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GREEN SUPPLY CHAIN MANAGEMENT IN HUNGARIAN AUTOMOTIVE OEMS' PRACTICE

Monika GÁBRIEL
Szent István University, Gödöllő, Hungary
gabriel.monika@gtk.szie.hu

Summary: Environmental issues get increasingly important, especially in industries with great environmental impact. Automotive industry is one of these, and in addition, its customers are increasingly environmental conscious. Automotive industry is also a good choice to research supply chain management topics, thanks to its outstanding level of SCM practice. The topic of this article is the green supply chain management practice in Hungarian automotive supply chains, combining the environmental and supply chain questions.
The aim of the paper is to analyse the green supply chain practice of Hungarian automotive OEMs (three car manufacturers and a truck manufacturer). For the analysis I performed a questionnaire survey, which included the topics of motivations and barriers of GSCM, the applied GSCM methods, cooperation in the supply chain and green performance. The results show the importance of GSCM in Hungarian automotive OEMs' operation, the most improved fields and the most popular methods of GSCM. We will see what are the strongest motivation towards green practices, and what improvements do the companies experience in their performance.

Keywords: supply chain management, green supply chain management, automotive industry, OEMs, Hungary

1. Introduction

The aim of the paper is to analyse the green supply chain practice of Hungarian automotive OEMs. The article is focused around three main questions:

- What motivates OEMs to use green supply chain management (GSCM) techniques?
- What kind of methods and techniques are used by OEMs and how developed are the separate fields of GSCM?
- What type of outcome do OEMs expect from GSCM, and what are the performance categories that companies monitor?

2. Green supply chain management – theoretical background

2.1 Green supply chain management principles, fields and methods

One of the main directions of green supply chain management research is the clarification of its fields of application, and the investigation of the applied management methods and techniques. I suggest to make a distinction between fields and principles, where fields are the green equivalents of supply chain activities within the company (purchasing, manufacturing, etc.), with a defined set of methods and techniques, while principles are general management methods that do not belong to any field of SCM (Gábriel 2013). **Principles** mentioned in the literature are cooperation with the other members of the supply chain, recycling, life cycle managment, organisational/management commitment and investment recovery (Dakov and Novkov 2008, Hsu and Hu 2008, Zhu et al. 2008, Eltayeb et al. 2011, Chan et al. 2012, Lin 2013).

The aim of **green design** (or eco-design) is the reduction of a product's environmental impact during its whole life cycle without compromising other essential product criteria, such as performance and cost (Eltayeb et al. 2011). In other words, green design means the design of products or services with certain environmental consciousness. Green design includes design of products for reduced consumption of hazardous materials, design of products for reuse, recycling or remanufacturing, and design of products for resource efficiency (Zhu et al. 2008, Eltayeb et al. 2011, Lin 2011).
The interpretation of **green purchasing** in the literature is quite coincident. The basic idea is decreasing the environmental impact caused by materials used in the products. This can be realised by the selection of appropriate materials and suppliers. Methods and techniques include demanding supplier certifications, environmental management systems (ISO14000, OHSAS18000, RoHS); supplier environmental auditing; establishing environmental requirements for purchased items; professional and financial support to the supplier to reach environmental objectives (Garcia Martinez et al. 2006, Chien and Shih 2007, Hsu and Hu 2008, Zhu et al. 2008, Ninlawan et al. 2010, Eltayeb et al. 2011, Chan et al. 2012, Chen et al. 2012).
The **green manufacturing** process shall use inputs with low environmental impact, work with high efficiency and generate the minimal amount of waste and pollution. The methodology of green manufacturing includes decreasing resource utilization; hazardous substance control; decreasing energy utilization by energy-efficient technologies and increasing the ratio of green energy; and ntegration of different forms of material reuse into the manufacturing process – disassembly, refurbishment, remanufacturing or recycling (Srivastava 2008, Ninlawan et al. 2010, Chen et al. 2012)).
According to Ninlawan et al. (2010) and Chan et al. (2012) **green distribution** consists of green packaging and green logistics. Green packaging involves downsizing of packages, use of „green" packaging materials, cooperating vendors to standardize packaging, minimizing material uses and time to unpack, adopting returnable package methods, promotion of recycling and reuse programs. Green transportation or green logistics means deliveries directly to the user's site, usage of alternative fuel vehicles, distribution in great batches and change to modal shift.
Two interpretations of **reverse logistics** can be found in literature. One group of researchers (e.g. Srivastava 2008, Eltayeb et al. 2011) view certain types of reuse activities (such as disassembly, refurbishment, remanufacturing and recycling) as part of manufacturing or as a separate set of activities. The other group (e.g. Beamon 1999, Ninlawan et al. 2010, Lin 2013) view them as part of reverse logistics. Although both views have arguments, if we interpret conceptions correctly, only real logistics activities should be considered as part of reverse logistics, which are collecting, inspection and sorting, pre-processing and location decisions and network design (Srivastava 2008).

2.2 Motivation

According to Bala et al. (2008) environmental supply chains emerge where environmental and supply chain pressures are synthesised. These pressures may come from multiple directions. The two external driving factors that are recognized by most researchers are regulations and pressures from stakeholders (Lin 2013, Kálmán 2002). Srivastava (2008) defines three sources of pressure: economical, regulatory and consumer. Kumar et al. (2012) breaks down economical and consumer pressures to smaller elements. Testa and Iraldo (2010) pointed out the importance of internal factors, such as strategy, values and targeted competitive advantages. According to Stevels (2002) the expected advantages of GSCM also function as motivators.

Managerial attitude as a barrier is mentioned by Beamon (2005) and Wooi and Zailani (2010). According to Côté et al (2008) small and partly medium-sized companies had problems with environmentally conscious operation due to lack of time, financial resources and doubts about the benefits of green policies.
Several attempts were made to organize the motivating factors and barriers. Green Business Network and National Environmental Education & Training Foundation (2001) separated primary and secondary motivations, and distinguished between internal and external ones in the primary group. Walker and Jones (2012) has widened the scope to the barriers of GSCM. My two-layered model of motivations and barriers expresses the difference between coercive and soft factors (first layer), while the second layer is about the internal/external and enabler/barrier manner of factors (Gábriel 2014).

2.3 Possible outcomes of applying GSCM

Environmental performance is considered as the most important result of GSCM, since this is the primary motivation for applying its techniques. Environmental performance is interpreted as the reduction of several negative environmental effects. The most often mentioned elements in the literature are: reduction of waste output and emission, smaller carbon footprint; reduction of material usage; reduction of usage of harmful materials; reduction of energy and water consumption; reduction of packaging materials usage; reduction of accidents and safety issues (Dey and Cheffi 2012, Eltayeb et al. 2011, Dos Santos et al. 2013, Kumar et al. 2012, Zhu et al. 2012, Beamon 1999).
The second most often mentioned effects are the ones on **economic performance**. Economic effects can be measured on company performance, primarily in the form of financial and market advantages or disadvantages. Authors define several positive effects, most of which are cost reductions (energy cost, direct materials cost due to less material used, waste disposal cost, fees and penalties) deductible from environmental effects, and the increase of revenues and market share (Kohlhéb and Illés 1999, Lin 2013, Dey and Cheffi 2012, Zhu et al. 2012, Eltayeb et al. 2011, Dos Santos et al. 2013). The strongest negative effects are caused by the large investment requirements of GSCM. The most important effects are the increasing investments and the increasing material costs (due to more expensive materials) (Lin 2013).
According to the most widely accepted interpretation of **operative performance,** these effects are basically economical ones, but their effect on the performance of the whole company is indirect. Operational performance elements mentioned most often in literature are improved product and service quality, improved flexibility, reduced inventory and high capacity utilization (Eltayeb et al. 2011, Dey and Cheffi 2012, Zhu et al. 2012).
Besides the performance categories above, Eltayeb et al. (2011) defines a fourth category, called **intangible outcomes**, which include growing customer satisfaction and loyalty, employee satisfaction, growing brand value, enhanced publicity and marketing opportunities, and better acceptance by local communities.

3. Materials and methods

The research is based on a questionnaire, involving three sections about different aspects of GSCM. The questions were prepared based on the literature. The aim of the **Motivation section** was to find and rank the factors that influence companies in applying GSCM. I have used the categories defined in Gábriel (2014). In **Green supply chain management section** I collected 27 GSCM methods, mentioned in the literature, grouped by type (principle or SCM field of activity). **Green supply chain performance section** explores the performance categories and indices measured by companies.

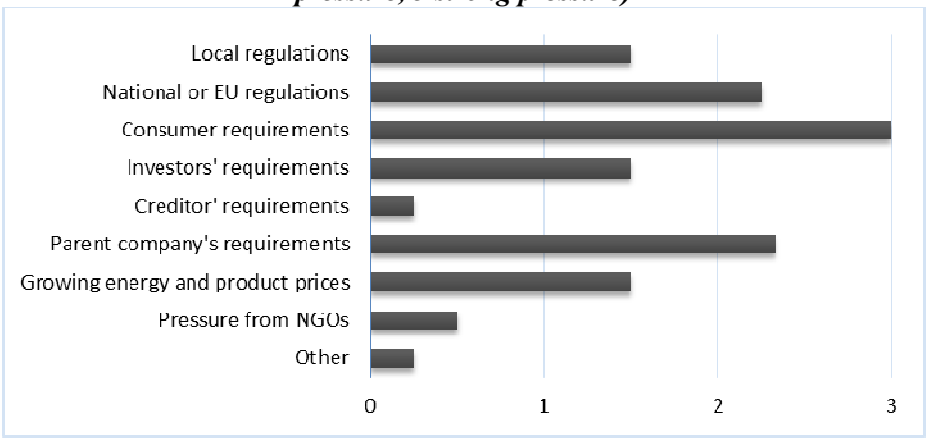
Three car manufacturers and one truck manufacturer, all operating in Hungary, were interviewed. This is 100% of OEMs in Hungarian car and truck manufacturing industry. The three car manufacturers are affiliates of global companies, while the truck manufacturer is owned by Hungarian shareholders.

4. Results

4.1 Motivation

Figure 1 shows the explicit pressure experienced by the companies from different external sources. The strongest pressure comes from consumers, parent companies (in the case of affiliates) and national or EU regulations.

Figure 1 Strength of coercive motivation factors (0 no pressure, 1 slight pressure, 2 moderate pressure, 3 strong pressure)



Source: own research

The strongest soft motivation factors for OEMs were the internal enablers. 6 out of 8 factors were rated at least moderate significance. The strongest motivators were the great environmental risk of core activity and management commitment. External enablers have weaker effect, the most important factor was potential subsidies for environmental development. Less than the half of the internal barriers mentioned in the literature turned out to be relevant for sample companies. The strongest factors were other (non-green) SCM priorities and cost-based strategy. Only 1 of 4 external barrier – pressure on prices – was rated over moderate significance.

4.2 GSCM activities

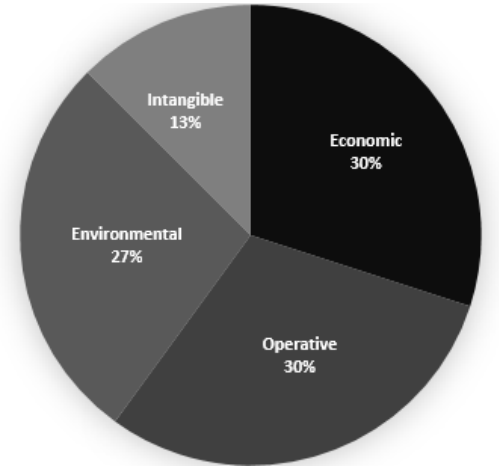
Green design activities (design for reduced consumption of hazardous materials, for reuse and for resource efficiency) are applied or being implemented by 75% of sample companies.
OEMs use a rich toolkit of **green purchasing**. All companies demand product testing reports and bill of materials from suppliers and provide them with design specifications. Demanding supplier certifications or environmental management system, replacing materials with environmentally less harmful ones, setting environmental requirements for purchasing items and demanding product content labelling at supplier are also popular techniques (3 out of 4 companies apply them). Supplier education in environmental topics, professional and financial support to the supplier and second tier supplier environmental evaluation are less used methods (1 or 2 OEMs performs them), but most companies plan or started to implement them.

Three methods of **green manufacturing** (decreasing resource utilization, decreasing energy utilization by energy-efficient technologies and hazardous substance control) are already implemented in 75% of the sample companies. The fourth method, integration of different forms of reuse into the manufacturing process is not yet applied but planned by all four OEMs.
Green logistics shows a heterogenous picture. Green distribution including distribution in great batches and change to modal shift is performed on a high level (applied or at least planned by all companies), while green packaging is applied by half of the companies. None of them performs or plans reverse logistics activities.

4.3 GSCM performance

Companies had to give weights to each performance category mentioned in the literature, the sum of weights was 100%. The results show that environmental performance is slightly less important for OEMs than economic and operative performance, while intangible outcomes are the lowest rated.
Out of **economic performance** indicators, reduction of direct materials cost and reduction of energy consumption cost are the most intensively monitored ones. In **operative performance** the reduction of operational costs, reduced inventory and high capacity utilization were in the top three.

Figure 2 Relative importance of GSCM performance categories



Source: own research

The most important **environmental performance** indicator was the reduction of waste output and emission (3 of 4 companies indicated this as most important). Reduction of material usage, reduction of energy consumption, reduction of usage of harmful materials and reduction of accidents and safety issues were mentioned by half of the companies. Growing customer satisfaction and loyalty, and growing brand value were considered as most important **intangible outcomes** by all companies.

5. Conclusions

Automotive OEMs in Hungary face both with regulatory and market pressure that motivate them to apply green methods in their supply chain processes. The fact that all Hungarian car manufacturers are affiliates of a global automotive company explains the strength of internal enablers, which are closely related to corporate strategy and corporate culture. The main barriers have economical reasons: high investment needs and cost pressure from consumers.

Since OEMs are responsible for product design, green design has probably the largest importance in this echelon of the supply chain. The results correspond with this assumption, as OEMs apply all green design methods. In automotive industry OEMs control the supply chain. This explains the large number and great intensity of green procurement activities. Setting up requirements for suppliers are the most popular methods that ensure that OEMs can purchase the environmentally proper materials and components. Supplier development is not common by now, but the answers suggest a tendency for it. Unlike in traditional supply chain management, automotive OEMs do not control the Tier2 suppliers from environmental aspect. Green manufacturing and green logistics is part of nearly all companies' practice, except for the forms of reuse and their logistics background.

Companies consider the outcomes with economic effect (economic and operative) the most important. Different types of cost reduction were chosen as most important performance indicators, which is in accordance with the intensive competition and price pressure in the industry. Regulatory pressure and growing consumer environmental awareness faced by the OEMs can explain the relatively high importance of environmental performance.

The results of this research are limited due to the small number of companies in the OEM category. Further investigations have to be made on the behaviour of other supply chain members, grouped by their role in the supply chain (Tier1, Tier2, etc.). Another research objective is to establish relationship between GSCM practice and GSCM performance.

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