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Sustainable Distribution in the Consumer Goods Supply Chain

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Sustainable Distribution in the Consumer Goods Supply Chain

Juliana Kucht Campos and Dustin Schoeder

Sustainability in logistics and efforts to increase economic gains while managing the impact on the environment and on society have been discussed in all spheres of companies' decision-making processes. Especially in the consumer goods industry, customers' pressures are becoming more intense, not only related to product stewardship but also to supply chain responsibility. This paper intends to discuss how companies have been preparing themselves or reacting to these new demands. Using the content analysis method, practices published in public reports and implemented by top ranked sustainable companies were collected and analyzed. The practices were structured according to a newly developed framework for sustainable supply chains and are focused on distribution activities. These activities account for a large percentage of companies' carbon footprint and therefore offer ample opportunity for improvements in sustainability. The results show that the bulk of companies' investments related to sustainability is in Equipment and Vehicles technologies, especially battery electric vehicles. To understand more about this new trend, a survey was conducted with 33 companies from different industries in order to detect business users' profiles as well as their technical characteristics. The paper's results include insights about the challenges and opportunities in the consumer goods industry towards a sustainable supply chain network.

Keywords: Sustainability, Supply Chain, Consumer Goods, Electric Vehicles

1 Sustainable Distribution Practices

The impact of the distribution of goods on the environment and on society is a topic well discussed and with growing research interest. The distribution of goods affects local air quality, generates noise and vibration, causes accidents and significantly contributes to global warming. Transport's share in global greenhouse gas emissions in 2000 had reached 14% (Stern, 2007, p.171) and continues to grow. Due to the growth of e-commerce, globalization and customers' demands, the amount of freight transport is growing substantially. Actions related to distribution activities offer strategic opportunities to decrease companies' carbon footprint, overall costs and negative impact on people's lives. According to a framework developed by Juliana Campos from the logistics department of the Technische Universität Berlin (still not published), practices related to distribution can be clustered in four groups: structure and network, modes of transport, distribution processes and equipment and vehicles (E&V). The focus of the present paper is on E&V related practices, the most cited practice within the selected companies. In other words, the paper explores how members of consumer goods supply chains use E&V improvements towards a more sustainable distribution.

According to the United States Department of Energy, two-thirds of future fuel efficiency gains will come from improvements in engine and exhaust systems (McKinnon, Browne and Whiteing, 2010, p.142). More efficient vehicles such as those complying with EURO emission standard are becoming more commonly used, especially in commercial transport. Metro Group declared that 95% of their trucks are EURO 5. Increasing efficiency also includes the use of less dense material in the chassis (Liimatainen, Stenholm,

Tapio and McKinnon, 2012, p.836). The use of aluminum instead of steel, for example, can cut up to 3000kgs of the tare/empty weight of the truck. This is a good solution when the problem is weight rather than space. Benefits include fuel savings and, consequently, reductions in the amount of emissions (McKinnon, Browne and Whiteing, 2010, 142). Efforts to increase vehicle capacity include the use of "mega trucks" that offers efficiency gains on the main haul (Gross et al., 2013, p.45). Among the various social impacts, infrastructure damage, additional congestion and an increased risk of accidents are highlighted on the literature (Grant, Trautrim and Wong, 2013, p.69). Regenerative braking, aerodynamics accessories and "next generation tires", which can raise fuel efficiency by 3.5-8%, offer additional improvements (Schönberger, Galvez-Martos and Styles, 2013, p.279). As for logistics service providers (LSPs), electric mobile powertrains in particular have a large potential to cut GHG emissions in transportation. Despite the current moderate level of development of this technology, various companies have already implemented electric vehicles, electric trucks and container stackers as part of their sustainability initiatives. By implementing this technology, they reduce their carbon footprint and at the same time meet customer's demand for more sustainable and eco-friendly logistics services. Furthermore, using electric vehicles is viewed as an approach to diversification, particularly in urban distribution (Smart e-User project, 2015a). Tightening regulations with regard to emissions or access permissions of city centers further spur the utilization of electric vehicles in order to serve customers in these urban areas. A major challenge with regard to electric vehicle adoption though is, that for most logistics companies their own user profile of a vehicle applied in urban distribution is still unknown.

2 Methodologies

In attempt to research how companies are using E&V improvements towards a more sustainable distribution, two methodologies were applied. First, to collect data about companies current practices related to E&V, content analysis was used. This included initiatives, practices, actions, programs or strategies recently implemented by two from the consumer goods industry, one from the retail sector (table 1) and six companies from the transportation and logistics industry (table 2). This method typically allows researchers to systematically evaluate and synthesize texts with a large number of words into smaller categories (Weber, 1990, p.37). The use of Corporate Sustainability Reports as source of information is a common practice in the research community (Bowers, 2010, p.253; Tate, Ellram and Kirchoff, 2010, p.21-22) and was one of the most relevant sources for this paper. Corporate Sustainability Reports constitute a freely available source of information that includes detailed information about environmental, social and economic strategies planned or implemented by the company. It also includes other important data related to targets, goals, mission statement, policies, programs and projects. Additionally, websites, case studies and other reports published by these companies were analyzed. All companies selected for this research were listed on the Newsweek Green Ranking 2012 or 2014 with the rationale that they represent some of the benchmarks in their industries.

Table 1 Researched Companies – Consumer Goods manufacturers and Retailer

Company	Industry Domain
Adidas (Adidas Group, 2014)	Consumer Goods
Beiersdorf (Beiersdorf, 2013)	Consumer Goods
Metro Group (Metro Group, 2013)	Retail

Table 2 Researched Companies - Logistics Service Providers

Company	Industry Domain
Deutsche Post DHL (DHL) (Deutsche Post DHL, 2013)	Transport and Logistics
FedEx (FedEx, 2013)	Transport and Logistics
Norfolk Southern (NS) (Norfolk Southern, 2013)	Transport and Logistics
Union Pacific (UP) (Union Pacific, 2014)	Transport and Logistics
United Parcel Service (UPS) (UPS, 2013)	Transport and Logistics
CSX (CSX, 2013)	Transport and Logistics

Table 3 Traffic volume by industry sector in urban distribution in Berlin

Industry Sector	Share of traffic volume caused by commercial transportation	Share of traffic volume caused by business passenger transportation
Health/Social Sector	-	6%
Construction Industry	26%	28%
Retail	16%	13%
Other Professional/Scientific Services	-	15%
Transportation and Warehousing	21%	.
Other Commercial Services	7%	7%
Manufact. Industry	7%	7%
Sum of all recorded km per year in 1'000	160'527	486'609

The second methodology used to study the use of battery electric vehicles consisted of an online survey with various companies in Berlin. According to the KID 2010 study, 70% of the overall volume of traffic in urban commercial transport in the city of Berlin is centralized in some industry sectors (DLR, 2012). The details are in Table 3.

Furthermore, in order to evaluate existing user profiles in urban distribution, over 120 companies in the Berlin area were contacted. 33 companies participated in the study, equaling a return rate of 27,5%. By means of a questionnaire containing 56 questions, participants were asked to specify their fleet structure, ownership of vehicles, touring development behavior, touring patterns, including e.g. average route, longest route, average number and length of stops etc., shift patterns, and user expectation towards electric vehicles.

Table 4 Researched Companies – Consumer Goods manufacturers and Retailer

Industry Sector	Number of Participating Companies
Health and Social Sector	5
Construction Industry	3
Retail	1
Manufacturing Industry	1

Industry Sector	Number of Participating Companies
Other Professional and Scientific Services	4
Other Commercial Services	6
Other Commercial Services	6
Sum	33

3 Findings – Practices Implemented by Companies

Among all the possible implemented practices in attempt to improve supply chain sustainability, some interesting examples were found within the selected companies' experience. In a first sight, it was clear the difference between manufacturers, retailers and LSPs. When implementing new technologies in E&V, most of the initiatives and investments come from the transport and logistics industry. Metro, representing the retail industry, seems to use some electric vehicles still as a pilot test. And lastly, manufacturers seem not to be involved at all in this topic (at least they haven't published about it). Since most of the distribution activities involving E&V from Adidas and Beiersdorf are outsourced, this result is not a surprise. It was expected, though, their involvement with collaborative initiatives with

LSPs, as well as the publication of this holistic approach regarding supply chain sustainability.

In a detailed research about companies efforts related to E&V, good examples are highlighted. The most common practice found within the researched companies is the use of alternative fuels. DHL (Deutsche Post DHL, 2013, p.65) and UPS (UPS, 2013, p.12-14) intensified investments in natural gas vehicles. UP (Union Pacific, 2014, p. 39) is evaluating not only liquefied natural gas (LNG) but also bio-diesel, propane and hydrogen. They pride themselves in being the only major railroad company worldwide with extensive gas turbine experience, having made its first investments in gas turbine-electric locomotives in 1952. NS (Norfolk Southern, 2012) highlights the use of 100 percent renewable diesel fuel at a rail terminal in Mississippi.

This research showed that the most widely used alternative energy source are battery electric vehicles (BEV). Use of a battery-operated switcher locomotive has been tested by NS since 2009 (Norfolk Southern, 2014). The company, along with other logistics service providers such as DHL (Deutsche Post DHL, 2013, p.65-66), UPS (UPS, 2013, p.14) are investing in this kind of vehicle.

Retailers seem to follow the same path as Metro Group invests in vehicles and charging stations (Metro Group, 2013, p.81). By doing so, they aim to reduce the carbon footprint and meet the demand of a growing number of clients. Interviews from DHL stated that BEV are ideal for frequent stops and starts - precisely like they occur in urban distribution. Investments in BEV are steadily increasing. Currently, FedEx employs more than 118 BEV

and additionally Zero Emission Electric Tricycles, used for package deliveries and collections in Paris (FedEx, 2015). FedEx (FedEx, 2013, p.9-19) and UPS (UPS, 2013, p.14) also invest in hybrid-electric vehicles. As part of the DHL project “CO₂ free delivery in Bonn”, the company plans to use 141 BEV in Bonn (DHL, 2015). In other cities in Germany, the company is testing and evaluating the exact user profile for BEV within urban mail, parcel and courier distribution.

Other companies, such as Meyer & Meyer, are currently applying battery electric trucks (7.5 to 12 tons) in their deliveries, despite the fact that these types of vehicles are not available in the market yet. Because of this lack of availability of electric trucks in the market, companies are investing in collaborative initiatives. Meyer & Meyer, for instance, has constructed a prototype vehicle - in association with Fraunhofer – in order to assess the usability of these trucks in the day-to-day business (Nanu project, 2015). The motivation for all these logistics companies to use BEV – apart from the increasing demand of their clients – are the opportunities for cost reduction and risk diversification (Smart e-User project, 2015b; a). According to DHL, the cost reduction potential is one major driver. This is because BEV have significantly lower operational costs than conventional vehicles with an internal combustion engine (ICE). A second important driver for the utilization of BEV is risk reduction. In light of tightening CO₂ and emission regulations in urban areas, logistics companies – and Courier Express Parcels (CEP) companies in particular – are using BEV in order to keep their business model working, even if major European cities start restricting access to city centers for ICE-vehicles either entirely or during certain time. How-

ever, one major challenge of all companies applying BEV in urban distribution is to figure out how to integrate vehicles with this new technology into existing logistics structures and processes.

Besides classic logistics companies and CEP-companies, other logistics related organizations, such as port and airport operators, have also begun using electric vehicles. For instance, the port of Long Beach, the Westhafen city port in Berlin, Stuttgart Airport and the port of Hamburg are using electric-powered reach stackers and container tractors at their sites (KV-E-Chain project, 2015; Port of Long Beach, 2015; Fairport STR, 2015). Their primary reason is to reduce pollution at port sites. In these cases, the new technology of electric mobility is exclusively applied to reduce emissions and the local CO₂ footprint. Similar reasons apply for the use of electric powered aircraft tugs, for instance at Stuttgart airport.

As previously identified, the use of BEV is increasing and it is the most cited initiative, implemented especially by LSPs and retailers, in order to decrease costs and emissions in logistics-related activities. Nevertheless, the current user profile of these vehicles is still largely unknown and is being researched worldwide. In an attempt to obtain a better image of these profiles, the mentioned survey was conducted to identify some technical characteristics from each of them. This information allows companies to better understand differences between industry sectors and user profiles, as well as opportunities and challenges when planning or implementing this technological trend. Results are presented in the next section.

Another finding from the content analysis pertains to consumer goods manufacturers. A review of Adidas and Beiersdorf reports and public documents did not reveal any concrete initiatives related to E&V. Both Adidas

and Beiersdorf state as their policy and targety to minimize emissions derived from transport but both seem not to integrate outsourced LSPs solutions, such as BEV use, in their own sustainability reports.

Adidas is listed as a supporter in an initiative, launched in 2011 that aims to support the mass-market deployment of clean vehicles in the northeast and mid-Atlantic states of United States. However, until now, no further information was published involving Adidas employment of these kind of vehicles (Transportation & Climate Initiative, 2015).

Beiersdorf introduced in 2013 a Green Car Policy in some countries but this applies only for employees transport (Beiersdorf, 2015). In late 2012, Beiersdorf SpA, joined eMilan project and installed an electric vehicle recharge point at its Milan offices (eMobility News - Bosch Italy, 2012). Details are not evident about how this rechaging point is used, although it is not expected to be used for recharging their trucks. Regarding freight transport, the company seems to focus on practices to optimize container loading, truck capacity utilization, transport routes and other logistics processes. In Spain, for instance, collaboration with other manufacturers allow shipments combining to the same 'ship-to' address. According to the company's website, since June 2012 truck usage has dropped by 27% and CO₂ emissions have been reduced by 32% (Beiersdorf, 2015). Other initiatives implemented with LSPs include investments in tools to measure their Europe-wide CO₂ emissions from transport and warehouses. This initiative is aligned with their membership in 'Green Freight Europe', an independent voluntary program in Europe for improving environmental performance of road freight transport (Green Freight Europe, 2015). This initiative provides a platform

for reporting CO₂ emissions and standards for the monitoring process. Collaborative initiatives from Beiersdorf seem to aim more at logistics processes optimization and information sharing/controlling than investments in E&V from their business partners. Other initiatives implemented by LSPs involve reducing the rolling and wind resistance of vehicles. DHL, NS and UP are among them. DHL, for instance, established a partnership with Fujitsu to discuss alternatives to reduce the environmental impacts of their client's logistics operations is the use of more efficient tires by transport partners (Deutsche Post DHL, 2014). NS equipped 100 percent of all railcar wheels with low-torque roller bearings. Estimations are fuel savings of 1 to 2 percent over the older bearings they replace (Norfolk Southern, 2013, p. 24). UP is testing train cars with premium low friction bearing seals that reduce torque, contributing to energy savings (Union Pacific, 2014, p.40).

An innovation being tested by FedEx involves developing and installing aerodynamic-shaped plastic, fiberglass and metal fairings to reduce wind resistance and air turbulence. Consequences were increase on fuel efficiency by 5 % (FedEx, 2013). DHL in England fitted more than 1,000 trailers with aerodynamic "teardrops" (Deutsche Post DHL, 2013, p.65) while Union Pacific is exploring modifications such as the Arrowedge® for freight cars and double-stack intermodal trains. Replacing less efficient aircrafts with more efficient ones also allow for estimated fuel savings of more than 37 million gallons per year (avoiding 353,792 metric tons of CO₂ emissions) (Union Pacific, 2014, p.40).

4 Findings – Users' profile for BEV in Urban Distribution

To evaluate the identified user profiles for electric vehicles in urban distribution, it is necessary to create a target profile. Comparison with the target profile allows detecting the suitability of the identified user profiles for electric vehicle usage. Currently, the electric driving technology has special restrictions compared with ICE. Based on a survey and expert interviews conducted in the "Smart e-User" research project the following criteria were identified for the target profile:

- Range: The average and maximum tour length should not exceed 100 km, so that the current battery capacity of electric vehicles - in changing climatic conditions - is sufficient.
- Charging time: Charging the battery needs additional time compared to refueling the tank of vehicles with an internal combustion engine. Thus, for multi-shift operation it is necessary to consider the standing time at the delivery point, respectively at the customers and between operations. In order to avoid negative impacts on business processes - such as an insufficient range to complete a customer order -, time slots for charging and recharging must be scheduled to make sure they are sufficient for fulfilling the order.
- Tour planning: Due to range restrictions, electric vehicle are more suitable for static tours, i.e. those without changes during the distribution process. Furthermore, seasonal effects must be taken into account during the planning of tours with electric vehicles. This refers to changes in temperature and transportation volume.

- Payload: The weight of the batteries reduces the payload available for cargo. The 2014 German electro mobility law includes a special regulation for electric vehicles.: the weight of the batteries does not count towards the weight of the vehicle. As a result, drivers with a valid driving license for vehicles with less than 3,5 t are allowed to drive electric vehicles with more than 3,5 t, as long as the total weight of the vehicle reduced by the weight of the battery is not exceeding 3,5 t.

The survey has shown that user profiles in commercial transport in urban areas cannot be derived from a company's industry sector. Hence, the relationship between companies of a particular industry sector and their suitability for using electric vehicles was not found. Quite the contrary, the results of the survey suggest a correlation between the dominant purposes of transport and their user profile. The question how companies are using their vehicles - i.e. for transporting textiles or parcels - is more important to answer the question whether this company can utilize electric vehicles within their business processes than the affiliation to a certain type of company or industry sector.

In the course of the survey three user profiles in commercial transport were identified:

- Pick up, deliver and transport of goods (commercial freight transport)
- Consulting, assistance, assembling, repair services and transport of passengers (business passenger transport)
- Other business transactions (both business passenger and freight transport fields)

The first profile, “pick up, deliver and transport”, belongs to the commercial freight transport sector and is characterized by smaller companies with an annual turnover of less than two million Euros, which have only one location or branch. The majority of these companies are buying their vehicles rather than leasing or rent them. The most common types of vehicle for this type of company are compact cars as well as vans and small transporters. Employees in these firms typically do not work in shifts but on average 5 days a week with 9 to 10 hours a day. These companies typically use static route planning methods, and their daily round tours (milk runs) are less than 100 km long. Furthermore, their business is not influenced by seasonal ups and downs. Larger LSPs described in the previous topic are also investing in BEV but are not considered in the present survey.

The second user profile “consulting, assistance, assembling, repair services and transport of passengers” belongs to the business passenger transport sector. The main purpose for using vehicles within this profile is to transport employees to a certain location, where they execute specific services, such as construction workers on a construction site or craftsmen and plumbers at a private household. This user profile is characterized by the utilization of small, compact vehicles (with little payload), which are bought by the company, and as well static and dynamic approaches in route planning. Employees are running heterogeneous tours, which are on average less than 100 km long.

In contrast to the user profiles mentioned before, companies belonging to the third user profile, (both commercial freight and passenger transport “other business transactions”), are characterized by differing vehicle ownership structures. Companies with this user profile have leasing contracts

for their vehicles, which are small and compact cars, and their tour structure varies. Due to their business purpose, these companies run smaller tours, in average with less than 50 km.

One limitation when trying to identify the user profiles of the most representative industry sectors in regard to the city of Berlin is the number of participants in the survey. No clear and valid statement concerning the match of users' profiles and characteristics to the specific requirements of electric mobility could be formulated. Nevertheless, the user profiles identified can be understood as indicators. Despite the survey's limitations, the data was consistent enough to identify the most important characteristics for electric mobile transport within the urban commercial traffic of Berlin. The criterion of range was shown to be the most important one. Although the survey does not allow for a conclusive statement about the daily driven distance, a tour length of less than 100 km is seen as sufficient to utilize an electric vehicle in distribution. Furthermore, it can be assumed that the criterion of payload is the second most important one. Particular in the commercial transportation of goods, the payload directly affects the usability of electric vehicles. Regarding business passenger transport, the payload showed to be an insignificant issue as individuals' transport is at the focus of this profile. To organize multi-shift operations, there is not enough data available to identify a trend. In regard to route planning, the data shows that most companies rely on static routing. In addition, the survey has shown that the attitude towards a more sustainable transportation is most positive within the user profile of "consulting, assistance, assembling, repair services and transport of passengers".

5 Conclusions

Innovations in supply chain sustainability hold a large potential to reducing companies' carbon footprint and their impact on peoples' lives. Among the most cited by companies worldwide are those related to improvements in equipment and vehicles. In the consumer goods industry, pressure from clients is clearly one of the main drivers for encouraging changes through the entire supply chain. As verified in the paper on hand, more efficient and cleaner E&V are being implemented by LSPs and retailers and, to a lesser extent, by manufacturers. This result is not particularly surprising as LSPs and retailers are the ones that implement most of the transportation and warehousing processes. In the meantime, logistics activities are typically outsourced by manufacturers as their core activities are developing and producing consumer goods. Nonetheless, one unexpected result was the lack of integration and collaboration between business partners in consumer goods supply chains. During the present research, the absence of co-operative projects specifically related to E&V implementation was clear when checking and analyzing documents from companies recognized as among the "greenest" companies in the world. Although Beiersdorf turned out to collaborate more closely with their LSPs, the primary goal was to increase data transparency and measure overall emissions. Initiatives related to co-operative development or investments in E&V were absent. It appears that LSPs have been shouldering the risk themselves when investing in new technological solutions for decreasing emissions on logistics activities, such as battery electric vehicles.

Regarding users' profiles of BEV, it became evident that distribution activities with short routes in regard to the distance and little payload lend themselves to being performed with electric vehicles. Well-planned routes as well as the factoring in of charging and recharging times support this suitability of technology and task. The survey has shown that the purpose of using the vehicle rather than the industry sector of a certain company is the significant variable for the usage of electric vehicles.

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