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Evolutionary Model for the Measurement of the Logistics Performance of Non-transnational Suppliers

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Abstract: Given the wide variety and complexity to select evaluation metrics of the logistics performance those allow organizations to monitor their own advance towards the improvement of their activities, storage and delivery of finished products supply. In this work we present a scaler model for its application in systems of logistics performance measurement in tier supplier, non-transnational and small and Medium Enterprises. This model suggests the application of logistical metrics by stages, in an evolutionary way, going up from one state to another gradually, moving the conduct, the purpose and the attitude towards the application of metrics. Each one of the metrics indicates another set of metrics with determined pertinent qualities to the stage of evolution to which they are parallel to activities to be extended in each one of the stages. A revision of the literature to identify pertinent logistical metrics in each stage has been necessary for the proposal of the model.

Key words: performance measurement systems logistics; metric logistic; sustainable supply chain
JEL codes: M11, M14, L14, L16

1. Introduction

Since two decades ago, the organizations have started to consider the concept of supply chain to get a competitive advantage. Knowles et al. (2005), mention that the performance of the supply chain is a very important topic in organizations nowadays and that has been much activity within the academic and industrial circles destined to the generation of improvements in this matter. Also, Gunasekaran et al. (2001) acknowledge that there have been many efforts over diverse aspects and areas of SCM, but until recently attention has been paid to the performance, and its corresponding metrics.

To evaluate the performance of the supply chains performance measurement systems have been designed, focused to the inside and outside of each of the organizations that form the supply chains, a topic noted by many authors according to Knowles et al. (2005), who also tells us that the measurement of the logistics performance plays an important role in the quality and the improvement of the productivity.

At present we can see that many providers have different ranks of logistical metrics utilization to evaluate the performance of participation within its supply chains. Many organizations are willing to initiate changes in their

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organizations, but they don't know where to start these changes. Bhagwat & Shama (2007), comment that "the enterprises that are in troubles to identify what measurement is the most important to follow an order and achieve the improvement of the logistics performance". On the other hand, Beamon (1999), says that the great amount of performance measures, makes hard the selection of these.

About the progress of the measurement of the logistics performance, Novack & Thomas (2004) show how it has evolved from an approach of individual measurements of functionality oriented to distribution costs (internal approach) to an emphasis of multiple measurements of process oriented to logistics costs and services output (external approach). But the author explains that the current challenge is what to measure. Therefore, this author says, that the following evolution step is to unite the performance to another success indicator, both internal and external. Another problem with the metrics of performance measurement, as Beamon (1999) says the performance measurement systems are insufficient because they are based in a great level in the use of the cost as key element and they aren't pertinent with the objectives and strategies of the organization and they don't take into account the effects of the uncertainty in a future (flexibility).

On the other hand, there haven't been found in the literature performance measurement systems implantation procedures for first and second level providers of the supply chains in general, on the other hand Subramani (2004), says that "most of the studies done, have examined the benefits for the network leaders, but little attention has been paid to the providing enterprises". To face this situation a logistical metrics implantation model is presented to allow the organizations that have started or that have the intention to increase their internal efficiency, Technological Innovation and later to be prepared for the next regulations that will be mandatory in a near future due to the scarcity of raw material resources and the care of the environment.

The framework of the article is formed in its second section, by a review of the literature of the necessities for the metrics of the supply chains and the different descriptions of metric that have been proposed by several authors are presented. In a third section the Needs Evolutionary Model for the measurement of the logistics performance in first level providers of the Small and Medium Enterprises (SMEs) is exposed. Finally, the conclusions and future work is presented.

2. Literature Review of the Logistical Metrics

Several authors have classified and defined the great variety of metrics related with the activities of supply and logistics (Lambert & Harrington, 1989; Neely et al., 1995; Beamon, 1999; Gunasekaran et al., 2001; Chan, 2003, Gunasekaran et al., 2004; Bask & Kuula, 2010; Hassini et al., 2012). However, one of the most distinguished classifications has been the one by Novack & Thomas (2004), who build a logistics performance measurement matrix using three areas of importance: (1) Importance of the client, (2) Performance of the company, (3) Improvement cost/time. Their idea was to let the companies to identify those areas of logistics performance where they should improve, meanwhile the cost/time elements were resources that are needed to be spent to improve the service. Later in 1999, Beamon defines that the strategic objectives involve key elements that include the measurement of the resources, productivity and flexibility. Resources Measures (generally the cost) and output measures (generally the response of the client) have been widely used in the models of supply chain. Therefore, according to Beamon, a supply chain of the measurement system must put emphasis in three different types of measures: resources performance measures (R, high level of efficiency), the output measures (O), and the flexibility measures (F). Each one of these types of performance measures has different objectives.

Metrics are described below, classified in accordance to the reliability to be proven, the profitability of the use of

the resources, the adaptation to changes through flexibility and to the recent interest in the sustainable development.

Table 1 The Logistical Metrics Related to Reliability

Metrics	Authors	Detection
Fill Rate	Beamon (1999) and Chan (2003)	They say that it is the proportion of orders filled immediately, this is, the percentage it has achieved with respect to the goal.
Backorder/ Stockout	Beamon (1999) and Chan (2003)	Calculate the backorders as the number of pending articles to be delivered due to the missing existences. Beamon (1999) also calculates the number of shortage, with the number of required products that are out of stock.
Stock out Probability	Beamon (1999)	For her, it is that the probability of out of stock.
	Chan (2003)	Whereas for he, it is the instant probability that a requested item isn't available.
On Time Delivery	Beamon (1999)	Says that the orders delivered on time can be evaluated in diverse ways. The first, called delayed products can be calculated deducting the date of delivery minus the expiration date; The average of delayed orders, is calculated adding the delayed orders and dividing them over the number of orders;
	Chan (2003)	For him, that is the percentage of on time orders can be calculated by adding the orders delivered on or before the expiration date.
	Gunasekaran et al. (2004)	According to them, it is the percentage of delivered orders on or before the expiration date. They are only the on time deliveries of products.
Lead Time	Beamon (1999)	She defines it as the waiting time required to deliver a determined product and calculates this metric as the amount of time between the solicitude of an order and its corresponding delivery.
	Gunasekaran et al. (2001)	Mentioned that in order to no reduce the reliability as provider and to don't decrease the client service level, it must be consistency in the delivery time. These authors say that the lack of consistency in the delivery time is due to bottlenecks, inefficient processes and fluctuations in the volume of orders handled.
Order Cycle Time	Gunasekaran et al. (2001)	Is one of the metrics needed to reduce the time of response of the supply chain, because it is an important source of competitive advantage and influence directly in the satisfaction of the clients and a reduction in the order cycle time leads to a reduction in the SC response time.
	Beamon (1999)	She defines it as the amount of time required to produce a particular product or a lot.
	Chan (2003)	Widens the definition as the time required once the product started its fabrication until the moment is processed completely.
Accuracy	Chan (2003)	He defines it as the percentage of exact products delivered to the clients.
	Gunasekaran et al. 2004	It is the reliable performance of the delivery.
Exchange of Information	Gunasekaran et al. (2001)	Tell us that just as other activities, the delivery depends heavily on the quality of the information exchanged. For example, once the activities are programmed, the continuous supervision is possible based on the obtained information as well as the information given through the channels of distribution. Therefore, the quality and the form in that the information is presented determine the delivery performance and can be used to measure and improve the performance.
Invoice	Gunasekaran et al. (2004)	The number of invoiced notes without failures in the delivery, they reflect client satisfaction This same author tells us that the invoice indicates the date of delivery, the time and the conditions in which the goods were received. By means of the comparison of these with the previous agreement, it can be determined if a perfect delivery has been made or not. Furthermore, the areas of discrepancy can be identified and thus achieve improvements in the delivery performance.
	Cooke (2001)	Presents the results of and study made to 350 enterprises, and mentions that 48% of these enterprises don't do a precise monitoring of the invoice. Furthermore in this study the author advices that the companies must begin with only one metric: the fulfillment of filled up orders, because this joins the client and the provider directly.
Perfect Delivery	Cooke (2001)	He presented the description of a perfect delivery; he also defines it as "the correct amount of correct product delivered on time, free of damage, with exactitude in the invoice". According to this author, it must be used as a control device with the key clients.
	Novack & Thomas (2004)	Present the challenges of implementing the concept of perfect delivery.

Note: This table introduces the logistic performance metrics that have the quality or attribute of reliability highlighted by several authors. Source: Authors.

Table 2 The Logistical Metrics Related to Profitability

Metrics	Authors	Detection
The Costs and the Service	Novack & Thomas (2004)	About the relationship of the cost and the expected impact on the service, they say that the enterprises are more apt to measure the costs of the proportioned service; also they would rather measure the logistics cost than the impact on the results states, although they mention as well that some organizations have started to associate the logistics service level with the financial results and that the world class companies aren't focused only in the internal performance (cost oriented) but to the external performance as well (client approach). But before starting, these authors recommend us that the companies must at first be capable of measuring their own costs before measuring the service, when they design a comprehensive logistics performance measurement system.
Distribution Cost	Gunasekaran et al. (2001)	Say that the cost is, maybe, the most important research about logistics. Therefore it needs a deep knowledge and a good evaluation of the performance of the total costs of distribution, furthermore these authors mention that with a rise in the number of deposits, the effects on the distribution costs can be estimated.
	Chan (2003)	Adds to this cost the transport cost, the handling cost and the safety stock cost.
Cost of Transport	Gunasekaran et al. (2001)	Mention that the single largest cost component of logistics is the transportation cost, often comprising half of the total logistics costs.
	Rushton and Oxley (1991)	Show that the trucking cost is always the highest among all costs of total distribution cost. In a physical distribution channel, the total transport cost can be treated as trucking cost plus local delivery cost.
Inventory Costs	Beamon (1999)	Mentions that the inventory cost can be associated with the obsolescence, work in progress and finished products.
	Gunasekaran et al. (2001)	They point that the inventory is where the biggest cost is hidden in most of the businesses nowadays and increases certain costs associated with the inventory. Some of them Some of them are the costs of the services such as values and insurances, opportunity costs, handling costs, damage or thief risks costs, costs associated to waste and rework, and others associated by the scarcity of inventory accounting for the loses of sales/loses of production. All of these without a doubt are costs that increase due to high levels of inventory, which frequently have little inventory rotation
Inventory Rotation	Gunasekaran et al. (2001)	Comment that a higher inventory percentage means under Inventory Rotation, which leads to an unnecessary increment in the immobilized capital. Later these authors explain that several factors can be attributed to this, such as the vehicle speed, the driver reliability, the delivery frequency, the storages location. A higher efficiency in these areas can very well lead to a decrease of the inventory levels.
	Lambert & Pohlen (2001)	Although the inventory rotation is an internal metric adequate to evaluate the inventory levels within an organization, they say that it could be inadequate to evaluate the performance of the whole supply chain with this metric, since it doesn't consider the risk of changes in the flows.
Cash to Cash of the Inventory	Kumar et al. (2011)	Informed that the 66% of the cash to cash improvements were due to the reduction of inventory days. The formula cash to cash adds to the inventory the accounts to charge and then deduct the accounts to pay (cash to cash = inventory + accounts to charge – accounts to pay). Accountably, an inventory must be registered as accounts to pay, and an account to charge must not be displaced whereas it hasn't been sold.
Work in Process	Gunasekaran et al. (2001)	Mention that in a supply chain, the inventories go from raw materials, subassemblies, finished products and transit kept inventories, traditionally called production shock-absorbers to deal with the uncertainty. These authors also mention that it is essential to find adequate trade-off for the on-transit inventories, since changing the way of transport can affect the inventories investment and the service performance, being able that a faster way of shipment, although more expensive, reduces in a significant way the inventories investment.
Costs of Inventory Handling	Lambert & Pohlen (2001)	Think that the costs of carrying the inventory can be improved by pushing the inventory backwards on the supply chain, to the point of origin. In the same way, this author mentions that this cost diminish when the sales information point is used to program shipments, instead of foretelling the requirements and keeping the safety inventory.
Picking	Lambert & Pohlen (2001)	Think that a storekeeper or a specialist in picking or order filler perhaps can't make the order picking and the exactitude of the picking more efficient. But these authors suggest that they can focus in reducing the picking time, whereas the productivity increases and the costs are reduced in each order. Furthermore, by reducing the mistakes in the order picking, results in a faster invoicing of the order and reduces the cost of returned products.

Note: This table introduces the logistic performance metrics that have the quality of profitability highlighted by several authors.
Source: Authors.

2.1 Set of Logistical Metrics with Reliability

These group of metrics related to the reliability, will have characteristics that will distinguish them from the other groups, due to the fact that their essence will be to show confidence and give good results to the users of the next link in the chain. They will be the metrics that perceive the leader of the supply chain, usually, the transnational assembly industry; they are those metrics that allow the provider to show its capacity to meet with the expectative of its clients. Beamon (1999) defines them as the output metrics related to the logistic performance, which are perceived by the next client of the link of the chain. These metrics even though they seem they are of individual characteristic, as Beamon mentions, usually they must be related with the organizational strategic goals. Table 1 show some of the metrics associated with the quality or attribute of reliability, the authors also are mentioned, and the detection made by each one of them in every of the metric.

2.2 Set of Logistical Metrics with Profitability

The characteristics of this group of profitability metrics are all of those metrics that allow proving that a profit is being produced by the company. It should be noted that some of these metrics measure the cost reductions, considering that the utility and the value for the investors is incremented like this, just as it's mentioned by Lambert & Pohlen (2001). Beamon (1999) proposes for the measurement of the performance the use of the supply chain: resources cost, distribution, fabrication, and inventory management. In Table 2 the metrics related to profitability are presented.

2.3 The Flexibility in the Logistical Metrics

According to the Royal Spanish Academy, being flexible is being susceptible to changes or variations depending on the circumstances or needs. The application of this quality on the metrics Gunasekaran et al. (2001) relate it as putting available the products/services to satisfy the individual demand of the clients. Therefore to this author, by defining the flexibility as a metric and its evaluation, the enterprises can achieve what it used to be impossible: the quickest response to the individual needs of the clients. This has been possible, according to Gunasekaran, as a result of the development of technologies such as:

- The Flexible Manufacture Systems (FMS) of the Group of Technology (GT) and Computer Integrated Manufacture (CIM);
- The Single-Minute Exchange of Die (SMED);
- The Information Technologies (IT) and the Communication Systems (CS), that provides information on line, and furthermore the quick response of the control system.

The flexibility that these systems impart counts with a high impact on the attraction of clients. Beamon (1999) only concerns these metrics with the changes adaptation. On the other hand, Kumar et al. (2011), say that the competence level in the organizations to attract clients in national and international markets must be quick, agile and flexible to compete in an effective way. But this author mentions that this level of flexibility can't be obtained without coordinating the distribution network of the supply chain with performance metrics appropriate, to the supply chain. For Beamon (1999), a general objective of the analysis of the supply chain is the minimization of resources. Although a minimum output level is often specified, the effect of reducing the resources in the flexibility of the supply chain isn't often considered. A supply chain can be reconfigured with reduced resources, whereas the current demand is satisfied, but these short term analyses don't take into account the dynamic nature of the demand. In this way, the author tells us, the resources are directly related with the output of the system and the flexibility performance. Gunasekaran (2001) says that the quick introduction of a product now depends considerably on the providers' reliability and the quickest response capability and this helps to evaluate the competitive level. Also this

author says that the way the orders go through is another important measure and the time of the different routes that the order takes can be taken and thus identify the activities that doesn't add value and delete them. Later, to Gunasekaran et al. (2004), being flexible signifies having the capability to provide products-services that meet the demands of the clients, furthermore says that the flexibility to respond to the needs of the clients is the key to produce value on the client. This author says that the measures that must include flexibility are: the cycle time for the development of new goods, the preparation time of the machines, the efficacy of the distribution planning programming. The study of relevance presented by this author in 2004 brought that the flexibility of the service system to attend the client's needs was the third place importance in the delivery performance measurement, being in first place the quality of the delivered goods, in second, the on-time deliveries of the products.

2.4 Flexibility in Information Exchange Systems

Chang et al. (2003), explain that a supply chain is composed by providers, manufactures, distributors and clients, and can consist of more than one scale in each level. Therefore, once a client wishes to change some specifications or the product design, it needs much time to transmit the final message to the supply chain, by which it is important to improve the quality of the information transfer by means of a more visible information exchange system. On the other hand, Gunasekaran (2001) comments that the role of information technology is changing, from being a passive management facilitator through data bases, to a highly advanced process handler that can control each activity and decide its own course. Dev et al. (2005) says that the information exchange is beneficial to reduce the wide inventory levels in the supply chain. About the information availability, Novack & Thomas (2004) say that the biggest obstacle to find internal and external Perfect Deliveries is to develop a structure for both measurements, just as the feedback time exchange to tax the details of transportation and to design a system that registers the changes of the original order. Once the delivery to the clients has been made, Novack mentions that many times they don't know immediately the result of the performance of the logistics process, and the variables such as the accuracy in the documentation and "on-time delivery" might not be captured for weeks or months after the order was delivered. This depends on how much and how often the perfect order rate is calculated and when the delivering company receives the logistics service quality information.

Electronic Data Exchange–EDI: Although it is common that the first level providers count with EDI programs, Chang et al. (2003), don't mention, if the direct transfer of any modification form one end to another, is feasible. It is well known that the EDI systems only allow the interaction of some information and not the necessary one to register the daily information that would allow the organizations a better control of their logistical activities. But it is necessary that the supply chains have the benefits of EDI Systems mentioned by McLeod (2002) as errors reduction, costs reduction (redundant steps, documentation elimination and paper distribution, order preparing), higher operative efficiency; higher capability to compete; better relationships with the commercial partners.

2.5 The Responsibility in Some Corporates

The Royal Spanish academy, defines responsibility as "the obligation to repair and satisfy, by itself or by another person, in consequence of a fault or another legal cause", another definition is "the moral duty that results to someone about the possible mistake in a determined issue"; and a different one is "the capability of the subject to acknowledge and deal with the consequences of and act done willingly". Due to this, in this article we refer to those metrics that allow the measurement of the capability of the organizations to recognize, accept, diminish and prevent the consequences of the waste generated since the supply, production, distribution, consumption and final stage of the useful life of the product.

Table 3 Selection of Metrics Relative to the Source of the Sustainable Supply Chain

Dimension	Aspect	Description
Economic	Market Presence	Politic, practices and expense providing corresponding to local providers in places where significant operations are developed. Indicate the factor that influence in the providers selection (e.g., cost, environmental and social performance), furthermore its geographical location. Direct economic value generated and distributed, including income, exploitation costs, employees' retribution, undistributed benefits and payments to capital providers and to governments. Employments dependent of the providers or distribution chains (e.g., evaluating the growth impacts or the contraction of the dimension of the organization over its providers)
Environmental	Materials	Materials used, by weight or volume. Percentage of used materials that are valued materials.
	Energy	Direct energy consumption broken down by primary sources. Indirect energy consumption broken down by primary sources.
	Biodiversity	Weight of the transported residues, imported, exported or treated that are considered dangerous according to the classification of the Basilea Agreement, Annex I, II, III, VIII and the percentage of international transported residues.
	Products and Services	Initiatives to mitigate the environmental impacts of the products, services and reduction rank of that impact. Percentage of sold products and their packing materials, which are retrieved at the end of their useful life, by products categories.
	Transport	Significant environmental impacts of products transport and other goods and materials used for the activities of the organization, and the personal transport as well.
Social	Investment and Supply Practices	Percentage of the main distributors and contractors that have been object of analysis in the matter of human rights, adopted measures as consequences.
	Human Rights	Significant identified operations and provider in which: The right to freedom of association and to embrace collective agreements may be violated or may take important risks. Carries a significant risk of incidents of child exploitation. Forced or mandatory labor.
Responsibility over products	Health and Safety of the Client	Specify for each of the following stages of the life cycle (Development of the product concept; I+D; Certification; Fabrication and production; Marketing and promotion; Storage, distribution and supply; Utilization and service; Elimination, reuse or recycling) if the impact over the health and safety of the products and services is subject to an evaluation process for its improvement. Indicate the percentage of significant products and service categories subject to such evaluation procedure. Number of total incidents derived from the breach of the legal regulation or of the volunteer codes relative to the impacts of the products and health services and safety during the life cycle, distribution in function of the kind of results of such incidents.
	Normative Fulfillment	Cost of those significant fines product of the breach of the normativity in relation with the supply and the use of products and services of the organization.

Source: Obtained from the Sustainable Memories Elaboration Guide, G3.1, Source: Global Reporting ™ (2011).

With the purpose of surviving and being competitive in the market, the enterprises must be extended to CSR (Corporate Social Responsibility) through the supply chain (Lee & Kim, 2009) cited by Bask & Kuula (2010), who in addition reveal the necessity to develop the best practices of goods recovery through recycling in the enterprises and the reuse of materials and components. These enterprises perhaps wish to show its ethical, humanitarian or good side. But in Mexico, Cajiga (2012) says that, only the strengthen companies have turned to look the advantages and benefits that can bring to the society throughout their actions, for the common wellbeing of the society with diverse activities that range from economic, social development to the preservation of the environment, topic to be boarded in this section. According to Cajiga (2012), the Corporate Social Responsibility (CSR) is inherent to the enterprise, recently it has become a way of management and doing business, in which the enterprise care its operations to be sustainable, in the economic, social and environmental sense, acknowledging

as well, the interest of distinct groups related to it; he also says it is conscience and congruent compromise of entirely fulfilling the purpose of the enterprise, from the internal and external, showing respect to the people, the ethical values, the community and the environment, contributing in this way to the building of the common welfare. However, other authors (Hassini et al., 2012) define the CSR, as the ability to conduct businesses, with short term goals to keep the welfare of the company, the environment and the society.

The rank of responsibility can be classified in the Sustainable Development dimensions: economic, environmental and social, where each one of them has diverse aspects, which are broken down in diverse performance indicators. Cajiga (2012) tells us that different tools or CRS instruments that allow implementing socially responsible practices exist. One of them can be presented by the Global Report Initiative (GRI, 2011), which is a set of guides to elaborate a sustainability report. Table 3 presents only the indicator of sustainable performance related to the provision of the supply chains are mentioned. The G3.1 (2011) evaluates the influence, that is, the organization must consider its capability to influence in the upstream entities (for example, in its supply chain) just as in the downstream entities (for example, distributors and users of their products and services). About the collaboration of the chain members, Vachon and Klassen (2008), referred by Hassini et al. (2012), observe how the collaboration in the environment impacts the factories performance. They find that even though the upstream collaboration has clear benefits, the case is not evident for the clients, based on the collaboration. Therefore, Vachon and Klassen (2008) referred as well by Hassini et al. (2012) say that the strength of the supply chains links, depends on the environmental and social sustainability performance at country level. Table 3 presents a subtraction of aspects and dimensions of sustainable development connected with the activities of logistics and supply chain management.

2.6 The Competitive Advantage of the Sustainable Supply Chains

Bask & Kuula (2010) reveal the need to develop better practices in the goods recovery enterprises through the recycling and reuse of materials and components. Besides, with the goal to survive and being competitive in the market, the enterprises must extend CSR through the supply chain (Lee & Kim, 2009) referred as well by Bask & Kuula (2010) too. As well, Hassini et al. (2012) say that it is expected that the companies that emphasize the sustainability in their competitive advantages, could reflect it in each of the six conductors of the supply chain (transport-logistics, inventory, facilities, information, price and supply; areas defined by Chopra & Meindl, 2007). Another competitive advantage by implementing CSR standards is the reputation, according to what is mentioned by Bask & Kuula (2010), who as well say that being open in their operations and taking initiatives to develop a mutually beneficial association with providers, can be a valuable publicity asset. Contrary to the reputation, Hassini et al. (2012) tells us that due to the external pressure, there exist organism that can execute boycotts and negative marketing campaigns to embarrass the company in the offering of more sustainable products.

By trying to define the objectives of the sustainable supply chains, Hassini et al. (2012) mention that a conflictive challenge exist in the objectives, since it is very hard to satisfy at the same time the objectives of: maximizing the utilities of the supply chain, whereas at the same time minimizing the environmental impact and maximizing the social welfare. Bask & Kuula (2010), also find contradictory objectives by trying to define the concept of ecologic design, since they mention that the products, infrastructure and services, that require a minimum of resources, energy and surface to provide the wished benefit in the best possible way and, at the same time, minimize the pollution and the waste arisen during the whole life cycle of the product.

Bask & Kuula (2010) describe three sustainability dimensions: the first one, the sustainable product design; then, the sustainable supply and at last, the handling of the end of the life of the product. The metrics for the

Sustainable Products Design have their own objectives it: reduces the amount of resources used to fabricate the product, reducing the environmental impact provoked by the use of the product, reduce the amount of (unrecyclable) residues in the final phase of its useful life, reduce transportation, reduce the packing and increase the recyclable packing. This set of metrics also will be able to measure the prevention of the raw materials shortage (Bask & Kuula, 2010). Finally, the authors formulate the following questions: What are the providers doing to prevent the shortage of any important raw material in their products? How to measure the acknowledgement and acceptance of the consequences that their products aren't produced with unrecyclable materials?

2.7 The Legislation and Sustainable Supply Chains

The enterprises also deal each time with a greater number of restrictions from the national legislation and the international norms in matter of environment according to Lee & Kim (2009) referenced by Bask & Kuula (2010). This author also tells us, that the new legislation and volunteer norms are introduced to guarantee that the enterprises are responsible of their impact over the environment and the society. Some of these known norms mentioned by Bask, are from the family of norms of Quality Management Systems — ISO 9000, the norm ISO 14000 is focused in the care of environment and the norm 14001, provides costs savings through the reduction of residues and the more efficient use of electricity, water and gas; the directive RoHS (Restriction of Hazardous Substances) in electric and electronic devices, was adopted in February 2003 by the European Union; the directive WEEE (Waste Electrical and Electronic Equipment), which pretends to promote the recycling and the reuse and recovery of residues from these equipment to reduce pollution (Directive 2002/96/EC, 2003).

Lee & Kim (2009) referred by Bask & Kuula (2010) mention that communicating this explanation giving to the interested parts can generate confidence and thus, the authors mention, the enterprises show their will to assume responsibilities and move towards CSR. Hassini et al. (2012), find a positive relationship between the financial performance and the sustainable practices. Furthermore, they mention that it seems that this correlation is strengthened with the presence of governmental incentives. In conjunction Hassini mentions that the associations with governmental and no-governmental organizations are important to achieve the transparency in the information and measurement. But they are needed environmental practices for securing the association with providers, could be the tracking audits and the training in reference to assure environmental practices, which proves, according to Bask & Kuula (2010), the level of commitment of the enterprise with the coordination of the supply chain and increase the transparency in the supply chain. Penetrating this topic, Bask & Kuula (2010) give similar recommendations and examples are presented about how the enterprises are working in conjunction with their providers to reduce the environmental impacts. However, the conjunction needs associations for sharing information with suppliers, to guarantee that dangerous substances won't be used in their components, this must be according to Bask & Kuula (2010), a metric that guarantees the transparency of the supply chain, on the contrary, it would be a risk for the enterprise the absence of transparency in the sustainable supply, explains the author. Bask, mentions again that the control of these substances presents challenges to the enterprises that supply materials and components of other areas of the markets in which they operate. Therefore they point out that, it is important for an enterprise to keep their providers updated in the requirements of the different objective market areas. Furthermore they suggest that the enterprises must work towards the creation of a mutual opening environment by working together through the supply chain with their mentioning that the cooperation is essential to try to reduce the use of materials, resources and the levels of waste.

3. Evolutionary Model for the Measurement of the Logistics Performance of Non-transnational Suppliers

In this article when we talk about needs, we understand that they are lacks that the current performance measurement systems have for their easy implementation, some of these areas need soon help, since it is impossible to evolve if basic supply supports aren't created. The reason of why evolutionary model of needs for the measurement of the logistics performance is directed to first and second level providers that supply the OEMs (Original Equipment Manufacturers). Specifically the needs of those "providers of the great leaders, that doesn't have the same benefits of the leaders. For example, when programs are created to give quick response to the manufacture of automobiles frequent deliveries are created, which incur in high inventory expenses management to the providers" (Subramani, 2004).

3.1 Representation of Stages

Each one of the stages must select the most suitable metrics to the system, but it must not be forgotten that they must have the characteristics of the effective measurement systems suggested by Beamon (1999): These characteristics include: inclusiveness (measurement of all the pertinent aspects), universality (allowing the comparison under different operation conditions), measurability (the required data are measurable) and consistency (measures compatible with the organization's goals).

The inspiration of the model is based on the needs pyramid of Maslow (1943), since according to this author, the human being has certain needs that could be able to be satisfied once a previous need is satisfied, is like this that in that scale of needs, it starts with basic needs such as the *physiological:* breathing, feeding, rest, etc.; just until this needs are covered, the ones of the next level will be able to be satisfied such as the *safety needs*, later the needs of *affiliation, acknowledgement* and *self-fulfillment.* For this reason this model, shown in Figure 1, is based on the hierarchy of needs, described below:

- The first metrics must have the attribute of *Reliability* in the metrics that the provider must fulfill. Then, in order for a company that wishes to show reliability, it must first create a culture of logistics metrics acceptance among its personal, we'll call this stage *Culturization.*
- Once that a way of life is created and the habit of measurement in every activity, a second stage will be able to be recognized, a set of knowledge will be able to exist that allowing the organization the *Logistic Resources Measurement*, identifying the financial and not financial benefits proposed by Gunasekaran et al. (2001). It must be noted that in this model is proposed to cover the basic logistic not financial metrics in the first stage of reliability. The set of metrics for the stage of logistic resources measurement must have the *Profitability* attribute, this is, performance indicators that allow measuring economically the logistic operations.
- The third stage called *Technology Innovation Adaptation* will be able to be measured by the *Flexibility* (metrics attribute) that the organization has to adapt to sudden environment changes (Beamon, 1999). This stage has this name, because in order for an organization to quickly respond to the needs of their clients, it must have a certain degree of adaptation to technological innovation to be able to respond to the requirements of the client quickly.
- The last stage of the needs for the performance measurement is the *Sustainability*, Hassini et al. (2012), defines the sustainable business as the ability to conduct businesses with long term goals to maintain the welfare of the company, the environment and the society. The set of metrics for this stage has the attribute of *Responsibility*, given that, beyond the legal obligations, these metrics need to guarantee the care of the environment through the sustainable supply. The providers must consider the anticipated preparation to deal with

the pressures of preserving the environment, because in a not so distant day, when the natural resources scarce, this will be the production system.

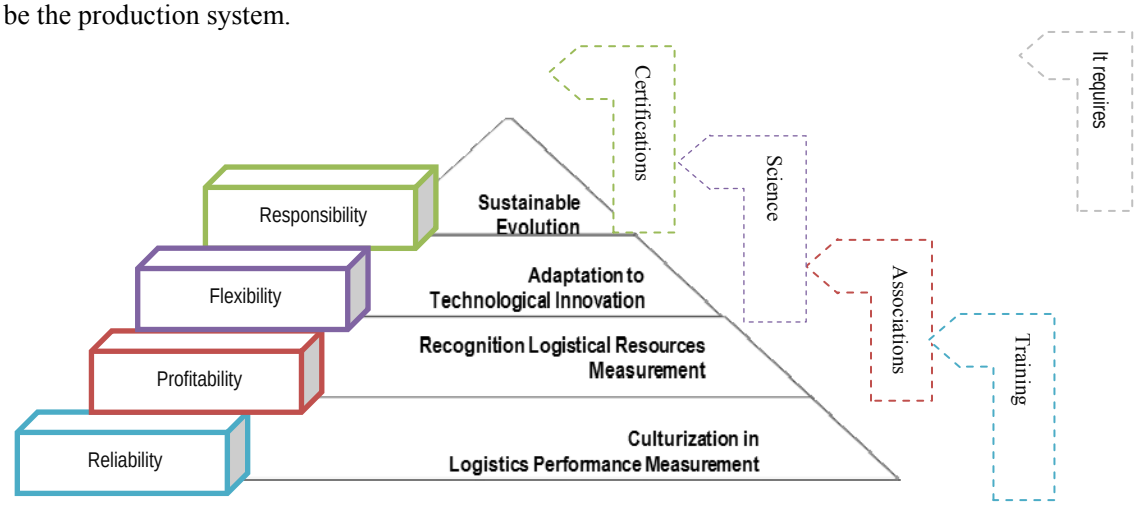

Figure 1 Evolutionary Model for the Measurement Logistics Performance of Non-transnational Suppliers

Note: This figure shows an evolutionary model for measuring logistics performance of non-transnational supplier or Small y Medium Enterprise's. This model suggests the application of logistical metrics by stages, in an evolutionary way, escalating from one state to another gradually, moving the behavior, the purpose and the attitude towards the application of metrics. Each one of the metrics indicates another set of metrics with determined pertinent qualities to the stage of evolution to which they are parallel to activities extended in each one of the stages. Source: Authors.

4. Culturization Stage

The initial stage of this model named Culturization, is defined as the phase where the personal involved is educated to include a measurement culture in the related areas to the logistics of an organization. In the manufacturing industries it is very acceptable the measurement in the tangible productive processes that add value to the product and in the quality inspection of the same; however, there is little habit about the intangible logistics operations related to the activities mentioned by Christopher (1992): the procedures of orders, purchases, inventory management, picking, packing, shipment, invoicing and transport processing, etc.

4.1 Problems for the Acceptance of Logistics Measurement Systems

It is very common that the personal of several organizations put resistance to change, especially to the implantation of new measurement systems, just as Davis & Newstrom (2004) mention it, "the employees aren't convinced that it is necessary", or possibly, "because they put in risk their safety needs, social interaction, status, competence or self-esteem". Other reasons are "the comfort of the certainty, fear of the unknown, lack of information, insensibility, authoritarianism and at last inequality".

Although many manufactures try to keep the client service satisfaction, many of them lack the knowledge to the development of efficient performance measures and metrics needed to achieve a totally integrated supply chain (Gunasekaran et al., 2001). For Beamon (1999), it is a difficult activity to select the metrics of the measurement system, since the following questions arise: What to measure? How are the multiple individual measures within a measurement system integrated? How frequently to measure? How and when are the measures reevaluated? Although it can be hard to choose the individual performance measures, is vital that in this stage the performance measures be related to the organization's strategic objectives (Beamon, 1999).

Table 4 Proposed Indicators to Measure the Reliability of Supplier

Metric	Impact on the customer	Calculation
% Fill Rate (FR)	It covers the need to immediately filling the number of orders required by the customer	% FR = [Number of Orders immediately delivered in a time period / number of orders required by customers in a time period] * 100
% On Time Delivery (OTD)	Determines supplier's ability to deliver on time the customer requirements.	% OTD = [Number of Orders delivered before o in time, in a time period / number of orders required by customers in a time period] * 100
Lead Time (LT)	Time wanted for a client to receive their product	LT = Is the addition of amount of time since entering the request of a customer order to delivery accordingly.
Cycle Time of the Order (CTO)	Improving this metric can reduce the time response of the supply chain.	CTO = The amount of time required to supply, produce, picking and delivering a product or batch.
Backorders (BO)	Customer dissatisfaction is not to deliver their requirements on time.	BO = The number of non-delivered or pending deliver because the lack of existence in a certain period of time.
% Invoiced Deliveries Without Failure (IDWF)	It is customer satisfaction by invoices delivered without mistakes	% IDWF = [This is the number of customer invoices delivered without failure in a period of time / number of deliveries in a period of time] * 100
% Perfect Order (PO)	It is total customer satisfaction without failure deliveries.	% PO = [Number of orders delivered on time, with quantity and correct product, free from damage and without errors in invoicing in a time period / number of orders delivered in a time period] * 100

Note: These metrics to measure the performance of the orders are delivered immediately, on time deliveries, the lead time, the cycle time of each order, the number of items not delivered yet and the percentage of perfect orders. Source: authors.

Table 5 Recommendations to Achieve the Training in the Supply Chain

Activities	what say the researchers
To make a diagnosis	To know the intensity of performance metrics knowledge in all of the activities of the enterprise, and thus detect the need for knowledge about metrics related to the logistics activities. To measure the intensity of Culturalization towards metrics.
To elaborate a measurement instrument	To know the administration abilities of change towards the logistics performance systems.
To build a program about the training	To use and the benefits of each metric that will be used in each evolutionary stage of the implantation of metrics related to the internal and external supply.
Organize a recognition system	Without forgetting that the employees will work harder when they perceive that a personal credit will be given to them due to their efforts, a barely moderate failure risks exists and specific feedback about their performance is given to them (Davis & Newstrom, 2003), therefore a rewards system must be designed to acknowledge the effort of the employees to the new measurement systems.
Identify resistance to change	Davis & Newstrom (2003) also recommend that to beat the resistance to change to recognize the difficulties that the employees have to let go the old methods; the inherent uncertainty to the changes that cause fear; to help the employees to have a wider focus; stimulate the employees to act and finally to try creating organizations that learn, in other words, promoting the capability of the people to learn about the change experience.

Note: These are some recommendations to achieve a culture of acceptance of new performance measurement systems, note that it is suggested to implement some activities were suggesting by Davis & Newstrom (2003) to overcome the resistance to change.
Source: authors

4.2 Attribute of Logistics Metrics: Reliability

In the results of this set of metrics the first level provider's output will be reflected, just as it is proposed by Beamon (1999), this goal will have as end generating high level client service. Its purpose is that, if the output isn't acceptable, the clients will recur to another supply chain.

Several first and second level providers participate in the solid supply chains, oriented to the use of logistics metrics to keep their stability. The linkage logistics metrics between these links, limit themselves only to the fulfillment of the order (Fill Rate) and to deliver on time these orders (on-time delivery), without forgetting of

course the product quality. These providers are focused in few metrics that are perceived directly by their immediate client, but doesn't know which ones are the internal logistics metrics that could guarantee the logistics performance of their link in the chain.

Several organizations cover their lack of interest in reducing the total times of the order cycle, which haven't calculated or don't know why they haven't wanted to take those times. Cover their lack of time cycle reduction initiatives, keeping high inventory levels, which in many occasions aren't even calculated and are unknown in a determined and sudden moment. By which they incur in the "Whip effect" of Forrester (1961).

4.3 What is Needed for Overcoming the Stage? Training

You can see in the Table 5, some of the activities recommended beyond the stage of Culturization.

5. Recognition Logistical Resources Measurement Stage

The manufactures are using logistics to change the relationships with their key clients, according to Cooke (2001), and furthermore tells us that, "if you start to orient the problems of the business, you will provide the greatest value to your clients and you will improve the service and by changing the relationships nature, these relationships will bring more profitability for both". One research paper that helps us to recognize how you should measure the internal logistics services is done in 2012, the Pennsylvania State University cited by Novack & Thomas (2004), mention what are the most measured logistics We showed the classification of metric with the attribute of reliability, in this section we will focus more in the costs and the inventory management as metrics with attribute of profitability, those metrics that produce profit or income.

5.1 Attribute of Logistics Metrics: Profitability

In the results of this set of metrics the use of the organization's resources will be reflected, just as it is proposed by Beamon (1999), this goal will have as an end to prove a high level of efficiency. Its purpose is that, the efficient handling of the resources is critical for the profitability (see Table 6).

Table 6 Proposed Indicators to Measure the Profitability Internal of Logistics Activities

Metric	Impact on the supplier	Calculation
Distribution costs	The lack of reduction in these costs, directly impacting on the sales price to the customer.	It is the sum of the costs associated with the transport, collection, packing and local delivery of a particular order, divided by the number of units of that order. *Transport* : shipping costs by distance and location *Collection:* labor costs for the time of picking *Packing:* labor and material costs for packing *Local delivery:*travel costs
Inventory carrying costs	The lack of reduction in these costs, directly impacting the sales price to the customer.	The addition of insurance costs, robberies, damage and waste, in a specific period of time
Inventory turn	The number of times that the inversion recovers in existence for a period of time. The percentage of covered sales inventory. The percentage of units per SKU which covered sales in a certain time.	RI = ($ Income from sales / inventory $) * 100 If greater than 90%, the level of inventory agrees RI = Number of units sold per SKU, in a period of time /number of units per SKU in stock, in a time period) * 100
Cash to Cash of the inventory	Let's look at the impact of inventory changes in cash flow from inventory.	Cash to cash = $inventory+$accounts receivables-$accounts payable

Note: These metrics measure the internal impact of supplier's logistics activities, ranging from determining the cost of distribution and inventory management, inventory returns and inventory capacity to convert cash to cash.

Source: authors and some other referenced.

5.2 What Is Needed for Overcoming the Stage? Associations

Table 7 shows some of the activities recommended beyond the stage of recognition of logistical resources measurement.

Table 7 Recommendations to Achieve Association in the Supply Chain

Activities	What say the researchers
Providers Selection	Lambert & Pohlen (2001) mention that the client selects and develops relationships with its providers, based on their contribution and criticality. This relationship, the authors mention, perhaps increases the incomes through the costs reduction lowing the price to the consumer and improving the quality obtained by the work with a selected group of providers.
Providers Reduction	It's recommended to reduce the cost of the sold merchandises through influencing big purchases with a little number of providers (Lambert & Pohlen, 2001).
Prizes and Rewards	Creating mechanisms for the lack of logistics performance measurement that capture the prizes/losses of collaboration between the companies in the supply chain (Novack & Thomas, 2004).
Benefits of the Associations	For Gunasekaran et al. (2001) a strong association must be counted with, with long term associations, fomenting the mutual planning to make efforts to solve the problems. Also, Gunasekaran, mentions that although the efficient and effective performance evaluation of the buyers and/or providers is not enough, the association degree that exists between them must be evaluated and improved; furthermore these associations must be encouraged to obtain a clear image in the network supply to prepare the steps that increase the efficiency and the chain speed.
Evaluation of the Association	Gunasekaran et al. (2001), retakes a set of criteria to evaluate the association. For example, the level and rank of information exchange; the costs reduction buyer and seller initiatives; the reach of the mutual cooperation that leads to a better quality; Entity and phase in which the provider is involved; and finally the reach of the mutual assistance in the effort to solve problems.

Note: In this table, we can see the recommendations to association. Source: authors.

The associations must be interrelated systems between themselves, where the general objectives of each link must be the ones proposed by Coyle et al. (2003), cited by Novack & Thomas (2004), who assume that the client is satisfied when the 7R-Objective (7Right Objective) are met in the delivery: Give the right product, client, quality, condition, place, at the right time and at the right cost.

6. Adaptation to Technological Innovation Stage

For Gunasekaran et al. (2001), the selection of a right strategy of the supply chain depends on the nature of the products variety and innovation. But Gunasekaran mentions that organizations have diverse capabilities to respond to the technological and competitive changing forces of the markets.

The Technology as change facilitator: The technology has had an important impact in the supply chain as a change facilitator, since the enterprises have transformed their processes due to their adaptation to Technological Innovation (Coyle et al., 2009). Also these authors tell us that the technology is an important force in the change of the market dynamics and that the individuals and the organizations are connected and having access to information over the same base through Internet. Equally, it has been explained that the technology, has allowed to the people and the smaller organizations to connect to worldwide knowledge groups to create an incredible set of opportunities for the collaboration in the supply chain.

6.1 Attribute of Logistics Metrics: Flexibility

These metrics with flexibility attribute can be measured as the speed in time of being fast in various needs of the client, as quick response to changes in the orders, to changes in the products design, changes in the materials processing, etc. In the results of this set of metrics the organization's flexibility will be reflected, as just proposed by Beamon (1999) this goal will have as purpose to prove the ability to respond to the environment changes. Its purpose is that, in an uncertainty environment, the providers must be able to respond to the changes (see Table 8).

6.2 What Is Needed for Overcoming the Stage? Science-linkage

The quick introduction of a product now depends considerably on the reliability and quick response capability of the providers (Gunasekaran et al., 2001). Furthermore the author says it helps to evaluate the competiveness level. This capability response will depend on the science, this is, of the "set of knowledge obtained by means of observation and reasoning, systematically structured and from which principles and general laws are reduced", according to the concept of the Royal Spanish Academy. Therefore it is necessary to link the science generated by the research facilities and the not transnational first level providers with the academy, so a quick introduction of the technological advances in the small and medium enterprises exist.

Table 8 Proposed Indicators for Measuring the Flexibility of Supplier

Metric	Impact on the supplier	Calculation
Rapid response to changes in the order (RRCO)	Produce value to the customer, because measured ability to respond to changing customer needs.	RRCO = Sum of time required to meet the changes of an original order RRCO = (number of orders with changes as perfect orders fulfilled in a time period/number of orders with changes in the same period) * 100 Saving time response to changes in orders = Current Time – New Time *New Time*: time resultant from investments in activities, equipment and systems to be flexible to enabling in orders.
Rapid introduction of new products (RINP)	Capturing new customers	RINP = The sum of times to change product specifications and reprogram all the activities of a supply chain. Saving Time to response to New Products = Current Time – New Time *New Time:* time resultant from investments in activities, equipment and systems, which allows flexibility to manufacture new products.
Reduction in time, by the use of Information Technologies (ITs, EDI, Internet, SAP)	Facilitates rapid response to the control system and share information	Saving Time with ITs = Current Time - Time new *New Time:* time resultant from investments in systems, which allows flexibility to sharing information.
Speed to respond to the needs of friendly environment products.	Create reliability and tranquility in consumption	Percentage of Products Friendly with Environment (PFE) "n" year = (number of products friendly with the environment/product number) * 100 Δ Annual increase of PFE= % PFE_n - % PFE_{n-1}

Note: These metrics to measure the speed of response to the need for changes required by customers, due to shifts in orders, product features, needs to share information and speed to respond to care of the environment.

Table 9 Technological Innovations Needs to Supply

Needs	what to do
Information Technologies	There is no structure within the informatics systems SAP and EDI for the daily record of necessary information to calculate the internal logistics metrics. Since the information needed for the evaluation of some logistics metrics important to the client is not registered in a permanent and frequent way. They only keep the Logistics Satisfaction of the Client, solving day by day the problems arisen by not fulfilling the on-time delivery of the finished products.
Flexible Manufacture	It is necessary to create flexible manufacture cells to produce a wide variety of products in one single line of production; also it is necessary to design a machine capable of processing diverse materials, that not only give a quick response to product changes in a short term, but in a long term as well.
Substitute Materials	Finding the latest tendencies in the substitute materials research, more economical, environment friendly or to deal with the shortage of non-renewable resources.

Note: In this table, we can see the principal technological needs of the Supply Chain. Source: other authors.

It is well known that in Small and Medium Enterprises (SMEs), the application of new technologies is in some occasions, delayed, due to the high initial costs of innovative products. A well-known example is the

incapability of the SMEs to acquire specialized informatics systems to improve the operation and the logistics performance measurement.

Table 9 provides some of the needs of the current Technological Innovation. It should be noted that these activities are general to every supply chain.

7. Sustainable Evolution Stage

In this article, we refer to it as the unfolding evolution, development of a thing that passes from one state to another, according to the Spanish Royal Academy it, is also moving towards a behavior, attitude or purpose. It is needed ecological evolution in supply chains, because the current systems of protection of the environment certification, only control the pollution side, in the other words, for example, they watch the pollution that the enterprise can generate, for example, hazardous residues handling, CO_2 emission, residual waters treatment, etc. (Bask & Kuula, 2010). But not the related to the supply of materials classified as non-renewables, as a preventive measure for the long term supply.

The supply chains must take care of the future scarcity of raw materials or non-renewable resources, according to Bhagwat & Shama (2007), who say that the supply chains are like extended enterprises, they are the responsible of the Life cycle of the product, since the materials acquisition and the supply management, the production and fabrication, and of the product distribution and client service, and finally the recycling and product elimination at the end of its life. It is because as shown in Table 5, a set of metrics is proposed where the supply chains should start to be implemented in their organizations.

7.1 Attribute of Logistics Metrics: Responsibility

The last sets of metrics proposed in this paper, are related and as previously mentioned to indicators of sustainable supply chains. This group of metrics would greatly help to supply chains to begin now and prevent future shortages, the proposed metrics are shown in Table 10.

Table 10 Indicators to Measure the Sourcing of Environmentally Friendly Products

Dimension	Economic	Environment	Social
Objective	Maximize	Minimize	Maximize
	the utilities of the supply chain	the environment impact	The social well-being
Indicators	% of Increment in sales as consequence of offering environment friendly products.	% of recycled material in a product (recycle). % of types of products with recycled material (recycle). % of types of products with disassembly design for the end of life of the product (recycle). % of products that have ecological materials again (reduce). % of products or packages with end of life, which are submitted again to the same process (recycle). % of products with environment friendly packing (reduce). % of finished products that can be used by third parties (reuse). % of collected packages or products at the end of its useful life (reduce). % of products that doesn't exceed the allowed hazardous substances limits according to the norms RoHS and WEE (reduce).	% of clients increment that are willing to pay an extra cost or the same cost for an environment friendly product. % of increment of local providers, developed as well in sustainable terms.

Note: In this table, we can see the principal metrics relatives to Sustainable Supply Chain. Source: authors and other authors.

It can't be out of the observations made by diverse authors (Bask & Kuula, 2011; Hassini et al., 2012) that mention that adapting the products design, the fabrication process and the environment friendly products delivery, require of an initial investment, which will only bring economical remuneration in a long term, when the clients

have a conscience to prefer sustainable products, or at the point in which the energy crisis and the scarcity of non-renewable products is inevitable.

7.2 What Is Needed for Overcoming the Stage? Certifications

Catalysts must exist that accelerate the technology searching development, in order for the organizations to be prepared now for the adaptation to future changes, like the scarcity of non-renewable materials. These catalysts can be motivations through public acknowledgement or public politics that obligate the organizations since this moment to take care of the natural resources that still exist, for example, petroleum, water, metals, etc. This stage requires of regulatory strategies and external certification for the companies to start preparing their production processes to the future critical needs of natural resources scarcity. Therefore certificating organisms about environmentally friendly products, with legal mandatory character care proposed.

8. Conclusion

In order to provide a performance measurement instrument to the logistical transnational organizations as well as small and medium enterprises, it is presented a model that can be easily implemented with a sequence of evolutionary stages, aimed particularly at those suppliers that have not yet evolved into a way to measure its internal and external logistics performance, and guarantee logistical service satisfaction given to their customers. This model also serves as a preventive tool to compete in the market, as it provides structure to short and long term needs.

The implanted methodology for developing this model was as follows: Firstly it was made a collection of studied and classified metrics by various authors. Then it was attempted to implement these metrics on a Plastic Processing Industry Automotive (PPIA), finding that it was necessary to organize these metrics in a priority way, that is, selecting the most appropriated at an early stage then it was determined that those be which permit to demonstrate the reliability as a supplier, called in this paper “reliability”, which had to have some culture to the acceptance of these metrics. The second stage called “Logistical Resources Measurement Recognition”, must be applied once the stage of acculturation is accepted by the staff of the ITPA, in this second stage, the metrics have the characteristic of “Profitability” as these permit to measure the economic performance of the logistics area. The third stage of development, called “Adaptation to Technological Innovation” will be achieved only in those organizations that are being prepared for the future, given the changing market needs, this feature of these logistical flexibility metrics, enable organizations to measure their adaptation to technological change. The last stage named “Sustainable Evolution”, can be reached once the organization has taken the “Responsibility” (metrics feature) to take the consequences of the waste generation produced by their products at the end of useful life, also this step would be reached, once raised awareness of the importance not only to reduce waste and pollution generation, but also to prevent the shortage of raw materials.

In this paper it can be seen a useful and simple tool to implement an adequate system of logistics performance measurement, it also allows an organization to find a way to self-assess its future performance. Some limitations of this study has been developed from the experience of implementing performance indicators in no transnational logistics industries, which do not have a certain culture of acceptance of performance measurement, and it is assumed that an Transnational organization already has the application of logistics performance indicators.

It remains as future prospects applying this model in some small and medium enterprises to validate the model, and the design the instruments to collect information from each of the metrics in an easy way to apply and evaluate it.

References:

Bask A. and Kuula A. (2011). "Measuring supply chain level environmental sustainability—Case Nokia", *International Journal of Business Insights & Transformation*, Vol. 3, No. 3, pp. 16-24.

Beamon B. M. (1999). "Measuring supply chain performance", *International Journal of Operations & Production Management*, Vol. 19, No. 3, pp. 275-292.

Bhagwat B. and Sharma M. (2007). "Performance measurement of supply chain", *Production Planning & Control*, Vol. 18, No. 8, pp. 666-680.

Cajiga-Calderón J. F. (2012). "The concept of corporate social responsibility", *Mexican Center for Philanthropy*, available online at: http://www.cemefi.org/esr/images/stories/pdf/esr/concepto_esr.pdf.

Chan F. T. S. (2003). "Performance measurement in a supply chain", *The International Journal of Advanced Manufacturing Technology*, Vol. 21, No. 7, pp. 534-548.

Chopra S. and Meindl P. (2007). *Supply Chain Management: Strategy, Planning, and Operation*, Prentice-Hall.

Cooke J. A. (2001). "Measuring value: Who should measure your performance?", *Logistics Management*, February, pp. 45-48.

Coyle J. J., Langley C. J., Gibson B., Novack R. A. and Bardi E. J. (2009). *Supply Chain Management*: *A Logistics Perspective*, South-Western.

Christopher M. (1992). *Logistics and Supply Chain Management*, Pitman Publishing, London.

Davis K. and Newstrom J. W. (2004). *Human Behavior in the Work*, McGraw Hill, México.

Dev N. K., Caprihan R. and Swami S. (2008). "Using Taguchi Paradigm for the design of information sharing policies within a supply chain network", *Proceedings of 32nd National Systems Conference*, NSC 2008, IIT Roorkee, December, pp. 507-513.

"Directive 2002/96/EC of the European Parliament and of the council on waste electrical and electronic equipment" (2003), *Official Journal of the European Union*, available online at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:037:0024:0038:en:PDF.

Forrester J. W. (1961). *Industrial Dynamics*, MIT Press: Cambridge, MA.

Global Reporting™ (2011). "Guide for the Preparation of Sustainability Reports G3.1", available online at: http://www.globalreporting.org/resourcelibrary/Spanish-MSS.pdf.

Gunasekaran, A., C. Patel and R. E. McGaughey (2004). "A framework for supply chain performance measurement", *International Journal of Production Economics*, Vol. 87, No. 3, pp. 333-347.

Gunasekaran A., Patel E. and Tirtiroglu C. (2001). "Performance measures and metrics in a supply chain environment", *International Journal of Operations & Production Management*, Vol. 21, No. 1/2, pp.71-87.

Hassini E., Surti C. and Searcy C. (2012). "A literature review and a case study of sustainable supply chains with a focus on metrics", *International Journal of Production Economics*, Vol. 140, No. 1, pp. 69-82.

Knowles G., Whicker L., Heraldez J. and Del Campo F. (2005). "A conceptual model for the application of six sigma", *International Journal of Logistics: Research and Applications*, Vol. 8, No. 1, pp. 51-65.

Kumar S., McCreary M. and Nottestad D. (2011). "Quantifying supply chain trade-offs using six sigma, simulation, and designed experiments to develop a flexible distribution network", *Quality Engineering*, Vol. 23, No. 2, pp. 180-203.

Lambert D. M. and Harrington T. C. (1989). "Establishment customer service strategies within the marketing mix: More empirical evidence", *Journal of Business Logistics*, Vol. 10, No. 2, pp. 44-60.

Lambert D. and Pohlen T. (2001). "Supply chain metrics", *International Journal Logistics Management*, Vol. 12, No. 1, pp.1-19.

Landeros R., Reck R. and Plank R. E. (1995). "Maintaining buyer-supplier partnerships", *International Journal of Purchasing and Materials Management*, Vol. 31, No. 3, pp. 3-11.

Lee K. H. and Kim J. W. (2009). "Current status of CSR in the realm of supply management: The rise of the Korean electronics industry", *Supply Chain Management: An International Journal*, Vol. 14, No. 2, pp. 138-148.

Maslow A. H. (1943). "A theory of human motivation", *Psychological Review*, Vol. 50, No. 4, pp. 370-396.

McLeod R. Jr. (2000). *Management Information Systems*, Pearson Education, México.

Neely A., Gregory M. and Platts K. (1995). "Performance measurement system design: A literature review and research agenda", *International Journal of Operations & Production Management*, Vol. 15, No. 4, pp. 80-116.

Novack R. A. and Thomas D. (2004). "The challenges of implementing the perfect order concept", *Transportation Journal TM*, Vol. 43, No. 1, pp. 1-16.

Rushton A. and Oxley J. (1991). *Handbook of Logistics and Distribution Management*, Kogan Page Limited, London.

Subramani M. (2004). "How do suppliers benefit from information technology use in supply chain relationships?", *MIS Quarterly*, Vol. 28, No. 1, pp. 45-73.

Vachon S. and Klassen R. D. (2008). "Environmental management and manufacturing performance: The role of collaboration in the supply chain", *International Journal of Production Economics*, Vol. 111, No. 2, pp. 299-315.