

**EXECUTIVE SUMMARY**

**APPLYING LEAN PRINCIPLES IN THE SUPPLY CHAIN:  
AN EXAMINATION OF MEASUREMENT SYSTEM ADAPTATION**

by

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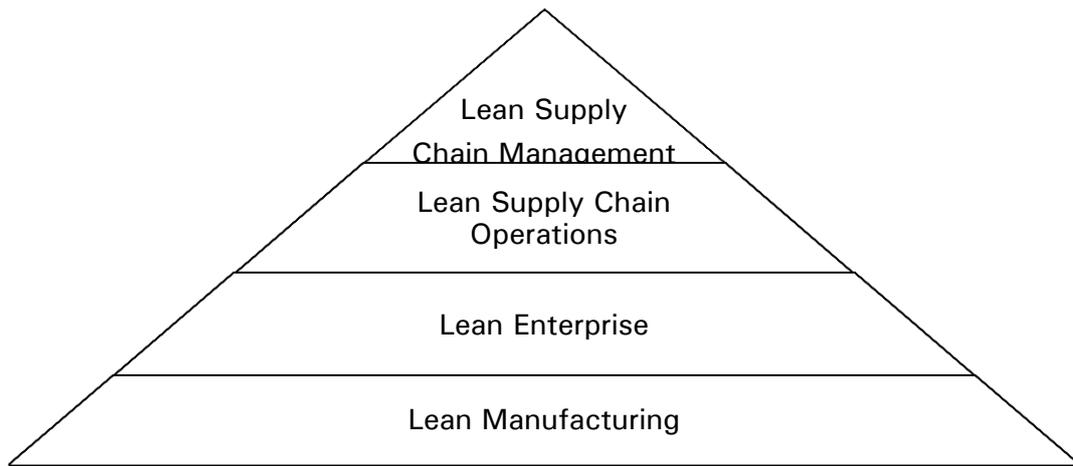
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## Introduction

"What gets measured gets managed, and what gets managed gets done," stated Peter Drucker back in the 1950s to show the importance of performance measurement as a means by which companies can better manage processes and people.

The evolution of business environments and of management mindsets today requires that performance measurement be open to the broader horizons in which business is conducted by providing a method for managers and executives to appraise the business, encouraging a holistic measurement strategy to help enable the success and well-being of the firm. Too often, measures are devised that optimize performance in one activity or business function only to the detriment of other activities or functions and, hence, proving sub-optimal for the business. Unfortunately, this fate is observed in organizations employing operational excellence techniques such as lean process improvements. When analysis is limited to one work cell, one department, or one location, the advents of a process change beneficial to the focal activity can prove taxing elsewhere in the organization or supply chain. Thus, the motivation behind this study is to develop a performance measurement framework adapted to meet today's needs, guiding lean principles and behavior throughout extended supply chains.

Figure 1 explains the lean evolution using a pyramid analogy: while many companies are applying lean principles within manufacturing or throughout the enterprise, only a few understand the value of applying lean in broader supply chain operations by managing customers' and suppliers' interfacing activities in accordance to lean thinking and using tools such as extended value stream analysis; a very selective number of companies are employing lean as a key part of the corporate strategy and applying lean thinking to holistic supply chain management. The focus of this research was to understand how these progressive companies are seeking the top of the pyramid. In particular, we sought to examine how measurement systems adapt when companies pursue higher orders of lean implementation in the supply chain.



**Figure 1. Lean Pyramid**

In sum, this research sought to address three specific objectives:

- A) To identify how lean principles and tools can be applied within and across an extended value stream;
- B) To develop a performance measurement framework to drive the behavior we are seeking for the lean supply chain, while considering today's management mindset and business environment; and
- C) To use the model as guidance to support management decision making in the lean supply chain.

### **Research Method and Companies Sample**

The research was developed in two steps. An in-depth analysis of the operational excellence journey and measurement systems employed at Cardinal Health comprised the first step. The second step of the research examined nine additional companies in an effort to validate and broaden the measurement framework proposed by the research. Each participating company is multinational with 2012 sales ranging from less than \$1 billion to more than \$100 billion. The identified companies represent a number of industries, including pharmaceutical products distribution, durable consumer goods manufacturing, biomedical goods research and manufacturing, highly engineering goods manufacturing, pharmaceutical products manufacturing, insurance service provision, fruit preparation and production, third-party logistics and supply chain solutions, and diverse consumer and industrial goods manufacturing.

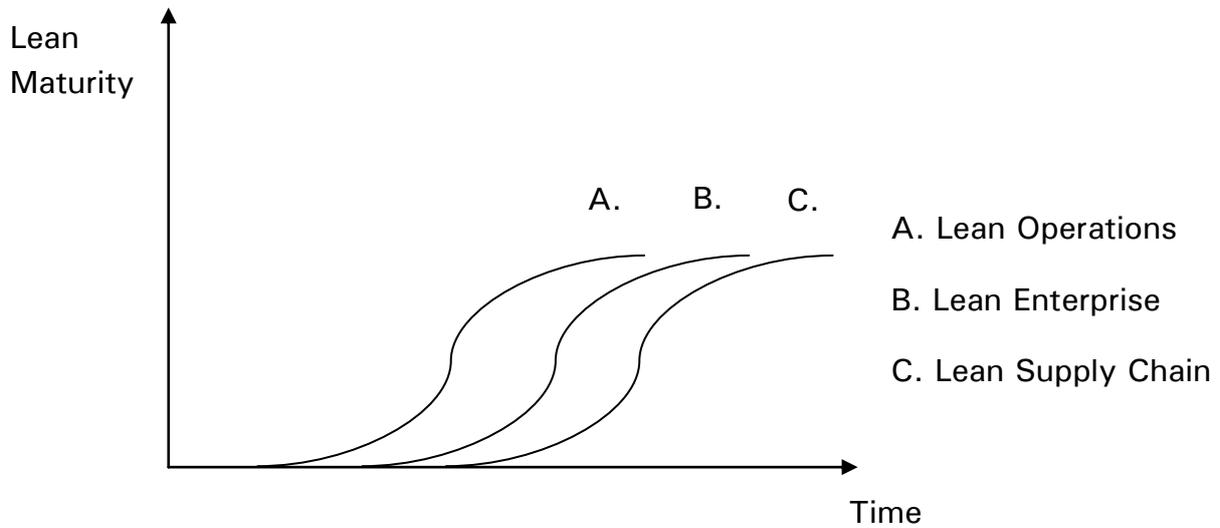
The data were collected from personal interviews with more than 80-hours of face-to-face interviews performed during the timeframe period October 2012 to February 2013. Senior executives with the titles of vice president in operational excellence, strategic sourcing, inventory, finance, sales or director of supply chain, operational excellence, operations, marketing or managers of various functions were involved in the conversations. The length of each interview ranged from 1 to 2.5 hours.

### **The Application of Lean Thinking to the Extended Supply Chain.**

*Do the principles and tools applied to Lean Enterprise find ready application in the extended, cross-functional supply chain processes?*

The research findings confirm that companies embracing lean tend to migrate from a purely operational focus to a larger cross-functional enterprise level of analysis, and, in many cases, they have matured further to incorporate customers and/or suppliers into their transformation effort across the supply chain. During the lean journey, companies need to overcome certain challenges through education and cultural change to be driven from the leadership level down to the lower levels of the organization such that employees are engaged, empowered and motivated to continually seek better outcomes and improve the work conducted each day. Moreover, companies adapt IT systems to accommodate the transformation and to employ lean tools such as extended value stream mapping in order to uncover waste and encourage enhanced relationships with customers and suppliers.

The findings highlight the migration from lean operations to lean enterprise and, finally, lean supply chain showing that these three journeys are often embarked at different points in time as independent means of achieving continuous improvement. Figure 2 illustrates these three journeys. The shape of each curve within each journey shows an initial developing phase, which requires intense investment of time and resources to train employees, to develop an operational excellence team and to spread the lean culture, guaranteeing greater yield for the company after this initial phase. With success demonstrated at the operations level, lean principles find application across functions at the enterprise level. Success at the enterprise level, then, encourages lean application in supplier and customer engagements, or supply chain level. In essence, the lean journey is really an on-going improvement process, by which companies are continuously seeking to improve simultaneously their operations, enterprise, and supply chain.



**Figure 2. Lean Maturity Model**

**Performance Measurement Framework for the Lean Supply Chain.**

*Do companies adapt their internal and external measurement systems in pursuit of Lean Supply Chain arrangements?*

All interviewed companies confirm that measurement systems are adapting to support the lean transformation. The degree by which this adaptation occurs is a function of the lean maturity of the company: in fact, the most progressive companies, the ones that are quite far along in lean progress, show a structured adaptation in their measurement systems at each step of the lean journey, within and beyond the organization, while "beginners" in this journey start by reviewing and accommodating the measurement systems to support the transformation at a process or operations level (Figure 3).

$$\text{Measurement Adaptation} = f(\text{Lean Maturity})$$

**Figure 3. Measurement Adaptation According to the Lean Maturity**

***Why do companies adapt their measurement systems in moving toward a lean supply chain?***

The discussion of the previous research question pointed out that companies adapt their measurement system to support their lean transformation; we next explore the motivations for adapting their measurement systems in pursuing lean supply chain arrangements.

"If companies do not change what they measure and what they reward, they cannot expect any difference to happen," stated Jack Welch in the early 2000s.

Indeed, companies need to adapt their measurement systems such that the new strategy, which has lean thinking as one of its pillars, can be most effective. Management defines the vision of the company, which is then deployed into goals; each goal is then translated into metrics, such that these metrics are aligned with the vision of the company and its effort to achieve lean transformation. Employees are then encouraged to define activities and behaviors to reach those goals, such that they are stimulated to find ways to do things better themselves rather than instructed to perform work as defined by others.

Also, measurement systems communicate to employees what aspect of performances are important to the company, driving people's behavior and giving individuals the legitimacy to focus their work toward accomplishing the defined goals. Thus, if the strategy changes and measurements do not adapt, employees focus on the same measures, hindering the effort of the company to put the new vision to work. Finally, companies need to adapt their measurement systems such that they can better identify areas where performance is weak so that steps can be taken to promote improvement and to achieve the desired outcomes sought through strategy.

***How do companies adapt their measurement systems in moving toward a lean supply chain?***

Given the importance of adapting measurement systems to accommodate lean transformation, we sought to develop a performance measurement framework populated with measures that guide behavior in pursuit of the lean supply chain.

The research discovered the following actions by our sample companies to devise more robust measurement systems in support of lean transformation:

#### **A) Introduction of New Dimensions.**

All ten interviewed companies underscore the importance of introducing new performance dimensions to be integrated with existing financial and operations measurement perspectives in order to take into account all the relevant aspects of the business. These include aspects of employee safety and morale as well as conventional measures of productivity, efficiency, cost, and service performance.

#### **B) Accountability of the Performance Measures (MBOs).**

Only the most progressive companies introduced a management by objectives (MBO) system, which establishes objectives and measures across the organization such that management and employees are engaged in pursuit of specifically defined outcomes and then feel responsible to work accordingly. In addition, companies show the desire not only to give accountability of specific measures to specific individuals, but also to link the incentive systems to the ability to reach those goals.

#### **C) Decomposition and Reconstruction: Cascading Measures Illustrated.**

The most progressive companies illustrated the notion of decomposition and reconstruction of their metric system. In fact, companies have high-level measures that deploy their strategy, which then cascade down to the lowest level of the organization, such that the measures can be re-aggregated in order to reconstruct the high-level measures from which they derive.

#### **D) Balance Between Financial and Non-Financial Measures.**

All ten companies understand the importance of balancing financial performance elements with non-financial elements in their measurement systems. Ultimately, performance is translated into aggregate financial terms, yet, these aggregate outcomes fail to provide ample guidance in operations. The inter-relationship among financial and non-financial measures is considered essential.

#### **E) Prioritizing Metrics.**

Given the importance of defining the right set of metrics, all interviewed companies take action to emphasize the measures that better drive lean behaviors and that can identify wastes and opportunities for improvement across the supply chain. As an example, some companies now emphasize Total Cost of Ownership over the Cost per Unit Purchased, as a way to emphasize lifecycle considerations.

#### **F) Measures Standardization.**

One of the first efforts that all the companies took when considering a measurement adaptation during their lean journey was the standardization of the measures such that they were consistently articulated and defined, ensuring that people working on the

same activities are measured in clearly one uniform way and ascertain one version of the truth to offer to customers.

**G) Raising the Bar of the Existing Performances.**

Among the initial steps taken by the ten companies is the recognition of the importance of continuous improvement to be driven by achieving higher levels of performances and goals. In essence, companies recalibrate expectations on key performance dimensions, such as lowered inventory, faster cycle times, higher fill rates, and heightened customer satisfaction. These outcomes help to justify and accelerate lean transformation.

**H) Substitute a Measure with a New One.**

During the measurement systems adaptation, companies showed that some of the old core measures were kept while others were substituted with new measures. The primary objective is to identify leading indicators, as opposed to lagging indicators, that help to uncover opportunities for future improvements. Also, the aim is to define measures that can drive lean behaviors by taking into account the perspectives of customers.

**I) Consider Fewer, Key Measures.**

Some of the case companies are struggling with the proliferation of metrics, especially in the cascade of measures to the lower levels of the organization. Therefore, there is a substantial effort from the companies to select few measures to make sure that employees understand what's important for the company and to guide lean behaviors.

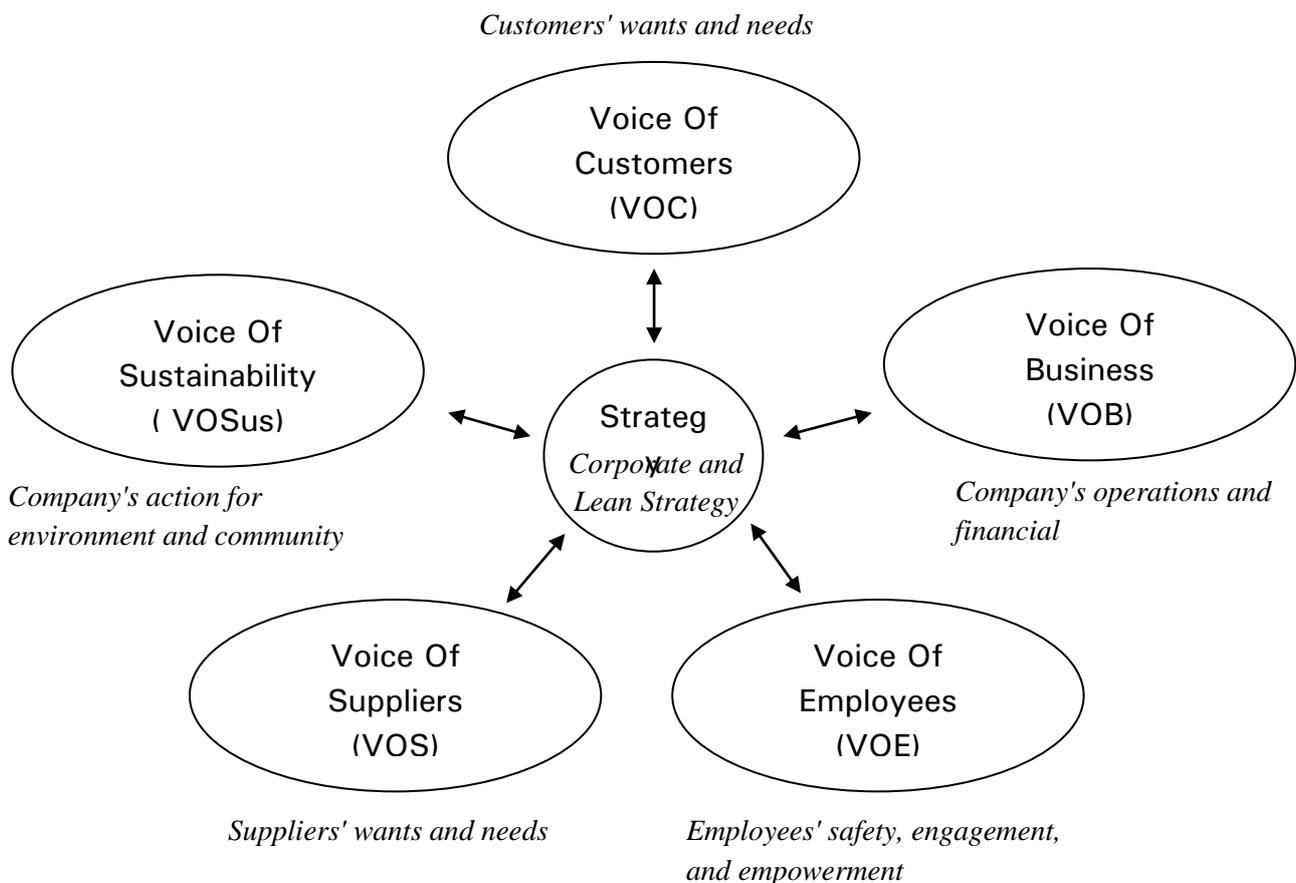
**J) Quantitative and Qualitative Measures.**

Companies recognized the importance to support quantitative measures with qualitative measures such that it is possible to capture the soft elements of the relationships with internal and external stakeholders. The most illustrative examples in this aspect are the introduction of surveys that consider satisfaction of customers, suppliers, and employees. These enlightened companies recognize that deficits in these satisfaction measures ultimately find reflection in measures of market and financial performance.

A primary purpose of this study was to develop a performance measurement framework that enables integration of the various functions across the company and the different companies with which the company interfaces in the supply chain, while incorporating lean as a basis to identify opportunities for improvement within and across the supply chain. The framework is

intended to take into account today's business environment while also adaptive to changing needs of key members of the supply chain. The delivered framework is presented in Figure 4.

In the center of the proposed framework is the strategy of the company, which has lean thinking as one of its pillars; the strategy is then deployed into the various performance dimensions, or "voices", each voice is then translated into measures that are tied to the overall strategy. The voices are described as follow:



**Figure 4. The Performance Measurement Framework for the Lean Supply Chain**

**a. Voice of Customers (VOC).**

The very first voice to consider is that of customers. It is regarded as the loudest voice of the supply chain and it must be taken into account from all the companies of the value stream such that they can identify opportunities to better serve the customers. The Voice of Customers (VOC) is a composite of immediate customers (i.e., those who buy directly from

the focal company) as well as end-customers (i.e., those who ultimately use or consume the focal company's products or services), when these are not the same. The VOC aims to capture customers' expectations, preferences, and aversions by identifying a set of customer wants and needs which become key inputs to uncover opportunities for improvements to better satisfy those needs, particularly for key or most valuable customers. All ten companies recognize the Voice of Customer as the most important dimension of the framework-- together with the Voice of Business (VOB) -- in order to truly understand what the customers' needs are which will, in turn, generate higher profits for the company.

**b. Voice of Business (VOB).**

Companies need to consider first the customer's needs but also understand the financial implications of its decisions and actions. In fact, managers need to keep an eye on all the dimensions at the same time in order to not lose focus on the overall business by considering only one dimension. The Voice of Business (VOB) encompasses the primary needs of a business and its stakeholders, including profitability, revenue, growth and market share, and can be used to establish goals and define business success. The ultimate goal of the lean supply chain is to improve a company's processes, in order to better serve its customers and generate greater yields for the company in the long term. The ten companies present different levels of sophistication in adapting this voice to support the lean transformation.

**c. Voice of Employees (VOE).**

The Voice of Employees (VOE) is tied to the lean philosophy that has respect for individuals, employee safety, engagement, and employee empowerment as its foundations. It summarizes the needs, desires, and preferences of all employees within an organization. VOE takes into account spoken needs, such as safety, wages, healthcare, and retirement savings, as well as unspoken needs that can include job satisfaction and the respect of their coworkers and supervisors. This voice aims to improve employee satisfaction and safety such that the company becomes the employer of choice for its employees. Highly engaged, safe and satisfied employees are believed to be more productive, have lower costs of training and employment, and to become advocates for the company and its offerings. The cross-case analyses show that, as lean transformation matures within companies, greater interest is directed toward this dimension.

**d. Voice of Suppliers (VOS).**

The Voice of Suppliers (VOS) dimension has been introduced in order to encourage the company to become the customer of choice for its suppliers. It is a dimension that aims to build stronger relationships with suppliers by understanding what their main concerns are and treating each other as true partners. Particular emphasis is placed on those suppliers deemed most critical to the current and future success of the focal company.

This dimension is relatively new for the interviewed companies; indeed only a few progressive companies recently introduced this dimension by devising a survey for all its suppliers in order to understand how suppliers rate the focal company in various areas, while other companies try to understand this voice through occasional interviews. One company introduced an on-line portal that enables suppliers to instantly see how well they are performing in the eyes of the focal company, what the root causes are that generate a bad performance, how well their customers are served from the focal company, the inventory levels at the focal company's plants, and how well they are performing against their peers. By better informing suppliers of their relative performance, they are both enlightened and incentivized to elevate the performance they generate for the focal company.

**e. Voice of Sustainability (VOSus).**

The Voice of Sustainability (VOSus) is a new dimension devised from the researchers in order to adapt the framework to today's business environment and management mindsets. Rising costs, increasing regulation, and expanding awareness of the ecological effects of business activities have driven managers to strategically rethink how they address issues pertaining to the environment and the communities in which the company resides and operates. Indeed, lean, by virtue of tools like value stream mapping, enables identification of wastes in processes, including excess material, packaging, water usage, energy usage, or transportation miles. By identifying these wastes and reducing resource consumption among water, energy, transportation, and material, or by recycling products and optimizing packaging, companies can reduce costs which, in turn, impact the top line of the income statement while reducing the impact on the environment. On the other hand, with regard to the community and societal aspects of sustainability, all ten companies are involved in charity

projects by giving financial support to their local and international communities. Measurement of these activities is limited, however.

In addition, as shown in Figure 4, management is aware that there is a bi-directional flow among business strategy and the voices; in fact, on one hand the strategy influences the various voices by dynamically changing the specific measures, but also the results within each voice influence the strategy and positioning of the company. Moreover, there is a bi-directional flow among managers and employees as leadership is responsible to set the overall goals of the business, while employees are encouraged to identify ways to better reach those goals. Further, the devised model can be useful for management to communicate and educate employees around the vision of the company and to drive behaviors in the desired direction.

Finally, the researchers embraced a triple-bottom-line approach such that today's business circumstances can be taken into account, by considering not only the economic implications of decision making, but also environmental and societal aspects. These elements present a more modern perspective that was not considered by the frameworks proposed in the previous studies.



## Appendix 1. Sample Items that Measure the Lean Supply Chain Performance

<b>1. Voice of Customers</b>
Overall Customer Satisfaction (Ratings, Complaints, Endorsements)
On-Time-In-Full (OTIF)
Responsiveness: Order Cycle Time, Inquiry Response Time, Order Flexibility
Reliability: Order Cycle Time Variability, Delivery Variability
Returned Parts Per Million
Return Cycle Time
First Time Pricing Accuracy
Supply Visibility: Available To Promise
Days of Inventory On-Hand (Dedicated to specific customers)
<b>2. Voice of Business</b>
<b>2.1. Internal Focus</b>
Profit Growth
Cash-To-Cash Cycle Time
Labor Productivity
Operations Productivity
Days Of Inventory On-Hand
Inventory Accuracy
Cost of Poor Quality (Rework, Scrap, Warranties, Sales Return, Sales Loss)
Total Lead Time
<b>2.2. Customer Focus</b>
Customer Profitability Report
Customer Lifetime Value
Product/Service Profitability Report
Quality Of The Relationship (Measures of Retention and Loyalty)
Share of Customer (% of Customer's spend in category directed to focal company)
<b>2.3. Supplier Focus</b>
Supplier Profitability Report
Total Cost Of Ownership
Supplier Lifetime Value
Vendor Rating
Supplier Certification
Quality Of The Relationship (Complaints filed, Innovations achieved, Savings)
Share of Suppliers (% of category spend with a given supplier)
<b>3. Voice of Employees</b>
Voice of Employees Satisfaction
Safety Performance Indicator

Talent Development (Number and Investment in development activities)
Talent Retention
Diversity in Organization
Diversity in Management Ranks
<b>4. Voice of Suppliers</b>
Overall Supplier Satisfaction
On-Time-In-Full (OTIF)
Sales (Customer's purchases with supplier)
Focal Company Profitability
Demand Forecast Accuracy
Days of Inventory On Hand (At supplier)
Supplier Performance Among Peers
Customer Service Level
Customer Overall Satisfaction
<b>5. Voice of Sustainability</b>
<b>5.1. Environment Focus</b>
Carbon Footprint
Reduction of Solid Waste
Reduction of Water Consumption and Releases in Water
Reduction of Air Emissions
Improvement in Energy Efficiency
Reuse, Remanufacturing and Recycling (Total volume, % of units sold)
<b>5.2. Community Focus</b>
Donations and Sponsoring (Annually)
Legal Violations (Per year, 5-year Period)
Employment (Number of persons, year over year)
Investment in Cities/Localities where company resides and operates
Noise Pollution (dB's)
Public Health (Cases of asthma, cancer etc..)
Public Hazards (e.g., Roadway accidents)
Recalls Issued