

# Lean and Quality Management Tools Used in Performance Measurement

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## **Abstract**

*Performance measurement is used in business to develop or sustain a competitive advantage. This paper presents the influence of performance measurement in companies along with the need of implementation of a performance management system, or improvement of the current one.*

*In recent years, more and more companies use the lean and quality management tools that are present in both the literature and industry. As the economic conditions change and the competition increases, the businesses constantly need to improve and optimize their processes and approaches in order to follow the Key Performance Indicators.*

**Keywords:** *performance, measurement, KPIs, lean methodology, management.*

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## **1. Introduction**

Performance measurement became more popular in the recent years. Many companies have adopted it and tried to integrate it within the business, in order to develop and maintain a competitive advantage. In the following paper we are going to present how various authors defined the performance measurement and what are their findings about the subject.

Price (1997) defines measurement as being the assignment of numbers to observations and states that there are usually four types of measurement levels: nominal, ordinal, interval and ratio. The author then describes the nominal measurement as a classification and presents that there is no assignment of numbers in nominal measurement. In the same paper, it is stated that ordinal measurement implies ranking and that ratio measurement has all the properties of interval measurement and as a particularity, it has a true zero. Price (1997) gives weight as an example of ratio measurement. In the handbook, z gives four criteria that guide the selection of the measures: quality, diversity, simplicity and availability. The author then shows that throughout history, measurement of variables within a company was mostly based on questionnaires and encourages the use of records when it is possible (Price, 1997).

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Throughout the 1980s, the emphasis was on improving productivity, while in the 1990s, quality had become popular and apparently critical to the success of an organization. Many companies have seen tremendous increases in productivity and quality, in line with the principle of what gets measured gets done, yet certain successful organizations with the best quality in their industry did not resist on the market (Niven, 2010).

Niven (2002) presents some research findings that show a tendency for the majority of the companies: they express the willingness to change the existing systems of performance measurement. For achieving this target, a consistent implementing strategy should be in place. Grady (1991) affirms that the performance measures should be integrated as a way of keeping track of the results of the organization and as a way of particularizing strategy. Planning in advance or performance measures should be introduced and to focus on the identification of the vital actions and tasks that are required to achieve the success factors that result from strategy. In this stage of planning one should consider the performance measures and should look for the objectives that are to be achieved in the same rhythm as the identification of aspects that are to be controlled. Usually the performance measures and the organizational strategies are applied in the same manner at the corporate level, as we start to get in the details of each project the performance measures are getting more specific and applied to more functional aspect and shorter periods of time.

The performance measures should be in accordance with the corporate level strategies and Grady (1991) states that this is not an easy task. These measures need to offer the support needed and should not prevent in any way the implementation of a strategy. The example given by Grady (1991) of a big consumer products manufacturer helps us to better understand the concept. This company implemented a strategy that aims to increase the customer satisfaction level throughout the company. The management created seven performance measures that supported the strategy offered the highly needed feedback regarding the satisfaction of the client. These measures included client complains index, order response time, service and satisfaction survey, product satisfaction survey, warranty frequency, loyalty index and on-time delivery performance. The author concludes that the performance measures should be derived from strategy and should be elaborated in such way that they support the organizational objectives, by being easy to collect and report within all the layers of the company (Grady, 1991).

Bourne, Mills, Wilcox, Neely and Platts (2000) present the major steps in the implementation of the performance measurement system. The steps are: “the design of the performance measures, the implementation of the performance measures and the use of the performance measures.”

## **2. Research Methodology**

The aim of this research is to present which are the most relevant Lean and quality management tools used in performance measurement. In order to achieve this aim, the following research questions were set:

1. How is the Lean methodology viewed by authors over the years?
2. Which are the tools that should be used in quality management?
3. How do articles approach the subject of performance indicators?

For answering the first research question, the analysis focused on articles published in the last ten years. This period is relevant as more companies focus on integrating the Lean approach into their operations. For the second question, the literature reviewed was from 1996 onward and for the third question the period considered was from 2006 onward.

## **3. The Lean Methodology**

Most businesses are, according to Comesaña-Benavides and Prado (2012), facing a large number of challenges that put in danger their future on the market, especially nowadays when the market conditions are fiercer than ever. Lower prices are not the only aspect that companies are forced to focus on as the quality standards are getting higher and the customers are demanding shorter periods for delivering the goods. Managing the processes of a company successfully can become a strong competitive advantage that can be achieved with the increase of the efficiency with the constant improvements and investments (Comesaña-Benavides and Prado, 2012).

The ability to use better the resources available is known as “continuous improvement” and can bring in discussion the lean methodology and Total Quality Management. The implementation of KPI’s through the participation of the employees can be achieved and will bring a great outcome for both a small and a medium business (Comesaña-Benavides and Prado, 2012).

Sobek, Durward and Lang (2010) define Lean as: “an approach to operations management that considers any resource expended that does not add value to the end customer to be waste. Lean emphasizes an array of tools and methods to aid managers and workers in improvement, each designed for specific types of problems to illuminate and remove sources of waste through systems redesign. These tools and methods include value stream mapping, Kanban and pull, demand levelling, single-piece flow, 5S, kaizen events, A3 reports, visual management and more.”

The implementation of Lean Management can help in the removal of eight different categories of wastes: Transport, Inventory, Motion, Waiting, Over-processing, Overproduction, Defects, and Talent (Kadarova and Demecko, 2016).

In order to preserve and increase their competitiveness in a globalized economy, the largest organizations from all over the globe have started to adopt the Lean philosophy. Supply optimization and sustainability can be achieved by

making use of the lean tools. The lean methodology does not focus on cost reduction, yet this is the outcome after the non-value-added activities are eliminated. The lean supply chain manages to develop a streamlined system that is highly efficient in the development of finished goods that meet the customers demand; little or no waste results from this process (Kadarova and Demecko, 2016).

The businesses that target the improved performance by waste reduction are the ones in which the lean methodology can be implemented seamlessly (Arif-Uz-Zaman and Nazmul Ahsan, 2014).

Arif-Uz-Zaman and Nazmul Ahsan (2014) exemplify how the supply chains that are cost competitive can benefit from the implementation of the lean approach in order to eliminate waste and thus, reduce costs. The authors continue by presenting how organizations that make use of a continuous improvement process to increase the core competitiveness of their company, often make use of a supply chain management, yet most of them have not achieved the upturn of their supply chain's capacity for the reason that they have not succeeded to implement the performance measures and metrics that are required for the fully assimilation of their supply chain partners to boost both their efficiency and effectiveness (Arif-Uz-Zaman and Nazmul Ahsan, 2014).

Lean manufacturing's precursor is the Toyota Production System that was also known as just in time production. The Toyota Production System had an approach called seven wastes: overproducing, waiting, transport, processing, inventory, motion and waste of defects and spoilage. The production philosophy of lean manufacturing suggest that the resources spent for anything else than value creation for the end customer are wasted and should be eliminated (de Bucourt, Busse, Güttler, Wintzer, Colletini, Kloeters, Hamm and Teichgräber, 2011).

If we are bringing Lean in discussion we should also get in more detail and present the benefits that Lean can bring to production. The first one, as being described by López-Fresno (2014), is about the bringing of a cultural change that can be introduced easier with the lean methodology. This means that we can bring the senior managerial team together with the employees and by clearly identifying the products the company brings to clients with the idea in mind that they have to provide added value.

Another argument stated by López-Fresno (2014) is that the facilitation of a cultural change will make the company achieve improvements that will directly help the workers because they will be able to reach to ideas that will positively influence their daily activities. This cultural change is also associated with a higher concerns related the well-being of the human resources within organization as well as of other categories of stakeholders (Cristache, Năstase, Petrariu, Florescu, 2019).

The second benefit is that Lean helps in the finding and bringing of fast and noticeable improvements, in such way that according to López-Fresno (2014), the idea of achievement and the feeling that the employees are part of the company as they notice their contribution for each product and the value added by them.

The third benefit thrives for the continuous improvement of the work of each member of the team as Lean is an easy to approach methodology that can be part of high-performance strategy of the organization. Last but not least, as stated by López-Fresno (2014), Lean will make continuous learning more approachable as it focuses on a time frame and patience thus underlining the connection between the goal and the contributions that make it possible. López-Fresno (2014) conclude that Lean Management sets up the premises for a competitive advantage that can be preserved and can be accompanied by a high level of excellence on all levels.

de Bucourt et al. (2011) consider lean as a set of so called tools that help one to recognize and eliminate the waste by improving the quality of the products and in the same time, decreasing the time allocated and the cost. The authors present the different tools that are part of the lean process as follows: the continuous process improvement, the mistake proofing and also the question asking method, that is known as the five whys. The five whys tool is often applied when the cause and effect relationships are to be studied, emphasizing certain problems by not making assumptions, with the end purpose of getting to the root cause of that problems.

The 5S method - The 5S method is described by Falkowski and Kitowski (2013) to be an important tool of the Lean way of managing processes. This tool can help a manager to visually control a business and consists of a sum of five simple rules. These rules have their origin in the Japanese philosophy that presents the elements of the system as being: sort (Seiri), set in order (Seiton), shine (Seiso), standardize (Seiketsu) and sustain (Shitsuke).

In order to insure the efficiency of the 5S method, it should be implemented only after the training of the team and after insuring that all members are fully committed to the process. The employees must see it as a useful tool in their daily work. At first, the team members can become unmotivated and reluctant to the change, as they are not familiar to their new way of work, yet this can be overcome by constantly displaying the tasks and steps throughout the company, and in the resting and dining areas. This action could increase the efficiency significantly, by forming fixed habits for each team member (Falkowski and Kitowski, 2013).

Falkowski and Kitowski (2013) characterize the 5 components as follows:

Sort – only the resources that are needed should be kept, in the appropriate quantity and at the right time. All the unneeded items for the current operation should be removed from the facility.

Set in order – there should be a clear labelling of the equipment and the items stored, and also, they should be positioned in a certain order that will facilitate the employees to easily find what they need. The identification process should be performed at a fast pace, so the unnecessary labelling and organizing of certain items should be avoided.

Shine – all the members of the team should take part in a general cleaning activity. This can include vacuuming, washing, renovation or the simple removal of

dust, dirt and waste. The process can also help in the prolonged lifespan of the equipment and even in the creation of a safe and friendly workplace.

Standardize – instructions can be implemented at the workstation in this stage. The standardization of the first three steps should be developed and maintained, with the introduction of new rules and procedures. These will have a positive impact upon the team and will make the implementation of the 5S method in the company a success.

Sustain – this stage encourages everyone to stay consistent to the previous ones and to the rules and procedures. It is recommended to continue to improve the previous steps and the rules and procedures as certain aspects are observed. Regular checks and audits should be performed, with the introduction of checklists which are necessary in order to be able to introduce bonus schemes targeting the employees that comply with the new way of working (Falkowski and Kitowski, 2013).

The authors conclude by presenting the benefits of a proper implementation of this tool. Cost reductions can be achieved with little financial input, as the labels and paint needed in the first 3S are not that expensive. Additional space that is always needed for expansion will be created after the cleaning and organization of equipment will be finished. In the end, the authors state that a company can have great success on the market by making the employees more committed with the use of trainings and incentive schemes (Falkowski and Kitowski, 2013).

#### **4. Tools Used in Quality Management**

Process mapping - A process map can provide an overview of the business processes of an organization. The process map can present in a visual approach the main relationships between the different processes within a business and can help one understand the way in which the company runs the operations (Malinova, Leopold and Mendling, 2014). Okrent and Vokurka (2004) state that process mapping is comparable to the process of developing a flow-chart for a software program. The important distinguishing factor of business process mapping is the fact that in this case, the participants in the process are also identified. Malinova et al. (2014) state that the concept of process mapping can be traced to the beginning of 1980s, when the value-chain model was presented by Michael Porter. The value chain consists of a sum of core activities that are performed by an organization with the purpose of creating value for the customer. This action can provide a process view of a business.

Check sheet - The check sheet is defined by Goetsch and Davis (2013) as a vital tool that can be applied in a large number of projects. This tool is customizable and should be adapted to the needs of the organization. Goetsch and Davis (2013) exemplify that it can be constructed as a drawing or a check list that should also help the one that uses it to collect data in order to integrate it in a useful scenario.

Histogram - The role of histograms is presented by Goetsch and Davis (2013) as being the one of representing the frequency of occurrence. There are two types of data used in the Histogram elaboration: attributes and variables. An attribute is described as being something that product can possess or not. Variables data are a direct result of measurement.

Pareto chart - The Pareto chart is described by Wilkinson (2006) as a bar chart of frequencies which are sorted by frequency. The chart is widely used in the quality control checks, as it identifies the critical elements that lead to flaws, defects and failure in a certain process. The most common type of this chart has the highest bars on the left side and uses a line to show the scores resulted from the sum of the heights in order, starting from the left side to the right.

Chart control - A preliminary control chart is described as being based upon individual remarks that are discovering a change in the mean, the variance or both. The chart is derived from a test of likelihood ratio. The advantages of using this chart, include the enhanced detection of constant shifts, in addition to enriched diagnostic data (Sullivan and Woodall, 1996).

Scatter diagram - The Scatter diagram is being described as the easiest tool to understand and apply and it is crucial for the determination of the link between two variables. One of the uses of Scatter Diagrams is when one decides to test the relationship between some items like factors of a process and characteristics of a product that is shifting of the regular process (Goetsch and Davis, 2013).

Ishikawa diagram - The Ishikawa diagram that is also known as the fishbone diagram was created in the 1960s by Kaoru Ishikawa, a Japanese statistician that specialized in quality control. This tool is used for the analysis of the effects and the causes that are creating or contributing to those quality problems. The event is correlated with its multiple causes in a visual a suggestive representation (Ilie and Ciocoiu, 2010). Ilie and Ciocoiu (2010) identify multiple benefits of using this diagram, such as: the determination of the root causes of a problem with the use of a structured approach, the identification of areas where the data should be collected for further study, the encouragement of group participation and utilization of group knowledge of the process. Bose (2012) affirms that there are six classic categories of an Ishikawa diagram. These are classified as the main causes of any disruptions of a business process. Bose (2012) presents them as materials, equipment, people, environment, management and process. The study of all six factors reveals the causes for a problem regardless of the form or extent of it.

## **5. Performance Indicators**

The information is the key in the new business conditions and this aspect gets the companies to implement new approaches in the performance management actions within the organization (Velimirović, Velimirović and Stanković, 2011).

Velimirović et al. (2011) mention that it is crucial for organizations to define and standardize the total number of processes within the company;

moreover, the businesses should implement an effective performance management system.

Measuring the organizational performance with the use of key performance indicators is reliable as they are static and stable indicators. Velimirović et al. (2011) define Key Performance Indicators as being both financial and non-financial indicators that are used by companies in their process of estimating and strengthening how successful they are and finally to set the premises for long lasting targets.

KPIs are offering a clearer image when one is comparing pieces of information. These indicators will remove the distractions from the decision process and will get both employees and managers more focused on the main goal of the company that is making profit (Velimirović et al., 2011).

Key Performance Indicator	This Period	Last Period	Change	% Change	Target	% of Goal	Warnings
<b>AVERAGES</b>							
Average Page Views per Visit	2.5	1.6	▲	56%	5	50%	
Average Visits per Visitor	2	2.5	▼	-20%	5	40%	Off Target
Average Time to Respond to Email Inquiries (Minutes)	10	15	▼	-33%	5	200%	Precipitous Drop
Average Cost per Visitor	\$40	\$60	▼	-33%	\$30	133%	Precipitous Drop
Average Cost per Visitor	\$20	\$24	▼	-17%	\$10	200%	
Average Cost per Conversion	\$125	\$80	▲	56%	\$100	125%	
Average Cost per Visitor	\$40	\$60	▼	-33%	\$40	100%	Precipitous Drop
Average Revenue per Visitor	\$20	\$10	▲	100%	\$30	67%	
Average Revenue per Visit	\$10	\$4	▲	150%	\$10	100%	
Average Order Value	\$25	\$8	▲	200%	\$10	250%	
Average Items per Cart Completed	50	50	▲	0%	\$10	500%	
Average Clicks per Impression (Email)	0.08	0.032	▲	150%	1	8%	Off Target
Average Clicks per Impression (Banner Ads)	0.06	0.016	▲	275%	1	6%	Off Target

**Figure 1. A classic KPI report, showing visual indicators of percentage and directional changes, percentage of goal, target values and warnings**

*Source: Peterson (2006, p. 9)*

Peterson (2006) suggests that the organizations should use colours and visual representations in order to present their Key Performance Indicators in such way that they catch the interest of the person which is reading the report. The author presents some recommendations that will help the responsible employee to better elaborate the KPI reports, such as presenting a sum of indicators that are contextualized in temporal comparisons. Another recommendation is to use colours such as green for improvement, red for indicators that get worse and yellow for when the data starts to decrease into an undesired way. Simple visual objects such as arrows that suggest the increasing or decreasing movement of the indicators are vital and they will help the reader see the big picture if they are also coloured accordingly. Peterson (2006) continues by stating that one should always display the change in percentages from one reporting period to the other as KPI's are created in such way that they set expectations. On the other hand, warnings should be displayed and they can be connected to a certain pre-set trash hold in order to

help the reader understand the gravity of the situation. Peterson (2006) concludes by suggesting that targets should be set and they should be kept in mind when elaborating the reports.

From our point of view, the approach of using colours and arrows when visualizing the data related to the key performance indicators is crucial, as it provides the reader with warnings and signs that help in making the process of analysis easier. Recommendations for decisions and actions can be elaborated having in mind the aspects that should be approached sooner than others. The author offers some key suggestions for the one that decides to elaborate and integrate KPIs in a business. Peterson (2006) describes a variety of indicators and states how they should be used. It can be affirmed that in an organization, the employees that gather information, analyze it and elaborate recommendations are to consider the fact that not all indicators are relevant for a certain type of report, the management should receive only the crucial and specific data in order to make an informed decision. Some evaluation criteria are to be taken into account when considering a certain indicator that one would decide to examine further. The author has a detailed way of explaining and presenting the information, having the user of the key performance indicators as the target audience. On the other hand, the work of Shahin and Mahbod (2007) is to be considered when discussing about KPIs. The authors have the aim of offering an integrated approach that focuses on performance indicators used in a business and the prioritization of them certain criteria, abbreviated SMART.

Shahin and Mahbod (2007) present that each and every indicator should be evaluated on such criteria that will make it suitable for a more detailed analysis. The authors present the SMART criteria as the most referenced in literature. The S in the acronym stands for specific and requires the goals to be as detailed and specific as they can be. M stands for measurable and refers to the requirement that the goal is quantitatively or qualitatively measurable against a standard. The A resembles the attainable and aggressive traits that a goal should possess. Shahin and Mahbod (2007) go further by presenting the meaning of R that stands for the realistic and result-oriented aspects that a goal should have and finally the T is mentioned as representing the Time-sensitive trait of a goal.

The findings of the authors are important, as the article presents how key performance indicators can be part of a process of prioritization in an original way. The article is as relevant for users of KPIs, as it is for other researches, as it offers an opportunity for further research.

## **5. Conclusions**

In this paper we discussed about how important the Lean and Quality Management tools are in Performance Measurement. Lean Methodology is vital if a company desires to increase the quality of the products and services, to put the client on the first place and to reduce waiting times. These actions will inevitably reduce the costs and will have a positive impact upon the cash-flow of the

company. The quality Management tools have been used since the middle of the last century in various production processes, yet the use of them in Performance Measurement started to become more and more usual among the largest companies from all sectors of activity.

The benefits of having a birds-eye view upon a business should be complimented by the detailed analysis that is performed using the Lean and Quality tools, along with the Key Performance Indicators, that should be set according to some relevant and achievable aspects.

Nowadays, both the articles published by researchers and the companies that adopt new approaches, help us understand that the use of Lean methodology and Quality Management tools can be vital to any kind of business, not only for mass production as they were a few decades ago.

The limitation of the paper is that it analyzed a vast amount of the literature that was published, and it centered the view upon how Lean and Quality Management Tools used in Performance Measurement can help companies maintain a competitive advantage. We can affirm that this limitation can also have a positive aspect, as the article offers a good perspective for the subject that was discussed.

As for future research, a study is considered to be developed, focusing on how the companies that implement these tools are facing the constant challenges that the economy can bring. Moreover, this study will be covering the impact that the world pandemic has on the businesses that are struggling to go forward in these problematic times.

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