The Influence of Green Innovation in Logistics Competitiveness and Sustainability. The DHL Case Study

Silvia Cosimato
Department of Industrial Engeenering
University of Salerno (Italy)
email: scosimato@unisa.it (corresponding author)

Orlando Troisi
Department of Management & Information Technology
University of Salerno, (Italy)
email: otroisi@unisa.it

Abstract

The purpose of this paper is to investigate, according to emergent green perspective and technologies, the recent challenges in making logistics sustainable.

The main green supply chain management practices are investigated in order to demonstrate their real and potential influence on economic performance and corporate competitiveness. To reach this aim, a brief literature review on green logistic (Tsoulfas and Pappis, 2006; Carter and Rogers, 2008; Dey et al., 2011; Garbara et al., 2014), green innovation and technologies (Van Bommel, 2011; Seuring, 2013; Brandenburg et al., 2014; Fabbe-Costes et al., 2014) has been carried out. Consequently, the DHL case study has contributed to better understand the influence of green innovation and technologies on SCM, and corporate results in terms of costs' saving, competitiveness, and social integration. 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. The study offers valuable insights for managers and practitioners in dealing with the sustainability and competitiveness of SCM. However, the paper is limited by the analysis of a single case study.

Keywords
Green Supply Chain Management; sustainability; logistic innovation; green innovation

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 logistics complexity (Hertz and Alfredsson 2003), 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. Moreover, national and international institutions have demonstrated a growing involvement in environmental issues, and their possible solutions, which can also be reinforced by green logistics global and local application. 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. Green logistic has an increasing appeal in academic debate (Murohy 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. The emergent technologies are considered an "important link in the logistics chain" (Gonzalez and Trujillo, 2008, p. 245) management, because they can help organizations to achieve interesting results in terms of sustainability and competitiveness. Thus, green technologies contribute to face the global competition thanks to a general costs reduction, a better Supply Chain Management (SCM), a risks' reduction (Gilman, 2003), and the development of sustainable distribution system (De Martino and Morvillo, 2008). This technologies can also led to a concrete innovation of logistics, in order to face the increasing global competition and gain a long-lasting competitive advantage. Green innovations are, generally, focused on logistic environmental burden reduction, especially in terms of pollution, gas emission (Hart, 2008), and 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 face the emerging challenges in terms of logistics sustainable development. To assess the influence of Green Technologies on SCM, this paper aims to compare the results of literature review with those emerged from DHL case study, analyzed according to Rao and Holt (2005) conceptual model of 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 on SCM, also 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 logistic industry (Murphy and Poist, 2003), as the lively debate among academic and business communities (Rodrigue et al., 2001; Lin and Ho, 2008; Jumadi and Zailani, 2010) demonstrates. Modern logistics is deeply related to sustainable development (Giddings, 2002; Hopwood et al., 2005; Pears et al., 2013; *Ghai and Vivian, 2014*), which led management to focus its activities on environment protection,

economic sustainability, and public welfare. In literature, different studies have discussed the growing importance of sustainability, and in particular of environmental sustainability in logistic industry, being strictly related to globalization and the traditional logistics tendency to destroy the surrounding environment (Rodrigue et al., 2001; Anderson et al., 2005; Frota Neto et al., 2008).

The "greenness" paradigm rose between the late 80's and the early 90's, when social awareness of environmental problems aroused from the public debate on pollution, and global warming. Therefore, logistics could not avoid making its activities sustainable and environmental-friendly, in order to face hot issues emerging from its relationship with transport industry, one of the main contributor to environmental degradation (Woensel et al. 2001). In 1990's, the "decade of the environment" (Kirkpatrick 1990), Green Logistics was deeply investigated according different perspectives focused on environment integration study (Murphy et al. 1994). 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, 2006) that respect the principles of sustainable development. 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). This activity has a positive influence on different actions and processes (Guide, 2000) related to purchasing, packaging and transportation, whose benefits and challenges have been investigated by several authors (tab. 1).

Table 1: Green purchasing, packaging, and transportation benefits, and challenges.

Green Activity	Benefit	Challenge	Authors
Purchasing	1) Reduces waste and liability cost; 2) Builds a "green" corporate image	High set up cost Requires management commitment and company-wide standards	Karpak et al., 2001; Min and Galle, 2001; Rao and Holt, 2005; Chen, 2005 ; Large and Thompson, 2011; Green et al., 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	Curmine et al., 2004; 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	Vannieuwenhuyse et al., 2003.

Source: adapted from Guide, 2000.

This discipline points to measure and minimize the ecological impact of logistic activities also through advanced technologies and equipment (Thiell et al., 2011), in order to reduce toxic emissions, resources consumption, and to gain a long-lasting sustainable development (Harris et al., 2009). In literature, this topic is often considered a part of Green Supply Chain Management (GSCM), being oriented to environmental issues integration into "closed-loop

supply chain management" (Chan et al., 2012). The greening of logistics is generally based on the action of three main players (Chunguang, 2008): 1) *Government* that should make law and regulations effective; 2) *Enterprise* that should put supply chain management in practice; 3) *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 affect competitive advantage and the green image of logistic organizations?

2.2. Green Supply Chain Management and emerging technologies

In recent years, the public awareness of environmental conservation, the emerging need for sustainable development and environmental legislation (Lau, 2011) have led a growing number of scholars and practitioners to focus their researches on GSCM. At the same time, an increasing number of 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. This activity 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). 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). Furthermore, 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). Logistics is one of the main components of SCM being focused on products distribution to the right place, at the desired time, and in the optimal quantities. In literature, an increasing number of 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 (tab. 2). 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):

1) *Green Supply Logistics*, related to the greening of traditional logistic processes;
2) *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;
3) *Green sales logistics*, related to the optimization of transport routes and the building of a "green" sales network; 4) *Reverse Logistics,* related to planning, implementing, and controlling the efficient, cost effective flow of raw materials, process inventory, finished goods and related information from the point of consumption to the point of origin for recapturing value or proper disposal.

Table 2: GSCM main definitions.

Definition	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*	Svrivastava et al., 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 et al., 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.

Moreover, others researchers have 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, green technologies have helped organizations to use methods and materials with a low impact on natural resources. In logistics, Information and Communication Technologies (ICT) are generally related to supply chain performances, cooperation, process improvement, data sharing, and a general costs reduction (Panayides and So, 2005). Moreover, Green Technologies have a positive influence on network integration, and competitiveness development (Wagner, 2008), also thanks to product and/or process innovation promotion.

2.3 Green innovation for logistics competitiveness and sustainability

In logistics, innovation is not only oriented to environmental burden reducing, but it also represent a fundamental driver in competitive enhancement. In literature, 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). Logistic innovative processes represent an interesting and emergent field of research and practical applications, because innovation can contribute to improve services efficiency and effectiveness (Lin and Ho, 2008). 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 is generally based on 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 Linden, 1995, pp. 64- 66): 1) *new technologies and approaches*, dedicated to the reduction of costs related to pollution dealing; 2) *improvement of resources productivities*, based on a more efficient use of inputs.

Innovations and in particular green innovations led to a more productive inputs management, in order to balance the costs needed to make organizations environmental-friendly. The link between SCM, innovation, and competitiveness has been investigated by a limited number of researches, while a growing number of scholars have analyzed the links between GSCM, green technologies and innovation, and their influence on competitiveness and performance improvement. These results 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, environment-friendly companies generally aims to a sustainable development that requires "fundamental transformations in technologies, industries and lifestyles (so-called sustainability transitions)" (Truffer and Coenen, 2012, p.2). Sustainability has had a lot of different interpretations and definitions emerging from various disciplines, nevertheless this concept is generally related to a responsible use of resources in order to meet the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987). 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). In this context, innovation is generally oriented to gain energy efficiency, reduce companies' dependence on fossil fuels, and to introduce green and renewable source of energy. Many academic researches have 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.

3. Methodology and conceptual model

In literature, the selection of a specific research method is related to: 1) the nature of the research problem, thus a case studies approach is generally chosen when a research is based on "how" and "why" questions; 2) the degree of control over events, when a small number of case studies or surveys are applicable; 3) 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 theoretical framework (2005), measured through the survey of some organizations active in the South East Asia region. The framework is made up of five latent constructs: 1) greening the inbound function of the supply chain; 2) greening production; 3) greening the outbound function; 4) competitiveness; 5) economic performance. In particular, the "*Inbound function*" is related to the benefits that an organization can achieve adopting a green approach to supply chain management 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: I) holding awareness seminars for suppliers and contractors; II) guiding suppliers to setup their own environmental programs; III) bringing together suppliers in the same industry to share their know-how and problems; IV) informing suppliers about the benefits of cleaner production and technologies; V) urging/ pressuring suppliers to take environmental actions; VI) 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. This function can be analyzed according to eight variables: I) environmentally-friendly raw materials; II) substitution of environmentally questionable materials; III) taking environmental criteria into consideration; IV) environmental design considerations; V) optimization of process to reduce solid waste and emissions; VI) use of cleaner technology processes to make savings in energy, water, and waste; VII) internal recycling of materials within the production phase; VIII) 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: I) environment-friendly waste management; II) environmental improvement of packaging; III) taking back packaging; IV) eco-labeling; V) recovery of company's end-of-life products; VI) providing consumers with information on environmental friendly products and/or production methods; VII) 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: I) improved efficiency; II) quality improvement; III) productivity improvement; IV) 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 green supply chain management on economic performance are the following: I) new market opportunities; II) product price increase; III) profit margin; IV) sales; V) market share.

4. DHL

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 focused 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 CO2, 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 according Rao and Holt (2005) conceptual model has led 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 (tab.3), DHL believes that successful projects have to be based on partnership's 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 same process and value (*www.dhlsupplychainmatters.dhl.com*).

Table 3: Inbound function

1. Inbound function	
FACTOR	**ACTIONS**
I. Holding awareness seminars for suppliers and contractors	Best practice sharing, learning, relationship improvement.
II. Guiding suppliers to setup their own environmental programs	Supplier Code of Conduct, suppliers ethical guidelines
III. Bringing together suppliers in the same industry to share their know-how and problems	Open dialogue, online and offline communication
IV. Informing suppliers about the benefits of cleaner production and technologies	Online and offline communication
V. Urging/pressuring suppliers to take environmental actions	Promotion of suppliers adherence to human rights, ethical, health, safety and environmental standards
VI. Choice of suppliers by environmental criteria.	Multi-step tendering process, based on Cost-effectiveness, quality and ethical criteria.

Source: our elaboration

In particular, DHL manages its relationship with suppliers through a "Supplier Code of Conduct" (*www.dhl.com; www.unglobalcompact.org*), which sets the standards for their activities also in terms of environmental programs. This 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; www.unglobalcompact.org*), in order to make them as compliant as possible with its principles and activities. Finally, suppliers are selecting according to a multi-step tendering process based also on cost-effectiveness and quality evaluation (*www.dpdhl.com).* The "Greening production" function (tab.4) 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; www.dhlsupplychainmatters.dhl.com; DHL Supply Chain GoGreen Agenda, 2008*).

Table 4: Greening production function

2. Greening production	
FACTOR	**ACTIONS**
I. Environmentally-friendly raw materials	Paper and printed matter; packaging; site consumables, energy reduction.
II. Substitution of environmentally questionable materials	Replacement of fluorescent lamps with large-scale installation of LED to reduce carbon emissions and energy consumption.
III. 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.
IV. Environmental design considerations	Flat packaging design related to storage space, and time for assembly reduction.
V. Optimization of process to reduce solid waste and emissions	Innovative solution to recycle 100% of raw material; transition to alternative fuels, optimization of carbon efficiency, and increasing environmental awareness among its employees.
VI. 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 U.S. network to provide enhanced shipment visibility for customers.
VII. Internal recycling of materials within the production phase	Collection of waste at the back door, taking material away to a MRF, organics waste management.
VIII. Incorporating environmental total quality management principles such as worker empowerment.	International environmental standard, such as ISO 14 001 certification

Source: our elaboration

For example, the company has replaced all fluorescent lamps with LED lighting to reduce carbon emissions and energy consumption (*www.dhl.com; www.dhl.com.jp*). In terms of current activities, DHL respects the main environmental international protocols (*www.unglobalcompact.org; 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; White paper 2012).* DHL have used its recycling and supply chain expertise to design and implement an innovative solution to recycle up to 100% of raw materials. In terms of wastes management, DHL often collect 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).* 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). The third function "Greening the outbound function" (tab.5) 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; www.businesswire.com; www.dhl.co.in).*

Table 5: Greening the outbound function

3. Greening the outbound function	
FACTOR	**ACTIONS**
I. Environment-friendly waste management	technical knowledge and expertise for reverse logistics, including used products collecting and recycling for final disposal.
II. Environmental improvement of packaging	new packaging range made from 100% 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.
III. Taking back packaging	No evidence has been found.
IV. Eco-labeling	QR code to give consumers all of the tools and information they need.
V. 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)"
VI. Providing consumers with information on environmental friendly products and/or production methods	No evidence has been found.
VII. Use of environmental-friendly transportation	new product for the shipment of bulk non-hazardous liquids, reduction of fuel consumption, environmentally-friendly trial vehicle test.

Source: our elaboration

The company has developed a new 100% 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*). 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; www.2dbarcodestrategy.com*). In terms of recovery end-of-life products, company has improved the reuse and recycling of paper, and has also developed "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; www.dnaindia.com; www.worldpackagingnews.com).* DHL has 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).* 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 (ww*ww.dhl.fr/en/press/releases/releases_2008/local/150408.html;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 FIDEUS (Freight Intelligent Delivery of Goods in European Urban Spaces) European Research Program *(www.dhl.fr; https://ec.europa.eu; www.gmartinesdesign.com).* In terms of "Competitiveness" (tab.6), 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; Logistic 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://mhlnews.com; www.supplychainbrain.com).* In particular, DHL achieved this certification in over 100 countries across the Americas, Asia Pacific and Europe. The improvement of corporate productivity represents another goal, which company aims to achieve through bottom-up initiatives oriented to a continuous improvement. Lean transformation are considered very important in terms of sustainable productivity and quality improvements, because of it contribution in supply chain efficiency and responsiveness.

Table 6: Competitiveness factor

4. Competitiveness	
FACTOR	**ACTIONS**
I. 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.
II. Quality improvement	Adoption of best practices across all functions and regions; ISO 9001:2008 certification, CO2 emissions reduction, quality and speed of delivery improvement.
III. Productivity improvement	bottom-up initiatives driven by a culture of continuous improvement; Lean transformation.
IV. Cost savings	No evidence has been found.

Source: our elaboration

The last function, "Economic performance" (tab. 7), showed that in terms of new market opportunities, DHL has focused 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;* Annual Report, 2012; 2013).

Table 7: Economic performance factor

5. Economic performance	
FACTOR	**ACTIONS**
I. New market opportunities	Asia Pacific would become the largest contract logistics market by 2016, due to the economic weakness of western Europe.
II. Product price increase	DHL annual price increase is targeted first and foremost at ensuring a competitive, sustainable value proposition for customers.
III. 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% between 2010 and 2015.
IV. Sales	With no enterprise-level view of customer information, there was little or no opportunity to improve sales and marketing efficiency.
V. Market share.	In 2013, DHL is leading player in the contract logistics market with 8 per cent 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% more than the prior year.

Source: our elaboration

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;* 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*). 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 have also forecasts a consistent earnings rising (between 13% and 15% between 2010 and 2015), even if it is quite difficult gaining benefits from shared sales and marketing campaigns (*hwww.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*).

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%. In the European road freight market, the growth remained slow at an estimated –1% to 1% (previous year: 0% to 2%), 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, 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. According to literature review and DHL case study, 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 respond to the second research question (*How green innovation affect competitive advantage and the green image of logistic organizations),* because of green innovation contribute to competitive advantage achieving, making organizations able to gain cost savings, a better product quality, and increase their efficiency and productivity. Consequently, these results contribute to competitive advantage improvement, making companies stronger than competitors and, of course, able to enter new markets. This ability is also related to stakeholders' better perception of corporate image, and companies' ability in new barriers creation to limit market access to other competitors.

In logistics, green product and process innovations are even more important because they contribute to give a good response to stakeholders' environmental pressures. On the other hand, green managerial innovation may not seems directly linked to environmental performance improvement, because the integration of a sustainable approach into current

business strategies is not so common (Chiou et al., 2011). Therefore, this study suggests that companies should work closely with their suppliers to achieve environmental goals and to acquire a better positioning than their competitors. This cooperation, based on a direct company- suppliers dialogue, and on a suppliers concrete environmental-friendly orientation, contribute to make them able to respond to market and environmental regulations requests, in order to build and maintain a "sustainable competitive advantage in the global market" (Chiu et al, 2011), which is directly relate to the general improvement of sales, profit margin, and market share. Consequently, an effective Green Logistics management can led not only to an operational and economic performance improvement (Alvarez et al., 2007), but also to a long-lasting competitiveness reinforcement (*Rao, 2003).* This research area still represents for practitioners, academicians and researchers a source of interesting challenges. Consequently, integrative studies will contribute to advance this research field, also thanks to a better diffusion of best practices, green technologies transfer and environmental performance measurement. Concluding, research findings cannot be generalized to all logistic organizations, even if DHL is on of the most important and globalized logistic companies. Future research should empirically test the results achieved through this analysis, also thanks to comparative studies based on a large sample.

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