

The Role of Six Sigma in Improving the Performance of the University Hospital Mustafa Pasha in Algeria

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Date of publication (dd/mm/yyyy): 29/01/2018

Abstract – The research aimed at testing the ability of using the Six Sigma in the public sector which is represented at the University Hospital Mustafa Pasha. Six Sigma is taken into consideration because it is the most new and removes patterns to ensure a good quality which is used in the world. The research used the analytical style beside the theoretical one in order to have many conclusions such as: the standards of health and treatment service for the patients which are very bad, the hospital is in need of controlling systems to show the standards of quality service that is presented in the hospital, therefore it is necessary to implement the Six Sigma in the hospital as a controlling system in order to improve the service. It also targeted to improve the operation theatre and laboratories according to the standards.

Keywords – Six Sigma, quality of services, improving the performance, patients' satisfaction, University Hospital Mustafa Pasha.

I. INTRODUCTION

Six Sigma is one of the most important developments in the concept of TQM. It includes a creative and strategic approach that is used in conjunction with other quality tools to improve quality and improve production processes. Motorola has created this term to improve the performance of operations to the extent that the number of defective pieces to 3.4 pieces per million pieces are produced. Six Sigma is a systematic and management philosophy based on a firm principle that focuses on the effort to obtain products and services that are very close to maximum quality and proficiency, at the lowest cost and in record time. However, this modern approach to quality is based on the understanding of top management, and the extent to which they are committed to applying its methodology.

Six Sigma's small change strategy is a systematic way to use very precise data collection and statistical analysis to accurately identify sources of errors and their removal. Six Sigma relies heavily on performance measures associated with statistical analysis, which removes the impurities in other quality programs.

The implementation of six sigma in health institutions has had a significant impact on the overall performance of the hospital. This study has highlighted six Sigma requirements to improve hospital performance.

Six Sigma's methodology provides business with the specific tools needed to improve business process capacity, which increases performance and reduces process changes. This reduces defect, maximizes profit, product quality and employee morale, and is robust and systematic. In order to measure and improve the operational performance of the organization, the applications and systems are improved by preventing or at least limiting defects in manufacturing and

operations-related services so as to predict and exceed expectations for all stakeholders to achieve effectiveness.

Objectives of the Study

The main objectives of this research are:

1. Six Sigma application in the public sector, represented by hospitals.
2. Provide a clear picture of quality and quality control as the most important topics at present, especially within the health sector.
3. Activate the role of six sigma as the latest and most prominent quality control methodologies used in the world.

Statement of the Problem

The health services are becoming increasingly competitive, especially with the advancement of medical technologies, the development of communication and technology, and in order to maintain the reputation and status of public hospitals in the community as the only one offering almost free services to all citizens in Algeria, The deterioration of the situation of the latter and the weakness of the level of modern and private services, in addition to the phenomenon of wolves due to medical negligence, is the most demanded by the adoption of comprehensive and sustainable management programs, which help them to improve the quality of services, level of expectations of beneficiaries and providers.

The study aims at identifying the various possibilities necessary to implement the most important concepts of total quality, namely the Six Sigma concept, which aims to reduce errors and the elimination of differences using statistical tools and techniques, as well as the development of efficiency and effectiveness of services, especially in terms of cost and time, and here we come to highlight the problematic of this study, which will try to answer the following main question: Does six sigma improve the performance of Mustafa Pasha University Hospital?

Research Hypothesis

To achieve the purpose of this study, the following hypothesis was formulated:

H1: The six sigma requirements are detrimental in improving the performance of Mustafa Pasha Hospital.

II. LITERATURE REVIEW

The story of Six Sigma begins in 1986 at Motorola, but the method becomes famous in the 1990s when General Electric decided to apply and improve it. Motorola had sought to put in place a method to improve its manufacturing processes with a view to satisfy its customers. Mikel Harry, an engineer at Motorola, defines the basics of Six Sigma based on the philosophy of William

Edwards Deming (quality wheel). He proposes to analyze the instabilities of the manufacturing process using statistical tools and gives priority to improving keep on going. Therefore, Motorola decides to use this method for all projects.

The six sigma methodology is an industrial quality improvement tool. And have employed six sigma strategies with remarkable gains in terms of efficiency, client/customer satisfaction and overall profitability.¹ Unlike other quality initiatives borrowed by the health care sector from the industrial sectors like the TQM and CQI, six sigma is different in that the improvement obtained through this approach provides sustained strategic achievements with long-lasting benefits. The six sigma philosophy is based on a reduction of variation in a process, customer oriented and data driven decisions.

Sigma (σ) is a Greek alphabet character, denotes the standard deviation. Six Sigma means six times Standard deviation², "deviation standard deviation of the process dispersion, we can also talk about Scope as a dispersion parameter: Range is the difference between Maximum value and minimum sample value. In the mathematical sense, the standard deviation is the root Contrast box. The method consists of ensuring that all elements resulting from an operation are included A break of no more than 6 sigma away from the overall mean of the elements of this process. Reducing product fluctuation process reduces risk See the product (or service) that the recipient has rejected because it is outside its expectations or specifications. In other words, a process performing at six sigma level translates into a phenomenal 3.4 Defects per Million (DPM) opportunities, the practical limit to perfection. The present day healthcare services are only functioning at 3 sigma and in some cases 4 sigma levels that translate roughly into 66,807 and 6,210 DPM opportunities respectively (Table 1). The only healthcare sector that has been close to achieve six sigma performance is Anesthesia, with mortality rates (taken as defects) as low as 5 per million opportunities.³ Though six sigma quality performance may not be ideally achievable by all. The goal of six sigma surely is that six sigma performance aims at an overall improvement in the performance of the process and if this is set as a fundamental goal in healthcare services, we start getting closer to six sigma level, thereby improving the performance of the process exponentially. It has been suggested that reaching a rate of 3.4 DPM opportunities is less important than developing a process to evaluate error rates and bring about systematic changes that increase reliability.⁴

Table 1: Levels of sigma performance and corresponding Defects per Million Opportunities.

Sigma Level	DPMO*
6	3.4
5	233
4	6,210
3	66,807
2	308,537
1	690,000

*Defects per Million Opportunities.

Improving healthcare quality to six sigma levels becomes imperative when one considers the percentage of population using healthcare services. With such a large denominator and millions of healthcare events occurring every day, even a minuscule percentage of errors represent a large number. On the same front, it is worth considering the fact that even a small error may terminate with catastrophic consequences to a patient's health. The current day healthcare system is content if their process functioning lies within ± 2 Standard Deviations (SD) of the mean. In a Gaussian distribution, this would result in only a 4.5% defect rate, but considering the potential of healthcare usage, this would be translated into an appalling 45,400 DPM opportunities. These figures would be of little solace to an already ill patient. The clinical diagnostic laboratories are content if their results enclose ± 2 SD or ± 3 SD limits. In other words, they find defect rates of 45,400 DPM opportunities and 2,700 DPM opportunities (Table 2) as acceptable performance.⁵

Table 2: Gaussian distribution in terms of Defects per Million Opportunities.

Gaussian Distribution	DPMO*
>2 SD	45,400 DPMO
>3 SD	2700 DPMO
>4 SD	63 DPMO
>5 SD	0.6 DPMO
>6 SD	0.002 DPMO
>7 SD	3×10^{-6} DPMO

*Defects per Million Opportunities.

It may well be argued that little is gained from improving a process performance beyond the five sigma (DPM) level. It is felt that six sigma method applications can actually tolerate small shifts in the process mean and do not significantly increase the defect rate. With a six sigma process, it is assured that the process is still producing results within the desired specifications and with low defect rates. The six sigma process provides an added advantage by being easily monitored with any Quality Control (QC) procedure unlike a process at five sigma or lower sigma levels where the choice of QC procedure is more important. In any process, variation is inherent. It is the variation in the process, which creates the opportunities for errors to happen, and therefore should be seen as the "enemy".⁶ The concepts of variation are devised by Walter Shewart.⁷ These variations exist as two types in a process, common cause and special cause. The common cause variations are intrinsic to a process and require action on the process itself to decrease the variation, whereas special cause variation occurs due to factors extrinsic to the process, which require identification and action on these special causes. The key lies in minimizing this variation and producing a stable process. These stable processes exhibit common cause variation, which are best reduced by correcting the underlying process.⁸ It is the variation in a process that has to be minimized and controlled to achieve high quality results. The reduction in variation is also a core concern in clinical governance.⁹

Shewart also devised the control charts, a graphical methodology to differentiate the two types of variation. The defects occurring through the common cause variation fall within the upper and lower lines of the graph (control limits) and special cause variation are represented by the data points falling outside the control limits. Shewart¹¹ suggested using limits set at three sigma from the mean. If beyond these points, it was suggested that the process required correction. If one were to apply the three sigma limits for accepting a process, it would translate into 66,807 DPM opportunities.

III. THE SIX SIGMA METHOD

Six Sigma is based on the notions of customer, process and measurement; it relies in particular on:

1. The customer's measurable expectations (CTQ - Critical To Quality);
2. Reliable measures measuring the performance of the business process relative to these expectations;
3. Statistical tools to analyze source causes affecting performance;
4. Solutions attacking these source causes;
5. Tools to control that the solutions have the expected impact on performance.

Controlling: How can we guarantee sustainable performance?

Innovate improve: What to do to solve the problem

Analyze: What are the root causes of these problems

Measure: What are the nature and extent of disorders

Define: What is the goal, understand the problem

DMAIC Principle

The method is thus based on five stages that contract in the acronym "DMAIC": Define, Measure, Analyze, Improve, Control is "Define, measure, analyze, improve, control".¹²

Each step in the cyclical DMAIC Process is required to ensure the best possible results. The process steps are:

Define the Customer, their Critical to Quality (CTQ) issues, and the Core Business Process involved.

- Define who customers are, what their requirements are for products and services, and what their expectations are
- Define project boundaries the stop and start of the process
- Define the process to be improved by mapping the process flow Measure the performance of the Core Business Process involved.
- Develop a data collection plan for the process
- Collect data from many sources to determine types of defects and metrics
- Compare to customer survey results to determine shortfall Analyze the data collect and process map to determine root causes of defects and opportunities for improvement.
- Identify gaps between current performance and goal performance
- Prioritize opportunities to improve

- Identify sources of variation Improve the target process by designing creative solutions to fix and prevent problems.
- Create innovate solutions using technology and discipline
- Develop and deploy implementation plan Control the improvements to keep the process on the new course.
- Prevent reverting back to the "old way"
- Require the development, documentation and implementation of an ongoing monitoring plan
- Institutionalize the improvements through the modification of systems and structures (staffing, training, incentives).

Stages of the Six-Sigma application

One of the stages of forming the teams that will apply the Six Sigma concept was inspired by the art of karate used by one of Motorola's experts.

1. *Black Belt*

This role is one of the most important roles in Six Sigma. It is the person who investigates the opportunity for change that affects all the time and then implements it and uses it to achieve results. It leads and inspires others as it trains and teaches. It must have the ability to evaluate, solve problems and design operations. To build their own confidence and work and participate in their training and management and maintain the continuity of the project to achieve the desired results and that six teams will not work effectively unless there is a strong black belt.

The black belt is usually tested by the middle management and has at least two years' experience in managing projects, special tasks, being dedicated to work, believing in change, and being a member of the organization in which he works very high.

2. *Master Black Belt*

In many organizations, the main black belt serves as a coach, observer and consultant for the rest of those who play the role of black belt and is often an expert in the analytical tools of Six Sigma with a scientific background in engineering or science or in high degrees in business administration or statistics The main black belt in the supervision of black belts in the training and follow-up process, in addition to identifying the needs of customers and developing methods of measurement of the basic processes and also collect information from their sources and carry out statistical analysis of their own, Professional managers and that the presence of the main black belt is necessary to adopt Sakma six and that his presence ensures continuity of change and reduces costs and develops the expertise of employees.

3. *Green Belt*

Green Belt is a person who is trained in Six Sigma skills and is almost like the Black belt level, but is a member of the Six Sigma team or a leader of six semicircular teams. Therefore, it requires training of very large groups of employees to become members of the Green Belt and their role is to ensure that new concepts and tools Six will be listed and included in the company's day-to-day activities.

4. *Champion / Sponsor*

The champion or sponsor is usually the executive director who supports the black belt or the six working

groups and is very important because he is ultimately responsible for continuing the work in Secama 6. The fact that the sponsor must have a high position in the organization or company shall usually, be a member of the Governing Council or Steering Committee and of its functions.

- A. Ensure that the projects are commensurate with the achievement of the higher goals, and provide advice and guidance in case of conflict.
- B. To inform the members of the leadership team of the most important developments and progress in the progress of projects.
- C. Providing the resources needed by teams such as time, money and supplies.
- D. Negotiating disputes and linking six other SEGMA projects.

One of the disadvantages is if the sponsor has assigned a person who does not have the capacity and authority to manage the work, which has a great impact on the results.

5. Implementation Leader

He is the biggest executor and this person organizes all efforts and in six positions, usually as vice president and always communicates with the chief executive or any higher management.

He must have a high experience in the field of development and quality have a high experience in the field of work and has strong leadership skills. The aim of this position is to lead the way of thinking, help in achieving satisfactory physical results and services to customers and meet their needs in many ways.

The duties and functions mentioned above must provide the management of companies or institutions to establish specialized courses and bring experts in the field of Six Sigma for the purpose of training and selecting members of the teams.

IV. STATISTICAL RESULTS AND DISCUSSION

A Brief Overview of the University Hospital Mustafa Pasha

University Hospital Mustafa Pasha is one of the oldest and largest hospitals in Algeria. It was established during colonialism period. It follows the Algerian Ministry of National Defense, a public administration institution.

The Actual Reality of the University Hospital Mustafa Pasha

Generally, the task of hospitals is to care of the sick and to minimize the conditions of the wolves which due to poor care or availability of the necessary supplies for treatment, or any other reasons related to the nature of the work of the hospital. It was revealed through the field visit and records that there are a large percentage of the wolves in the hospital Mustafa Pasha. They are summarized in the following table:

Months	1	2	3	4	5	6	7	8	9	10	11	12
The number of deaths	15	90	172	159	196	148	175	178	164	148	198	125

The table shows that the percentage of deaths by month of 2016 is close, and high due to the size of the hospital and the number of patients it receives.

IV. FIELD STUDY

Society and Sample of the Study

The study population consists of senior management staff in the hospital during the year 2016, and the sample of the study was determined by 28.

Cronbakh's Alpha

Factor	Cronbakh Alpha
Activities supporting the successful implementation of six sigma	0.92
Customer focus activities	0.63
Infrastructure	0.602
Training and qualification	0.69
continuous improvement	0.58

The Importance of Key Factors

The analysis aimed at identifying the importance of the main factors through the method of global analysis, the method of describing the factors, and summarizing the results in the following table:

Factor	Mean	standard deviation	Importance
Activities supporting the successful implementation of six sigma	3.94	1.0	First
Customer focus activities	3.10	0.77	Third
Infrastructure	2.95	0.78	Fourth
Training and qualification	2.93	0.92	Fifth
continuous improvement	3.14	0.53	Second

The results of the importance presented (in the arithmetic mean and the standard deviation) indicate the importance of factors from the study sample. Thus, according to the table, the support factor is most suitable for implementing the six sigma requirements and its positive effects on continuous improvement.

Linear Regression Analysis and Hypothesis

declined variable regression (performance improvement) on key variables						
Independent variables	R	R ²	F Calculated	F Scheduled	SIG	Smaller than standard (0.01,0.05)
	0.512	0.28	5.42		0.001	

The correlation coefficient R for the dependent variable with the independent variables was 0.512 indicating that the response was significant and fairly strong for the variable adopted in relation to the independent variables.

The interpretation factor was 28%. This means that the variables explain the value of 28% of the main variable. In other words, the requirements for implementing six sigma in the hospital have a fairly clear effect on achieving an improvement in hospital performance.

The adjusted F value of 5.42 was significant for regression and acceptance of the main hypothesis that attention to six sigma requirements improves hospital performance.

The weak impact of the six sigma requirements in the continuous improvement of hospital performance is due to the weakness of this hospital with six sigma implementation requirements.

V. CONCLUSIONS

- The level of health and treatment for patients is poor and does not respond to the minimum requirements of patients and their needs, and the lack of service is apparent in the hospital, which receives a large number of patients.
- Mustafa Pasha Hospital's lack of supervision and control system, which explains the quality of service and its consequences, as well as the lack of possibility to improve the quality of health service in the hospital and reduce the negative cases.

To achieve success by the implementation of six sigma, the following dimensions should be given a great importance. First the activities, second continuous improvement, third infrastructure, fourth the focus on the patient, and the fifth training and qualification. Consequently, attention to these dimensions in sequence will of course facilitate the possibility of improving the hospital.

- The regression model demonstrates the acceptance of the main hypothesis that attention to the six sigma requirements improves the hospital performance.
- 1) Appropriate for publication or might be adequately treated in just a few pages.
 - 2) Authors must convince both peer reviewers and the editors of the scientific and technical merit of a paper; the standards of proof are higher when extraordinary or unexpected results are reported.
 - 3) Because replication is required for scientific progress, papers submitted for publication must provide sufficient information to allow readers to perform similar experiments or calculations and use the reported results. Although not everything need be disclosed, a paper must contain new, useable, and fully described information. For example, a specimen's chemical composition need not be reported if the main purpose of a paper is to introduce a new measurement technique. Authors should expect to be challenged by reviewers if the results are not supported by adequate data and critical details.

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