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Strategic Initiatives for Sustainability Performance Improvement of Supply Chains: Best Practices from the German Market

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Abstract
Companies are being assessed not only for their sustainability performance and targets but also for the supply chain initiatives they implement in order to achieve sustainability improvement. Decision makers look for meaningful practices with huge sustainability performance improvement potential, in order to stake out a position of competitiveness and leadership, or just fulfil their customer's expectations. The aim of this paper is to present a series of innovative initiatives related to supply chain operations that contribute to sustainability performance improvement and provide an update on the implementation status from the industry side. For this purpose, a review of innovative initiatives that drastically contribute to sustainability performance improvement is conducted, based on literature review and on information from published reports of global companies that are considered from international rankings as some of the most sustainable in the world. Finally concrete cases from the German manufacturing, logistics and retail sector are presented. Key findings are interesting updates in the area of supply initiatives that contribute to GHG emissions reduction, waste reduction, cost reduction, but, also, to the people engagement and awareness, in an endeavour to increase the overall sustainability performance.

Keywords: initiatives, supply chain, sustainability, practices

JEL classifications: Q56, R41

Introduction

Sustainable development is the development that meets the requirements of the present without compromising the ability of future generations to fulfil their needs. Sustainability is the concept of robust future development in the ecological, economic and social dimension of human existence. These three pillars interact with each other and require a well-balanced long term coordination (Selinger & Khraisheh, 2012). Logistics and supply chain operations have direct impact on global economy. The product movement and the concepts of transportation, warehousing, order management and information systems enable the right

products to be in the right place in an efficient and effective manner. Additionally, the complexity of global supply chains stimulates companies to change their behaviour towards the environment and corporate social responsibility (Campos, et al., 2014). Thus, sustainable supply chain management could be defined as an integrated set of initiatives that consider the environmental impact of all stages across the entire value chain of a product and a multidisciplinary perspective that clusters the entire product life cycle (Gupta, 2011). Collins dictionary defines the term initiative "as an important act intended to solve a problem" and synonyms of the word are the terms "plan", "action", "measure", "strategy" and "practice". In this case, problem under question is the triple bottom line problem (Cetinkaya, et al., 2011). Strategic initiatives are the strategies implemented with intention to achieve three outcomes; (i) realization of important benefits to stakeholders, (ii) a boundary spanning vision, (iii) transformation of the organization (Githens, 2015).

According to a recent study (Handgield et al., 2013), held by BVL International, sustainability is one of the current and future trends of supply chain and logistics worldwide. Companies are continuously and increasingly being assessed, not only for their sustainability performance and targets but also for their supply chain initiatives they implement in order to achieve sustainability performance improvement. Corporate stakeholders and decision makers look for meaningful and aggressive sustainability practices in order to stake out a position of competiveness and, finally, leadership (McKinnon et al., 2014). According to KPMG survey published in 2013, almost 90% of the 250 biggest companies in the world publically report their sustainability figures and corporate social responsibility (Campos, et al., 2014). Within the logistics service provider sector this figure increased by 30% from 2011 to 2013.

The aim of this paper is to make a high-level connection between strategic supply chain initiatives and sustainability performance improvement and present innovative concepts and approaches. In particular, it aims to make a contribution by; (i) presenting a review of supply chain innovative initiatives that contribute to sustainability performance improvement (research topic 1), (ii) providing recent examples of sustainability initiatives from the German market and highlight the potential areas of vast opportunities of improvement (research topic 2).

Content analysis was used as major method for this scientific work. Content analysis is a set of manual or electronic assisted techniques for "contextualized interpretations of statements or reports produced for communication purposes, having as absolute target the creation of conclusions (Frzden, et al., 2015). In particular, the sustainability reports of 30 out-performed companies were analysed for supply chain initiatives that contribute to sustainability performance improvement (research topic 1). By using evaluation criteria, the most innovative practices from content perspective are presented as best practices and the impact to performance improvement is indicated.

The rest of the paper is structured as following: in chapter 2, a prior research review to the topic, restricted to years 2011-2015 is presented. In chapter 3, the context framework is set by defining sustainability performance measurements and relevant supply chain operations. Chapter 4 contains the research results. Initially, the review of strategic initiatives is presented. Secondly, this framework

is aligned with cases from the German market which could be considered as best practices. Finally, in chapter 5, some final thoughts are developed and a light for future research in the topic is shed.

Prior Research

In the recent years, sustainability initiatives became one of the main topics of research in the science of logistics and supply chain management. Major focus in literature from 2000-2010 was the practices description (Hick, 2000; Theyel, 2001; D. & Pohlen, 2001; Handfield, et al., 2002; Murphy & Poist, 2003; Rice, 2003; Cuthbertson & Piotrowicz, 2008) with limited references to strategic corporate initiatives (Holt & Ghobadian, 2009; Sarkis, et al., 2010). From 2011 onwards, the scientific focus is on what companies do towards sustainability, because, for most of them, year 2015, is considered as an interim milestone for their ambitious sustainability targets of 2020 (McKinnon & Pieryk, 2012).

Initiatives description: Cetinkaya, et al. (2011) describe practical ideas for moving towards sustainability best practices. In particular, a structured and coherent concept of sustainable supply chain strategy is developed considering a wide perspective, from pure performance monitoring to organisation management and sustainability risk management. Although Cetinkaya et al. (2011) believe that during the last years, co-operations provide a strong commitment towards sustainable supply chain management, Straube & Nagel (2011) highlight that companies are still in the beginning of sustainable strategies implementation in terms of improving resource efficiency in the area of logistics operations.

In the area of CO_2 reduction, a core element of sustainability science, the Freight Transport Association (UK, 2011) published practical tips for reducing carbon emissions such as the case of Ceva Logistics, which expanded the lifting deck fleet to reduce CO2 emissions. Indeed, the payload volume increase and the delivery frequency reduction was practically translated into less mileage, less fuel and finally less emissions. In the same area, Kingsbury, et al. (2012) presented a Cradle to Grave analysis for laundry detergent products of Unilever for emission reduction. Among others, they concluded that 35% of Greenhouse Gas emissions is emitted during consumer user phase. Thus, pilots in the area of consumer engagement were conducted by determining the amount of effective loads per bottle and then estimating the CO2 emitted per load, including additional determinants which the consumer can influence (water temperature, electricity consumption, laundry machine etc.). On the logistics sector, however, Liimatainen et al. (2012) conducted a survey in 295 logistics companies and draw the conclusion that hauliers are aware of possible efficiency actions but they lack the know-how and the resources to utilize them.

In the same area of eco-efficiency and CO2 emission reduction, McKinnon, et al. (2013) provided updated recommendations on how to improve the environmental sustainability of logistics. In particular, the strategies of restructuring logistics systems, outsourcing to greener providers, and developing operational solutions in transportation and warehouse operations were further justified by providing cases from UK retails sector, such as Asda and Tesco. Going beyond freight transportation and including social responsibility, ethics, risks and issues in supply chain, Grant, et al. (2013)

explained the sustainability dimension of freight and warehousing, product design and packaging, purchasing and procurement, reverse logistics and recycling. An example is the case study of Green Cargo which in 2003 increased revenues and reduced cost by cutting administrative expenses through operations centralisation and by operating a full load centre, achieving finally cost effectiveness, customer satisfaction and efficient fuel consumption.

From corporate side, various companies published concrete reports and recommendations as best practices for their industry. In "Delivering tomorrow" DHL report, the forward stocking, the packaging design, the efficient network design, the modal mix sourcing and the urban consolidation centre are considered as some of the most efficient and environmental friendly practices. On the other hand, DB Schenker moved to strategic partnerships with biofuel providers as part of their implemented initiatives to achieve CO_2 savings.

Performance Improvement: Cetinkaya, et al. (2011) indicated that the structure of the supply chain, the processes, the operations and enablers such as IT integration are the leavers for sustainability performance improvement and sustainability targets achievement. McKinnon, et al., (2011) indicated the CO2 savings from the implementation of technological developments of greener means of transport such as hybrid technology which can improve fuel efficiency by 50%, a finding which is proven by DHL (2013) and Volvo. Bertze & Barkawi (2013) measured the impact of technological approaches for a more efficient usage of energy and resources. For example, telematics can offer carbon savings up to 5-10% if connected online to a control stand, because consumption can be monitored permanently for each vehicle individually. A similar index with practices for CO2 savings was developed by Gregory & Wimmer (2011) with the support of Bundes Vereiningung Logistik (BVL) in Austria and it was updated in 2014 by indicating the performance improvement after the implementation of city logistics initiatives. Loulos (2014) summarized all these technological initiatives by creating an operational index. However, indexes like that should be carefully considered because it is not the technology itself that could create disruptances, but the underlying operational models (Braithwaithe & Christopher, 2015). Finally, Yang, et al. (2013) confirmed that internal green practices and external green collaboration have positive impacts on green performance, which, in turn, supports the firm competitiveness enhancement.

Important studies were released in the area of sustainability targets, which at the end, are driven by performance improvement (Decker, 2012). Wu & Pagell, (2011) examined trade-offs in performance and targets through explaining how organizations balance short term profitability and long term green performance when it comes to supply chain decisions under uncertainty. McKinnon & Piecyk (2012) presented a detailed typology of GHG target setting criteria such as reference, scope, pathway and commitment period criteria and demonstrated levers that can lead to target achievement through performance improvement. On the other side, Schatsky (2013) demonstrated that environmental target nature is similar to other corporate targets because they provide focus and they are a statement of commitment. Finally, Gouldson & Sullivan (2013) examined whether the commitments of companies in the supermarket sector of UK can be considered to be an appropriate response to the threat presented by the climate change and whether these targets are dependable and plausible. They concluded that corporate sustainability targets align with or may exceed the climate change policy goals being set by national governments.

Research Context

Supply Chain Components

During the previous years, numerous frameworks provided definitions for supply chain. Aim of this paper is not to dive into the details or how a supply chain can be defined. For reference purposes and for a common understanding, the study uses the supply chain framework of Chopra & Meindl (2009). According to this framework, key aspects of supply chain and drivers of performance are the transportation (modes, location, routes etc.), the facilities (central vs decentral warehousing and fill centres, capacity etc.), the inventory (cycle, safety, seasonal, product level), the information (IT), the sourcing (product and services procurement, outsourcing etc.) and the pricing (cost, pricing and economies of scale, bundling etc.).

Sustainability performance metrics

Cetinkaya et al. (2011) developed a framework for evaluation of supply chain sustainability performance. The framework was built upon the three main dimensions of sustainability, which are further sub-divided. This modular composition allows analysis in a flexible manner and can be used from both big and small companies, even in cases when accurate data are not available.
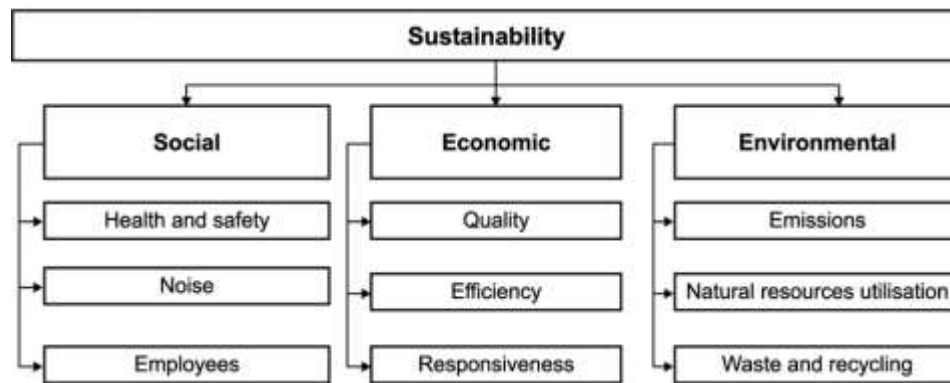

Figure 1: BestLog sustainability performance metrics framework

Economic performance is the pillar of company activities. Good economic performance increases the likelihood that certain processes or activities could continue and could be sustained. The quality of supply chain services and the customer satisfaction are key issues to generate long term profits (Darkow, 2013). Responsiveness metric describes how a company can respond to changing customer needs and could be measured with demand and supply measures which indicate the product or service availability along the supply chain (Cetinkaya, et al., 2011). Efficiency metric is about cutting costs and increase resource utilization (Chopra & Meindl, 2009).

The environmental group of metrics focuses on lowering the negative impact of the supply chain components to the natural environment. CO_2 emissions are considered to be not only in the centre of corporate sustainability strategy but also core strategic aspect of overall business activities. It is primarily related with the energy usage and overlaps the subcategory of natural resource utilization. Waste and recycling can be reflected by the amount of waste sent to landfill in relation the recycling quantity (McKinnon, et al., 2013).

Social dimension is still not commonly incorporated into performance measurement systems. Health and safety reflects the number and the type of working accidents. Noise is included into the social dimension, since it less important in industrial areas. Finally, employment could be reflected as the percentage of key staff turnover, the professional training and the position of women in management positions (Cetinkaya, et al., 2011).

Analysis

Research approach: Review of strategic initiatives that contribute towards sustainable supply chains

As it was briefly described in Chapter 1, the method of content analysis was used as major method for this scientific work. Content analysis is a set of manual or electronic assisted techniques for "contextualized interpretations of statements or reports produced for communication purposes, having as absolute target the creation of conclusions (Frzden, et al., 2015). Initially, thirty sustainability outperforming companies were selected. Criteria of selection process were their inclusion in the Dow Jones Sustainability Index or in the Newsweek Green Ranking by Newsweek Magazine, in year 2014. A complete list of the companies could be found in Table 1.

As a second step, the sustainability reports of these companies were analysed following the steps of value stream analysis methodology "create, cluster and condense" (Erlach, 2013). After the initiative identification (similar to "create" phase), the initiatives were clustered and condensed in separate sub-categories. With this way, it was easy to identify between common and innovative methods. The complete list of the condensed practices is shown in Table 2. The first column shows the initiative description and the second column differentiate the strategic initiatives from operational initiatives. The criteria of differentiation are the realization of important benefits to stakeholders, a boundary spanning vision and the transformation of the organization. For personal bias avoidance, a group of experts including one strategy manager from manufacturing industry, two consultants, 2 scientific researchers and 4 master students from TU Berlin contributed with their insights for this classification. Column three shows the relevance for the sample of the companies. As it is not the purpose of this paper to provide relevant literature review for the initiatives, an exemplary reference is given in column three.

As a third step, the most innovative practices were identified. The identification process was conducted in two phases. In the first phase the following criteria of innovation evaluation, proposed initially by Tidd & Bessant (2009), were used: (i) superiority, (ii) early and sharp concept definition and (iii) novelty. In the second phase, the same group of experts evaluated all the initiatives in a daily workshop which took place in March 2014 in Berlin. The group concluded that 9 initiatives fulfilled all three criteria and further clustered them into the following categories: (i) supply chain technology and IT, (ii) supply chain processes, and (iii) supply chain structure. Figure 2 shows a list of innovative strategic supply chain initiatives that during the evaluation phase fulfilled the criteria of superiority, early and sharp concept definition and novelty. "Supply chain technology" group clusters the following strategic initiatives: eco-facilities, integration of the internet of the things and

innovative developments for transport operations. "Supply chain processes" group clusters the following initiatives: e-freight processes, controlling processes and safety consulting processes. Finally, "supply chain structure" group clusters the following strategic initiatives: sustainable network design, modal shift and operations interconnection.

Table 1: List of studied companies

Sector	Companies
FMCG	Henkel, Unilever, P&G, Tcibo, L'Oreal, Nestle
Manufacturing	Roche, BASF, BMW, Akzonobel, Adidas, Daimler, HP, Linde, Dell, VW, MAN, Lanxness
Retail	Marks and Spencer, Woolworth, Tesco, Alnatura,
Logistics Service Providers (LSP)	KLM-Air France, Schenker DB, DHL, Fedex, Lufthansa Royal Mail, TNT, Schachinger Logistik

Table 2: Condensed list of identified initiatives

Initiative	Classification	Company related	Reference
Innovative developments for transport operations (in-house and out-tasking	Strategic	Woolworth, Marks & Spencer, KLM, HP, DHL, Schenker DB	(DHL, 2013), (Liimatainen et al., 2012)
Efficient intra-logistics	Strategic	Unilever, Tcibo	(Richards, 2011)
Increase safety transport of hazardous materials	Operational	Adidas, BASF,	(Grant, et al., 2013)
Eco-facilities	Strategic	Daimler, Marks & Spencer, Tcibo, Schachinger Logistik	(BVL, 2014)
Product life cycle assessment	Operational	Henkel	(Rushton, et al., 2014)
Use of recyclable and reusable packaging/ containers	Operational	Henkel, Roche, Woolworth, Marks & Spencer, Adidas	(Grant, et al., 2013)
Increase vehicle utilization	Operational	BMW,	(Aronsson & Brodin, 2006)
Efficient inventory management	Operational	Coca Cola, Nestle,	(Aronsson & Brodin, 2006; Metro Vancouver, 2011)
Integration of internet of the things	Strategic	DHL	(Marr, 2015)
Modal shift	Strategic	Unilever, P&G, BASF	(McKinnon, et al., 2013)
Track & Trace solutions for efficient product movement	Operational	BASF	(van Dorp, 2002)
E-freight	Strategic	Lufthansa	(IATA, 2010)
Vertical and horizontal collaboration within supply chain	Strategic	Unilever, Henkel,	(McKinnon, 2010)
Inclusion of code of conduct in procurement contracts	Strategic	Lanxess	(Walker & Brammer, 2009)
Participation or implementation of closed loop schemes/ adoption of reverse logistics strategies/ reduce waste	Operational	Unilever, P&G, Roche, Marks & Spencer, AkzoNobel, KLM, HP, Adidas	(Richards, 2011)

Suppliers education	Strategic	Adidas	(Giannakis, 2011)
Sustainable network optimization	Strategic	P&G, Henkel	(Eskandarpour, et al., 2015)
Safety consulting	Strategic	P&G, Henkel, Roche, Woolworth, BASF, AkzoNobel, KLM,	(Cetinkaya, et al., 2011)
Sustainability controlling	Strategic	DB Schenker, Lanxness	(BVL, 2014)
Eco-driving training	Strategic	Unilever, AkzoNobel, Linde AG, DHL,	(Liimatainen et al., 2012)

Research results: Best practices from the German market

Germany is the largest national economy in Europe, the fourth largest by nominal GDP in the world and the fifth by GDP (PP). In 2014 Germany recorded the highest surplus in the world worth $285 billion, making it the biggest capital exporter globally (Welt, 2015). The country was selected as baseline for best practice selection as it is a manufacturing and logistics leader in Europe. From the sample of selected companies, the following companies have their headquarters in Germany: Henkel, Tcibo, BASF, BMW, Daimler, Linde, VW, Lanxness, Alnature, Schenker DB and Lufthansa.
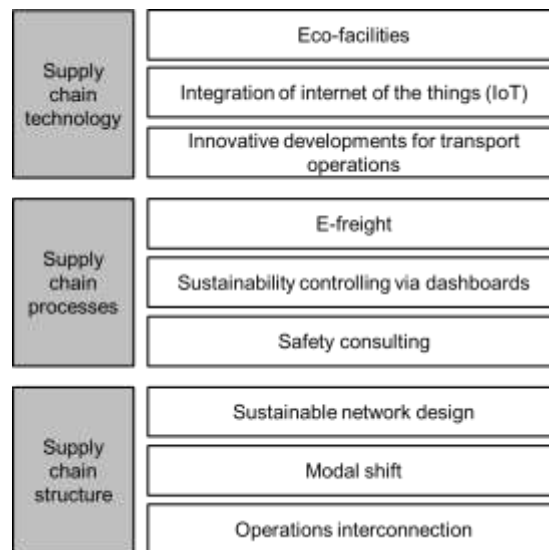

Figure 2: Innovative strategic initiatives towards sustainability

Supply chain technology initiatives
Eco-facilities: Typical examples of facilities that could be found at almost all stages along the supply chain are the warehouses and the fulfilment centres. Interventions that could lead towards an eco-warehouse are the heating and cooling, which according to Ten-Hompel (2011) counts for 35% of the energy consumption, lighting (15%) and intralogistics. An example of eco-warehouse is the one of the German LSP Schachinger Logistik, which won the Green Blue Award in 2013. By maximizing utilization of the building height, customized isle widths and optimal screening of the pallet heights, intra-logistics processes are optimized. Moreover, energy efficiency practices such as supply of 65% self-energy production (25% from photovoltaic and 75% through heat pumps) and 35% from green electricity providers, LED lighting with natural roof lights, controlled ventilation and venting, concrete poor

in CO_2 and environmental friendly materials such as domestic wood and silver fir offer very low overall CO_2 emissions (Schachinger, 2014). The German retailer Alnatura owns the world's largest wooden high-bay warehouse. Made completely of 5,000 cubic meters of wood, the high-bay warehouse highlights the topic of sustainability in logistics in an unprecedented manner and meets the latest ecological standards. Thanks to prime insulation and a ground floor that is 2.50 meters below the ground, the new facility does not even need heating or cooling, and is thus carbon-emission free. Eco-electricity, green areas and rainwater aquifer areas combine to create a great eco-balance. Thus, performance in terms of emissions and resources utilisation is highly affected (Alnatura, 2014).

Integration of internet of the things (IoT): Internet of the things or IoT encompasses a diverse array of different technologies including wireless, mesh network wide area connections as well as wired connections. IoT includes consumer oriented devices, applications and embedded technology. IoT connects objects, people and intangible things such as information. DHL, the leading German logistics service provider recently implemented initiatives around the IoT concept. First example is the Track and Trace (T&T) initiative combined with the Smart Sensor. T&T monitors the location and condition and provide transport visibility and security. The SmartSensor can monitor temperature and humidity, while also indicating shock and light events, to ensure complete integrity during transportation. This initiative further contributes to safety, noise and efficiency. Another example is the DHL Resilience360 for supply chain risk management. This tool provides a multi-tire visualisation of the end-to-end supply chain and checks any disruption on a global scale in terms of effects on key trade lines. In future, Resilience360 could integrate all the data transmitted from assets and warn when a track carrying an urgent cargo is about to break or when a warehouse is in danger of fire. Thus, safety, quality and efficiency could be improved (DHL, 2015).

Innovative vehicle developments: One of the most famous initiatives in terms of vehicle developments is the GoGreen program of DHL. GoGreen is based on two fundamental underlying pillars: Burn less and burn clean. Burn less relevant initiatives from DHL are the aerodynamic optimisation, the change of motors with more environmental friendly, the usage of telematics and the usage of hybrid electric cars. Burn clean relevant initiatives are the usage of alternative fuels and the usage of green electric cars. With the implementation of these initiatives, DHL targets to decrease its CO_2 emissions by 30% until 2020 (DHL, 2013).

Supply chain processes initiatives
E-freight: E-freight is an initiative introduced from IATA and aims to take out the familiar paper documents that have been used in the air cargo industry from the entire logistics chain and replace them with standardised electronic messages and regulated data exchange. Lufthansa cargo already implemented these initiative and managed to decrease the overall process cost which is estimated in 1 Euro per document. Moreover, e-cargo helped Lufthansa to become more efficient by lowering the administrative burden due to less documentation and save time up to 80% for the required data storage and up to 50% for documents handling. The initiative further improved quality due to errors elimination as a result of manual entries and duplicates avoidance. Finally, e-cargo protects the environment because it lowers

the CO_2 emissions for tree cutting plus paper production and it reduces the generated waste up to 7800 tonnes per year.

Controlling: Transparency and emission measurement is important for target setting. DB Schenker developed the Eco-transist tool which calculates the emissions of all means of transport. Moreover, the tool provides alternative options for decision making in terms of route optimization and means of transport selection. DB not only uses this tool for their own internal processes but with the initiative Eco-transparency they use it to evaluate the carriers and the subcontractors and to offer consulting to customers with the target to offer solutions with low CO_2 emissions (Lufthansa, 2015).

On the same direction, Lanxess, a chemical manufacturer, developed with Bayer Business services the CO2 Monitor Dashboard, which allows the comparison between two potential sites (shared distribution centres or warehouses) in terms of CO2 efficiency considering as main criteria routes and means of transport. This tool helped them to come up with a logistics concept in terms of network design with rapid cycle times which can handle 20,000 containers and 270.000 tons of freight per year (BVL, 2014).

Safety consulting: To promote even greater safety awareness, to provide all employees throughout the world with a network platform for exchanging experience of best practice examples and minimize risks, many companies launch global safety initiatives in terms of employees consulting. BASF, the leading chemical company in in 2008 launched the initiative ''Safety first". BASF conducted workshops on transportation and warehouse safety in various facilities in Germany, US, Mombasa, Kenya, and Tema, Ghana, in 2013 as part of a cooperation project of the United Nations Environment Program and the International Council of Chemical Association. The main goal is the conduction of risk assessment for the transportation of raw materials with high hazard potential. In 2013, for example, they carried out risk assessments for the combined road and rail transport of chlorine in Italy as well as for the transport of propylene oxide in India (BASF, 2014).

Supply chain structure initiatives
Sustainable network design: Cornerstones for a sustainable network design are the route optimization and strategic warehouse location. In order to optimize the pallet movement and eliminate transports, Henkel, the consuming good manufacturer, created a customer service centre in their main factories in Düsseldorf and placed there their pallet supplier Chep. The initial distance between Chep and Henkel production was 59 km and before the customer centre initiative, resulting in total distance of 800.000 km per annum for all the trucks. With this initiative, the distance between Chep and Henkel was eliminated into 0 km, and the total transported distance was reduced to 650.000 km per annum, resulting in 27% less CO2 emissions (Wittig & Adamczyk, 2013).

Modal shift: The modal shift initiative is one of the most discussed strategies in literature. However, interesting concepts were implemented during the previous years from various companies such as Tcibo, a big Fast Moving Consuming Goods (FMCG) company which was rewarded in 2013 with the Bundesregierung Customer Social Responsibility (CSR) award. Two of the main products of Tcibo are tea and coffee; for the raw material import operations Tcibo uses sea freight means of transport instead of airfreight. Moreover, Tcibo management improved significantly the precise planning of import flows

by fully utilizing the filling of the containers and by connecting the central warehouse in Bremen to the Neustadt port. Finally, most of the products that leave the warehouses in Bremen and Hamburg they are transport either with rail or with barging services (BVL, 2014).

Operations interconnection: A best practice example for operations interconnection could be considered the Verbund concept of BASF, the chemical manufacturer. The strategy includes increase of energy efficiency and resource consumption reduction in the whole value chain in a cost-effective manner. The Verbund concept enables BASF to add value as a whole company through efficient use of resources. The Verbund system creates efficient value chains that extend from basic chemicals right through to high-value-added products such as coatings and crop protection agents. In addition, the by-products of one plant can be used as the starting materials of another. In this system, chemical operations consume less energy, produce higher product yields and conserve resources. In that manner, BASF saves on raw materials and energy, minimize emissions, cut logistics costs and exploit synergies (BASF, 2014).

Conclusions

The previous analysis provided concrete answers to both two research topics. In particular after assessing sustainability outperformers, it was proved that the strategic initiatives belong to the areas of technology, processes and structure. In fact, technology needs to go hand in hand with appropriate business models which could be expressed via differentiated supply chain processes and structures. These levers of sustainability as a combination could improve various metrics as it is shown in Figure 3.

Apart from the contribution to the research topics, interesting findings are the following: (i) Sustainability outperformers adapt both strategic and operational initiatives in an endeavour to improve their sustainability performance, (ii) Innovative strategic initiatives from the German market that contribute towards sustainability are in the areas of emissions, efficiency and resource consumption. As regards the former, strategic and operational initiatives are part of an overall strategic roadmap which aims to lead to sustainability targets achievement. For most of companies, reference years are 2020 and 2025 and 2015 is considered as intermediate year.

For resource consumption and emissions, key issue is the top down European legislation and the European GHG targets. In the light of climate change, and in pressure of initiatives such as the Kyoto Protocol or the EU climate and energy package, governments or international organizations set overambitious targets for cutting Green House Gas (GHG) emissions by 60-80% by 2050, towards a 1990 baseline. In particular, the new White Paper for European Transport launched by European Commission sets the target to reduce 60% of GHG emissions by 2050 from 1990 baseline and 20% reduction by 2030 from 2008 baseline (Liimatainen, et al., 2012). This forces German companies to align their sustainability performance with the overall European targets.

Cluster	Strategic Initiative	Best practices	Performance metrics		
Supply chain technology	Eco-facilities	Schachinger Logistik & Alnatura	Resource Consumption	Efficiency	Emissions
	Integration of internet of the things (IoT)	DHL	Safety	Efficiency	Effectiveness
	Innovative developments for transport operations	DHL	Emissions	Resource consumption	
Supply chain processes	E-freight	Lufthansa	Efficiency	Emissions	Resource Consumption & Waste
	Sustainability controlling via dashboards	Lanxness & DB Schenker	Resource Consumption	Emissions	Responsiveness
	Safety consulting	BASF	Safety		
Supply chain structure	Sustainable network design	Henkel	Efficiency	Emissions	
	Modal shift	Tcibo	Emissions	Emissions	
	Operations interconnection	BASF	Efficiency	Emissions	Resource consumption

Figure 3: Impact indication of initiatives into sustainability performance metrics

On the other side, beyond the operational practices in warehousing and transportation, Industry 4.0 initiatives such as IoT and big data analytics could offer data transparency not only for an educated decision making but also for operations optimization and could drive the business towards sustainable solution. More specifically, it is not easy to be generic and provide an index of numerical benefits or savings of these initiatives. Indeed, the benefits are different from case to case and they usually arise through a bottom up analysis of different factors such as quantification of initiatives, corporate capabilities and future investments. Remarkable is that there were no innovative initiatives identified for employees' metrics. Companies still focus on crucial traditional topics such as women in management position, diversity and equal opportunities. External pressure to companies involving more women in logistics activities is becoming more intensive every year. Past studies proved that, globally, women were involved in senior management positions in a rate of 24% (Grant Thornton, 2013) whereas in logistics industry this rate is reduced to 23% (The women foundation, 2013). The forces of pressure are basically two: initiatives for promoting women in senior management positions and business ethics for equal opportunities (Grant Thornton, 2013).

Overall, it could be said that most of the strategic initiatives for performance improvement of sustainable supply chains arise from the various corporate sustainability targets. What would make sense for future research is to study how companies operating in different markets set their sustainability targets related to supply chain operations and what strategic roadmaps do they follow towards sustainability target achievement.

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