A sustainable urban logistics dashboard from the perspective of a group of logistics managers

Joëlle Morana, Jesus Gonzalez-Feliu

A sustainable urban logistics dashboard from the perspective of a group of logistics managers

Joëlle MORANA [a], Jesus GONZALEZ-FELIU [b],

[a] *Laboratoire d'Economie des Transports, Lyon, France*

[b] *Laboratoire d'Economie des Transports, Lyon, France*

Abstract

Urban logistics has now become a priority issue in both supply chain management and urban planning. However, the different stakeholders involved develop different approaches whose aims and objectives do not always coincide and sometimes present conflicting standpoints. The aim of this paper is to complete existing literature by proposing a sustainable dashboard for evaluating the sustainable performance of urban delivery systems, from the perspective of operational logistics managers, one of the categories of stakeholders given less consideration by public authorities in their quest for consensus. First, a synthesis of the main works on the subject is proposed, in order to provide a common grid of economic, environmental and social/societal indicators for Sustainable Supply Chain Management, after which the method for defining the dashboard is presented. This method is derived from a collaborative decision-aid approach and applied to a panel of operational logistics managers. Next, the results of the analysis framework are presented, and the selected indicators proposed and commented. Finally, a model dashboard is presented and discussed, followed by conclusions and further developments in view to the practical application of the approach proposed.

Keywords: Sustainable Supply Chain Management; urban logistics; sustainability dashboard; collaborative decision making; consensus.

1. Introduction

The sustainability of supply chain management is becoming increasingly important for organizations that want to gain a competitive advantage, and for industries sensitive to environmental problems or social issues (See [17] and [14]). However, although these issues of sustainability are coming under greater theoretical and practical scrutiny (eco-design, waste management, life-cycle assessments, etc.), the management and measurement of sustainability performance over their whole supply chains are given too little attention. Nonetheless, sustainability issues in supply chains have become an important topic in the strategic management of organizations and the adoption of a sustainable supply chain management requires that particular attention be focused on performance management, accounting, auditing and management control. In our view, the design of a sustainable dashboard is a tool that can be used to encourage the practice of sustainable supply chain management and allow stakeholders to discriminate positively in favor of sustainable products and services.

The need in companies to gather data, make information available, and generate knowledge for decision-making has never been stronger. Although economic indicators remain major

concerns, the measurement and management of the social and environmental performance of complete supply chains is becoming steadily more central to the work of firms. The good reputation of a firm is increasingly linked to the elimination of forced labor and/or child labor. Also, the certification of "green" processes, products and services is a feasible means of supporting economic recovery. However, this requires reliable and clear key sustainability performance indicators.

The organizational aspects of urban logistics schemes in the global sustainable supply chain must be considered (See [1]). Indeed, as urban traffic increases, some organizations are faced with the problem of efficient urban freight distribution. Additional constraints include relations with public authorities which apply different criteria for managing products flows (i.e. no deliveries to the city-center by modes of transport considered highly pollutant).

The aim of this paper is to examine the use of indicators by private organizations in the context of sustainable urban supply chains, while considering the constraints of public actors. To do this we first provide a synthetic review of the literature to present the main principles of sustainable urban supply chain management and its links with the global supply chain. Secondly, we assess the importance of performance measurement in sustainable urban logistics. Thirdly, we propose a dashboard with a set of indicators, designed on the basis of an investigation conducted with logistics professionals. Finally, we discuss these results and present further developments in a near-future perspective.

2. Literature review: from the performance measurement of Sustainable Supply Chain Management to Urban SSCM

Taking into account the managerial interest of Sustainable Supply Chain Management

While the contribution of supply chain management is becoming ever more significant, it does not stop at the economic aspect. It can also to be found in ecosystem preservation. The same is true of social and societal recognition of the actors who make up the supply chain. It is therefore becoming appropriate to speak of sustainable supply chain management, which is akin to sustainable development (See [14]).

Historically, French research dedicated to Sustainable Supply Chain Management initially focused on reflections on the notion of freight transport: maritime (See [8]) and especially road (See [3], [2], [4]). It was then logical from the urban standpoint that attention was paid to the prominent economic/environmental aspect: high cost due to frequent stops correlated with growing pollution (See [9], [11], [16]). The perspective then shifted to improving collaborative logistics practices (See [4]).

Regarding research published in English in the period 2007-2009, several studies focused on a review of work on the Sustainable Supply Chain Management, in order to define a conceptual framework and a generic definition. Several definitions were provided, such as:

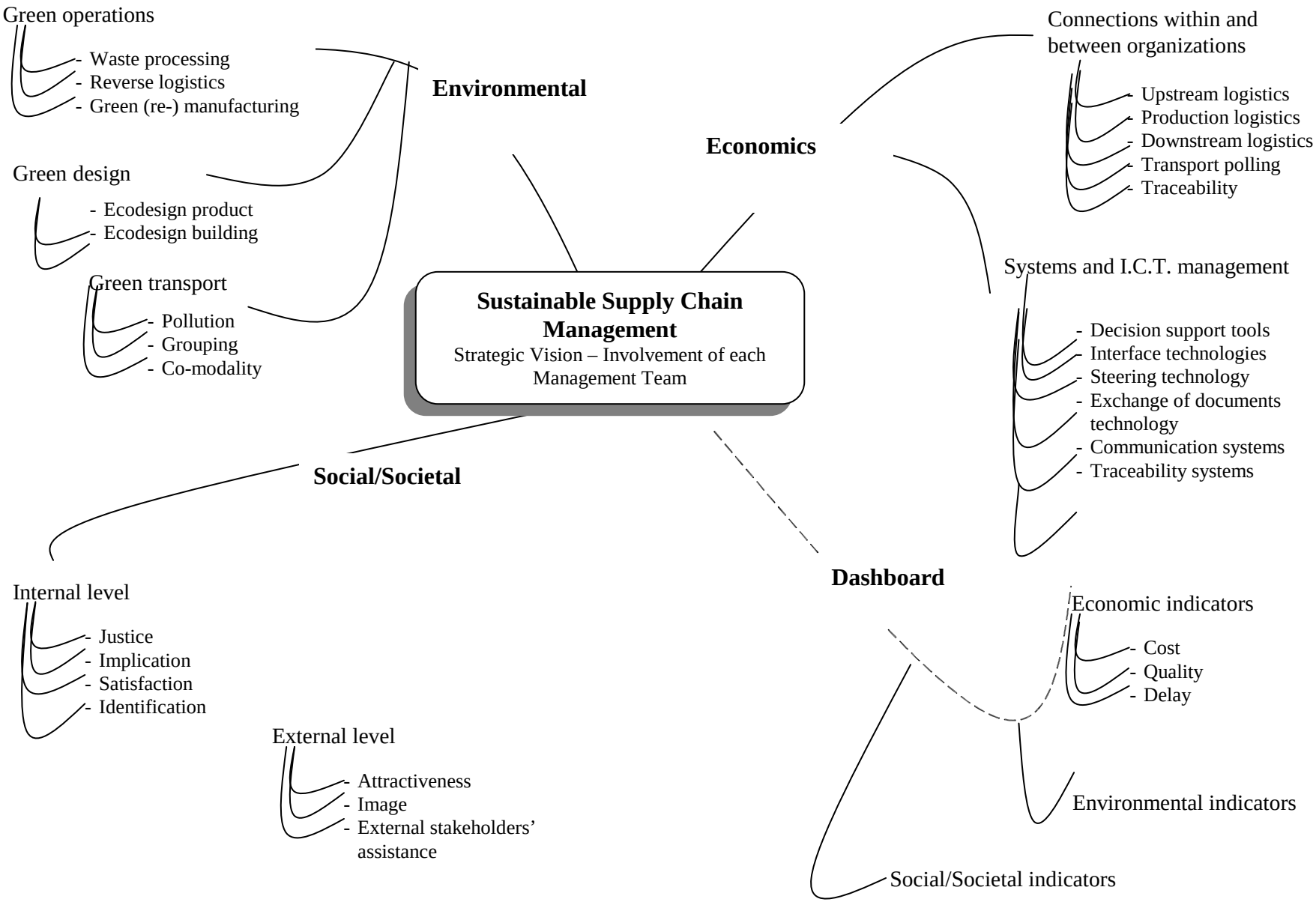
> *"we define SSCM as the strategic, transparent integration and achievement of an organization's social, environmental, and economic goals in the systemic coordination*

of key interorganizational business processes for improving the long-term economic performance of the individual company and its supply chains." (See [6]) ;
"we define sustainable supply chain management as the management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental and social, into account which are derived from customer and stakeholder requirements." (See [17]);

In line with these work, we consider the definition of Morana (2013): "Sustainable Supply Chain Management can be understood as the management of the flows of materials, information, capital, people and intelligence with an economic, environmental and social/societal goal. As a strategic management approach, it can be found in the quite deliberate set of intra- and inter-organizational connections, in view to ensuring the long-term performance of each company and of its supply chain."

These developments show that sustainable supply chain management has become a strategic issue for firms. But it must be clear that its success depends on the ability to clearly connect each economic, environmental and social/societal element. Consequently, we built a chart (see fig. 1. Paths of Sustainable Supply Chain Management, adapted from Morana, 2013) in which we can find paths for the coherent implementation of SSCM:

Fig. 1. Paths of Sustainable Supply Chain Management, adapted from Morana, 2013



To operate, SSCM requires the conjunction of three elements, i.e. economic, environmental and social/societal while the measurement of its performance can be established by implementing dashboard(s):

- the application of SSCM from the economic standpoint is based mainly on intra- and inter-organizational connections. These connections have an impact on the "three logistics" which are often outlined in the description of the logistical strategy: upstream, production (internal) and downstream stages. But in a long-term framework, other elements need to be developed like strategic transport management (transport pooling, urban logistics space management), the role of the logistics providers, the traceability approach and, of course, the information and media used to facilitate these connections;
- the strategic importance of environmental SSCM has become a crucially important element. The article by Srivastava (2007) provides an interesting insight into green logistics. We enriched this work (See [14]) and considered three main focal areas: green design and eco-design with the latter integrated in processes and building; green operation with actions in green manufacturing and remanufacturing, waste management such as electrical and electronic equipment waste management[1] and reverse logistics; green transport with actions to promote multimodality, the use of vehicles considered non or less-pollutant, eco-conduct and eco-taxes;
- it is crucial to link (internal and external) human resources and logistics. Although human aspects are often highlighted in (Green) Supply Chain Management, the interest of specifying these aspects clearly has become appropriate. In line with the work of Gond (2006) who examined human resources in sustainable development, we propose two main focal areas for sustainable logistics. Firstly, in an internal context with particular emphasis given to four aspects: individual rights with -for example- the implementation of the SA8000 standard[2]; organizational commitment which focuses on the recognition of competence, motivation, training, etc.; organizational identification; and, finally, job satisfaction. Secondly, in an external context, we highlight the role of the company's attractiveness, reputation and image (for instance, the implementation of the IS0 14000 standard and traceability), the support of unions and external partners.

To conclude this paragraph, we must not forget "performance measurement" which, as is generally recognized, falls under the adage "we can only manage what we can measure". In our view, as a decision-support measuring tool, performance measurement is one of the most influential factors of the "dashboard". In logistics, this tool must highlight financial (linked to a financial type balance sheet) and non-financial indicators. In SSCM, the dashboard presents economic data (cost, quality and delay), and environmental (pollution, for instance) and social/societal (rate of absenteeism and customer satisfaction) data.

Sustainable Supply Chain Management and Urban logistics

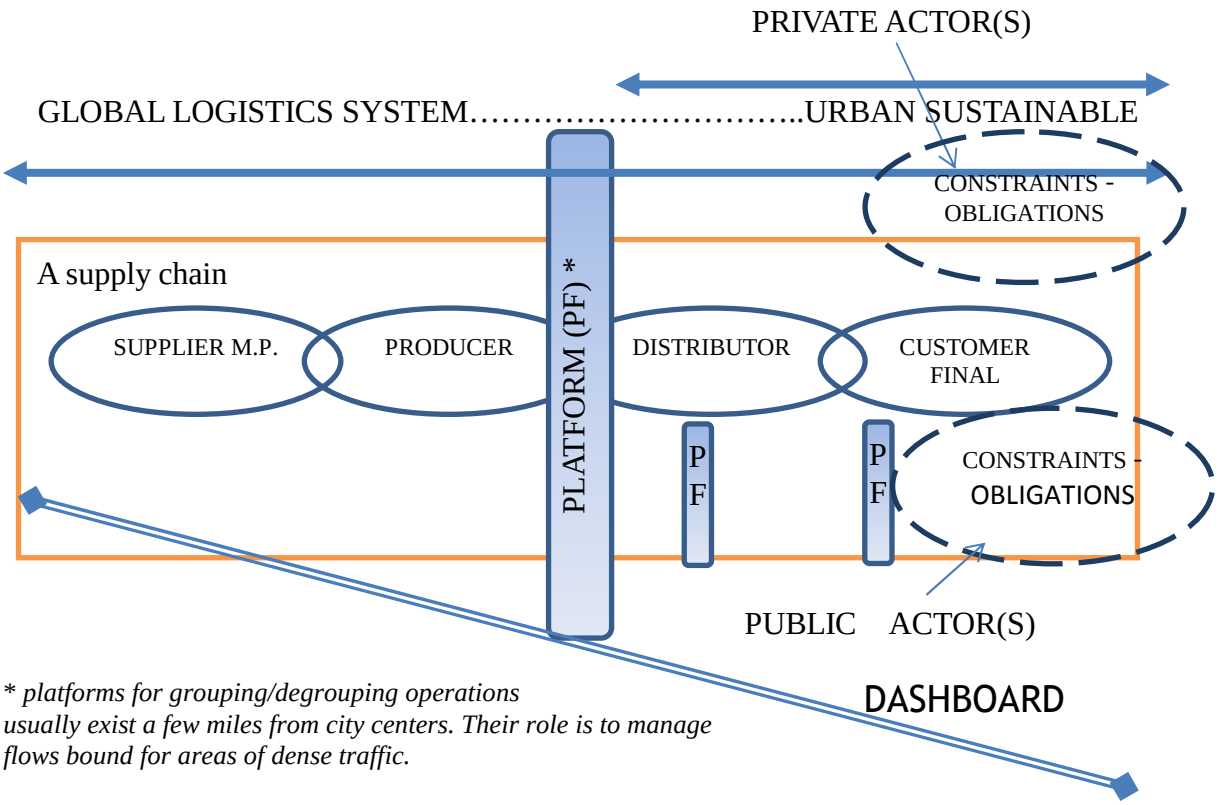
Although all the links in the supply chain are important, it is necessary to underline the value of urban logistics or "last-mile logistics". Indeed, logistics in close connection to customers'

[1] Decree no. 2005-829 of 20 July 2005 (Official Gazette no. 22)

[2] The SA8000 standard was drawn up in 1997 by an American organization: SAI (Social Accountability International). It relies upon human rights reference texts. It is based on the conventions signed by the International Labor Organization (ILO), the Universal Declaration of Human Rights published by the United Nations (UN) and the UN Convention on the Rights of the Child.

needs has always been an important element in the supply chain (See [7]), and the growth of e-commerce only reinforces this fact. Thus FEVAD (Fédération des Entreprises de Vente A Distance – Federation of Remote Sales Companies) has reported an increase in online sales in all countries around the world in 2012[1]. In terms of logistics, this has consequences for the ways in which orders are prepared and delivered. In addition to the constraints of private actors, it must take into account the requirements of public authorities. Therefore, having a tool that incorporates key performance measures which consider the interests of all market players is essential. Fig. 2 presents the approach proposed. This approach specifies the challenges involved in evaluating/maximizing sustainable performance measures of urban flows. To assure good coordination between private and public actors, it is necessary to determine sustainable variables that can be used to represent the interests of each stakeholder. Naturally, the success of an urban sustainable supply chain management system must consider the interests of the global logistics system. Thus clear understanding of the supply chain concerned is also needed.

Fig. 2. Urban logistics in a sustainable global logistics system



** platforms for grouping/degrouping operations usually exist a few miles from city centers. Their role is to manage flows bound for areas of dense traffic.*

Key Performance Indicators in Sustainable (Urban) SCM

In logistics, the aim of measuring performance is in general directly linked to a goal of ensuring permanent improvement that leads to the conceptualization and implementation of

[1] http://www.fevad.com/uploads/files/Publications/Chiffres_Cles_2013(1).pdf

measurement systems combining diagnostics and decision-aids. If we focus on evaluating Supply Chain Management (SCM) with Key Performance Indicators (KPI), we find two interesting references on the subject: (1) the work of Gunasekaran and Kobu (2007), with a list of 26 indicators; and (2) the work of Griffis et al (2007) with 14 indicators. Although these lists do not include any environmental indicator, while social indicators are over-represented, they can be used as a basis for an initial sustainability evaluation (See [14]).

Regarding the context of measuring sustainable urban logistics from the standpoint of a private company, Morana et al. (2014) proposed a set of 28 indicators (14 for economic, 6 for environmental and 8 for social performance) (Cf. Tab. 1).
Tab. 1. Main indicators for urban logistics sustainability (See [15])

Economic indicators (Nb. = 14) concern cost, quality and delay	
• Distance travelled	• Investment costs
• Vehicle load factor	• Operational costs
• Warehouse load factor	• Return on investment
• Vehicle load path	• Total travel time
• Number of parcels at warehouses	• Service rates
• Number of delivery points	• Delay respect rates
• Number of collection points	• Customer satisfaction rates
Economic indicators (Nb. = 6)	
• Greenhouse gas emission rates	• Noise rates
• Pollutant gas emission rates (NOx, SOx)	• Road occupancy rates
• Solid particles emission rates (PM 10)	• Reverse flow rates
Economic indicators (Nb. = 8)	
• Absenteeism rates	• Employment creation rates
• Stress management rates	• Employment conversion rates
• Users' acceptability	• Training rates
• Inhabitant satisfaction rates	• Estimation of city's image

3. Methodology

Using a basic list of indicators, we propose a collaborative decision support methodology in view to formulating a sustainable urban logistics dashboard. This can be done with two prerequisites:

- the first is the consideration of a minimum number of indicators, as recommended by Bouquin (2001). According to this author, as an instrument of action, a dashboard includes a *"relatively small number of indicators (five to ten) [integrated] to inform managers of the state and evolution of the systems they control and identify the trends that will influence these systems over a time scale consistent with the nature of their functions"* (Ibid, 2001, pp. 397-398);
- the second is the inclusion of three types of measurement that reflect the three dimensions of sustainable development, i.e. economic, environmental and social/societal.

To answer our question, we contacted logistics (urban) experts that interact and collaborate in an urban supply chain and are thus able to choose the most suitable indicators. To do this, we follow-up the approach according to a basic group-decision process (See [19]). In this context,

logistics experts make individual decisions, if possible without interactions with others. This process was followed by a decision communication phase where choices and the importance of using the different indicators were discussed. Third and last, a consensus research phase took place between experts in order to make consensual decisions.

The action plan consisted of the following:

1. Common definition of the scope, goals and targets to reach. The scope is to measure the sustainability of urban logistics systems; the main goal was to establish a dashboard comprising three sets of indicators with at least 2 significantly different indicators per category (in line with Bouquin's suggestions (2001), i.e. to obtain at most 10 indicators globally).
2. Individual decision phase. Experts gave a list of indicators from which they had to choose those they considered more suitable to achieve the expected goal, initially without any limitation of number.
3. A meeting was organized to discuss the results and choose the most suitable set of indicators.
4. The set of selected indicators was presented to all the experts in order to reach consensus and validate or modify the group's decision.

The sample was composed of a group of logistics experts. This group included 10 scientists from university and research institutions, 3 operational managers from companies, 5 project managers from logistics consulting and transport planning software development companies, and 2 representatives from freight transport standardization organizations, thus making a total of 20 experts.

The meetings were scheduled as follows:

- a first meeting to agree on the common scope, goal and targets;
- 21 days after the first meeting, an initial list of 90 indicators (both quantitative and qualitative) was proposed to the expert panel;
- one week afterwards, a meeting was scheduled in to deliberate on the suitability of the list of indicators proposed and to launch the decision communication phase. However, most of the experts agreed during this meeting that the list proposed was too exhaustive. Thus they decided to reduce the list of 30 indicators and spend more time to improve their choice;
- after 45 days, the choices of each expert were discussed and a principle of agreement was sought The conclusions were that two types of indicators had to be defined: those that measure the performance of the proposed urban logistics system itself, and those that measure the effects on the urban environment. Similarly, the indicators must be classified according to three paths in line with the rationale of sustainable development, i.e. economic, environmental and social;
- 30 days later, a final set of indicators was proposed with the associated dashboard. A technical document specifying each indicator was associated with the dashboard.

4. Results

This part presents the resulting sustainable urban logistics dashboard. To provide an easy-to-read tool usable by the different actors of the platform, we propose 5 categories of indicators and 7 indicators (3 economic, 1 quality and 3 environmental and societal) (Cf. tab. 2).

Tab. 2. The key indicators of urban logistics from the standpoint of sustainability

Section	**Category**	**Main indicator**
Economic	Logistics	Transport loading rate Ratio of loaded miles over travelled miles
	Logistics	Warehouse fill rate
	Audit	Financial indicators
Economic and social/societal	Service quality	Service rate
Environmental	Environmental effects	Greenhouse gas emissions
Environmental and social/societal	Congestion reduction	Saving in number of trucks used
Social/societal	Social/societal effects	Rate of jobs to be converted

We observe that the indicators are in general more specific than those proposed in the literature. The needs imply the definition of detailed indicators that public and/or private stakeholders from both sides can understand. For example, logistics indicators are related to transport loading rates, with and without linking them to the distances traveled. Similarly, such indicators need to be associated with warehousing performance (in terms of loading rates) and with the general financial balance. In this case, for instance, no inventorying performance indicators were calculated due to collaboration with transport carriers or the parties directly associated with them (i.e., mainly 2PL and 3PL), as they make their inventory management decisions themselves.

Environmental indicators showed the importance of greenhouse gas and pollutant emissions. It is noteworthy that noise was not selected because transport and logistics practitioners are less sensitive to societal issues than public authorities). Additionally, gains in less congestion (reduction in the number of trucks, for example) appear as more central for public actors than for private actors. Regarding the social path, the importance of converting the potential number of employees to be shed into new and added-value jobs is also viewed more as a public issue than a private one.

Finally, it is important to note that to evaluate sustainable urban performance, it is necessary to establish/identify a reference grid in terms of key performance indicators in order to respond to the problems faced by professional and private stakeholders.

5. Conclusion

The evaluation of urban logistics projects should be seen from the perspective of sustainable development. Consequently, three dimensions (economic, environmental and social/societal) must be taken into account. Likewise, it is advisable to enumerate a limited though sufficient number of indicators for decision-making. We proposed a framework based in group decision-making for defining a dashboard to evaluate the sustainability of urban logistics projects, taking into account both public and private stakeholders' visions and viewpoints.

From the economic standpoint, the perspective of private enterprise predominates. Two main groups of economic indicators were evaluated in the different works (dealing equally with the

efficiency of the company as a whole and with global logistics in the case of urban goods transport): the macroscopic indicators of a company's economic continuity and the economic performance indicators of logistics.

Regarding the environmental dimension, the main variables to be studied are the following: energy consumption, variations of pollutant emissions in comparison to an initial situation and to all urban transport emissions (people + goods). Only greenhouse gas emissions as an indicator appear central for professionals, while others elements are considered by public authorities (congestion, noise)

The social/societal dimension is more difficult to characterize and requires more in-depth study. Nonetheless, identifying social/societal factors within the company and variations in the number of jobs and their reassignment appear to be the main variables involved in the search for social and societal indicators.

References

[1] Allen, J., Browne, M. (2010). Sustainability strategies for city logistics. In A. McKinnon, S. Cullinane, A. Whiteing & M. Browne (Eds.), *Green Logistics: Improving The Environmental Sustainability of Logistics.* New Delhi, India: Kogan Page Limited.

[2] Bazin, S., Beckerich, C. (2008). Le renforcement des contraintes spatiales des entreprises : le transport comme vecteur de valorisation de la prestation logistique, *les Cahiers Scientifiques du Transport*, n° 54, pp. 49.72.

[3] Bernadet, M. (2008). Introduction au dossier « Transport et logistique durables : vers la nécessaire prise en compte de leur interdépendance », *Notes de synthèse du SESP*, n° 168, pp. 5-8.

[4] Blanquart, C., Carbone, V. (2008), La place du transport dans les organisations logistiques durables, *les Cahiers Scientifiques du Transport*, n° 54, p. 11-24.

[5] Bouquin, H. (2001). *Le contrôle de gestion*, Presses Universitaires de France, Paris, 5th éd.

[6] Carter, C., Rogers, D. (2008). A framework of sustainable supply chain management: moving toward new theory, *International Journal of Physical Distribution & Logistics Management*, vol. 38, n° 5, pp. 360-387.

[7] Colin, J., Paché, G. (1988)., La logistique de distribution : l'avenir du marketing, Chotard et Associés Editeurs, Paris.

[8] Collin, M. (2003) (Coord.). *Ville portuaire, acteur du développement durable*, L'Harmattan.

[9] Durand, B. (2010). Quand la durabilité interpelle l'e-logistique…., *Document de travail Lemna – Nantes*, n° EA 4272.

[10] Gond, J.-P. (2006). Gestion des ressources humaines et Développement Durable. In Reynaud, E. (Eds.), *Le Développement Durable au cœur de l'entreprise*, Ed. Dunod, pp. 83-116.

[11] Gonzalez-Feliu, J., Morana, J (2010). A la recherche d'une mutualisation des livraisons en milieu urbain: le cas du groupe NMPP, *Revue Française de Gestion Industrielle*, Vol. 29, n° 2, pp. 71-92.

[12] Griffis, S.E., Goldsby, T.J., Cooper, M., Closs, D.J. (2007). Aligning logistics performance measures to the information needs of the firm, *Journal of Business Logistics*, 28(2), pp. 35-56.

[13] Gunasekaran, A., Kobu, B. (2007). Performance measures and metrics in logistics and supply chain management: a review of recent literature (1995-2004) for research and applications, *International Journal of Production Research*, 45(12), pp. 2819-40.

[14] Morana, J. (2013). *Sustainable supply chain management*, London: Wiley-ISTE.

[15] Morana, J., Gonzalez-Feliu, J., Semet, F. (2014). Urban Consolidation and Logistics Pooling. Planning. In Gonzalez-Feliu J., Semet, F., Routhier, J.L. (eds), *Sustainable urban logistics: concepts, methods and information systems*, Springer, Heidelberg, pp. 187-210.

[16] Savy, M., Liu X. (2010). La plate-forme logistique, objet exemplaire d'aménagement urbain, *Les premières Journées du Pôle Ville de l'Université Paris Est Ville : Transport et Territoire, Quoi de neuf ?*, PRES Paris Est.

[17] Seuring, S., Müller M. (2008). From a Literature Review to a Conceptual Framework for Sustainable Supply Chain Management, *Journal of Cleaner Production*, 16(15), pp. 1699-1710.

[18] Srivastava, S. (2007). Green supply-chain management: a state-of-the-art literature review, *International Journal of Management Review*, vol. 9, n° 1, pp. 53-80, 2007.

[19] Yearwood, J.L., Stranieri, A. (2006). The generic/actual argument model of practical reasoning, *Decision support systems*, 41, pp. 358-379.