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# A Performance Management Framework for Managing Sustainable Collaborative Enterprise Networks

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**Abstract.** Many enterprises have difficulties to understand how sustainability can be managed. This scenario requires new tools that aid to define and collect the necessary information for managing the performance of the network and assuring its sustainability at the same time. The purpose of this paper is to introduce an integrated performance management framework that fills this research gap and aid to manage the sustainability of the enterprise network from its strategy into its operations in order to provide a tool for managing the sustainability performance more efficiently and effectively. The framework has been applied within a bathroom furniture supply chain.

**Keywords:** collaborative enterprise networks, sustainability, performance management framework, case study.

## 1 Introduction

In the current global competitive environment, enterprises need to constantly adopt new strategies to remain competitive in the marketplace. One of these strategies is the adoption of a sustainable culture. There are numerous causes that make enterprises to pursue sustainability such as legal demands/regulation, response to stakeholders, competitive advantage, customer demands, reputation loss, and environmental and social pressure groups. In the literature, one can find success cases of implementation of sustainable practices. However, many enterprises have difficulties to understand how sustainability can be managed. This scenario requires new tools that aid to define and collect the necessary information for managing the performance of the network and ensuring its sustainability at the same time. For that purpose, performance management frameworks are tools that, if properly designed and implemented, may aid collaborative enterprises to manage the sustainability of their operations.

In addition, an organization's sustainability initiatives and its corporate strategy must be closely interrelated instead of keeping separate programs that are managed independently of one another [1]. Then, it is essential to note that a proper implementation of the sustainable culture of the enterprise network should be first included in the strategy, and then, derived from the strategy into operations. [2] define sustainable supply chain 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*'. [3] define sustainable supply chain management as *'the strategic, transparent integration and achievement of an organization's social, environmental and economic goals in the system coordination of key interorganizational business processes for improving the long-term economic performance of individual enterprises and its supply chains'*. Based on the aspects that appear in the definitions, a proper performance management framework for sustainable collaborative networks can be derived including various characteristics. First, all the enterprises within the enterprise network should agree on common goals/objectives that are pursued by all the enterprises. Otherwise, monitoring performance will be an isolated task lacking value to management. Then, it is necessary to establish mechanisms to deploy the strategy into operations which can be measured, and therefore, managed through performance measurement elements (objectives, performance indicators, etc.). Second, all three sustainable dimensions (economic, environmental and social dimensions) should be managed within the structure of the performance framework. Third, the interorganizational processes must be considered in the structure of the performance management framework in order to manage the value flows to customers. Fourth, both individual enterprise and collaborative enterprise network performance levels have to be monitored and linked as it is needed a strategic and operations alignment between both levels in order to prevent collaboration to fail.

The purpose of this paper is to introduce an integrated performance management framework for collaborative contexts that meet all four characteristics and aid to manage the sustainability of the enterprise network from its strategy into its operations by including all the required aspects within its structure in order to provide a tool for managing the sustainability performance more efficiently and effectively. The developed framework has been applied within a bathroom furniture supply chain presented as case study.

## **2 Background**

The study of the benefits and success of implementing practices of supply chain sustainability is at an initial stage of development [4]. This fact is probably one of motives why there are few works developed in this field, the majority published in the recent years. Some of these works have exposed frameworks that aid to conceptualise and classify supply chain sustainability literature such as the works by [2] and [3]. Other works present models for evaluating some aspects of supply chain sustainability such as supplier selection [5] or the selection of a supply chain configuration [6]. In fact, most of these works only consider economic and environmental sustainability and the social dimension has barely been considered [2].

Regarding the main focus of this paper, few works deal with the development of performance management frameworks for managing the sustainability of collaborative enterprise networks. In this section, the four characteristics exposed before (strategic focus, three sustainability dimensions, interorganizational processes, and individual and collaborative performance levels) are the key points to perform the literature

review. It is observed that the works that present a performance management framework for collaborative contexts use to lack of a pillar for measuring sustainability dimensions and a complete solid structure. In this work, when we say that a work does not consider the sustainability dimensions, in fact we refer that framework specifically does not include the social and environmental dimensions. The economic dimension is always included within the performance management frameworks.

Performance management literature has proposed different frameworks for managing performance in collaborative contexts. Table 1 shows a summary of these frameworks regarding the consideration of the four characteristics: strategy deployment, sustainability dimensions, interorganizational processes and performance management levels.

**Table 1.** Literature review summary (x means that the framework does not have the characteristic)

Performance framework	Strategy	Sustainability dimensions	Interorganizational processes	Management Levels
Brewer & Speh [7]		x		x
Gunasekaran et al. [8]	x	x		x
Chan & Qi [9]		x		
Bititci et al. [10]		x		
Folan & Browne [11]		x	x	
Chalmeta & Grangel [12]		x		
Alfaro et al. [13]		x		
Romero et al. [14]		x	x	x
Westphal et al.[15]		x	x	x

As can be observed in the table, the environmental and social dimensions are overlooked in all the works. In addition, the deployment of the strategy is commonly introduced despite it is missing in one work ([8]), the interorganizational processes are missing in three works ([11], [14] and [15]) and the two necessary management levels are missing in four works ([7], [8], [14] and [15]). Therefore, the limitations exposed justify the lack of a framework that meets all four characteristics under a solid performance structure. The framework proposed on this paper aims to fill this research gap.

### 3 The Performance Management Framework for Managing Sustainable Collaborative Enterprise Networks

As stated in a previous section, it can be observed that there is a need of tools (methods, systems and procedures) that aid enterprises to manage sustainability within collaborative contexts following an integrated approach. The framework proposed in this section introduces these characteristics by adapting the performance framework developed by Alfaro et al. [13] whose methodology is founded on three phases: 1) definition of the strategic framework, 2) definition of the process framework and 3) monitoring. The characteristics of a framework for managing the sustainability of

collaborative environments are related to the requirements that should be covered by the framework in order to be considered solid and integrated. This means that the framework should have all the proper functions to manage the context for which it was designed. Also, that framework should support the decision-making process of the enterprises and entities that collaborate. For that reason, it is necessary that it considers two levels: interorganizational level (where collaboration takes place) and individual enterprise level. Both levels should be aligned and linked in order to keep traceability among the performance elements that are to be defined and monitored.

At the individual enterprise level, the framework derives from the vision and vision and reflects the most important aspects of the business. If this concept is extended within the interorganizational context, it can be said that it is a process of strategic planning for all the partners and implies a common understanding of their goals what facilitates the evaluation and degree of success reached in their objectives. Thus, the framework starts with a strategic approach for its adequate interpretation and application. Therefore, the starting point is the definition of the strategic framework (phase 1).

Figure 1 shows the composition of the performance management framework which distinguishes, at the same time, between two types of sub-frameworks: strategic and process framework. In detail, the definition of the strategic framework needs to incorporate all the performance elements mission and vision, objectives and key performance indicators (KPIs). All these elements are defined for the four performance perspectives: financial, customer, process, and learning & growth. These perspectives aid to structure performance measurement following relationships of cause-effect.

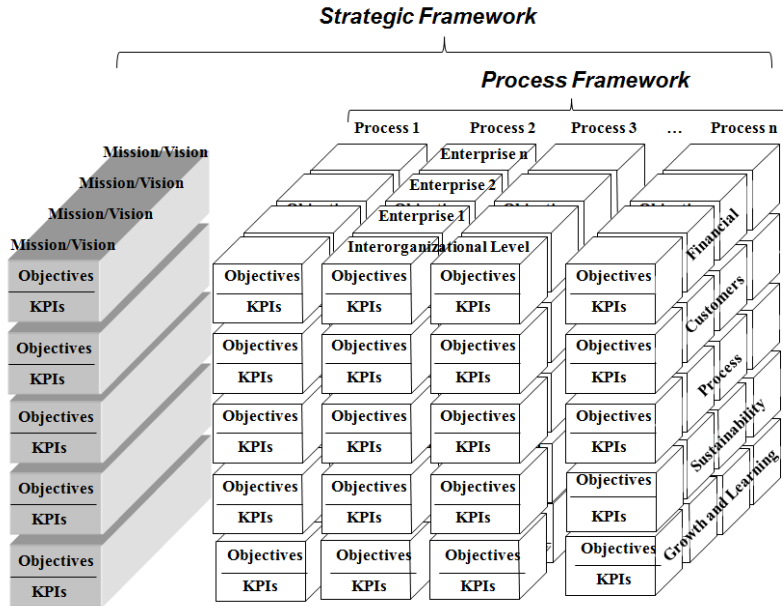


Fig. 1. Performance Management Framework for Sustainable Collaborative Networks

In addition, it is necessary to introduce one perspective oriented to manage sustainability that covers the environmental and social dimensions of sustainability. The aspects of the economic/business dimension of sustainability are already considered in the financial, customer and process perspectives. Then, the sustainability perspective supports the consecution of the other three perspectives located above, due to the fact that environmental and social practices are to support the internal processes, the customer value proposition (as we said customers demands are common causes of implementing sustainable practices) and the financial management of both individual enterprises and collaborative enterprise networks. The Growth and Learning perspective stands below the sustainability perspective because its purpose is to support the training, partnerships, and information technology aspects to assure the consecution of the rest of perspectives in the long term.

The content of the sustainability perspective will consist of a set of objectives and corresponding KPIs related to environmental and social sustainable dimensions. Some authors have proposed different structures for these two dimensions. In [5], it is presented an interesting classification of the content of these dimensions. On the one side, environmental dimension comprises pollution controls, pollution prevention, environmental management system, resource consumption, and pollution production. Regarding social dimension, it distinguishes between employment practices, health and safety, local community influence, contractual stakeholders influence and other stakeholders influence.

It is not the purpose of this paper to provide a full overview of the content of these dimensions but to present the elements that a performance management framework

should have to manage them. For that reason, this classification is only given as example that may be considered but do not conform a definitive list.

Once the strategic framework is obtained, performance elements of the process framework (objectives and KPIs) are defined for those key business processes associated to the collaborative context (Phase 2). These key processes are processes directly linked to a common product/service produced by the partners or processes that support the success of the production of those products/services.

In the previous phases (phase 1 and 2), all the performance elements have been defined. Finally, the third phase aims at monitoring of all those elements in order to know which are the most important elements, i.e. what levels are the most relevant from a performance management point of view and where are located special indicators for a specific partner.

#### 4 Case Study

The performance management framework has been applied within a Spanish bathroom furniture enterprise network. Specifically, as an initial stage, it has been developed the pilot for the furniture supply chain. From the mission and vision of the supply chain, the main objectives were defined. Table 2 shows the objectives and corresponding KPIs of the strategic framework. The strategic framework was established after two meetings of two hours with four managers of the supply chain and comprises fourteen objectives and eighteen KPIs what seems reasonable. As can be observed, for each objective, it has been needed to define at least one KPI to monitor its evolution. In some cases, e.g. profitability, two KPIs were necessary (KPI2=ROI and KPI3=ROA). The sustainability perspective comprises at this stage four objectives and five KPIs.

**Table 2.** Objectives and KPIs of the strategic framework at the Supply Chain Level

Perspectives	Objectives	KPIs
Financial	Reduce costs Increase profitability	KPI1 = product cost per family. KPI2 = ROI KPI3 = ROA
Customer	Increase market share Increase customer satisfaction	KPI4=national market share KPI5=international market share KPI6=customer loyalty KPI7=loyalty programs implemented
Process	Reduce lead time Reduce non- quality parts Increase on-time delivery orders Increase efficiency in process management	KPI8=lead time KPI9 = conformance quality KPI10 = % parts delivered on time KPI11= efficiency per process
Sustainability	Increase recycling Increase environmental management culture	KPI12= implementation of recycling sections KPI13 = ISO 14 000 certification KPI14= environmental programs implemented KPI15= H&S programs implemented

	Increase Health & Safety culture Reduce H&S incidents	KPI16=H&S problems
Learning and Growth	Increase innovation capability Increase knowledge management	KPI17 = development of new programs KPI18=implementation of knowledge management tool

After defining the strategic framework of the supply chain, the process framework was defined for two key interorganizational processes of the supply chain: new product development and production planning. Table 3 shows the objectives and KPIs for the new product development process. In this case, eleven objectives and fifteen KPIs were defined in two meetings of two hours by the new product development team composed of members from all the enterprises within the supply chain.

**Table 3.** Objectives and KPIs of the new product development process at the Supply Chain Level

Perspectives	Objectives	KPIs
Financial	Reduce raw material cost Increase profitability	KPI1 = raw material cost per product. KPI2 = internal rate of return KPI3=net present value
Customer	Increase perceived value of product Increase customer satisfaction	KPI4=customer meetings KPI5=customer relationship management KPI6=customer complaints
Process	Reduce time to market Reduce non-conformance parts of production trials	KPI7=time to market KPI8 = quality monitoring of trials
Sustainability	Reduce raw material needs  Reduce waste Increase Health & Safety culture	KPI9= raw material consumption KPI10= % raw material reduction KPI11= waste per component KPI12 = H&S suggestions implemented KPI13= new product H&S standards
Learning and Growth	Increase innovation capability  Increase knowledge management	KPI14 = follow-up meetings with all the members of the supply chain KPI15=improvements in tool for new product management

Once the process framework was defined for the supply chain, every enterprise has adapted its performance management system. Some of the enterprises of the supply chain have one performance management framework already implemented so that they have to modify it accommodate the new requirements from the supply chain level performance framework. However, some of the enterprises do not have a proper system and they are beginning to work in it. That is the reason why some aspects such as coordination and collaboration objectives and KPIs so far have not been introduced despite its importance. In one year, it is planned to review the status of the whole performance management framework but quarterly reviews are established as well to monitor its evolution. The sustainability of the network will come as the members use the information provided by the performance framework monitoring, analyzing the objectives reached and defining proper action plans when the objectives are not reached. This will help to create and manage operational supply chains due to the focus



on monitoring the key aspects for developing the strategy into operations and monitoring its evolution.

The main conclusion from the partners is that the process followed to elaborate this framework has provided them knowledge about the main areas of interest of the evolution of supply chain as well as a tool for monitoring performance. For each objective, a percentage target has been established (i.e. Reduce by 10% raw material cost). In addition, a percentage of achievement of the different objectives is to be monitored through the collected data of KPIs. Decision makers of the supply chain have defined that at least the percentage of achievement of the objectives has to be 75% in order to meet sustainability requirements.

## 5 Conclusions

This paper has reviewed the literature regarding managing sustainable collaborative enterprise networks. From the review, we have observed that there is a lack of a proposal that meets the four characteristics that we consider essential for managing sustainability in these contexts (strategic focus, three sustainability dimensions, interorganizational processes, and individual and collaborative performance levels).

Based on the gaps coming from the literature review, we have introduced a new performance management framework, which includes all four characteristics and the necessary connection mechanisms within its structure in order to provide a tool for managing the performance of sustainable collaborative enterprise networks.

This framework considers five performance perspectives in order to manage performance. In fact, there is a need to consider a specific perspective for managing the sustainability dimensions (environmental and social dimensions) as they act as a link element for reaching the elements that compose the other performance perspectives. In addition, we have presented a case study of a pilot developed within a supply chain dedicated to manufacture bathroom furniture. The initial stage has focused in applying the framework to the furniture supply chain and two interorganizational processes: new product development and collaborative planning. Next development stages will consider its extension to the enterprise network level as well as other interorganizational processes.

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## References

1. Shrivastava, P.: The role of corporations in achieving ecological sustainability. *Academy of Management Review*, 20, 4, 936-60 (1995).
2. Seuring, S., Müller, M.: From a literature review to a conceptual framework for sustainable supply chain management. *J of Cleaner Production*, 16, 1699-1710, (2008).

3. Carter, C.R., Rogers, D.S.: A framework of sustainable supply chain management: moving toward new theory. *Int J of Physical Distribution & Logistics Mgmt*, 38(5): 360-387 (2008).
4. Ageron B, Gunasekaran A, Spalanzani A: Sustainable supply management: an empirical study. *Int. J. Production Economics*, 140, 1, 168–182, (2012).
5. Bai, C., Sarkis, J.: Integrating sustainability into supplier selection with grey system and rough set methodologies. *Int. J. Production Economics*, 124, 252–264, (2010)
6. Sarkis, J.: A strategic decision framework for green supply chain management. *Journal of Cleaner Production*, 11, 397–409 (2003).
7. Brewer PC, Speh T.W. Using the balanced scorecard to measure supply chain performance. *Journal of Business Logistics*, 21, 1: 75-93 (2000).
8. Gunasekaran A, Patel C, Tirtiroglu E. Performance measures and metrics in a supply chain environment. *Int J of Operations & Production Management*, 21,1-2: 71-87 (2001).
9. Chan FTS, Qi HJ. Feasibility of performance measurement system for supply chain: a process-based approach and measures. *Integrated Manuf System*, 14, 3: 179-190 (2003).
10. Bititci, U.S., Mendibil, K., Martinez, V., Albores, P. Measuring and managing performance in extended enterprises. *Int J of Operations & Production Mngement*. 25, 4, 333-353 (2005).
11. Folan, P.; Browne, J. Development of an Extended Enterprise Performance Measurement System. *Production Planning and Control*, 16, 6, 531-544 (2005).
12. Chalmeta R, Grangel R. Performance measurement systems for virtual enterprise integration. *Int J of Computer Integrated Manufacturing*, 18, 1: 73-84 (2005).
13. Alfaro, JJ., Ortiz, A., Rodríguez, R. Performance measurement system for Enterprise Networks. *Int J of Productivity and Performance Management*, 56, 4, 305-334 (2007).
14. Romero D, Galeano N, Molina, A. A conceptual Model for Virtual Breeding Environments Value System. In *Establishing the Foundation of Collaborative Networks*, Luis Camarihna-Matos, Hamideh Afsarmanesh, Paulo Novais, Cesar Analide, eds. Boston: Springer (2007).
15. Westphal I, Thoben KD, Seifert M. Measuring collaboration performance in virtual organizations. In *Establishing the Foundation of Collaborative Networks*, Luis Camarihna-Matos, Hamideh Afsarmanesh, Paulo Novais, Cesar Analide, eds. Boston: Springer (2007).