3.1 EU commission policies

Although in the EC transport policy document from 2001 [9], many dimensions for analysis are used, such as environmental, social and industrial, the latest working documents published in 2006 [10, 11] clearly separate transport-related problems into economic, social and environmental. Working papers [10, 11] consider the minimisation of the negative effects caused by various modes of transport, and at the same time, stress the need for economic growth, cost reduction, service quality improvement and increased competitiveness [10], aiming to lead to the sustainable growth of transport and logistics.

Various aspects of transport and logistics included in the EC documents are listed in the table no 1 and assigned into economic, social and environmental dimensions. Economic aspects are also grouped into sub-categories, such as efficiency, quality, competitiveness, information and communication technology (ICT). It is worth noting that ICT is perceived as a tool to solve some of problems listed, rather than a direct goal in itself.

3.1 Economic, social and environmental benefits in the pilot cases

The majority of the metrics used in the pilot cases are economic (relating to cost, time, quality and customer). However, the review of the cases also resulted in a list of metrics and benefits that can be classified as social or environmental. In fact, in some case studies the category of environmental benefits was used [12, 13], while [14] clearly

separated benefits into economic, environmental and social.

The major issues that arose from the analysis of the collected best practices are the:

- **Economic benefits dominate,** while social and environmental aspects are often ignored.
- **Supply chain dimension is lacking.** The cases concentrate mainly on internal issues at a company level, not on the whole supply chain.
- **Operational benefits dominate**, while the strategic impact is often ignored.
- **Benefits are not quantified.** In many cases there is no confirmation that they were ever achieved.
- **Background and contextual information** is required for fully understanding a case.

3.1.1 Economic

The economic benefits and metrics are analysed using various frameworks and approaches, to provide a multi-dimensional view of their impact on the organisation and its situation, including Plan/Source/Make/Deliver [15-17], scorecard approaches [18-21], qualitative and quantitative approaches [17, 22] and the initial framework developed as the starting point of the BestLog project. The benefits and metrics listed in the pilot cases can be classified into strategic, tactical and operational [15, 16]. A minority of the benefits and metrics are assigned to the strategic group relating to long term performance and competitive advantage. Most pilot cases concentrate on improvements in operations and elements of processes rather than the impact on the supply chain as a whole. The focus on a single organisation is clearly visible when the scorecard perspectives are considered. Similarly, quantifiable productivity benefits or softer customer service benefits at the organisational level dominate the pilot cases. As might be expected, commercially sensitive financial measures are not made public. The methodological framework developed should aim to address such issues as far as practicable.

The different economic measures identified can be found in Appendix I, where they are assigned into qualitative and quantitative categories [22].

3.1.2 Environmental

In the case studies, some benefits and metrics which can be classified as environmental were identified:

- Reduce other pollutant emission [14]
- Reduce fuel consumption [13, 14]
- Fuel consumption [23]
- Reduce road congestions [12]
- Total Co2 produced (kg) [12]
- Co2 produced per litre delivered (grams) [12]
- Co2 emission (% or in tons) [12-14, 24]

The environmental group of metrics focus on lowering the negative impact of transport on the natural environment. The most common metric relates to Co2 emissions [12-14, 24].

3.1.3 Social

The least common group of issues are those that can be classified as social:

- Fewer accidents involving goods vehicles (leading to fewer injuries and fatalities) [14]
- Number of drivers educated in eco-driving, traffic safety working environment and health issues [13]
- Less stressful work for planners [25]
- No of employees who work in EU [3]
- % of production in EU [3]

There are no common metrics, rather a range covering accidents, employment and training.

3.2 Analysis of the pilot cases

When the case studies are analysed, it is possible to observe the difference between the benefits and measures used in collected cases and the third party assessments prepared by each BestLog research partner. Partners were asked to rank the cases from 1 to 5 (where 1-not at all, 5-main domain), to reflect how the practices cover economic, social, environmental and technology issues. The partners' assessment of the importance of each domain reflects the internal, organisational and functional focus of most of the pilot cases. Benefits and measures associated with the economic (business and financial) issues score highly (score 4.35 of 5). External, longer-term environmental (score 3.28 of 5) and social issues (score 2.76 of 5) are recognised as important but at a lower level. Correspondingly, a low number of environmental and social indicators are identified in the cases. However, some of the practices presented in the case studies do have a positive impact on the environment, but such an impact is not usually formally assessed by the organisation concerned. For example, in some cases a reduction in fuel consumption is listed as a metric. This can be considered as an environmental benefit but is listed only as a cost reduction, an economic measure, instead.

3.3 Framework for the best practices assessment – working version

The underlying framework for the pyramid can be defined combining the literature review, the results of the pilot case analysis and EC policy documents,. Hence, this framework is built upon solid foundations in theory, practice, and policy, as shown in Figure 2.

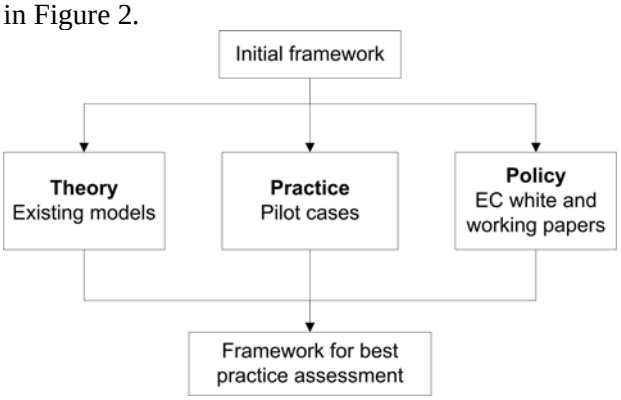

Figure 2 Framework development process

Additionally, from the research undertaken, it is possible to group key issues that have similar characteristics into sub-dimensions (categories of metrics) of each of the three main dimensions, as presented in Figure 3.

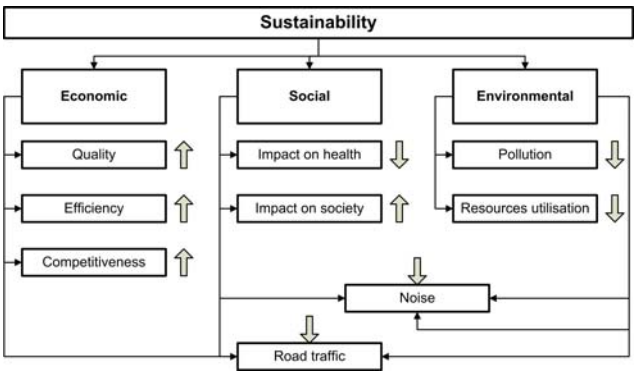

Figure 3 Framework for best practices assessment

The sub-dimensions (categories) are developed based on the separation of elements included in EC policies, theoretical frameworks from the literature and the results of the analysis of cases presented in the previous sections. Each category includes various impacts; however their detailed definition will be determined during the next research stages.

To achieve the goals set by the EC, it is necessary to reduce negative social and environmental impacts, and at the same time continue with economic growth. Selected negative impacts need to be reduced while other positive impacts must be encouraged to grow. The general trends are marked by arrows in Figure 3. In practice, all categories and dimensions are interlinked, so the framework is structured to enable analysis, rather than to reflect every situation for every organisation. However, two sub-dimensions are assigned across more than one category:

- Noise – this has major social impacts (especially in urban areas) as well as an important environmental dimension
- Road traffic - influences all categories, and may need to include other modes of transport, such as air, at a later date.

Current metrics identified within each category are shown in Table 2. These metrics could be used to assess existing logistics and SCM practices. The metrics represent a mixture of both hard (quantitative) and soft (qualitative) measures. Hard metrics such as costs, utilisation or number of accidents are relatively easy to measure, while the soft metrics will require judgment to determine their relative value. In some cases, there might be the need to create further sub-categories which would provide a deeper overview of the best practices under assessment.

4 Conclusions

The analysis of the collected pilot cases, as well as the completed literature review, resulted in changes of the initial framework. The dimension "technology" was considered unnecessary, as technology improvements are not a goal, but technology implementation aims to enable improvement in other areas. Three key dimensions, "economic", "social" and "environmental", are confirmed by the analysis. The collected cases employed similar benefits categories or groups, though benefits in the "social" dimension were not common. Application of the BestLog pyramid would allow looking at the logistics and supply chain issues from the balanced and multi-perspective view, where not only economic, but also social and environmental aspects would be considered.

The three-dimensional pyramid is therefore fixed as the overall framework for further research with the more flexible underlying structure sub-dividing each dimension.

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Economic aspects	**Social aspects**
Efficiency	Employment, new jobs creation [10, 11]
Unnecessary runs (on the road) [10]	Accidents [9-11]
Empty runs [10, 11]	Accidents on the urban areas [9]
Loading capacity utilisation [9-11]	Public health [10]
More fright carried in one vehicle (modularity) [11]	Noise emission [9-11]
Transport, operating and customer costs [10]	Congestion [9, 10]
Resource use [10]	Negative effects on peoples health [10]
Economic and resource efficiency [10]	Negative impact on citizens [10]
Energy efficiency of transport per tonne-kilometre [10]	Training - logisticians and related personnel [9-11]
Operating efficiency (rail transport) [10]	Number of victims on the roads [9]
Too many km to transport goods – low efficiency [10]	Road safety [9]
Efficiency of nodal points [11]	Risk of accidents [9]
Quality	
Quality in logistics services (chains) [10, 11]	
Quality in logistics companies [11]	
Service quality across all transport modes [10]	
Quality of transport services [9]	
Road transport	**Environmental aspects**
Number of lorries on the road [10]	
Km/per transport mode in relation to tonne-kilometres per mode [10, 11]	Negative effects on environment [9, 10]
Growth of modes in relation to each other [11]	Pollutants emission [9-11]
Vehicle kilometres [9]	Air and soil quality [10]
Tonne kilometres [9]	Climate change [10]
Rationalisation of private car use [9]	Land use [10]
Congestion [10, 11]	Consumption of energy [10]
Negative impact on industry [10]	
More balanced use of transport modes [10]	
No of private vehicles on the roads [9]	
Competitiveness	
European competitiveness [9]	
Long term economic performance [10]	
Competitiveness [10]	
Technology	
Logistics planning (road transport) [10]	
ICT standardisation [11]	
ICT interpretability [10]	
Increasing adoption of new technologies [10]	

Table 1 Economic, social and environmental listed in EU documents [9-11]

Main dimension	**Sub-dimension** (category)	**Elements** (metrics) – examples, more detailed definition required. Planned in next research stage
Economic [10, 11, 14]	**Quality** [26, 27]	Quality in logistics services (chains) [10, 11] Quality in logistics companies [11] Service quality across all transport modes [10] Quality of transport services [9] Customer service level [14, 28]
	Efficiency [10, 11, 29, 30]	Utilisation [9-12] Costs [3, 6, 10, 11, 14, 22, 24-27, 31, 32] Productivity [22, 25, 27] Financial results [19-21, 27, 33, 34] Process improvement [34]
	Competitiveness [9, 10]	European competitiveness [9] Long term economic performance [10] Flexibility [35-37] Customer related aspects [19-22, 27, 32-34, 38] Learning and innovation [19-21, 33]
Social [9-11, 14]	**Impact on health** [9, 10]	Accidents [9-11, 14] Road safety [9] Less stressful work [25] Risk of accidents [9]
	Impact on society [10]	Employment, new jobs creation [10, 11] No of employees who work in EU [3] % of production in EU [3] Training [9-11, 13]
	Noise emission [9-11]	
Environmental [9-11, 24]	**Pollutants emission** [9-11]	Co2 emission [9-14, 24] Other pollutants emissions [14]
	Resources utilisation [9-11]	Fuel consumption [13, 14, 23] Land use [10] Consumption of energy [10]
	Road traffic [9-11, 14]	Congestion [10-12] Fleet size reduction [25] No of lorries on the road [10] Km/per transport mode in relation to tonne-kilometres per mode [10, 11] Growth of modes in relation to each other [11] Vehicle kilometres [9, 12, 14, 24, 37] Tonne kilometres [9] More balanced use of transport modes [10] No of private vehicles on the roads [9] Reduce mileage [14]

Table 2 Dimensions, categories and examples of metrics for best practices assessment

Appendix I Economic benefits and measures – qualitative and quantitative

Qualitative	**Quantitative**		
Higher level of customer service [14] Improve customer service level [28] Increased flexibility (customers can order only the quantities what they need) [12] Improved service level [25] Increased operational flexibility [37] Reliability of forecasts [28] Potential access to wider customer base [12] Weekly conference call focusing on operational issues [39] Improved communication [39] More consistent approach to business planning [39] Clean data [7] Earlier warnings of anticipated supply problems [39] Better forecast accuracy [39] Product traceability [8] Track and trace visibility [24] Less stressful work for planners [25] Wastage information by depot [39]	**Based on costs** Payback period [23] Reduced transportation costs [14] Reduce total costs [14] Costs – personnel, financial, infrastructure, transport, inventory level, administration and management [6] Reduce lost sales [28] Reduced insurance premiums [14] Improve resale vehicle values [14] Reduce running costs (maintenance an tyres costs) [14] Reduce fuel costs [12, 14, 23] Reduce running costs (maintenance an tyres costs) (AEA Technology Lower cost per RCE [37] Cost savings from lower operating costs [12] Cost savings [24] People costs [3] Manufacturing costs [3] Distribution costs reduction [25]	**Based on customer** Returns/refusals by customers [40] Faster response to changes in fashion [3] Number of promotions [28] Reduced incorrect deliveries [25] Shorter lead time [3] Reduce the order cycle [28] Provide on-time an scheduled shipments [24] Accurate collections [24] Proof of delivery control [40] Improved time-keeping [14] [28] [40] Number of out-of-stock [28] Total process length (design to delivery) [3] Damage free shipments [24]	**Based on productivity** Reduce empty running [14, 40] Improve vehicle time utilisation [14, 24] Improved vehicle average utilisation per mile (%)[37] Greater efficiency in operation –savings in km/run, reduced no of tractors and trailers [14] Reduced km per pack [14] Reduce home delivery mileage [14] Reduce daily mileage [14] Total distance travelled (miles) [12, 14, 24, 37] Better vehicle productivity [14] Increased picking/lading productivity [14] Truck fill rate [14, 28, 30, 40] Pallet fill [28] Average of total journey run empty (%)[12] Average vehicle utilisation per mile (%)[12] Capacity utilisation [25] Productivity (% in regard of oil per km) [25] Minimize the inventory in the transit pipeline [24] Increase the number of stock turnovers [28] Drops per load [40] Minimum fill target (80%) [24] More efficient transport capacity [30] Reduced stockholding (%)[24] Stock rotation [28] Reduced in number of deliveries (%)[24]