

Greening Logistics Centers : The Evolution of Industrial Buying Criteria Towards Green*

Ceren ALTUNTAŞ** · Okan TUNA***

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Abstract

The rapidly globalizing world trade requires longer supply chains with higher attention on the environmental effects of logistics activities. Latest international conventions related with environmental regulations reinforce governments and corporations to adhere to environmental protection precautions. An effort to decrease the negative environmental effects of logistics activity is the geographical concentration of logistics companies which are called logistics centers. This study aims to provide a green industrial service buying approach for the industrial customers of logistics centers. The study combines green purchasing literature with previously developed environmental performance indicators (EPIs) and develops a green industrial buying model for logistics centers. The model provides a framework for potential residents of a logistics center and supports their industrial buying processes. The model also serves as an input for green industrial service design in a logistics center.

Key Words : Logistics centers, Environment, EPIs, Green buying

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** Lecturer, Yasar University, Turkey, Email : ceren.altuntas@yasar.edu.tr

*** Professor, Beykoz Vocational School of Logistics, Turkey, Email : okantuna@beykoz.edu.tr

I. Introduction

In the rapidly globalizing world with its highly integrated and continuously demanding global markets, the supply chains of today face many challenges when compared to their predecessors. Many intermediaries which were established depending on the requirements of logistics industry keep evolving due to this transformation in the business and new areas of outsourcing. Third party logistics service providers (3PLs) are no longer solely enough for the companies that demand a much more integrated service from a specialist coordinator and this creates the term fourth party logistics service providers (4PLs) which are asset free companies that coordinate 3PLs with the help of information technologies in order to provide full supply chain solutions to their customers.

The evolution is not over though. With the aims of a seamless integration of global supply chains, increased speed of transshipment between transportation modes, new value added service offerings which can postpone the finalization of manufacturing until the last node before the customer, logistics service buyers now tend to demand one stop shops in which they can find every logistics service they seek. So the fragmented logistics services are started to get together in special areas called inland ports, distribution centers, intermodal terminals and finally logistics centers. Despite the different names and different service context they offer, there is a one common point among all these concepts. They are all logistics service clusters, where logistics companies, suppliers, support service providers, related industries and institutions are geographically concentrated¹⁾ and they try to solve the problem of integration.

Considering economic dimension as a fundamental prerequisite in order to survive in today's highly competitive environment, logistics centers also play a very important role in the international and national sustainability targets as they mainly lean on environmentally friendly transportation modes. Their aims to remove the logistics activity from city centers in order to eliminate urban pollution, transfer high volume freight moving on roads to rail and maintaining a high environmental management standard within the center boundaries are all effective factors in terms of green logistics. Therefore,

1) Porter(2008).

logistics center projects are also inline with international conventions like sustainable development,²⁾ Kyoto Protocol³⁾ and European initiatives like the White Paper on transport.⁴⁾

Under the light of these developments and international initiatives effecting the adoption of environmental approaches in logistics decisions, the aim of this study is to combine green purchasing literature with EPIs and propose a green industrial service buying model from logistics centers. This exploratory model will provide an enhanced understanding of the green logistics center concept and how the organizational buying criteria should be developed in order to comply with green purchasing norms for the industrial customers of logistics centers.

The first part of the study reviews the literature on logistics center concept. The second part combines green purchasing concept and practices with the logistics center facilities. The third part draws a green industrial buying model from logistics centers through the utilization of a comparison method between two studies in related fields. Finally in the conclusion part results, limitations and future studies are discussed.

II. The Logistics Center Concept

Logistics centers act as intermodal transportation hubs in an either local or international nodes and links system and they provide several valuable collection, logistics and further distribution activities while transferring freight from one mode to another.⁵⁾ This nodes and links system may be located in the hinterland of one or more sea-ports⁶⁾ so they are a part of the global supply chain of goods passing through the pipelines of different transportation facilities. They are either a supplier or a customer of a seaport, a railway company or a trucking company and they supply or buy industrial service.

An official definition of a logistics center is made by Europlatforms,⁷⁾ the European Association of Freight Villages, in which the members emphasize:

2) WCED(1987).

3) UNFCCC(2012).

4) EC(2001).

5) Notteboom(2009).

6) Iannone et al.(2007).

7) Europlatforms(2012).

1. intermodality by referring to several transportation modes,
2. the coverage area which may both be national or international,
3. the availability of freely competing different logistics service operators,
4. the supporting services for the fundamental facilities,
5. the management structure which is a single body either public or private.

There are many other efforts to define and classify logistics centers academically.⁸⁾ Using freight village term synonymously logistics centers are defined as *logistical interconnection points within a logistics network that primarily function as an interface between local and long-distance goods transport.*⁹⁾

There are classifications depending on their geographical coverage.¹⁰⁾ This classification depends either on the proximity to sea-ports or to the level they serve. Proximity to sea-ports is an important issue in terms of the intermodality dimension as a close center serves as the dry extension of the sea-port with larger land available for storage and transshipment. The short connection between the sea-port and the dry port is preferred to be by rail but rail is generally not an economic mode for short hauls.¹¹⁾ The inland ports which are located in farther areas from sea-ports utilize much more from rail connections due to the long haul and productive rail haulage in between. The other subdimension of geographical coverage is about the level the center serves which may be domestic, interregional or international.¹²⁾

Business generation for the stakeholders it serves is another essential part.¹³⁾ The stakeholders of a logistics center are mainly its customers who buy industrial logistics services from them, its suppliers who sell the industrial logistics services and required infrastructure in its boundaries, the public authorities that are either deciders or policy makers and sometimes are directors of logistics centers and the civil society that is influenced in a way by its operations. As in a recent report published by Deutsche GVZ-Gesellschaft mbH (DGG),¹⁴⁾ the logistics centers should provide a synergy and innovation opportunity which may require further revisions in singular

8) for a detailed analysis of definitions please see Meidute(2005) ; Rimiene and Grundey(2007).

9) Winkler & Seebacher(2011).

10) Nathanail(2007) ; Rimiene & Grundey(2007).

11) Tsamboulas & Tatsi(2010).

12) Rimiene & Grundey(2007).

13) Meidute(2005).

14) DGG(2010).

organizational structures for the tenants located within.

Combining all the emphasized dimensions, the logistics centers definition adopted for this study is: *inland nodes of seaports and global supply chains which are accessible through more than one mode of transport and which provide value added logistics services according to the demands of the customers existing within the geographical coverage through the governance of a single logistics center operator serving to a large number of service providers accommodated in the same area.*¹⁵⁾

By exploring all these definitions and classifications of logistics centers, it was observed that an environmental emphasis is missing when conceptualizing these clusters. Logistics centers are established in order to contribute to environmental protection.¹⁶⁾ Transportation holding the first row, the energy consumption, packaging, purchasing and reverse logistics activities¹⁷⁾ all incur separate negative effects on the environment. Only transportation itself, is accounted for the 13% of all GHG emissions of the world and 24% of CO₂ emissions in 2006.¹⁸⁾ European policy makers aim to reduce CO₂ emissions by 60% as of 2050 when compared to its levels in 1990 and reduce the transport industry's dependence on oil industry by introduction of decarbonised transport.¹⁹⁾

Logistics centers are aiming to eliminate these adverse effects as they are intermodal terminals where the cargo carried by road transport is transhipped to railways where CO₂ emission levels are much more lower. They have a special role on the development of green corridors on transportation networks.²⁰⁾ They also provide logistics areas out of the city centers and thus eliminate heavy congestion of freight transport in urban areas.

Because logistics centers claim to be a solution for the negative impacts of different logistics activities on the environment, establishment of the link between green organizational buying and logistics centers is required to promote the service purchasing from these centers on an environmentally friendly basis.

15) Altuntas & Tuna(2011).

16) Tsamboulas and Dimitropoulos(1999).

17) Wu and Dunn(1995).

18) ITF(2009).

19) EC(2011).

20) Panagakos and Psaraftis(2011).

III. Industrial Services and Green Purchasing

1. Industrial Services Provided by Logistics Centers

The industrial markets are the markets where the transaction takes place between organizations and for the purpose of further production of goods and services that are sold, rented or supplied to others.²¹⁾ The services that are being sold to organizations by other organizations in order to support or facilitate the production or consumption of goods or services are called industrial services.²²⁾ Logistics, together with its all separate activities, takes place under this class. Logistics services are further classified under industrial services as facilitating services which are defined as “all those services offered to facilitate the productive operations of organizations including the provision of finance, storage, transport, promotion, insurance etc.”²³⁾ Although the logistics activities have a hybrid nature with tangible elements like warehouses, trucks, containers and intangible elements like expertise of transportation organization or inventory management; they are evaluated as business services by their customers.²⁴⁾

Taking these classifications as basis, the service provided by logistics centers can be classified as an industrial service so the logistics center is a supplier of different industrial services to organizations.

There are many different industrial services provided by logistics centers. Besides the traditional logistics functions like shipping and receiving, freight forwarding, transportation (especially intermodal) storage, order picking, break-bulk, freight consolidation and deconsolidation, containerization, maintenance and repair, stuffing and unstuffing, customs clearance; some other value-added services like packaging, labeling, kitting, bar-coding, quality control, final assembly are also examples of services offered by logistics centers. In order to provide these, a strong infrastructure, transportation facilities, warehouses, information and communication technologies are required in these areas.

21) Kotler and Armstrong(2008).

22) Marrian(1968).

23) Marrian(1968), p. 23.

24) Wagner and Busse(2008).

2. Industrial Service Supply Chain in a Logistics Center

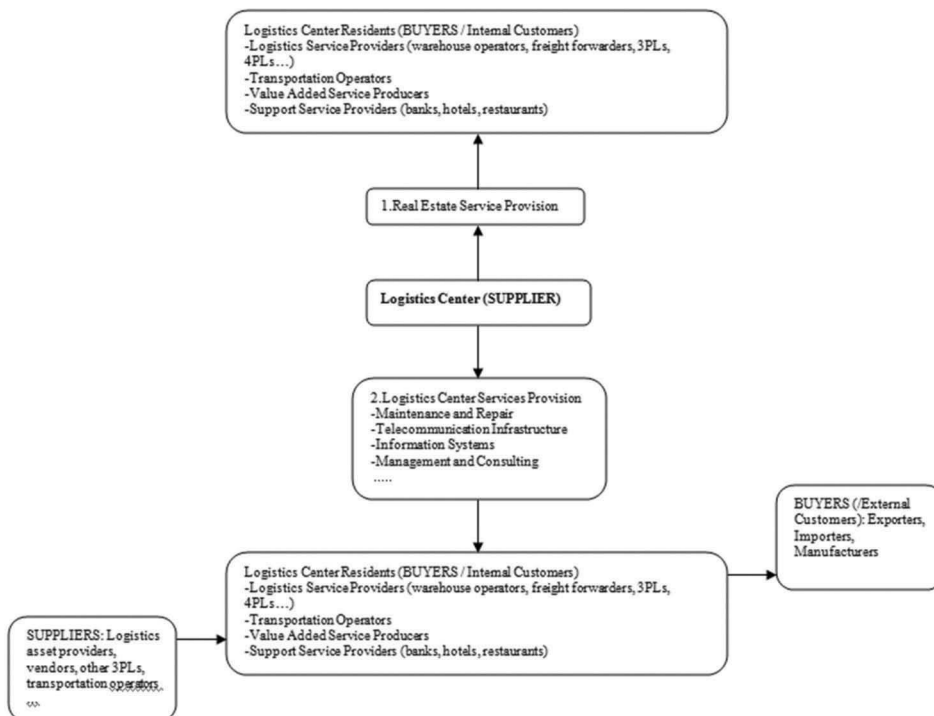
The primary industrial customers that these services are offered for can be summarized under two main headings: (1) the importers, exporters or cargo owners (2) the logistics service providers (including transportation services operators) operating in the logistics center or considering to carry their operations to the logistics center.²⁵⁾ There are other service providers which are composed of banks, restaurants, insurance companies, public offices and the like and these generally supply secondary services. The goods and services flow in and out of the logistics center constitutes an industrial service supply chain.

This industrial supply chain has a twofold structure in terms of service design (Figure 1). A logistics center is actually a real estate company. The logistics center owners/management establish a facility and offer rental facilities of warehouses, consolidation centers, value added service plants, restaurants, hotels, banks and such. The logistics service providers, transportation operators, support service providers, exporters or importers rent these facilities and they start to produce their services. During this service production, there are some supplementary services which are demanded by the residents of the logistics center from the management. A non-exhaustive list can be stated as maintenance and repair, consulting and management, information system operations and telecommunication infrastructure building.

Once the logistics center establishes these services, there are two groups of customers buying service from this place: internal and external customers. The internal customers are the residents of the logistics center like 3PLs, 4PLs, warehouse operators, retailer depots or support service providers. The external customers are the exporters or importers who buy services from the internal residents of the center. So the industrial service supply chain is integrated in such a way that the flow between these members is smoothly transacted by the facilitating services of the logistics centers.

25) Altuntas and Tuna(2011).

<Figure 1> Industrial service supply chain of logistics centers
(The general structure)



As seen on Figure 1 the logistics center provides a twofold industrial service to the logistics center customers. The first one is the real estate service provision for the internal customers who demand land and facilities from the center. The second one provides the facilitator services produced by the logistics center authority like information and communication technology services, maintenance and repair, consulting services for business generation. Here the internal customers are the direct buyers of these industrial services. These internal customers also work with suppliers like shipping lines, truck vendors or other 3PLs located out of the logistics center and they provide services to the shippers and manufacturers. Although being located out of the logistics center, these shippers and manufacturers are affected by the quality and characteristics of the service that they are buying from these service providers which will vary depending on the performance of the logistics center as a whole. So despite being located outside, they should be included in the industrial customer list of a logistics center.

2.Green Purchasing

Either due to the forced regulations by state authorities or the growing concern on the deterioration of the natural environment, organizations have increased their attention on practices with negative impacts on the environment.²⁶⁾ This attention is not solely on an organization's own activities like production or marketing but also on its suppliers' activities. This focus brought the concept of green purchasing and this concept has an important effect on several supply chain practices.

Green supply chain practices focus on managing the supply chain in a way to reduce negative environmental impact and monitor the efficient usage of resources.²⁷⁾ Green purchasing focuses on buying products with green ingredients, buying green semi-manufactures, organizing delivery schedule in an environmentally friendly way and inspecting purchased products with green criteria.²⁸⁾ A broader term is green supply where the supply side of the logistics activities are being controlled in terms of environmental efficiency. Green supply has two different subdimensions. The first one mainly deals with green supplier management where the purchasing organization tries to assess and improve the environmental capabilities and performance of its suppliers. The second one deals with the green products where the focus is on the products which are being purchased. Recycling, reducing waste, elimination of hazardous destruction processes are all examples of this type of green supply.²⁹⁾

As the supply chain consists of many different organizations facilitating the flow of goods and services from the point of origin to the point of final consumption, the green supply managed in between the members of these chains can be defined as the green industrial buying process. Because every industry and every supply chain level intersecting with different industries have their sector specific structures, the green industrial buying practices vary among them. For example, the green purchasing in iron and steel enterprises is totally different as the suppliers in the industry are generally the largest energy and resource consumers and worst polluters.³⁰⁾

26) e.g. Berry and Rondinelli(1998) ; Hart(1997) ; Schmidheiny(1992) ; Schaltegger et al.(2003).

27) Walton and Handfield(1998).

28) Qianhan et al.(2010).

29) Bowen et al.(2001) ; Rao & Holt(2005).

30) Pang et al.(2011).

Although the logistics centers are claimed to be environmentally friendly due to the increased usage of transportation modes with lower carbon emissions like rail and removing high dense logistics activity from the city centers to aggregated areas, there are still concerns due to the efficiency and accumulation pressures on these places. As the throughput of freight coming in and out of a dry port increases and these are transported on long distance within shorter time periods, the environmental impact of this accumulation would increase due to the dense transportation activity.³¹⁾ So greening the logistics center is crucial for both its developers and managers and also for the industrial customers that are buying services from the center.

Transportation sector is highly dependent on oil industry and consuming a significant portion of overall energy – 24 % of all energy in the world,³²⁾ 31 % of all energy consumed in Europe. Road transportation has the largest share in this rate with 83 %. Logistics clusters and their impact areas are expanding in Europe. For example in trans-European network for transport (TEN-T) 30 main European transport routes from different modes are included and it keeps expanding. By 2020, it is targeted to reach 89.500 km of road, 94.000 km of railways, 210 inland ports and the network will be connected to 294 seaports and 366 airports.³³⁾ These clusters will increase the environmental impact of logistics facility which is geographically concentrated in certain areas.

Considering all these dimensions and definitions of green purchasing, it can be assumed that the framework for green industrial buying from logistics centers needs established criteria for assessing the environmental performance of a logistics center and the shared practices to improve its performance by the members within the center. Greening the industrial services provided by them should be demanded and monitored by the customers. The next section of the study proposes a model based on the industrial buying criteria of the potential buyers of a logistics center with regard to the environmental performance indicators (EPI) and

31) Haralambides & Gujar(2012).

32) ECMT(2007).

33) Eurofound(2008).

IV. Green Industrial Buying Model Development

1. Methodology

This study attempts to integrate industrial buying criteria with green purchasing purposes in a logistics center. The study can be regarded as an exploratory research design through the adoption of a conceptual approach depending on the literature review. In order to achieve this aim, the services being bought from a logistics center which are represented by Figure 1 are combined with an environmentally friendly approach depending on the previous literature developed for green purchasing.³⁴⁾

The literature divides the green purchasing process into two phases which are 1) green product purchasing and 2) supplier evaluation and improvement with an environmental approach. This study evaluates the industrial service buying process under these two phases and combines the buying model with EPIs developed in previous studies.³⁵⁾

EPIs are common yardsticks which can be used while evaluating the environmental performance of a certain facility. The existing EPI development efforts are reviewed and listed. After the industrial service buying model is divided into two phases of green purchasing, the EPIs are distributed to these phases depending on their characteristics

2. Model Development and Proposal

In this part of the study, a framework for environmental evaluation criteria of industrial service buying from logistics centers is attempted to be built. Several approaches to environmental performance indicators (EPIs) are reviewed. In the end, selected criteria are classified among the two facets of green purchasing process.

1) Environmental Performance Indicators (EPIs)

Environmental performance indicators (EPIs) are common yardsticks used to measure and motivate the environmental performance of a business.³⁶⁾ They provide help in terms of standardization while checking out the position of a certain enterprise in terms of environmental goals and targets. They are

34) Min & Galle(1997) ; Rao & Holt(2005) ; Chen(2005) ; Noci(1997).

35) Ditz and Ranganathan(1997) ; Handfield et al.(2002) ; Henri & Journeault(2008).

36) Ditz and Ranganathan(1997).

also used by Environmental Management Accounting (EMA) to measure environmental impact, regulatory compliance, stakeholder relations, and organizational systems.³⁷⁾ There are several different approaches towards the establishment of common EPIs,³⁸⁾ however, when the subject matter is the environment not all EPIs are easy to measure by the interested stakeholders.³⁹⁾

Table 1 shows the EPIs used in this study and their sources. Handfield et al⁴⁰⁾ developed the EPIs from a literature review study which is purified after a Delphi study conducted with supply chain managers of Fortune 500 companies. Ditz and Ranganathan⁴¹⁾ proposed a leaner EPI model that would be universally applicable to all companies independent of the industry that they are operating in. Henri and Journeault,⁴²⁾ conducted a survey research using the EPIs offered by ISO 14031 performance evaluation guidance.

<Table 1> Environmental performance indicators

Handfield et al, 2002	Ditz & Ranganathan, 1997	Henri & Journeault, 2008 (from ISO 14031)
Public disclosure of environmental record	Materials Use	Conformity with requirements or expectations
Second tier supplier environmental evaluation	Energy Consumption	Inputs of energy
Hazardous waste management	Non-product Output	Community relations
Toxic waste pollution management	Pollutant Releases	Outputs of solid waste
On EPA 17 hazardous material list		Outputs of air emissions
ISO 14000 certified		Financial impact
Reverse logistics program		Installation, operation, and maintenance of the physical facilities and equipment
Environmentally friendly product packaging		Outputs of waste water
Ozone depleting substances		Inputs of raw materials
Hazardous air emissions management		Inputs of water
		Implementation of environmental policies and programs
		Inputs of auxiliary materials
		Indicators providing information on the local, regional, or national condition of the environment

Green purchasing needs to use specific EPIs in order to establish a solid

37) Illinitch et al(1998) ; Veleva and Ellenbecker(2000).

38) see Ditz and Ranganathan(1997) for a detailed discussion.

39) Handfield et al.(2002).

40) Handfield et al.(2002).

41) Ditz and Ranganathan(1997).

42) Henri and Journeault(2008).

framework for the evaluation of suppliers in terms of their environmental performance. When the two facets of green purchasing are taken into consideration, these EPIs should be able to assess both supplier evaluation and improvement and purchasing green products (or services). Also the EPIs of a steel factory would be different from a food producer or a hospital as different enterprises have different processes which constitute different types of risks in terms of the environment. So the EPIs to assess a logistics center would again be different in terms of the services produced in such a facility.

2) The Green Industrial Service Buying Criteria Model for Logistics Centers

As stated by Figure 1, logistics centers are both real estate companies and service providers for their inhabitants. The service that they produce has a hybrid structure with many tangible assets like buildings and infrastructure and with an intangible part like the executed services.

By taking into consideration the previous EPI classifications and the ISO 14031 Environmental Management System performance evaluation guidance, a green purchasing model is proposed in order to evaluate this hybrid service produced by logistics centers.

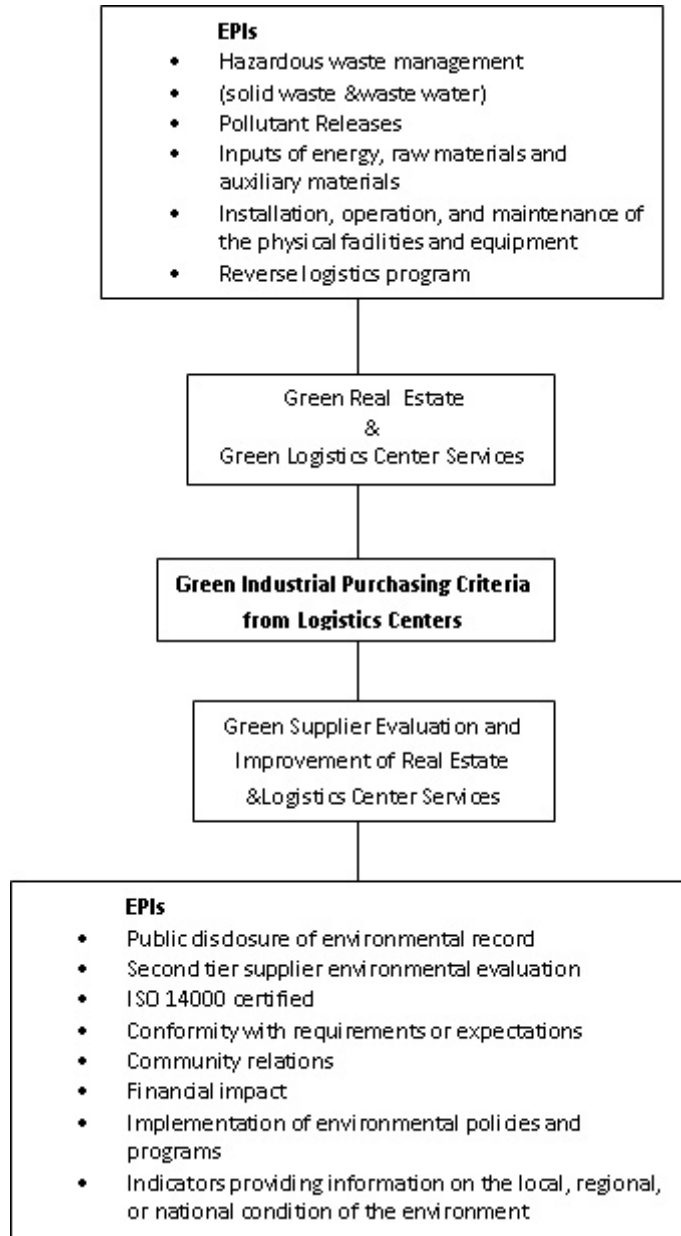
By combining these EPIs with the industrial service structure of logistics centers stated in Figure 1, the green assessment model for the industrial services of a logistics center is proposed in Figure 2.

While evaluating the environmental performance of a logistics center, it is important to differentiate the greenness of the service being purchased and the way the logistics center manages its environmental performance. The model being proposed here divides the environmental evaluation process into two as suggested by Bowen et al.⁴³⁾ and Rao & Holt.⁴⁴⁾ The potential customers of a logistics center here could use the upper criteria to assess how green are the facilities being rented by the logistics center and how green are the services being produced by the center.

43) Bowen et al.(2001).

44) Rao & Holt(2005).

<Figure 2> Green industrial service evaluation criteria from logistics centers



The green service part is related with inputs of energy, water, auxiliary products and raw material that are going to be used in the service production process of logistics centers. Also there will be outputs of solid waste, air emissions and waste water. As the product of a logistics center is an industrial service it also carries service characteristics of perishability, homogeneity,

inseparability and intangibility. Due to their inseparability feature, the service inputs and outputs would be hard to trace separately. The monitoring of inputs and outputs should be synchronized.

This monitoring of the green product (in this case green service) can be done on two facets: source reduction and waste elimination.⁴⁵⁾ Ability to recycle and reuse all materials being utilized for service delivery like energy or packaging material would contribute to the green emphasis in a logistics center. Also heavy energy or water consuming inputs can be examined to be replaced with more purified resources like renewable energy instead of coal. Both of these are also valid for outputs of solid or liquid waste and air emissions so service producers should seek for ways to eliminate waste production while turning inputs to outputs. Noci⁴⁶⁾ lists these criteria under the heading of “Current Environmental Efficiency”.

By greening the service they are offering, logistics centers would compound their one stop shopping advantage with an environmentally sensitive approach. However, this must be undertaken together with its stakeholders during service design and communicated throughout the whole process. This cooperation with stakeholders would contribute to the legitimacy, knowledge and complementary resources capabilities of logistics centers.⁴⁷⁾

The second part of green industrial buying from logistics centers is related with supplier evaluation and improvement. The supplier here is the logistics center as a whole. However, the logistics center contains many individual logistics service operators within, so both the green product dimension and supplier evaluation and improvement dimensions should be managed in two stages. As the individual service operators established inside the logistics center develop greener services themselves and manage their green performance, this will also contribute to the green performance of the logistics center as a whole. So the evaluation process and evaluation criteria should be developed according to this approach.

The evaluation criteria for individual logistics service providers, exporters, importers and the support service providers in the logistics center should be developed in partnership with the logistics center management. This is the service design done together with the customers as these entities are the

45) Min & Galle(1997).

46) Noci(1997).

47) Wu & Haasis(2011).

customers of the logistics center in the same time. Their green performance should be evaluated both by themselves and by the logistics center management in order to sustain good community relations and in order to secure conformity with regulations or expectations. This service design and improvement process should be monitored in terms of the costs and the cost of offering a green service by the logistics center should be evaluated on a total cost mentality; together with its social and environmental costs to society as a whole.

The supplier evaluation and improvement part of green purchasing criteria is mainly related with the management style, legislation, extensive planning and costs. The green service design is a strategic management issue so any ability to evaluate the industrial service that is going to be bought from a logistics center will be closely related with the management style, the duty distribution and ownership structure of the facility. If customers want to improve the green performance of the logistics center, they should develop specific criteria according to the one stop shopping feature of the logistics center, a special internal policy for the center and special legislation for a place that will accumulate a high volume of logistics activity.

V. Conclusion

This study focuses on green purchasing concept and makes an attempt to converge green purchasing terms to green industrial service buying criteria from logistics centers. The model is an original approach in terms of adopting green purchasing principles to industrial services and combining it with previously developed EPIs which are suggested to be included in green industrial buying processes from logistics centers.

There are some initiatives which resemble to a green logistics center in terms of their development targets. Japanese Eco-Towns, which are a form of industrial cluster, aim to develop centers for recycling, waste management and zero emission industry with innovative methods.⁴⁸⁾ However, these areas serve to industrial production mainly. Logistics centers produce logistics services and light transformations instead of heavy industrial activity. In this respect,

48) Higuchi and Norton(2008).

this study makes an original conceptualization effort for green services buying from logistics centers.

Due to the characteristics of services, the service production and consumption takes place at the same time. In some projects the greening objective is secured through joint participation in ecological design of products, providing technical assistance to suppliers and letting suppliers manage environmentally friendly inventory management and packaging.⁴⁹⁾ Similarly, here in the logistics centers, the customers that will require the green criteria while purchasing a service will also be the partners when these criteria will be met. This is a mutual process which needs to be developed under the light of common strategic objectives.

Sustainable development of freight villages is an important and strategic issue for both the success of the logistics center itself⁵⁰⁾ and the success of national and international policies. However, developing a logistics center alone does not satisfy the environmental objectives, an environmental evaluation and management approach is required both for the developers and the customers of the center. The creation of a green logistics center would require organization-specific service design inline with potential environmental requirements and service structure. The model developed in this study can be used as an input for green service design in logistics centers.

To the best of our knowledge, green purchasing from logistics centers is a relatively underlooked area of logistics literature. Further studies in order to build models and test the above mentioned criteria in terms of their green weights would shed the light for future green service design attempts in logistics centers. Bechmark analysis of few green logistics center initiatives and management studies on green clusters are also future areas to be studied.*⁵¹⁾

49) Qianhan et al.(2010).

50) Wu and Haasis(2011).

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