

# Green supply chain management

## Practices and tools for logistics competitiveness and sustainability.

### The DHL case study

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#### Abstract

**Purpose** – Globalization has led worldwide organizations to balance their economic and environmental performances in order to achieve a concrete sustainable development. In an environmental centered world, logistics is called to put into action advanced programs based on technological and organizational improvement, in order to gain or maintain a concrete competitive advantage. The purpose of this paper is to investigate how logistics organizations try to face the recent ecological challenges and the role that the emergent green technologies play in making them finally “green” and competitive.

**Design/methodology/approach** – Green supply chain management (GSCM) practices have been investigated to better understand their influence on economic performance and corporate competitiveness. After providing a background discussion on Green Logistics and GSCM, the authors have also identified specific research questions that are worthy of investigation, also thorough the DHL case study. The case study analysis has been conducted according to a specific conceptual model (Rao and Holt, 2005), which allows a deeper understanding of literature review results.

**Findings** – The present paper offers some insights on innovation influence on supply chain management (SCM) greenness, a process oriented to a sustainable and environmental-friendly approach to management of supply chain. According to DHL case study evidence, in logistics innovation, often based on emerging green technologies, is strictly related to the development of a much more sustainable and environment-friendly approach to SCM, based on reduction of core activities’ ecological impact, cost saving, quality, reliability, performance and energy efficiency. In this context, the respect of environmental regulations is fundamental to achieve not only a reduction of ecological damage, but also to overall economic profit.

**Research limitations/implications** – There is a concrete need of further research to better understand the potential link between GSCM, green innovation and logistic organizations competitiveness. In fact, this research area still represents a source of interesting challenges for practitioners, academicians and researchers. Concluding, the research findings cannot be generalized to all logistic organizations, even if DHL is on of the most important and globalized logistic companies. Future researches should empirically test the achieved results also through comparative studies based on a large sample.

**Originality/value** – The suggestion of literature review and the result of case study analysis represent a first attempt to better understand the real and potential influence of GSCM on corporate image and competitiveness. In fact, the present investigation has pointed out that logistic organization can achieve environmental goals and acquire a better positioning than their competitors also cooperating with stakeholders. Therefore, it is necessary that organizations contribute to make them able to participate in corporate activities and develop a concrete environmental-friendly orientation, based on the respect of market’s requests and environmental regulations in order to get their corporate reputation strong than ever.

**Keywords** Sustainable innovation, Green Logistics, Green supply chain management

**Paper type** Case study



## 1. Introduction

In recent times, the role of logistic services has radically changed according to globalization demands and the emerging market conditions. In a setting of increasing complexity (Hertz and Alfredsson, 2003), logistic organizations can face their competitors also providing advanced services (Van Klink and Visser, 2004) designed for a more competitive and environmental-friendly supply chain management (SCM). In this context, “greenness” (Sugiyama *et al.*, 2008) represents an emerging topic that led to a wide range of environmental issues, essentially, related to the sustainability of logistic strategies and operations. In fact, Green Logistic has an increasing appeal also in academic debate (Murphy and Poist, 2000; Srivastava, 2007; Dekker *et al.*, 2012), nevertheless its real application is quite difficult because of its inner features and correlation with modern transport systems.

In logistics, the emergent technologies represent an important link in SCM (Gonzalez and Trujillo, 2008), because they can help organizations to achieve interesting results in terms of eco-friendliness and competitiveness. In particular, green technologies can contribute to face the global competition thanks to a general costs reduction, a better SCM, a risks’ reduction (Gilman, 2003), and the development of sustainable distribution system (De Martino and Morvillo, 2008). These technologies can also lead to a concrete innovation of logistics, focussed on environmental burden reduction policies, mainly oriented to pollution, gas emission (Hart, 1997), economic and material inputs optimization (e.g. raw materials, clean and alternative energies, low-emission vehicles, etc.).

This paper aims to offer a new perspective on green technologies and innovations’ influence on SCM (Zhu *et al.*, 2008); in order to achieve a better understanding of strategies and policies designed to deal with the emerging challenges in terms of logistics sustainable development. To assess the influence of green technologies on SCM, the study also tries to compare the results of literature review with those emerging from DHL case study, analyzed according to Rao and Holt (2005) conceptual model of green supply chain management (GSCM) competitiveness and economic performance. The paper is structured as follows. The next section outlines the theoretical background and the research questions, in order to better understand the influence of green strategies and technologies on logistic industry and SCM in terms of system innovation and competitiveness. The research methodology is described in Section 3, while the case study has been analyzed in the following section. The insights in terms of green technologies influence on SCM strategies, competitiveness and economic performances resulting from the case study analysis are discussed in Section 5, which also provide some key challenges and suggestions for further researches.

## 2. Theoretical background and research questions

### 2.1 Logistics goes green

In these days, environmental issues represent one of the emergent challenges for contemporary society and of course for logistics industry (Murphy and Poist, 2003), as the lively debate among academic and business communities demonstrates (Rodrigue *et al.*, 2001; Lin and Ho, 2008; Jumadi and Zailani, 2010). Modern logistics seem to be deeply related to sustainable development (Giddings *et al.*, 2002; Hopwood *et al.*, 2005; Pearce *et al.*, 2013; Ghai and Vivian, 2014), thus organizations are even more focussed on specific activities related to the environmental protection, economic sustainability and public welfare.

In literature, several studies have discussed the growing importance of environmental sustainability in logistics, a topic strictly related to globalization and

its traditional tendency to destroy the surrounding environment (Rodrigue *et al.*, 2001; Anderson *et al.*, 2005; Frota Neto *et al.*, 2008). Therefore, between the late 1980's and the early 1990's the growing social awareness of environmental problems and the public debate on pollution and global warming influenced the rising of the so-called "greenness" paradigm. Consequently, logistics could not avoid making its activities more sustainable and environmental friendly, in order to face hot issues mainly emerging from its relationship with transport industry, one of the main contributors to environmental degradation (Van Woensel *et al.*, 2001). In 1990's, the "decade of the environment" (Kirkpatrick, 1990), Green Logistics was deeply investigated according different perspectives focussed on environment integration study (Murphy *et al.*, 1994); thus in the current literature, there are different and sometimes alternative definitions of Green Logistics. In particular, according to Wu and Dunn (1995) it is related to "a logistics system responsible for the environment, which not only includes forward logistics process from the acquisition of raw materials, production, packaging, transport, storage, to the delivery to end users' hands, but also includes the reverse logistics dealing with waste recycling and disposal" (p. 24). In recent times, others scholars has considered Green Logistics as "an environmentally friendly and efficient transport distribution system" (Rodrigue *et al.*, 2001), whose development must be joined with green production, marketing, consumption and other economic activities (Hang, 1996) that respect the principles of sustainable development. It is almost clear that Green Logistics includes a lot of different activities such as: green purchasing, green material management and manufacturing, green distribution and marketing, and reverse logistics (Hervani *et al.*, 2005), which can have a positive influence on different processes (e.g. purchasing, packaging and transportation), whose benefits and challenges have been investigated by several authors (Table I).

This discipline points to measure and minimize the ecological impact of logistic activities also through advanced technologies and equipment, in order to reduce toxic emissions, resources consumption, and to gain a long-lasting sustainable development

Green activities	Benefits	Challenges	Authors
Purchasing	(1) Reduces waste and liability cost; (2) builds a "green" corporate image	High setup cost requires management commitment and company-wide standards	Karpak <i>et al.</i> (2001); Min and Galle (2001); Rao and Holt, 2005; Chen (2005); Larson (2011); Green <i>et al.</i> (2012)
Packaging	(1) Reduces packaging cost and solid waste; (2) maximizes environment friendliness through alternative packaging materials and techniques	High cost of using alternative packaging materials and techniques	Curty (2005); Rokka and Uusitalo (2008); Ouyang (2014)
Transportation	(1) Reduces fuel consumption and cuts operating cost; (2) generates less noise, air pollution and traffic congestion; (3) improves customer and public relationships	High investment cost of alternative fuel vehicles	Vannieuwenhuysse <i>et al.</i> (2003)

**Table I.**  
Green purchasing, packaging, and transportation benefits, and challenges

Source: Adapted from Guide (2000)

(Harris *et al.*, 2009). In literature, Green Logistics is often considered a part of GSCM, being oriented to environmental issues integration into “closed-loop SCM” (Chan *et al.*, 2012). In fact, the greening of logistics is considered as the result of three main players’ actions (Chunguang, 2008): first, government that should make law and regulations effective; second, enterprise that should put SCM in practice; third, consumer that should promote green consuming.

Concluding, the current study aims to answer the following research questions:

RQ1. How green technologies are involved in SCM?

RQ2. How green innovation affects competitive advantage and the green image of logistic organizations?

## 2.2 *Emerging technologies for GSCM*

In recent years, the public awareness of environmental conservation, the emerging need for sustainable development and the environmental legislation (Lau, 2011) have led a growing number of scholars and practitioners to focus their researches on GSCM. At the same time, several companies have implemented GSCM initiatives (Zhu *et al.*, 2008) in order to reduce pollutant discharge, waste and/or emissions related to production, packaging, transportation, distribution and consuming. GSCM is based on different environmental initiatives (e.g. green purchasing, eco-design, outbound logistics, etc.) that aim to reduce or even eliminate the adverse impact of logistic activities also thanks to the involvement of different actors such as: suppliers, service contractors, vendors, distributors and users (Vachon and Klassen, 2006). Current literature lacks a shared definition of GSCM, because its classification mainly depends on the investigation of a supply chain single function or activity (Rao and Holt, 2005). Furthermore, SCM is generally related to the strategic coordination of core functions and tactics within a specific organization and across its partners, in order to achieve better long-term performances (Li *et al.*, 2006). SCM handles a complex network of activities that goes from products manufacturing, assembling, storage, delivering, and tracking, to orders, and distribution channels management (Hervani *et al.*, 2005).

In literature, several researches have analyzed GSCM according to the main features of different contexts such as: product design (Hu and Hsu, 2006), process design (Porter and Van der Linde, 1995; Hervani *et al.*, 2005; Zhu *et al.*, 2008), manufacturing practices (Chien and Shih, 2007), purchasing (Handfield *et al.*, 2002; Hu and Hsu, 2006). This concept is strictly related to SCM and its definitions, to which must be added a greater attention to environmental issues. As showed in the following table, in academic literature scholars have provided different definitions (Table II). In particular, a GSCM strategy “requires companies to adopt environmentally friendly purchasing, including taking into consideration the purchasing of materials that consist of less environmentally harmful elements, the use of fewer materials and more renewable and recyclable resources.” (Shi *et al.*, 2012, p. 59).

GSCM has its roots in the following activities (Zhu *et al.*, 2008): first, green supply logistics, related to the greening of traditional logistic processes; second, green production logistics, related to the use of clean production technology, to a more efficient resources utilization, and to the reduction of energy consumption and waste emissions; third, green sales logistics, related to the optimization of transport routes and the building of a “green” sales network; fourth, reverse logistics, related to planning, implementing, and controlling the efficient, cost effective flow of raw materials, process

Definitions	Focus	Authors
GSCM is the set of SCM policies held, actions taken and relationships formed in response to concerns related to the natural environment with regard to the design, acquisition, production, distribution, use, reuse and disposal of the firm's goods and services	Green SCM strategies and design	Zsidisin and Siferd (2001)
"GSCM [...] emerged from SCM as an important organizational philosophy to achieve corporate economic profit whilst also improving the environmental and social performance of the organization and its partners"	Philosophy, concept and definition	Van Hoek (2002)
GSCM is a new field of research concerning climate change, unsustainable consumption of natural resources and very high rate of energy consumption	GSCM strategies and framework	Sarkis (2003)
It is related to SCM extension, including the reuse and recycling throughout product and service life cycle	Waste management in SCM	Kainuma and Tawara (2006)
GSCM integrates environmental thinking into SCM, including product design, material sourcing and selection, manufacturing processes, delivery of the final products to the consumers	Concept and definition	Srivastava (2007)
GSCM scope goes from green purchasing to integrated life-cycle management of supply chains flowing from supplier, through to manufacturer, customer, and closing the loop with reverse logistics	Performance measurement	Zhu <i>et al.</i> (2008)
GSCM incorporates environment-friendly initiatives into SC activities encompassing sourcing, product design and development, manufacturing, transportation, packaging, storage, retrieval, disposal and post sales services including end-of-product life management	GSCM strategies and design	Min and Kim (2012)

**Source:** Our elaboration

**Table II.**  
GSCM main definitions

inventory, finished goods and related information from the point of consumption to the point of origin for recapturing value or proper disposal.

Scholars have also ranked the main green supply chain initiatives (Eltayeb and Zailani, 2009) in terms of: green or eco-design, green procurement (e.g. certifying suppliers, purchasing eco-friendly materials/products, etc.), total quality environmental management, eco-friendly packaging and transportation, materials reduction or reuse, and remanufacturing or recycling products. In recent times, these activities have been enhanced also by those technologies related to data sharing, costs reduction, cooperation, and supply chain performances improvement and greenness (Panayides and So, 2005; Wagner, 2008).

### *2.3 How green innovation affects logistics competitiveness and sustainability*

In logistics, innovation is not only oriented to environmental burden reducing, but it also represents a fundamental driver in competitive enhancement. In fact, innovation has been defined as "the application of new ideas to the products, processes or any other aspect of a firm's activities" (Rogers, 1998, p. 6). In particular, green innovation is related to ICT, biological, monitoring and many others specific technologies that can be applied to logistics management (Jumadi and Zailani, 2010).

In literature, some authors have defined green innovation as the sum of green products, processes and managerial innovation effects on corporate activities and

performances (Chen, 2008). Consequently, it seems to be based on the interaction and cooperation between different logistic players, such as shippers, carriers, transporters and suppliers that aims to gain a long-lasting competitive advantage. Consequently, two main categories of innovations have been defined in order to better respond to environmental regulation (Porter and Van der Linde, 1995, pp. 64-66): first, new technologies and approaches, dedicated to the reduction of costs related to pollution dealing; second, improvement of resources productivities, based on a more efficient use of inputs.

Several scholars have analyzed the link between GSCM, green technologies and innovation, and their influence on competitiveness and performance improvement. Consequently, innovations and, in particular, green innovations seem to point to a more productive and conscious management that aims also to balance the costs needed to make an organization environmental friendly. This result can be achieved also thanks to an innovative approach to business and resources management, which is often based on specific techniques and technologies designed for social and ecological conditions protection and improvement. Thus, environmental-friendly companies generally aims to gain a sustainable development that requires “fundamental transformations in technologies, industries and lifestyles (so-called sustainability transitions)” (Truffer and Coenen, 2012, p. 2). In logistics, the growing importance of sustainability has directly influenced industry competitiveness, driving companies to change “the way they think about products, technologies, processes, and business models” (Nidumolu *et al.*, 2009, p. 9). Scholars have also point out that sustainability is one of the main areas in which organizational and technological innovations take place, contributing to: lower costs reducing the used inputs; generate additional revenues thanks to better products; new business creation. In particular, the so-called sustainable or green innovation (Archibugi and Iammarino, 2002; Chen, 2008) is generally oriented to gain energy efficiency, reduce companies’ dependence on fossil fuels, and to introduce green and renewable source of energy.

### 3. Methodology and conceptual model

In literature, the selection of a specific research method is related to: first, the nature of the research problem, thus a case studies approach is generally chosen when a research is based on “how” and “why” questions; second, the degree of control over events, when a small number of case studies or surveys are applicable; third, the past or ongoing trends that, when are ongoing, can be investigated through the case study method (Yin, 2003). Consequently, this study has been based on a case study method that point not only to exploratory and descriptive goals, but also to explanatory purposes (Yin, 2003). DHL case study has been analyzed according to the Rao and Holt (2005) theoretical framework, a conceptual model developed through a deep analysis of literature on all aspects and traits of supply chain. This framework is based on a specific definition of SCM, according to which it is related to all the activities concerning materials flow, their transformation from the extraction phase till to the consumption of goods and services by end users, and the associated information (Handfield and Nichols, 1999). Moreover, according to the authors this definition can be useful also in terms of GSCM, a set of activities that promote efficiency and synergy among business partners also thanks to environmental performance enhancement, waste reduction and costs saving. These activities can have a positive influence on fundamental elements such as corporate image, competitive advantage and marketing exposure (Rao and Holt, 2005).



Rao and Holt's framework has been also tested through SEM techniques, in order to encapsulate supply chain main issues "using five latent constructs, measured using indicator variables developed from the responses obtained from the survey of organizations in the South East Asia region" (Rao and Holt, 2005, p. 900). The five constructs are:

- (1) greening the inbound function of the supply chain;
- (2) greening production;
- (3) greening the outbound function;
- (4) competitiveness; and
- (5) economic performance.

In particular, the "inbound function" is related to the benefits that an organization can achieve adopting a green approach to SCM in terms of cost reduction, and suppliers' integration in decision-making process (Bowen *et al.*, 2001; Rao, 2003). This function is essentially related to green purchasing strategies dedicated to face the increasing concerns of environmental sustainability. Information about Inbound function can be collected using the following six factors:

- (1) holding awareness seminars for suppliers and contractors;
- (2) guiding suppliers to setup their own environmental programs;
- (3) bringing together suppliers in the same industry to share their know-how and problems;
- (4) informing suppliers about the benefits of cleaner production and technologies;
- (5) urging/pressuring suppliers to take environmental actions; and
- (6) choice of suppliers by environmental criteria.

The "greening production" is related to the exploration of specific green supply chain actions, such as: cleaner production, design for environment, remanufacturing and lean production. Consequently, this function can be analyzed according to the following eight variables:

- (1) environmentally friendly raw materials;
- (2) substitution of environmentally questionable materials;
- (3) taking environmental criteria into consideration;
- (4) environmental design considerations;
- (5) optimization of process to reduce solid waste and emissions;
- (6) use of cleaner technology processes to make savings in energy, water and waste;
- (7) internal recycling of materials within the production phase; and
- (8) incorporating environmental total quality management principles such as worker empowerment.

The "greening the outbound function" is strictly related to outbound activities such as: green marketing, environment-friendly packaging and environment-friendly distribution. These activities can help organization in cost savings and in competitiveness

enhancement (Rao, 2003), being based on the following factors: environment-friendly waste management; environmental improvement of packaging; taking back packaging; eco-labeling; recovery of company's end-of-life products; providing consumers with information on environmental-friendly products and/or production methods; use of environmental-friendly transportation. "Competitiveness" is related to the possibility to achieve a competitive advantage implementing the managerial principles of customer satisfaction, employee empowerment, quality cost system, lean manufacturing, continuous improvement and productivity enhancement. The main factors related this function are: improved efficiency; quality improvement; productivity improvement; cost savings. The last function, "economic performance," is related to the reduction or minimization of environmental activities' costs. In fact, several organizations are still trying to define a possible trade-off between environmental performances and economic performances; thus, environmental ones in many different ways affect financial performances. The factors used to explore the potential influence of GSCM on economic performance are: new market opportunities; product price increase; profit margin; sales; market share.

#### 4. DHL case study

DHL is an international logistic company, active in over 220 countries across the globe. It is also part of the world's leading postal and logistics group, Deutsche Post DHL, encompassing three different divisions: DHL Express, DHL Global Forwarding, Freight and DHL Supply Chain. Since 2009, DHL is focussed on corporate social responsibility and sustainability, having developed the following programs: PPGoGreen, dedicated to environment protection; PPGoHelp, dedicated to disaster management; PPGoTeach, dedicated to the spread of education in the world. In terms of sustainability, DHL believes that sustainable and environmental-friendly services can contribute to long-term competitiveness improvement. Thus, sustainability will also have a positive influence on new customers' acquisition and on existing ones retention. The most important sustainable actions are related to the optimization of transport routes, the use of vehicles with alternative drive systems and energy-efficient warehouses. DHL offers a great number of green products and services oriented to CO<sub>2</sub>, and greenhouse gas emissions reduction, according to a general logic of green optimization. Concluding, the company believes that environmental protection and business success are not only compatible, but also closely related.

##### 4.1 Discussion

The analysis of DHL case study, conducted according Rao and Holt (2005) conceptual model, has allowed us to collect the main programs, actions and technologies that company uses to improve its sustainability and greenness. In particular, the investigation of different corporate and public documents (e.g. articles, corporate publications, web site, corporate social network, online magazines and journals, etc.) has contribute to better define DHL sustainable approach to SCM and to green technologies, as stated in the research questions presented in the previous section. According to the first function (inbound function) and the related factors (Table III), DHL believes that successful projects have to be based on partnerships with its transportation contractors, sub contractors, vendors, suppliers and ultimately clients. To achieve this goal, DHL shares its best practices and experiences with its suppliers, in order to make them able to participate to some processes ([www.dhlsupplychainmatters.dhl.com](http://www.dhlsupplychainmatters.dhl.com)). In particular,



**Table III.**  
Inbound function

Factors	Inbound function Actions
(1) Holding awareness seminars for suppliers and contractors	Best practice sharing, learning, relationship improvement
(2) Guiding suppliers to setup their own environmental programs	Supplier code of conduct, suppliers ethical guidelines
(3) Bringing together suppliers in the same industry to share their know-how and problems	Open dialogue, online and offline communication
(4) Informing suppliers about the benefits of cleaner production and technologies	Online and offline communication
(5) Urging/pressuring suppliers to take environmental actions	Promotion of suppliers adherence to human rights, ethical, health, safety and environmental standards
(6) Choice of suppliers by environmental criteria	Multi-step tendering process, based on cost-effectiveness, quality and ethical criteria

**Source:** Our elaboration

DHL manages its relationship with suppliers through a “Supplier Code of Conduct” ([www.dhl.com](http://www.dhl.com); [www.unglobalcompact.org](http://www.unglobalcompact.org)), which sets the standards for their activities also in terms of environmental programs. The company promotes also an open dialogue based on honesty, respect and mutual trust with its internal and external stakeholders, using a wide range of communications channels (e.g. e-mail, intranet, extranet, employee magazines, etc.). DHL also encourages suppliers to adhere to its ethical, health, safety and environmental standards ([www.dhl.com](http://www.dhl.com); [www.unglobalcompact.org](http://www.unglobalcompact.org)), in order to make them as compliant as possible with its principles and activities. Finally, suppliers are selected according to a multi-step tendering process based also on cost-effectiveness and quality evaluation ([www.dpdhl.com](http://www.dpdhl.com)).

The “greening production” function (Table IV) is mainly based on environmental issues management. In particular, DHL green purchasing policies are related to the following sectors: paper and printed matter; packaging (in particular pallet wrap); site consumables (various products), energy reduction ([www.dhl.com.sg](http://www.dhl.com.sg); [www.dhlsupplychainmatters.dhl.com](http://www.dhlsupplychainmatters.dhl.com); DHL Supply Chain GoGreen Agenda, 2008).

For example, the company has replaced all fluorescent lamps with LED lighting to reduce carbon emissions and energy consumption ([www.dhl.com](http://www.dhl.com); [www.dhl.com.jp](http://www.dhl.com.jp)). In terms of current activities, DHL respects the main environmental international protocols ([www.unglobalcompact.org](http://www.unglobalcompact.org); [www.dhl.com](http://www.dhl.com)), such as: Greenhouse Gas Protocol (GHG Protocol), the “Corporate Accounting and Reporting Standard,” and “Corporate Value Chain Accounting and Reporting Standard.” In particular, data are analyzed according to European Emissions Trading System (EU-ETS) requirements, and EN 16258 and ISO 14064 standards. DHL environmental design is mainly related to packaging design in order to satisfy customers, and shipping needs, in terms of storage space, and time for assembly reduction ([www.dpdhl.com](http://www.dpdhl.com); Withe Paper, 2012). The company has also used its recycling and supply chain expertise to design and implement an innovative solution to recycle up to 100 percent of raw materials. In terms of wastes management, DHL often collects them at the back door, taking material away to a MRF, but not looking or thinking about the waste stream coming out of the business ([www.letsrecycle.com](http://www.letsrecycle.com)); in fact, technological solutions are dedicated to organics waste management and monitoring. The company has oriented its core activities to the principles expressed by the obtained ISO 14001 certification (Sustainability Report, 2008, 2009; Rate Guide, 2014).

Factors	Greening production Actions
(1) Environmentally friendly raw materials	Paper and printed matter; packaging; site consumables, energy reduction
(2) Substitution of environmentally questionable materials	Replacement of fluorescent lamps with large-scale installation of LED to reduce carbon emissions and energy consumption
(3) Taking environmental criteria into consideration	Estimation of greenhouse gas emissions according to international standards: Greenhouse Gas Protocol (GHG Protocol), the "Corporate Accounting and Reporting Standard," "Corporate Value Chain Accounting and Reporting Standard," European Emissions Trading System (EU-ETS) requirements, EN 16258 and ISO 14064 standards
(4) Environmental design considerations	Flat packaging design related to storage space, and time for assembly reduction
(5) Optimization of process to reduce solid waste and emissions	Innovative solution to recycle 100 percent of raw material; transition to alternative fuels, optimization of carbon efficiency, and increasing environmental awareness among its employees
(6) Use of cleaner technology processes to make savings in energy, water and waste	The 2012 project dedicated to the diffusion of 100 Propane Autogas Vans for Pickup and Delivery Fleet. GoGreen Services. The latest "new generation" scanning technology applied to US network to provide enhanced shipment visibility for customers
(7) Internal recycling of materials within the production phase	Collection of waste at the back door, taking material away to a MRF, organics waste management
(8) Incorporating environmental total quality management principles such as worker empowerment	International environmental standard, such as ISO 14001 certification

**Source:** Our elaboration

**Table IV.**  
Greening production function

The third function "greening the outbound function" (Table V) led to better understand DHL green approach to outbound actions. In particular, corporate supply chain provides a nationwide transport network, a regular outbound logistics, technical knowledge and expertise for reverse logistics ([www.laa.asn.au](http://www.laa.asn.au); [www.businesswire.com](http://www.businesswire.com); [www.dhl.co.in](http://www.dhl.co.in)).

The company has developed a new 100 percent recyclable packaging range, based on: environmentally lower impact materials, a range of new shapes and sizes, the reduction of required storage space, a versatile packaging range for all needs (<http://postandparcel.info>; [www.dhl.gr](http://www.dhl.gr)). DHL uses also QR Codes to label its packages in order to give carriers, and consumers all information they need about delivery services (e.g. tracking, costs, served countries, local DHL office information, etc.) ([www.yoiscan.me](http://www.yoiscan.me); [www.2dbarcodestrategy.com](http://www.2dbarcodestrategy.com)). In terms of recovery end-of-life products, company has improved paper reuse and recycling, developing "multipurpose returnable containers (MRC)" that can reduce the environmental footprint during the shipping of precision equipment by reusing the containers multiple times ([www.dhl.co.jp](http://www.dhl.co.jp); [www.dnaindia.com](http://www.dnaindia.com); [www.worldpackagingnews.com](http://www.worldpackagingnews.com)). DHL has also introduced a new product for the shipment of bulk non-hazardous liquids, designed for chemicals and beverages sectors according to ISO regulation for tank containers ([www.dhl.com](http://www.dhl.com)).

Greening the outbound function	
Factors	Actions
(1) Environment-friendly waste management	Technical knowledge and expertise for reverse logistics, including used products collecting and recycling for final disposal
(2) Environmental improvement of packaging	New packaging range made from 100 percent recyclable materials and based on: environmentally lower impact, range extended with new shapes and sizes, less storage space required at customer premises, one versatile packaging range for all needs
(3) Taking back packaging	No evidence has been found
(4) Eco-labeling	QR code to give consumers all of the tools and information they need
(5) Recovery of company's end-of-life products	Switching off computers, lights and other electronic equipment that are not in use, decrease the amount of paper we use for current operations, "multipurpose returnable containers (MRC)"
(6) Providing consumers with information on environmental-friendly products and/or production methods	No evidence has been found
(7) Use of environmental-friendly transportation	New product for the shipment of bulk non-hazardous liquids, reduction of fuel consumption, environmentally friendly trial vehicle test

**Table V.**  
Greening the  
outbound function

**Source:** Our elaboration

In June 2006, DHL promoted an awareness campaign dedicated to the reduction of its fleet fuel consumption, which is estimated to be more than one million liters a month ([www.dhl.fr/en/press/releases/releases\\_2008/local/150408.html](http://www.dhl.fr/en/press/releases/releases_2008/local/150408.html); [www.dpdhl.com/en/responsibility/environmental-protection/improving\\_efficiency/vehicles.html](http://www.dpdhl.com/en/responsibility/environmental-protection/improving_efficiency/vehicles.html)). The company has also tested a highly environmental-friendly trial vehicle, in partnership with Renault Trucks and Grand Lyon, within Freight Intelligent Delivery of Goods in European Urban Spaces European Research Program ([www.dhl.fr](http://www.dhl.fr); <https://ec.europa.eu>; [www.gmartinesdesign.com](http://www.gmartinesdesign.com)). In terms of "competitiveness" (Table VI), DHL trends for 2014 are related to efficiency improvement; in fact the company aims to replicate consistent operations across sites, countries and regions ([www.dhl.com](http://www.dhl.com); Logistic

Competitiveness	
Factors	Actions
(1) Improved efficiency	Replication of consistent operations across sites, countries and regions; clear operational methodologies based on technologies that enable replication and local or global deployment
(2) Quality improvement	Adoption of best practices across all functions and regions; ISO 9001:2008 certification, CO <sub>2</sub> emissions reduction, quality and speed of delivery improvement
(3) Productivity improvement	Bottom-up initiatives driven by a culture of continuous improvement; lean transformation
(4) Cost savings	No evidence has been found

**Table VI.**  
Competitiveness  
factors

**Source:** Our elaboration

Trends Radar, 2013). Nevertheless, this process can be facilitated by clear operational methodologies based on technological tools and solutions. DHL's quality management processes have been designed according to main best practices, in order to achieve ISO 9001:2008 certification that state the effective implementation of quality management and control systems in all corporate areas ([www.dhl.com](http://www.dhl.com); <http://mhlnews.com>; [www.supplychainbrain.com](http://www.supplychainbrain.com)). In particular, DHL achieved this certification in over 100 countries across America, Asia Pacific and Europe. The development of corporate productivity represents another goal, which company aims to achieve through bottom-up initiatives oriented to a continuous improvement.

The last function, "economic performance" (Table VII), showed that in terms of new market opportunities, DHL has focussed its activities on China and India market development, because of, in these economies, consumers are spending more and more on retail products as they seek to emulate the lifestyle of people in established markets (Annual Report, 2011, 2012). DHL analysts have predicted that Asian and Pacific areas would become the largest contract logistics market by 2016 ([www.dpdhl.com](http://www.dpdhl.com); Annual Report, 2011, 2013). In terms of price increasing, DHL is used to fix it every year, taking into account inflation and other rising costs in each of the more than 220 served countries. Price adjustments will vary from country to country, depending on local conditions ([www.dpdhl.com](http://www.dpdhl.com); Annual Report, 2011, 2012, 2013).

In terms of profit margin, during the first quarter of 2013 DHL built its successful performance on good performance of 2012. Thus, groups increased revenues by 0.6 percent to EUR 13.4 billion in the first three months of the year compared with the same period last year ([www.dhl.com](http://www.dhl.com)). The driving forces of this growth were primarily the volume and revenues generated by the international express business as well as the parcel segment in Germany.

The group has also forecasted a consistent earnings rising (between 13 and 15 percent between 2010 and 2015), even if it is quite difficult to gain concrete benefits from shared sales and marketing campaigns ([www.dpdhl.com/content/dam/Investors/Publications/Annual\\_Reports/DPDHL\\_Transcript\\_Conference\\_Call\\_08032012.pdf](http://www.dpdhl.com/content/dam/Investors/Publications/Annual_Reports/DPDHL_Transcript_Conference_Call_08032012.pdf); [www.dhl.com/en/press/releases/releases\\_2013/group/deutsche\\_post\\_dhl\\_boosts\\_operating\\_profit\\_in\\_the\\_first\\_quarter\\_of\\_2013.html#.U7qob6iCLnk](http://www.dhl.com/en/press/releases/releases_2013/group/deutsche_post_dhl_boosts_operating_profit_in_the_first_quarter_of_2013.html#.U7qob6iCLnk)

Economic performance	
Factors	Actions
(1) New market opportunities	Asia Pacific would become the largest contract logistics market by 2016, due to the economic weakness of western Europe
(2) Product price increase	DHL annual price increase is targeted first and foremost at ensuring a competitive, sustainable value proposition for customers
(3) Profit margin	For 2013, the group expects the world's economy to generate moderate growth. DHL forecasts earnings to rise by an annual average of between 13 and 15 percent between 2010 and 2015
(4) Sales	With no enterprise-level view of customer information, there was little or no opportunity to improve sales and marketing efficiency
(5) Market share	In 2013, DHL is leading player in the contract logistics market with 8 percent of the overall market with revenues of €13 billion (£11 billion) in 2012. The German market volume totalled around €8.2 billion in 2013, nearly 5.1 percent more than the prior year

Source: Our elaboration

**Table VII.**  
Economic performance factor

In 2013, DHL has been the leading player in the contract logistics market with 85 of the overall market with revenues of €13 billion euros in 2012 (Annual Report, 2012, 2013). Overall, DHL market share in 2013 was approximately 42.3 percent. In the European road freight market, the growth remained slow at an estimated -1 to 1 percent (previous year: 0-2 percent), due to the European macroeconomic environment and the intense competition in this sector (Annual Report, 2012, 2013).

## 5. Conclusions

The present paper offers some insights on innovation influence on SCM greenness, a process oriented to a sustainable and environmental-friendly approach to management of supply chain. According to DHL case study evidence, logistic innovation, based also on emerging green technologies, is strictly related to the development of a much more sustainable and environment-friendly approach to SCM, which can lead not only to the reduction of core activities' ecological impact, but also to the improvement of quality, reliability, performance and energy efficiency. In this context, the respect of environmental regulations is fundamental to achieve a reduction of ecological damage and to overall economic profit.

According to literature review and DHL case study evidence, it has been possible to respond to the first research question (How green technologies are involved in SCM?); thus emerging green technologies represent an important source of innovation for SCM, because of they contribute to gain a better energy efficiency, to introduce new tools oriented to reduce toxic emission, to increase the use of renewable source of energy, and to better manage or reuse waste. According to previous statements, DHL case study has demonstrated that this company uses different kind of green technologies to improve its greenness, to gain better results in terms of sustainable development, and to achieve a better management of environmental issues. Therefore, it is also possible to partially respond to the second research question (How green innovation affects competitive advantage and the green image of logistic organizations?); in fact, nevertheless in literature green innovation is considered a fundamental driver in competitive advantage achieving (Zhu and Sarkis, 2004; Rao and Holt, 2005; López-Gamero *et al.*, 2010), few empirical studies have highlighted concrete evidences of its influence on corporate competitiveness (Sarkis *et al.*, 2011). Moreover, the reported case study demonstrates that GSCM initiatives and green innovation not necessarily affect firm's performance and competitiveness (Montabon *et al.*, 2007), even though globalization has led organizations to gain better performances than competitors also improving their technological resources. According to previous statements, in logistics some organizations are trying to integrate environmental management and policies into their operational activities through specific processes such as reverse logistic or waste exchange, which are able to positively affect cost savings and corporate competitiveness (Rao and Holt, 2005). In this context, green marketing, which is based on a broad range of activities (e.g. product and process modification, sustainable packaging, and new sustainable advertisement policies) oriented to the promotion of services and products that are presumed to be environmentally preferable to others (Rex and Baumann, 2007), represents the existing link between GSCM and corporate competitiveness (Menon and Menon, 1997). In fact, according to the results of DHL case study, these specific activities can have a direct influence especially on greening the outbound function, making them able to respect environmental regulation and prescriptions (e.g. the acquiring of knowledge and expertise for reverse logistics, including used products collecting and recycling for final disposal; New packaging

range made from 100 percent recyclable materials; switching off computers, lights, and other electronic equipment; the decrease of paper used for current operations; the use of MRC; the use of new products for non-hazardous liquids bulk shipment; the reduction of fuel consumption; the use of environmentally friendly vehicle). Consequently, some green initiatives have positively affected DHL competitiveness thanks to: the replication of consistent operations across sites, countries and regions; clear operational methodologies based on green technologies; the adoption of best practices across all functions and regions; the respect of main regulations and certifications (e.g. ISO 900: 2008); the improvement of quality and speed of delivery, etc. The achieving of these results can be based, for example, on such reverse logistics initiatives that encourage suppliers to take back packaging, on supply chain strategies focussed on waste reduction and on the cutting of supply chain non-value-adding activities related to excess time, labor, equipment, space and inventories (Corbett and Klassen, 2006). Consequently, green marketing strategies can make companies stronger than competitors thanks to a better corporate image and able to enter new markets or create new barriers to limit the access to existing markets. In literature (Bacallan, 2000; Li *et al.*, 2006; Ageron *et al.*, 2012), some evidences state that logistic organizations are enhancing their competitiveness also through environmental-friendly performances often addressed by stakeholders' concerns. Therefore, the study suggests that companies should work closely with their stakeholders to achieve environmental goals and to acquire a better positioning than their competitors. This cooperation, based on a direct company-stakeholders dialogue and on a suppliers concrete environmental-friendly orientation, can contribute to make them able to respond to market requests and environmental regulations, in order to build and maintain a "sustainable competitive advantage in the global market" (Chiou *et al.*, 2011). Consequently, an effective Green Logistics management can led not only to an operational and economic performance improvement (Álvarez-Gil *et al.*, 2007), but also to a long-lasting competitiveness reinforcement (Rao *et al.*, 2009). However, there is a concrete need of further research to better understand the potential link between GSCM, green innovation and logistic organizations competitiveness. In fact, this research area still represents a source of interesting challenges for practitioners, academicians and researchers. Concluding, our research findings cannot be generalized to all logistic organizations, even if DHL is one of the most important and globalized companies. Future researches should empirically test the achieved results also through comparative studies based on a large sample.

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