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MIDDLE EAST UNIVERSITY

Application of Lean Six Sigma to Optimize Admission Waiting Time at AL-Mowasah Hospital

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Authorization

I am ***Basil Asfour;*** authorize Middle East University to make copies of my dissertation to libraries, institutions, or people when asked

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Basil Asfour

Dedication

To

I am pleased to dedicate this work to my father and my mother and my wife and my brothers and sisters and all friends and family

Basil Asfour

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Abstract in English

Application of Lean Six Sigma to Optimize Admission Waiting Time at AL-Mowasah Hospital

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The main objective of this study is to Identify to what extent AL-Mowasah Hospital is committed to Application Lean Six Sigma Principles, the level of admitted patient's satisfaction about AL-Mowasah Hospital services, and to determine the impact of Lean Six Sigma Principles on admitted patient's satisfaction in AL-Mowasah Hospital, the impact of Lean Six Sigma on admitted patient's satisfaction in AL-Mowasah Hospital and the difference between employees and admitted patients in AL-Mowasah Hospital about Application Lean Six Sigma Principles

This study was applied on AL-Mowasah Hospital, and took the samples from the employees and admitted patients.

In order to achieve the objectives of the study, the researcher designed two questionnaires, the first questionnaire (employers' staff working in AL-Mowasah Hospital) consisting of (32) paragraphs to gather the information from the study sample. The Second questionnaire (patients) consisting of (25) paragraphs to gather the information from the study sample.

The Statistical Package for Social Sciences (SPSS) program was used to analyze and examine the hypothesis. The results were:

1. There is a positive impact of Lean Six Sigma Principles (Top management involvement and support; Quality-driven organizational culture; Customer involvement; Process management & implementation of other quality improvement programs) on admitted patient's satisfaction in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).
2. There is a positive impact of Lean Six Sigma on admitted patient's satisfaction about Room services, Interpersonal skills and Technical quality in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).
3. There is no significant difference between employees and admitted patients in AL-Mowasah Hospital about Application Lean Six Sigma Principles at level ($\alpha \leq 0.05$).

Finally, the study set the following recommendations:

1. Interest in the concept of Lean Six Sigma and the emphasis on the possibility of its use in AL-Mowasah Hospital because of its importance in terms of scientific and that by reducing medical errors and improve the quality of services provided, which fit with the expectations of the beneficiaries.
2. Adoption the AL-Mowasah Hospital, lean Six Sigma approach because of its importance in the development of risk management and control systems in the hospital.

CHAPTER ONE
General Framework

(1-1): Introduction

(1-2): Study Problem and Question

(1-3): Significance of the Study

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(1-6): Study Limitations

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(1-1): Introduction

Six Sigma has evolved over time. The concepts behind Six Sigma can be traced through the centuries as the method took shape into what it is today.

The roots of Six Sigma as a measurement standard can be traced back to Carl Frederick Gauss (1777-1855) who introduced the concept of the normal curve.

Six Sigma as a measurement standard in product variation can be traced back to the 1920's when Walter Shewhart showed that three sigma from the mean is the point where a process requires correction.

Many measurement standards (Cpk, Zero Defects, etc.) later came on the scene where the credit for coining the term "Six Sigma" goes to a Motorola engineer named Bill Smith. (Incidentally, "Six Sigma" is a federally registered trademark of Motorola).

In the early and mid-1980s with Chairman Bob Galvin at the helm, Motorola engineers decided that the traditional quality levels -- measuring defects in thousands of opportunities -- didn't provide enough granularities. Instead, they wanted to measure the defects per million opportunities.

Motorola developed this new standard and created the methodology for testing and needed cultural change associated with it. Six Sigma helped Motorola realize powerful bottom-line results in their organization - in fact, they documented more than $16 Billion in savings as a result of their Six Sigma efforts (http://healthcare.isixsigma.com)

Since then, hundreds of companies around the world have adopted Six Sigma as a way of doing business. This is a direct result of many of America's leaders openly praising the benefits of Six Sigma.

Leaders such as Larry Bossidy of Allied Signal (now Honeywell), and Jack Welch of General Electric Company.

As Geoff Tennant describes in his book Six Sigma: SPC and TQM in Manufacturing and Services: "Six Sigma is many things, and it would perhaps be easier to list all the things that Six Sigma quality is not. Six Sigma can be seen as: a vision; a philosophy; a symbol; a metric; a goal; a methodology." We couldn't agree more. (Geoff Tennant)

All over the world healthcare is facing serious quality problems while costs are exploding. The institute of medicine produced 2 reports demonstrating healthcare has serious safety and quality problems and is in need of fundamental change (IOM 1999, 2001).

Care processes are poorly designed and characterized by unnecessary duplication of services, long waiting time and delay. Costs are exploding and waste is identified as an important contributor to the increase in healthcare expenditures. As a result healthcare does not succeed in meeting patient needs. (Antony, 2004).

Hospitals find themselves in an environment that is becoming highly competitive, to attract the same number of preferably more patients, hospitals have to put customer satisfaction first. At the same time, due to competition,

insurance companies are confronted with increasingly lower margins that subsequently lead to lower prices paid to hospitals. Delivering more quality while revenues are going down is the major challenge in healthcare.

In this study we will implement six sigma combined with lean principles that can help hospitals enhance quality and reduce cost and time for admission of patients to the hospital.

(1-2): Study Problem and Questions

The registration process is the first process that patients interact with hospitals. The quality of experience in registration will form the patients perceptions for the hospitals. The waiting time is an important performance metric for the registration process. In this paper, a rigorous Lean Six Sigma approach is used to analyze an existing registration process and the root causes for the long average waiting time are identified. Lean operation principles are used to redesign the registration process.

Based on the above, we may demonstrate the study's problem via stirring up the questions below:

Question One: To what extent AL-Mowasah Hospital is committed to the Application of Lean Six Sigma Principles (***Top management involvement and support; Quality-driven organizational culture; Customer involvement; Process management & implementation of other quality improvement programs***).

Question Two: What is the level of admitted patient's satisfaction about AL-Mowasah Hospital services (***Room services; Interpersonal skills & Technical quality***)?

Question Three: Is there a positive impact of Lean Six Sigma Principles (***Top management involvement and support; Quality-driven organizational culture; Customer involvement; Process management & implementation of other quality improvement programs***) on admitted patient's satisfaction in AL-Mowasah Hospital?

Question Four: Is there a positive impact of Lean Six Sigma on admitted patient's satisfaction (***Room services; Interpersonal skills and Technical quality***) in AL-Mowasah Hospital?

Question Five: Is there a different view between employees and admitted patients in AL-Mowasah Hospital about Application Lean Six Sigma Principles?

(1-3): Significance of the Study

The significance of the current study is demonstrate three dimensions:

1. To understand and measure the performance of the hospital under lean six sigma.
2. To encourage researchers to undertake further studies.
3. To show the importance of lean six sigma in the healthcare sector.
4. Very few lean six sigma studies implemented on the healthcare sector in Jordan and in Arab world.

(1-4): Objectives of the Study

This study seeks to achieve the following objectives:

1. Identify the extent that AL-Mowasah Hospital is committed to Application Lean Six Sigma Principles.
2. Represent the level of admitted patient's satisfaction regarding AL-Mowasah Hospital services.
3. Determine the impact of Lean Six Sigma Principles on admitted patient's satisfaction in AL-Mowasah Hospital.
4. Determine the impact of Lean Six Sigma on admitted patient's satisfaction (***Room services; Interpersonal skills and Technical quality***) in AL-Mowasah Hospital.
5. Determine the different views between employees and admitted patients in AL-Mowasah Hospital about Application Lean Six Sigma Principles.

(1-5): Study Model and Hypotheses

In measuring Lean Six Sigma the researcher depends on (Psychogios, et..al, 2012). In the measurement of admitted patient's satisfaction the researcher depends on (Al Sharif, 2008).

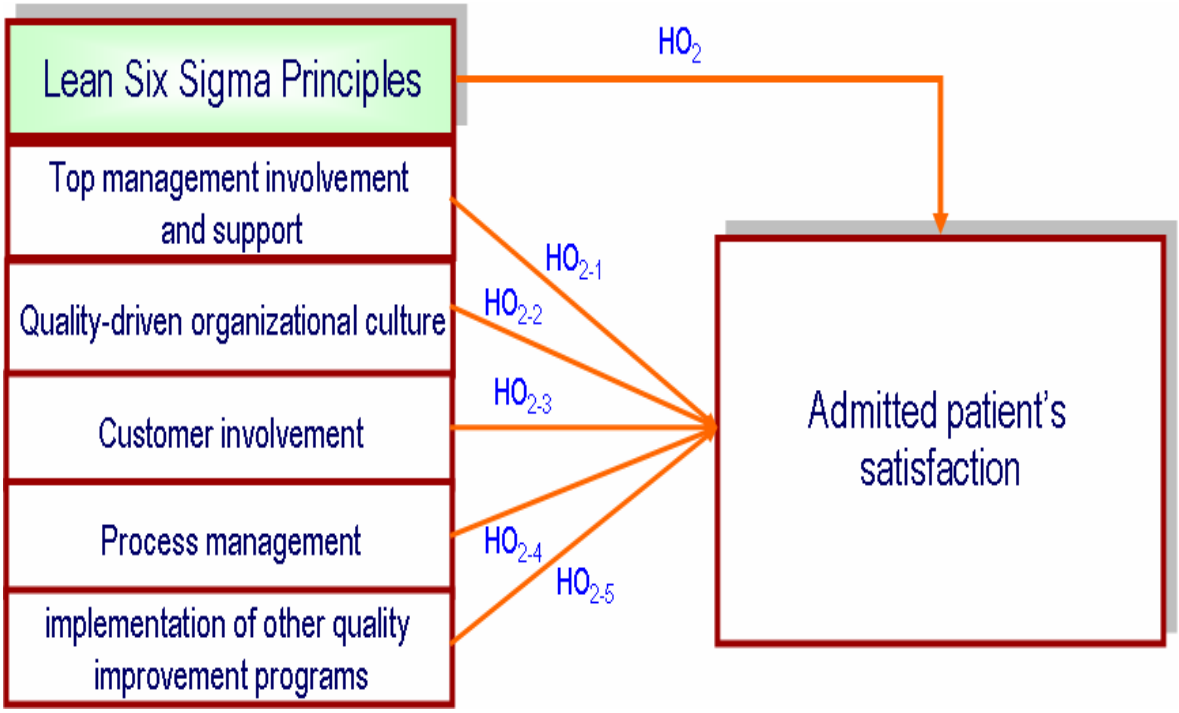


Figure (1 – 1)

Study Model

Prepared by researcher

Based on the study problem and the literature review, the following research hypotheses were formulated:

Ho1: AL-Mowasah Hospital is committed to Application Lean Six Sigma Principles (***Top management involvement and support; Quality-driven organizational culture; Customer involvement; Process management & implementation of other quality improvement programs***) at level ($\alpha \leq 0.05$).

Ho2: There is a positive impact of Lean Six Sigma Principles (***Top management involvement and support; Quality-driven organizational culture;***

Customer involvement; Process management & implementation of other quality improvement programs) on admitted patient's satisfaction in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

Ho_3: There is a positive impact of Lean Six Sigma on admitted patient's satisfaction (***Room services; Interpersonal skills and Technical quality***) in AL-Mowasah Hospital on admitted patient satisfaction at level ($\alpha \leq 0.05$).

Ho_4: There is no significant different between employees and admitted patients in AL-Mowasah Hospital about Application Lean Six Sigma Principles at level ($\alpha \leq 0.05$).

(1-6): Study Limitations

Human Limitations: the current study includes employees and admitted patients in AL-Mowasah Hospital in Amman as this is a case study.

Place Limitations: AL-Mowasah Hospital in Amman (Jordan).

Time Limitations: The time needed for study accomplishment from November 2011 to May 2012.

Scientific Limitations: The researcher in measuring Lean Six Sigma the researcher depends on (Psychogios, et..al, 2012). In the measurement of admitted patient's satisfaction the researcher depends on (Al Sharif, 2008).

(1-7): Study Delimitations (Difficulties)

1. The study concentrates on AL-mowasah Hospital chosen using it as a case study.
2. The accuracy of the study depends on AL-mowasah Hospital patients, staff manager's respondents.

(1-8): Study Terminology

Six Sigma: is a set of tools that addresses problems of process variability and capability. These performance improvements lead to waste and cost reduction, increases in revenue and cash flow, improved profitability, and employee satisfaction.

Lean: is a systematic methodology to reduce complexity and streamline a process by identifying and eliminating sources of waste in the process; waste that typically causes a lack of flow

DMAIC: (Define, Measure, Analyze, improve, control) methodology provides a structured framework for solving business problems by assuring disciplined and effective process execution. It entails defining a problem precisely, measuring to bound and clarify that issue, analyzing the business process to identify the problem's root cause, improving the process by considering alternative solutions, and controlling the process through ongoing measurement to ensure that the problem does not reoccur.

CHAPTER TWO
Theoretical Framework & Previous Studies

(2-1): Introduction

(2-2): Quality Management

(2-3): Six Sigma

(2-4): Lean Six Sigma

(2-5): Previous Studies

(2-6): Study contribution to knowledge

(2-1): Introduction

This chapter is divided into the following five sections: Quality Management; Six Sigma; Lean Six Sigma; previous studies and study contribution to knowledge.

(2-2): Quality Management

Quality is a significant element of production or services in keeping the customers satisfied. There are different definitions and competing views of the term quality by different people and the common element of the business definitions is that the quality of a product or service refers to the perception of the degree to which the product or service meets the customer's expectations. Crosby (1979) defined quality as the conformance to requirements or specifications and also suggested that to manage quality adequately; it must be able to be measured. ISO 9000: (2000).

Vorley and Tickle (2001) defined quality as the degree to which a set of inherent characteristics fulfill requirements.

The American Society of Quality sees quality as being subjective, with different individuals having their own perception of it (www.asq.org). To them, quality can be seen as having two meanings – the characteristics of the product or service ability to satisfy a particular need or a product or service devoid of faults. It can be defined as a state of conformance to valid requirements where

valid requirement are defined as conditions that meets the needs of customers, measurable and achievable.

Peters (1999) defined quality as a ‘magic bullet’ which provides lower cost, higher customer service, better products and higher margins. He also explained that ‘quality is in the eyes of the beholder’, this mean it is what the customer say it is.

Kondo (1997) defined quality as a source of employee’s empowerment. To him, a major aim of a company is to make itself attractive to its employees and customers while making profits for its shareholders.

Stebbing (1992) noted that two forms of qualities exist in the world, efficiency and inefficiency. To him, efficiency is what every senior manager should strive to achieve and the efficiency in service is what the customers expect to get. He explained that organizations are inefficient because of the inadequate trainings given to employees by the employers or the assignment of task to unqualified workers. Which ever way quality is defined, it is viewed as part of an organizational culture; this should be inclusive of all different facets of production.

Quality management involves the formulation of strategies, setting goals and objectives, planning and implementing the plans; and using control systems for monitoring feedback and taking corrective actions. An organization’s quality management implementations are of two folds (Dale, et.. al,1994):

a) Satisfying customer's expectation.

b) Improvement in the overall business efficiency.

According to Juran (1988) the basic goal of quality management is the elimination of failure; both in the concept and in the reality of products, services and processes. This does not only mean that product, services and processes will fail in fulfilling their function but that their function was not what the customer desires. Failure must be prevented in quality management and to handle this there should be planning, organizing and controlling.

The Four stages of quality management treated by Dale, et..al (1994) are inspection, quality control (QC), quality assurance (QA) and total quality management (TQM).

(1) Inspection

According to (ISO 8402, 1986) inspection can be defined as 'activities such as measuring, examining, testing, gauging one or more characteristics of a product or service and comparing these with specified requirements to determine conformity'. It involves the examination, measurement and testing of the characteristics of a product or service and the comparison to specified requirement and to access if the characteristics conform to specified requirement (Dale, et..al, 1994).

Inspection is an efficient and effective way of discovering defects in services and products. According to Deming (1986) 'inspection with the aim of finding bad product and throwing them out is too late, ineffective and costly'.

Quality to him comes from the improvement in the process rather than inspection.

(2) Quality control

Quality control is a conventional way that businesses have used to manage quality. Quality control is concerned with checking and reviewing work that has been done, this is mainly done by inspection of products and services (checking to make sure that what's being produced is meeting the required standard) take place during and at the end of the operations process.

Juran (1988) defined quality control as the regulatory process through which we measure the actual quality performance, compare it with standards, and act on the difference.

It is a more sophisticated management tool that aims at preventing goods and services which do not conform to basic requirements from getting to the final consumer.

Quality controls are operational techniques and activities that are used to fulfill quality requirement (ISO 8402, 1994). As a measure of quality, quality control however is costly when viewed in terms of tangible and intangible variable cost. It could also result in the production of substandard goods and services when conducted late in the process of production. Due to the problems associated with quality control, businesses now focus on other avenues or means through which quality could be managed effectively.

Dale, et..al, (1994) noted that the solving of a problem after a non conformance issue has been created is not an effective route towards eliminating the root cause of a problem.

(3) Quality assurance

This is a principle based on the designing of the business process of production with a view of minimizing the chances of producing substandard goods.

According to Dale, et..al, (1994) quality assurance is a prevention based system, which improves product and service quality with increased productivity by placing the emphasis on product, service and process design.

Quality assurance emphasis on defect prevention, unlike quality control that focuses on defect detection once the item is produced. Quality assurance is focused on the prevention of the production of non conforming product and much emphasis is placed on the activities involved in the process of production.

Thus, it is a management design that aimed at controlling quality at all stages of production to prevent quality problems from emerging.

The quality assurance philosophy opined that quality is created in the design stage and not the control stage and that problems associated with quality are caused by poor process design.

According to Lockwood, et..al, (1996) ‘to be effective, quality assurance must involve the development of a new operating philosophy and approach that

looks to be proactive rather than reactive, that includes motivating and involving people in the process across normal departmental barriers'.

Oakland (1995) defined quality assurance as broadly prevention of quality problems through planned and systematic activities, which include documentation.

(4) Total Quality Management

This is the highest level of quality management. It is concerned with the management of quality principle in all the facets of a business including customers and suppliers (Lockwood, et..al, 1996).

Total Quality Management (TQM) involves the application of quality management principles to all aspects of the organization, including customers and suppliers, and their integration with the key business processes. It is an approach which involves continuous improvement by everyone in the organization. TQM is a principle which involves the mutual cooperation of everyone that aids the business process of an organization and it involves all the stake holders of an organization.

Dale, et..al, (1994) cites 'TQM is defined as a philosophy embracing all activities through which the needs and expectations of the customer and the community, and the objectives of the organization are satisfied in most efficient and cost effective way by maximizing the potentials of all employees in a continuing drive for improvement.'

According to Mohammed (2006), TQM is an effective system for integrating the quality development, quality maintenance and quality improvement efforts of various aspects of a system so as to enable services at most economical level and derive full satisfaction.

TQM is aimed at the satisfaction of customers needs in an efficient, reliable and profitable way. It involves a radical direction through which an organization performs its day to day operations in other to ensure that quality is put at the top of mind of every employee and departments in which they operate.

Vorley and Tickle (2001) defined TQM as the synthesis of the organizational, technical and cultural elements of a company. They opined that TQM is a heart and mind philosophy which recognizes that company culture affects behavior which in turn affects quality.

Oakland (1989) describes TQM as an approach to improve competitiveness efficiently and flexibility for the whole organization.

According to Hellsten and Klefsjö (2000), TQM can be defined as a management system which consists of interdependent unit namely core values, techniques such as process management, benchmarking customer focused planning or improvement teams and tools such as control charts.

Dahlgaurd, et..al, (1999) saw TQM as a corporate culture that is characterized by increased customer satisfaction through continuous improvement involving all employees in the organization.

Oakland (1989) noted that 'for an organization to be truly effective each part of it must work properly together towards the same goal, recognizing that each person and each activity affects and in turn is affected by each other – the methods and techniques used in TQM can be applied through out any organization.

(2-3): Six Sigma

Six Sigma in statistical terms means 3.4 defects per million opportunities. Early in its development, a team at Motorola developed a four-phase process for improving the quality of its products looking at "Definition," "Analysis," "Optimization," and "Control" (Harry and Lawson, 1992).

According to Snee & Hoerl (2003) the Six Sigma Evolutionary Timeline is:

1736: French mathematician Abraham de Mover publishes an article introducing the normal curve.

1818: Gauss uses the normal curve to explore the mathematics of error analysis for measurement, probability analysis, and hypothesis testing.

1896: Italian sociologist Vilfredo Alfredo Pareto introduces the 80/20 rule and the Pareto distribution in Cours d'Economie Politique.

1924: Walter A. Shewhart introduces the control chart and the distinction of special vs. common cause variation as contributors to process problems.

1941: Alex Osborn, head of BBDO Advertising, fathers a widely-adopted set of rules for “brainstorming”.

1949: U. S. DOD issues Military Procedure MIL-P-1629, Procedures for Performing a Failure Mode Effects and Criticality Analysis.

1960: Kaoru Ishikawa introduces his now famous cause-and-effect diagram.

1970s: Dr. Noriaki Kano introduces his two-dimensional quality model and the three types of quality

1986: Bill Smith, a senior engineer and scientist introduces the concept of Six Sigma at Motorola.

1994: Larry Bossidy launches Six Sigma at Allied Signal.

1995: Jack Welch launches Six Sigma at GE.

To compete with the rest of the world organizations need to become more effective and efficient. The time for developing new products must be reduced; quality has to be improved with increasing production while costs have to be reduced. To meet those needs, a six sigma approach can be effective (Breyfogle, 1999).

This differentiates six sigma from other improving methodologies is the packaging of quality tools and philosophies, the focus on cost reduction and organization (foster, 2004).

Six sigma was first intiated by Motorola to cut the company's costs in 1982. The CEO at that time wanted to cut the annual cost in half. This focus on costs gave a reason for Motorola to improve product design with help of analytical techniques. This was the start for Motorola's six sigma program (foster, 2004).

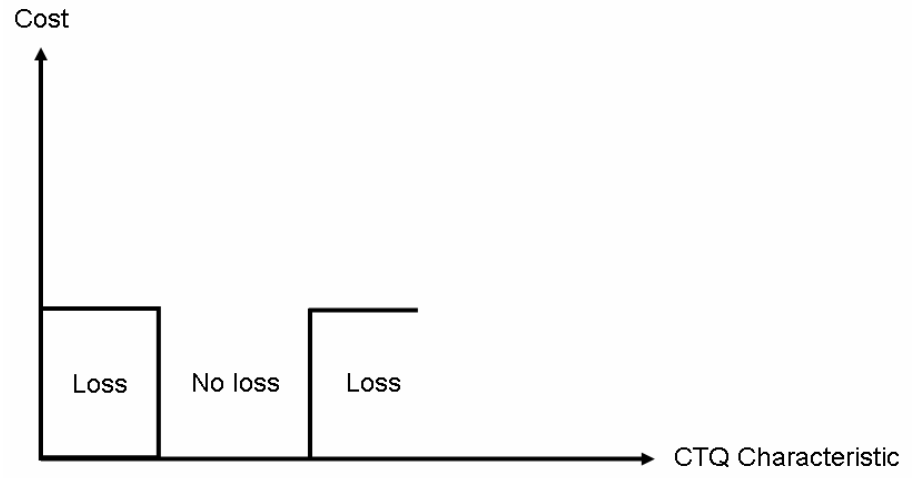
Magnusson, et..al, (2003) gives a technical definition of six sigma :

"Technically, sigma is a letter in the Greek alphabet; it is written as σ and used both as a symbol and a metric of process variation. Process performance equals six sigma when the variation in the individual process or product characteristic gives no more than 3.4 defects per million opportunities."

The traditional vies says that a quality characteristic is acceptable as long as the value is between upper and lower specified limit (Bergman & Klefsjo, 1995). As shown in figure (2 – 1).

Figure (2 – 1)

Traditionally View on Variation

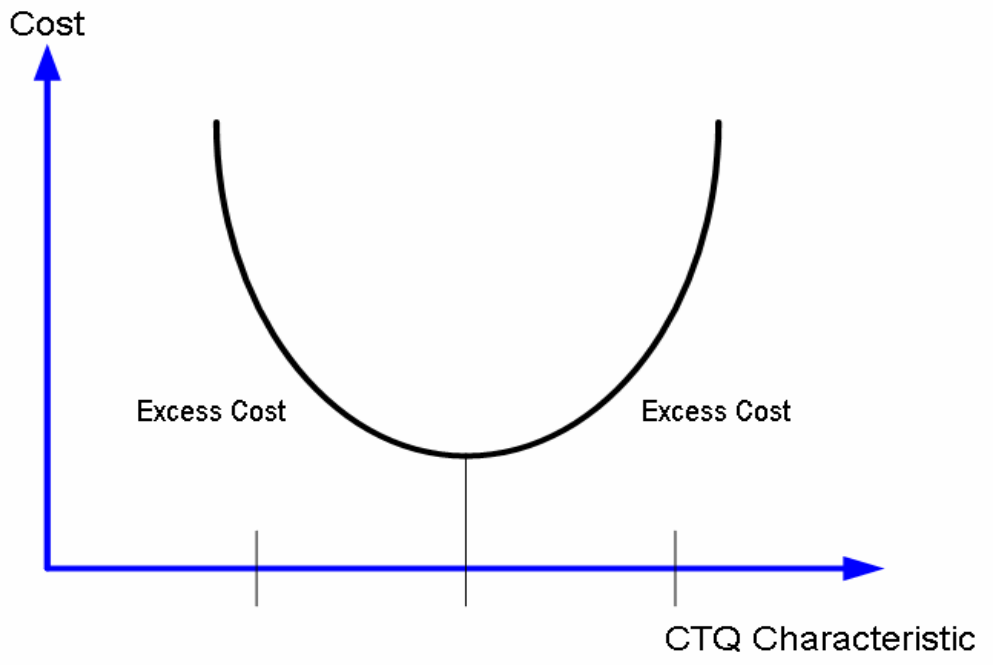


Source: Bergman, B. and Klefsjö, B. (1995). Quality: from Customer Needs to Customer Satisfaction. Taylor & Francis, London: 171

The difference between six sigma and other improvement methodologies is the focus on reducing variation. Variation results in costs for the organization itself or its surrounding, suppliers and customer. The cost of variation can be described by “the loss function” shown in figure (2 – 2). The cost increases as the value moves away from the target. (Magnusson, et..al, 2003).

Figure (2 – 2)

Six Sigma View on Variation: The Loss Function



Source: Montgomery, DC (2005), "Introduction to Statistical Quality Control", 5th Ed., New York: 17

Many organizations today, are working with improvement projects. Because of its large range of improvement areas, six sigma is preferred by a majority of the companies, to reduce variation. Six sigma can be used in ongoing improvements, but also in breakthrough improvement projects. The focus on variation reduction assumes that the mean first has been improved to a satisfactory level (Magnusson, et..al, 2003).

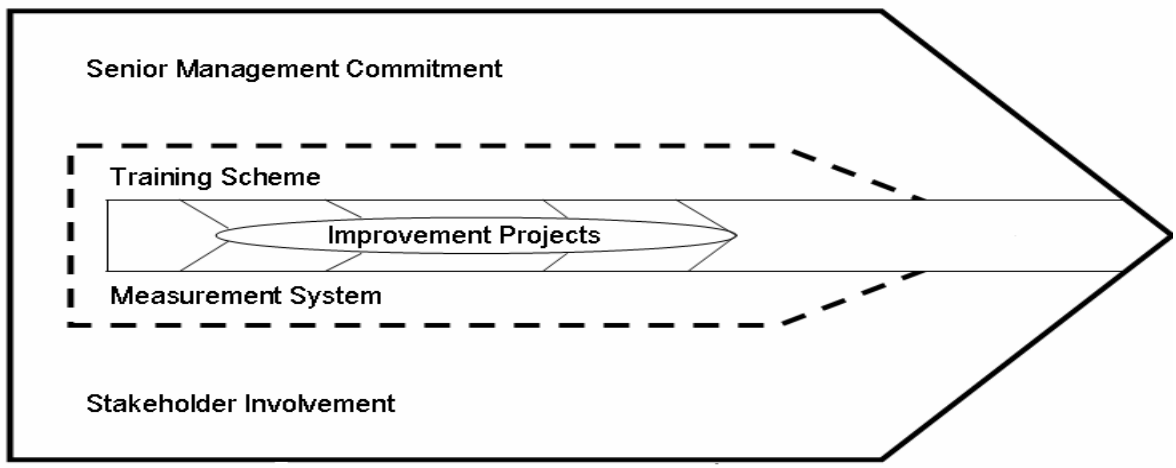
According to pyzdek (2001) the main effort in the six sigma methodology is to reduce process variation and consistently meet or exceed customer expectations and requirements. But, to attain breakthrough improvements, which are needed for the company to grow and adapt to a changing environment, some

waste and variation has to be allowed when developing new products. It is important for the manager to understand this paradox.

The six sigma framework consists of four elements: Senior management commitment, stakeholder involvement, training scheme and measurement system. Stakeholders include customers, employees, owners and suppliers. Senior management commitment and stakeholder involvement are important, because without these, training scheme and measurement system are meaningless (figure 2-3). Launching a six sigma initiative is a strategic decision and must be taken by the senior management. (Magnusson, et..al, 2003)

Figure (2 – 3)

Six Sigma frameworks including the four main elements with the improvement projects in focus



Source: Magnusson, K., Kroslid, D. and Bergman, B, (2003), "Six Sigma: The Pragmatic Approach", 2nd ed., Studentlitteratur, Lund : 33

The more a six sigma project is characterized as breakthrough improvement. The more commitment from senior management is needed. The senior management commitment should among other things contain formulating the company's six sigma mission statement, monitor projects and listen to project report, select and follow up black belts and regularly review the progress of the six sigma implementation.

Pyzdek (2001) argues that size sigma improvements have a strong technical ingredient, and expertise at different levels needed. The expertise is ranging from understanding basic quality tools to in-depth understanding of mathematical theory and advanced statistical analyses. To differentiate these personnel with various levels of knowledge, names are borrowed from the martial arts. Those with most technical training and understanding are called black belts and those with basic understanding are called green belts.

The black belts pay the most important role in the six sigma organization as their daily efforts make the six sigma projects successful.

A typical six sigma organization can be viewed. The common used guideline for organizing a six sigma organization is one black belt for every 100 employee, 20 green belts for one black belt and 20 black belt for one master black belt (Magnusson, et..al, 2003).

According to Antony J. (2006), the following are the different phases of Six Sigma;

(1) Defining Phase:

Following are the steps involved in the define phase:

- Define the problem accurately and specifically.
- Identify stakeholders.
- Understand the link between the problem at hand and the critically of the problem from the perspective of the customers.
- Conducting of the simple mapping of the processes both up- and – downstream to identify the problem.
- Establish the process inputs, outputs and various controls of the processes.
- Forming a Six sigma project charter which clearly defines the roles of the people and their responsibilities for the project. Defining the resource required for the project and allowed time-frame for the project at hand. The charter must also reveal the scope of the project, its boundaries and the key benefits to internal and external customers.
- Identifying the project sponsor and stakeholders and determine whether this project is worth an effort using cost benefit analysis.
- Identify all customers both internal and external and justify how this problem is linked to customer satisfaction

(2) Measuring Phase:

Measure phase encompasses the following steps:

- Identifying the current performance of the service process.
- Decide what to measure (critical to quality characteristic) and how to measure.
- Establish a simple measurement system study (if applicable).
- Determine how well our process is performing compared to others through benchmarking exercise.
- Identify the strengths and weaknesses and determine the gaps of improvement.

(3) Analysis Phase:

The following are the points must be looked at during the phase:

- Uncover the root causes of defects in processes.
- Understand the root causes of variability which lead to defects and priorities them for further investigation.
- Understand the nature of data and the distribution or patterns of data.
- Determine the key service process variables that may be linked to defects.
- Financial quantification of the improvement opportunity (i.e. estimate of potential financial benefits).

(4) Improving Phase:

The improvement phase of the methodology covers the following steps:

- Develop potential solutions to fix the problems and prevent them from recurring.
- Evaluate the impact of each potential solution using a criteria-decision matrix. Solutions that have a high impact on customer satisfaction and bottom line savings to the organization need to be examined to determine how much time, effort and capital will be needed to expand for implementation.
- Assess risk associated with potential solutions.
- Validate improvement (i.e. reduce defect rate or improve sigma quality level of the process) by pilot studies.
- Re-Evaluate the impact of chosen potential solution.

(4) Controlling Phase:

The Control phase of the methodology comprise of the following steps:

- Develop corrective actions to sustain the improved level of service process performance.
- Develop new standards and procedures to ensure long-term gains.
- Implement process control plans and determine the capability of the process.
- Identify a process owner and establish his/her role.

- Verify benefits, cost savings/avoidance.
- Document the new methods
- Close project, finalize documentation and share key lessons learned from the project.
- Publish the result internally (monthly bulletins) or externally (conferences or journals) and recognize the contribution made by the team members

Six Sigma paradigm can be implemented in the service orientated organization.

As Cho R.B. (2007), indicated that six sigma is a powerful business strategy that results in dramatic reduction in defects, errors, or mistakes in service processes. According to previous researches, Six sigma is considered to accelerate improvement in service quality by reducing the process variation and eliminating non-value added steps. However, the concept of Six Sigma was adopted by the manufacturing organizations for the quality and process improvement but the service organizations are adopting the methodology exponentially. The implementation of Six Sigma strategy in the service processes is to understand how defects occur and then to devise process improvements to reduce the occurrence of the defects resulting in improved customer experience and enhanced customer satisfaction.

According to Cho R. B. (2005), service organizations adopting Six Sigma business strategy gain the following benefits:

- Improved cross functional teamwork throughout the entire organization.
- Transformation of the organizational culture from fire-fighting to fire-prevention mode.
- Increased employee morale.
- Reduced number of non-value added steps in critical business processes through systematic elimination, leading to faster delivery of service.
- Reduced cost of poor quality (cost associated with late delivery, customer complaints, misdirected problem solving, etc.).
- Increased awareness of various problem solving tools and techniques, leading to greater job satisfaction for employees.
- Improved consistency level of service through systematic reduction of variability in processes.
- Effective management decisions due to reliance on data and facts rather than assumptions and instincts.
- Transformation of organizational culture from being reactive to proactive thinking or mindset.
- Efficient and reliable internal operations, leading to greater market share and satisfied shareholders

The Six Sigma toolkit includes basic statistical process control (SPC) tools, called the “Magnificent Seven”. These tools are employed in various stages of the DMAIC cycle. The objectives of employing SPC tools are to bring the process in control and to reduce variations due to special causes. SPC tools are widely used by industry for problem solving. After discussing the “Magnificent Seven” on-line processing monitoring tools, the off-line techniques Regression Analysis, Hypothesis Testing, and Analysis of Variance (ANOVA) will also be discussed.

(1) Run Chart (Check Sheet)

A run chart keeps track of process measurements over time. It is used for a rough check of the process stability, and it is particularly useful in identifying changes in the process mean and standard deviation. When looking at run charts, one pays attention to huge jumps in measurements, patterns that occur over time (e.g. whether the measurements show an increasing trend), and an increase in variance. A check sheet is similar to a run chart, but it is used to keep record of equipment over time.

(2) Histogram

A histogram is a graphical display of measurement frequencies. It is used to identify the shape and location of the distribution of measurements, but the process must be in control for the identification of distribution to be accurate. A histogram shows the proportion of measurements that fall into each bin. The

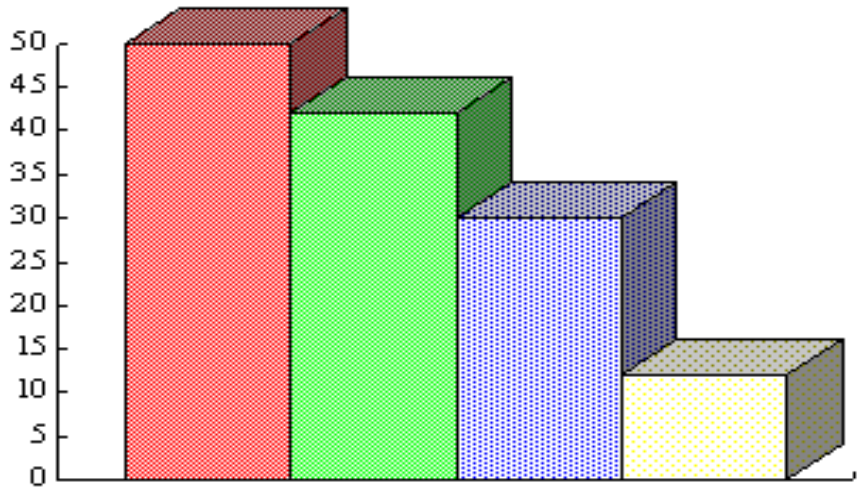
number and range of bins are determined by the constructor of the histogram. The mean and variability of the process can be easily seen on the histogram. If the specification limits are shown, the histogram can display the process capability.

(3) Pareto Diagram

A Pareto diagram is similar to a histogram, but the bins show attribute data instead of measurement ranges. Also, the values plotted are arranged in descending order. This is due to Pareto Principle, which states that a small number of causes contribute to the majority of problem. The aim of the Pareto Chart is to identify these causes, so they can be eliminated later.

Figure (2 – 4)

Pareto diagram



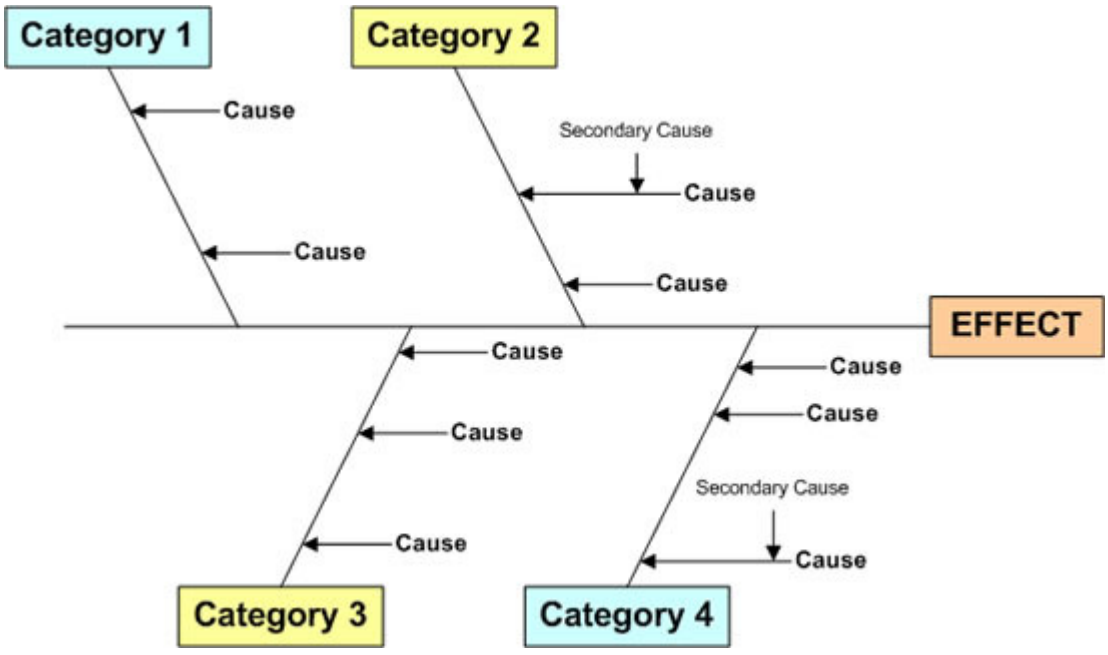
Source: Pyzdek, T. (2001), "The Six Sigma Handbook: A Complete Guide for Green belts, Black belts and Managers at all Levels", New York: McGraw-Hill.

(4) Cause and Effect Diagram

A cause and effect diagram is used to identify and analyze a problem in a team setting. Teams brainstorm to generate categories such as materials, machines, personnel, environment, etc. Within each category, the team identifies causes that contribute to the effect (the problem). A cause and effect diagram visually displays these causes, and helps the team to locate the most significant causes that lead to the problem.

Figure (2 – 5)

Cause and Effect Diagram



Source: Pyzdek, T. (2001), "The Six Sigma Handbook: A Complete Guide for Green belts, Black belts and Managers at all Levels", New York: McGraw-Hill.

(5) Scatter Diagram

A scatter diagram is used to investigate the relation between the two quality characteristics on the x and y axes, e.g. whether x values increase as y values increase. However, note that correlation does not imply causality, e.g. one cannot conclude that an increase an x causes and increase in y, even if x values increase as y values increase. To investigate causal relationships, one can use the Design of Experiments (DOE).

(6) Control Chart

The control chart is similar to a run chart, but it plots measurements over time on a chart with control limits. The objective of a control chart is to quickly identify the occurrences of special causes. When an occurrence is indicated by the chart, e.g. if a measurement falls outside of the control limits, then the process is stopped and the cause is investigated. The cause is identified, eliminated, and the process is improved. One also looks for patterns on the control chart. If a pattern exists, it may be an indication that the process is unstable. There are many types of control charts (to name a few – X-bar, R-bar, S, I, MR) that are used for different circumstances.

(2-4): Lean Six Sigma

Lean Management is a philosophy emphasizing the reduction of wastes. The elimination of waste leads to improved quality, and decreased production time and cost. In comparison, Lean Management is the more process-driven quality control initiative, while Six Sigma is more data-driven. Lean Management encompasses the following key principles (Kumar, 2006):

Pull processing: production is triggered only when there is demand from the customer end, not pushed by the production end

Perfect first-time quality: strive for zero defects, locating defects and controlling variances at the source

Waste minimization: minimize all non-value added activities that do not add value, maximize efficient usage of resources

Continuous improvement: continuously reduce costs, improve quality, increase productivity and encourage information sharing an overall strategy

Flexibility: systems can react to changing demands to produce a greater diversity of services in small batches quickly

Supplier relationship management: a long term relationship with suppliers is created and maintained through collaborative risk sharing, cost sharing and information sharing arrangements. There is no disconnection between the parties.

Lean Management encourages small batch sizes and the “pull” strategy, which means that nothing is made until there is a customer demand. This is called the make-to-order (MTO) approach (Arnheiter, 2005). With this approach, waste is eliminated and non value-added activities are cut down. The reduced cycle time with this approach ensures that defects are discovered quickly.

Similar to Six Sigma, Lean Management is also an overall strategy. At every chance, Lean Management strives to reduce variability. A lean organization attempts to reduce demand variability, manufacturing variability and supplier variability. For example, when a Lean organization reduces manufacturing variability, it not only considers variability in the product quality parameters, but also in task operation times, such as machine downtime, employee absenteeism and operator skill level.

The Lean Management toolkit includes a number of tools, techniques and practices that enable and facilitate the implementation of Lean. The SPC tools and techniques used in Six Sigma are also part of the Lean Management toolkit. Lean tools and techniques include Five-Why analysis, 5s practice, Just-in-time (JIT) production, Kanban, value stream mapping, Total productive maintenance (TPM), Production flow balancing, and many more (Kumar, 2006).

(1) Five-Why Analysis:

The Five-Why Analysis supports kaizen (continuous improvement), a key principle of Lean Management. This technique requires employees to pose the question “Why?” five times every time a problem is encountered. The employee

should go to a deeper, more detailed level with each “Why?” and become closer to locating the root cause of the problem. The Five-Why Analysis is critical because countermeasures can only be identified when the root cause of the problem is understood. Below is an illustration of 5 Why Analysis:

(1) The company is missing due dates – why?

(2) Services have long lead times – why?

(3) The company does not have enough manufacturing capacity – why?

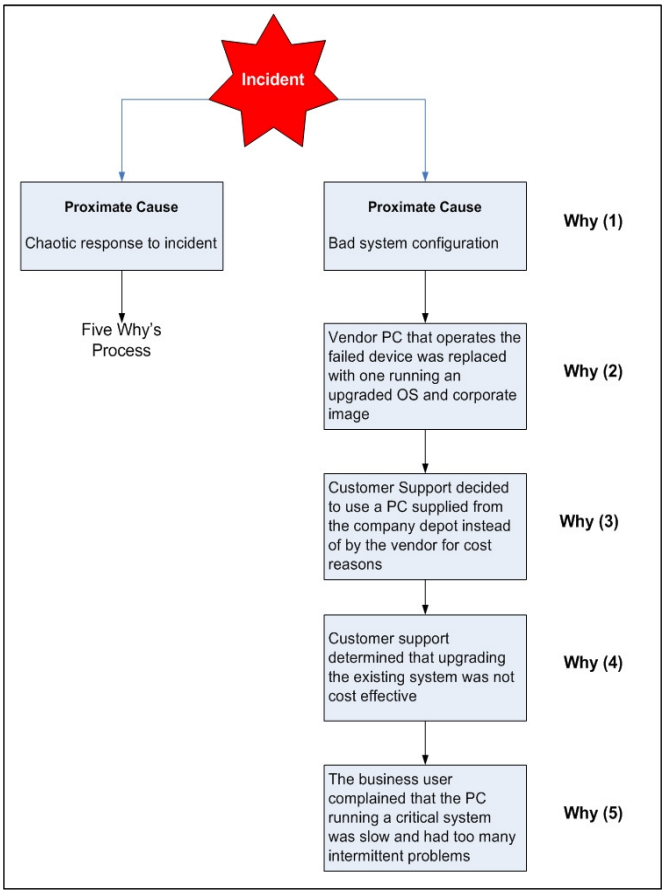
(4) Setup times are long – why?

(5) Services changeover is time consuming – why?

After this analysis, the company can locate the root cause of the problem, and can rectify the problem by reducing the changeover time between products, thereby increasing manufacturing capacity.

Figure (2 – 6)

Five-Why Analysis



Source: Kumar, Antony, Singh, Tiwari, Perry, (2006), "Implementing the Lean Sigma framework in an Indian SME: a case study", *Production Planning and Control*, Vol.17, No.4: 407-423.

(2) 5S Practice:

5S is a lean tool that facilitates teamwork. The 5S stand for sort, stabilize, shine, standardize, and sustain – a series of activities for eliminating wastes that lead to errors, defects and injuries (Liker, 2003).

- ***Sort*** through items and keep only what is needed while disposing of what is not.

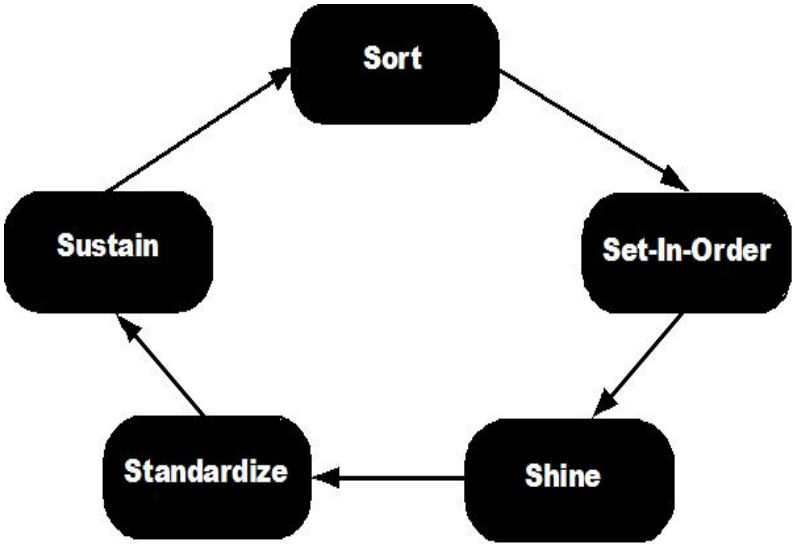
- ***Set in order*** There is a place for everything and everything should be in its place.
- ***Shine*** The cleaning process exposes abnormal and pre-failure conditions that could hurt quality or cause machine failure.
- ***Standardize*** Develop systems and procedures to maintain and monitor the first three S (Sort, Straighten, and Shine).
- ***Sustain*** Maintaining a stabilized workplace is an ongoing process of continuous improvement, so regular management audits should be employed to stay disciplined.

5S practice supports a smooth production flow, an essential characteristic of a lean system. It also helps to make problems visible.

To enforce 5S practice, workers have to be equipped with the necessary education and training; they should also be encouraged with rewards to give them incentive to properly maintain and continuously improve operating procedures and the workplace environment.

Figure (2 – 7)

5S Practice



Source: Kumar, Antony, Singh, Tiwari, Perry, (2006), "Implementing the Lean Sigma framework in an Indian SME: a case study", *Production Planning and Control*, Vol.17, No.4: 407-423.

(3) Just-in-Time (JIT) Production:

Just-in-Time is a set of principles, tools, and techniques aimed to eliminate wastes by producing "only the necessary products, at the necessary time and in the necessary quantity" (Regani, 2004). JIT encourages the organization to produce and deliver products in small quantities, with short lead times, to meet specific customer needs. With JIT, the company does not build up excessive inventory, resulting in significant reduction of inventory costs. Also, the company is more flexible to changing customer demands.

JIT is based on the „pull system of manufacturing. With the pull system, production is initiated with customer demand. In other words, there would be no production if there were no demand. The „pull system is contrasted against the

„push system, where the company pushes 0production to its highest potential, producing as much as possible, often leading to excessive inventory of work-in-process (WIP) as well as finished goods. With the pull system, customer demand pulls the workflow, and processes in the assembly line begin when parts are delivered by the previous process in the line. Theoretically, if JIT is successfully implemented throughout the organization, the company would have no need for storage as WIP and finished goods inventory would be completely eliminated.

(4) Kanban:

A Kanban means „signboard in Japanese. Kanban s definition has broadened to signify a tool used to effectively control the flow and the quantity of parts in production. In the Kanban system, when an operator needs parts for a certain process of the production line, he writes the details of the parts needed and quantity needed on the Kanban. He then takes this card to the preceding process to withdraw the amount needed (Regani, 2004).

(5) Value Stream Mapping:

A value stream is the set of activities that contributes value to the customer. Value stream mapping is a method for showing the material and information flow in a diagram form. The value stream map captures process, material flows, and information flows of a given product family and helps to

identify waste in the system. Activities that do not contribute to value in the customers eyes are waste and should be eliminated.

(6) Total Productive Maintenance (TPM):

Total Productive Maintenance (TPM) is a set of tools that gives workers a high degree of autonomy and responsibility in improving productivity. Every worker leans how to clean, inspect, and maintain equipment. Workers are trained to analyze information flow and processes such that they can see waste and solve problems at the root cause. With an effective method of maintaining the plant and equipments, productivity is increased, and so are employee morale and job satisfaction.

(6) Production Flow Balancing:

Production Flow Balancing is a technique used to level out the workload of a production line. It discourages rushing production in batches to meet deadlines, and encourages producing a variety of products in small batches on a consistent basis. This eliminates overburden to people and equipment. Workers have more time to focus on continuous improvement. It also helps to reduce huge inventory buildup of one or a few particular products.

It is believed that the Toyota Company is the inventor of “lean production” (also known as the “Toyota Production System”). Utilizing the Toyota Production System (TPS), Toyota has consistently manufactured automobiles with superior

quality. To be a truly lean organization, the company must go beyond the surface tools and techniques of Lean and adopt a Toyota-style culture of quality. There were two aspects to TPS – the hard or technical part focusing on manufacturing systems like JIT and Kanban, and the „soft or people related part emphasizing respect for every human in relation to the company, such as workers and suppliers. Moreover, all employees must be committed to learning continuously and creating a Lean enterprise. Below is a summary of the 14 Toyota-Way Principles, the pillars of the successful Toyota Production System (Liker, 2003):

Principle 1: Base your managerial decisions on a long-term philosophy, even at the expense of short-term financial goals.

Principle 2: Create continuous process flow to bring problems to the surface.

Principle 3: Use “pull” system to avoid overproduction.

Principle 4: Level out the workload.

Principle 5: Build a culture of stopping to fix problems, to get quality right the first time.

Principle 6: Standardized tasks that are the foundation for continuous improvement and employee empowerment.

Principle 7: Use visual control so no problems are hidden.

Principle 8: Use only reliable, thoroughly tested technology that serves your people and technology

Principle 9: Develop leaders who thoroughly understand the work, live the philosophy, and teach it to others.

Principle 10: Develop exceptional people and teams who follow your company's philosophy.

Principle 11: Respect your extended network of partners and suppliers by challenging them and helping them improve.

Principle 12: Go and see for yourself to thoroughly understand the situation.

Principle 13: Make decisions slowly by consensus, thoroughly considering all options; implement decisions rapidly.

Principle 14: Become a learning organization through relentless reflections and continuous improvement.

Lean Six Sigma is an approach combining and capitalizing the strengths of the Six Sigma and Lean Management improvement programs. It has been claimed that companies that practice either lean management or Six Sigma exclusively would reach a point of diminishing returns. After the initial problem solving and process re-engineering efforts, systems show significant improvement, but further improvements are not easily realized (Arnheiter, 2005).

The effectiveness of Lean Sigma stems from integrating the two popular process improvement methodologies to create a single, coordinated initiative. Lean and Six Sigma methods complement and reinforce each other. In comparison to applying the two methodologies separately, improvements are identified and implemented more rapidly, processes variations are more controlled and cost reductions are greater. The data-driven aspect of Six Sigma pushes the organization to make efficient use of data in decision-making and

problem solving, using the structured DMAIC methodology that promotes a scientific approach to quality. The resulting higher process capability leads to substantial cost reduction. To complement a high quality production process, a company should also provide high quality service. Some Lean organizations are characterized by the produce-to-order strategy. With this strategy, a company starts small-batch productions only when there is a customer order and avoids unnecessary long production runs; hence, manufacturing lead times are reduced.

This means that the products are delivered to the customer more quickly. Other Lean organizations adopt the produce-to-stock strategy. These companies also provide better service through Lean Management because they decrease their horizon of their forecasts and replenish their stocks more often, thereby reducing leads times and inventory costs, and increasing the company's profit and inventory turnover rate (Arnheiter, 2005).

Because of its practicality and effectiveness, the Lean Sigma approach is widely popular among various manufacturing and service industries. Table (2-1) summarizes the key Lean and Six Sigma principles embodied by the Lean Six Sigma approach (Arnheiter, 2005):

Table (2-1)

Combining key Lean and Six Sigma principles

Lean Principles	Six Sigma Principles
There is an overriding philosophy that aims to eliminate non-value added operations	Data-driven methodologies are emphasized. Changes are based on quantitative analysis rather than intuition.
Incentive systems encourage global optimization instead of local optimization.	Variation of quality characteristics is minimized using structured methodologies.
Decisions are made according to their relative impact on the customer	A company-wide and highly structured education and training program is designed and implemented.

In simple terms , lean looks at what we should not be doing and aims to remove it; six sigma looks at what we should be doing and aims to get it right first time and every time, for all time.

Lean is all about linkage of tools and not using tools individually. In fact, none of the tools are new. The strength of the approach is the sequence of tools.

Figure (2 – 8) showed the interaction between lean and six sigma and its outcomes.

Figure (2 – 8)

Lean Sigma

Source: Arnheiter, Maleyeff, (2005), "The integration of lean management and Six Sigma". *The TQM Magazine*, Vol. 27, No. 1: 5-18

Lean Sigma is the integration of Lean and Six Sigma process improvement methodologies. Six Sigma and Lean are both business improvement methodologies, more specifically business process improvement methodologies.

Their end goals are similar, better process performance, but they focus on different elements of a process. Unfortunately, there is confusion about their integration. Often, Six Sigma and Lean have been positioned as competitors when in fact they are wholly complementary.

For the purpose of CRH's approach to process improvement:

σ Six Sigma is a systematic methodology to focus on the key factors that drive the performance of a process, set them at the best levels, and hold them there for all time.

σ Lean is a systematic methodology to reduce complexity and streamline a process by identifying and eliminating sources of waste in the process; waste that typically causes a lack of flow.

In simple terms, Lean looks at what we should not be doing and aims to remove it; Six Sigma looks at what we should be doing and aims to get it right first time and every time, for all time.

Lean Sigma is all about linkage of tools, and not using tools individually. In fact, none of the tools are new. The strength of the approach is in the sequence of tools.

(2-5): Previous Studies

(2-5-1): Previous Studies in Six Sigma

Antony, et..al, (2007) under title "***Six sigma in service organizations: Benefits, challenges and difficulties, common myths, empirical observations and success factors***".

The purpose of this paper is to present a review of the literature on six sigma as applied to the service industry, followed by a presentation of the key findings obtained from a pilot survey carried out in UK service organizations'. This paper presents some of the most common challenges, difficulties, common myths, and implementation issues in the application of six sigma in service industry settings. It also discusses the benefits of six sigma in service organizations', tools and techniques of six sigma for service performance improvement, key criteria for the selection of winning projects, followed by the results of a six sigma pilot survey in UK service organizations. The results of the study show that the majority of service organizations in the UK have been engaged in a six sigma initiative for just over three years. The average sigma quality level of the companies was around 2.8 (approximately 98,000 DPMO). Management commitment and involvement, customer focus, linking six sigma to business strategy, organizational infrastructure, project management skills, and understanding of the six sigma methodology are the most critical factors for the successful introduction, development and deployment of six sigma.

Ho, et..al, (2008) under title "***An empirical study of key success factors for Six Sigma Green Belt projects at an Asian MRO company***".

This study determines critical factors for aircraft maintenance, repair, and overhaul company during the initial incorporation stage of Six Sigma programs. This is achieved by examining 14 key success factors. Employees of an Asian maintenance, repair, and overhaul company are surveyed. Factor analysis is used to identify five key factors that are pertinent to successful completion of Green Belt improvement projects

Cheng, (2008) under title "***Implementing Six Sigma via TQM improvement: an empirical study in Taiwan***".

This paper aims to review the related literature on TQM and Six Sigma, and then to construct and explore the conceptual framework via an empirical study. Discussions follow on the conceptual framework, and there is a case study on the experience of Kinpo Electronics (KE) company in Taiwan implementing Six Sigma via TQM improvement. The objective of the research is to examine the relationship between TQM and Six Sigma. To achieve this, the paper conducted a conceptual framework with six improvement factors "system", "product", "control", "training", "technical", and "assessment". The six factors are considered in detail in a discussion of the case of KE Company with regard to its implementing Six Sigma via TQM improvement. The results of using TQM improvement activities to implement Six Sigma may be divided into two main paradigm shifts, namely

transfer and adjustment. “Transfer” means the requirements for macro change in implementing Six Sigma via TQM improvement, and “adjustment” refers to the micro changes undertaken in moving from TQM toward Six Sigma.

Hekmatpanah, et..al, (2008) under title “***Six Sigma Process and its Impact on the Organizational Productivity***”.

The purpose of this paper is the survey of six sigma process and its impact on the organizational productivity. So the researcher studies key concepts, problem solving process of six sigma as well as the survey of important fields such as: DMAIC, six sigma and productivity applied programme, and other advantages of six sigma. The results present that there is a direct and positive relation between six sigma and productivity.

Salaheldin & Abdelwahab, (2009) under title “***Six Sigma Practices in the Banking Sector in Qatar*** “.

This paper aims to investigate the process of six sigma implementation by banks in Qatar in order to identify its perceived benefits and to explore the critical success factors. Data were collected with a mail survey of both local and foreign bank officers at different managerial levels in Qatar. Out of a total of 150 questionnaires distributed, 73 useable responses were received resulting in a 48.7% response rate. Findings indicated that the belief among the respondents that in implementing quality control tools in general and six sigma in particular requires certain tools and techniques that are found to be unsuitable or are difficult

to be implemented in the banking industry of Qatar. Surprisingly, the findings of the survey confirm that there is hardly any difference among the different managerial levels in perceiving and evaluating the benefits and the successful factors of the quality control tools implementation in banking.

Gutiérrez, et..al, (2012) under title "***Six sigma, absorptive capacity and organizational learning orientation***".

The purpose of this paper is to extend understanding of the success of six sigma quality management initiatives by investigating the effects of six sigma teamwork and process management on absorptive capacity. It also seeks to understand the relation between absorptive capacity and organizational learning as two sources of sustainable competitive advantage. The information used comes from a larger study, the data for which was collected from a random sample of 237 European firms. Of these 237 organizations, 58 were six sigma organizations. Structural equation modelling (SEM) was used to test the hypotheses. The main findings show that six sigma teamwork and process management positively affect the development of absorptive capacity. A positive and significant relationship is also observed between absorptive capacity and organizational learning orientation. The findings of this study justify six sigma implementation in firms.

(2-5-2): Previous Studies in Lean Six Sigma

Shah, et..al, (2008) under title "***In pursuit of implementation patterns: the context of Lean and Six Sigma***".

Combining Lean practices with Six Sigma has gained immense popularity in recent years. Whether a combined Lean-Six Sigma approach is the latest management fad, or leads to significant performance benefits that exceed isolated implementation is not yet apparent. Using implementation and performance data from a sample of 2511 plants, the research study attempts to uncover associative and predictive pattern of implementation between 15 Lean practices and the Six Sigma program. The results indicate two major findings. First, implementation of any practice from a broader set of Lean practices improves the likelihood of implementing Six Sigma. Additionally, practices commonly bundled under quality management predict and distinguish the group of plants implementing Six Sigma extensively from non-implementers. Second, the regression results indicate a significant difference in the performance levels of the Six Sigma implementers group compared with the non-implementer group.

Näslund, (2008) under title "***Lean, six sigma and lean sigma: fads or real process improvement methods?***".

The purpose of this paper is to explore if six sigma and lean are new methods, or if they are repackaged versions of previously popular methods - total quality management (TQM) and just-in-time (JIT). The study is based on a critical comparison of lean with JIT and six sigma with TQM, a study of the measure of the publication frequency - the number of academic articles published every year of the previous 30 years - for each topic, and a review of critical success factors (CSF) for change efforts. The results showed the more recent concepts of lean and six sigma have mainly replaced - but not necessarily added to - the concepts of JIT and TQM. Lean and six sigma are essentially repackaged versions of the former, and the methods seem to follow the fad (product) life cycle. The literature offers fairly similar and rather general CSF for these methods.

Glasgow, et..al, (2010) under title "***Guiding inpatient quality improvement: a systematic review of Lean and Six Sigma***".

Two popular quality improvement (QI) approaches in health care are Lean and Six Sigma. Hospitals continue to adopt these QI approaches -- or the hybrid Lean Sigma approach -- with little knowledge on how well they produce sustainable improvements. A systematic literature review was conducted to determine whether Lean, Six Sigma, or Lean Sigma have been effectively used to create and sustain improvements in the acute care setting. Databases were searched for articles

published in the health care, business, and engineering literatures. Study inclusion criteria required identification of a Six Sigma, Lean, or Lean Sigma project; QI efforts focused on hospitalized patients; descriptions of project improvements; and reported results. Depending on the quality of data reported, articles were classified as summary reports, pre-post observational studies, or time-series reports. Results: Database searches identified 539 potential articles. After review of titles, abstracts, and full text, 47 articles met inclusion criteria -- 10 articles summarized multiple projects, 12 reported Lean projects, 20 reported Six Sigma projects, and 5 reported Lean Sigma projects. Generally, the studies provided limited data, with only 15 articles providing any sort of follow-up data; of the 15, only 3 report a follow-up period greater than two years. Conclusion: Lean, Six Sigma, and Lean Sigma as QI approaches can aid institutions in tackling a wide variety of problems encountered in acute care. However, the true impact of these approaches is difficult to judge, given that the lack of rigorous evaluation or clearly sustained improvements provides little evidence supporting broad adoption. There is still a need for future work that will improve the evidence base for understanding more about QI approaches and how to achieve sustainable improvement.

Fraser & Fraser, (2011) under title "***Lean Six Sigma applied to a Customer Services Process within a Commercial Finance Organization: An Empirical Case Study***".

This study explores the use of Lean Six Sigma methodologies and tools as applied to supply chains within a services environment. The approach taken was to examine a Lean Six Sigma project as run within a large American financial services conglomerate to understand how this has been applied. The project not only demonstrated the results achievable but also the business thinking presented some compelling findings. Although there are differences between the Lean and Six Sigma approaches as well as the difference between a manufacturing and services environment, there were also some key learning's demonstrated. Certainly some of the key issues uncovered is that clear objectives combined with accurately set parameters and data gathering aligned with stakeholder buy-in is key to the success of a project of this nature. The implications and strategy adopted by the services company are borne out with the results as outlined in this study and further supports the deployment of a carefully thought through Lean Six Sigma programmer within services supply chains.

Ray & John, (2011) under title "***Lean Six-Sigma application in business process outsourced organization*** ".

The purpose of this paper is to present a Lean Six-Sigma case study for reducing cycle time in a BPO operation and to demonstrate application of Lean Six-Sigma methodology in BPO and ITeS industries. Paper presents an application of Lean Six-Sigma methodology for cycle time reduction in BPO organizations. The findings were Lean Six-Sigma is found to work very well in BPO industries for reducing process cycle time by carrying out process changes. "Improve result by improving the process" - this motto of Six-Sigma is very well demonstrated by this approach of Lean Six-Sigma for BPO organizations.

Corbett, (2011) under title "***Lean Six Sigma: the contribution to business excellence*** ".

Proposes to examine how quality award-winning organizations have used lean Six Sigma to assist their efforts to improve their business excellence scores, through using a case study approach and using data collected by interviews and at public workshops. In addition, publicly available materials such as award applications were also examined. Two organizations were studied, one in New Zealand and one in the USA. The results show that lean Six Sigma can contribute strongly to each category of the business criteria for performance excellence. There was no evidence of compatibility problems between the lean and Six Sigma components.

Hilton & Sohal, (2012) under title "***A conceptual model for the successful deployment of Lean Six Sigma***".

Purpose to examine the relationship between the successful deployment of Lean Six Sigma and a number of key explanatory variables that essentially comprise the competence of the organization, the competence of the deployment facilitator and the competence of the project leaders. The preliminary fieldwork involved interviews with two senior Master Black Belts; then, combined with the results of a literature review, the authors develop a conceptual model. A number of hypotheses are developed and the procedures involved in empirically testing these hypotheses are briefly explained. The results showed the technical and interpersonal attributes of Black Belts and Master Black Belts are identified as well as the factors for success in deploying Lean Six Sigma. These factors relate to: leadership, communication, behavior and awareness of Six Sigma; policies, culture and organizational support and strategy; education, training and competency of the Six Sigma experts; project improvement teams and project management; and performance evaluations based on quality criteria, information systems, data and measurement.

Psychogios, et..al, (2012) under title "***Lean Six Sigma in a service context: A multi-factor application approach in the telecommunications industry***".

Its purpose is to investigate issues related to the application of Lean Six Sigma in a service industry. By adopting a case-study approach this paper analytically explores the critical success factors that affect Lean Six Sigma implementation. The study adopts a qualitative approach attempting to explore the nature of Lean Six Sigma application in a service context. In particular, two case studies from the telecommunications industry have been selected. Secondary data were collected through an analysis of companies' documents, written procedures and quality assurance policies. Moreover, primary data were collected through a number of interviews with managers and quality experts. The results showed there are particular factors that influence the implementation of Lean Six Sigma in organizations, that can be distinguished in facilitators like Top Management Involvement & Support, Quality-driven Organizational Culture, Quality-driven Training, Top Down & Bottom Up Project Selection, Customer Satisfaction, Prior implementation of other quality improvement programs and Supportive Performance Management & IT Systems, and inhibitors such as Lack of Awareness for L6σ, Lack of Awareness for the Need of Continuous Quality Improvement Programs & Lean Six Sigma, Lack of Strategic Orientation, Working Mentality & Habits.

Timans, et..al, (2012) under title "***Implementation of Lean Six Sigma in small- and medium-sized manufacturing enterprises in the Netherlands***".

The study provides an exploration and analysis of Lean Six Sigma (LSS) implementation in Dutch manufacturing/engineering small- and medium-sized enterprises (SMEs). Critical success factors (CSFs) and impeding factors are identified and analyzed. Exploratory empirical evidence about LSS implementation in Dutch SMEs was collected from a survey study on Dutch SMEs. Statistical testing was applied to validate the ranking of the CSFs. To deepen insight in how organizations translate CSFs into practice and cope with impeding factors, additional in-depth qualitative information was gathered from six case studies. Linking to customer, vision and plan statement, communication and management involvement and participation are the highest ranked CSFs. Internal resistance, the availability of resources, changing business focus and lack of leadership are the strongest impeding factors. The case studies confirmed the importance of the CSFs and revealed three new CSFs: personal LSS-experience of Top management, development of the project leader's soft skills and supply chain focus. SMEs in the Netherlands make no distinct separation between lean manufacturing and Six Sigma, but rather apply both approaches intertwined.

Alexandros, et..al, (2012) under title "***Towards an integrated framework for Lean Six Sigma application: Lessons from the airline industry***".

Aims to investigate the critical factors influencing the application of Lean Six Sigma in an airline company. Secondary data were collected through an analysis of company's written procedures and quality assurance policies. In addition, primary data were collected through a number of interviews with managers. Findings suggest that there are particular factors that influence the implementation of Lean Six Sigma such as leadership and strategic orientation, quality-driven organizational culture, continuous training, teamwork, customer satisfaction, and technical systems. This study supports the view that the above factors are not only significant for Lean Six Sigma application but, also, can be seen as useful investigation tools in their potential application.

Manville, et..al, (2012) under title "***Critical success factors for Lean Six Sigma programmes: a view from middle management***".

The purpose of this paper is to evaluate lean six sigma from a middle managers' perspective. A mixed method approach was adopted involving a structured survey to 200 managers and semi-structured interviews with two of the management team. The paper highlights the importance of developing learning capabilities in the middle management team and the empowering of them. A greater role should be given to middle management in performance improvement and strategy formulation.

Assarlind, et..al, (2012) under title "***Multi-faceted views on a Lean Six Sigma application***".

The purpose of this paper is to explore an application of Lean Six Sigma in practical improvement work. The empirical study was conducted through interviews, meetings, document analysis and observations over a period of four months. Based on this paper, it seems unfeasible to apply one standardized approach to improvements in one company. Continuous smaller improvements and larger improvement projects demand different formulas. It seems that using both Lean and Six Sigma in parallel is appropriate but this should be done through clever cross-fertilization. This paper shows one possible way of working with one improvement concept in one company. It does not claim to present the only possible way of combining Lean and Six Sigma nor does it suggest universal applicability.

(2-6): Study Contribution to knowledge

After reading and through examining previous studies that related to the subject of this study, which can be achieved by the researcher, the researcher found that the most important characteristics that distinguish this study from the other pervious studies can be stated in the fact the other previous studies were Six Sigma & Lean Six Sigma not rely on a clear principles and standards to measure Lean Six Sigma. However, this study measure Lean Six Sigma depends on (Psychogios, et..al, 2012).

CHAPTER THREE
Method and Procedures

(3-1): Introduction

(3-2): Study Methodology

(3-3): Study Population and Sample

(3-4): Demographic Variables to Study Sample

(3-5): Study Tools and Data Collection

(3-6): Statistical Treatment

(3-7): Validity and Reliability

(3-1): Introduction

In this chapter the researcher will describe in detail the methodology used in this study, and the study population and its sample.

Next, the researcher will design the study model and explain the study tools and the way of data collections. After that he will discuss the statistical treatment that is used in analysis of the collected data.

In the final section the validation of the questionnaire and the reliability analysis that is applied will be clearly stated.

(3-2): Study Methodology

Descriptive research involves collecting data in order to test hypotheses or to answer questions concerned with the current status of the subject of the study. Typical descriptive studies are concerned with the assessment of attitudes, opinions, demographic information, conditions, and procedures. The research design chosen for the study is the survey research. The survey is an attempt to collect data from members of a population in order to determine the current status of that population with respect to one or more variables .The survey research of knowledge at its best can provide very valuable data. It involves a careful design and execution of each of the components of the research process.

The researcher designed a survey instrument that could be administrated to selected subjects. The purpose of the survey instrument was to collect data about the respondents on lean six sigma.

(3-3): Study Population and Sample

To increase credibility, it is important to choose the sample that will represent the population under investigation. The populations of the study are the admitted patient's entre AL-Mowasah Hospital at year 2012, and all Employers staff working in AL-Mowasah Hospital. On the other hand, the researcher chooses a random sample consists of (150) patient's, eemployers' staff working in AL-Mowasah Hospital consists of (60).

After distributing (150) questionnaires for patient's, a total of (133) answered questionnaires were retrieved, of which (30) were invalid, Therefore, (103) answered questionnaires were valid for study. Whereas, the researcher distributing (60) questionnaires for employers' staff working in AL-Mowasah Hospital, a total of (49) answered questionnaires were retrieved, of which (15) were invalid, Therefore, (34) answered questionnaires were valid for study.

(3-4): Demographic Variables of the Study Sample

Table (3-1) and (3-2) shows the demographic variables of the study sample.

Table (3-1)

Descriptive sample of the demographic variables of the study from employers' staff working in AL-Mowasah Hospital

No.	Variables	Categorization	Frequency	Percent
1	Age	30 years or less	18	52.9
		From 31 – 40 Years	7	20.6
		From 41 – 50 years	6	17.6
		51 Years More	3	8.8
Total			34	100%
2	Gender	Male	21	61.8
		Female	13	38.2
Total			34	100%
3	Educational Level	BSc or less	25	73.5
		High Diploma	2	5.9
		Master	4	11.8
		PhD	3	8.8
Total			34	100%
4	Experience	5 Years or Less	10	29.4
		From 6 – 10 Years	6	17.6
		From 11 – 15 years	9	26.5
		16 Years More	9	26.5
Total			34	100%
5	Years of Service	5 Years or Less	14	41.2
		From 6 – 10 Years	11	32.4
		From 11 – 15 years	2	5.9
		16 Years More	7	20.6
Total			34	100%
6	Specialty Job	Managerial	15	44.1
		Medical	19	55.9
Total			34	100%

Table (3-1) the results of descriptive analysis of demographic variables of respondent members of the study sample. The table shows that the (52.9%) of the sample ranged (30) years or less. This indicates that the focus will be on the element of youth and new blood. On the other side the (61.8%) of the study sample is male and (38.2%) is Female. The educational level; all members of the study sample have a scientific qualification which is a good sign in adopting the high educational qualifications to accomplish the work in the health Sector.

Descriptive analysis for the experience of 5 years or less (29.4%), and experience from 6 -10 years (17.6%), from 11-15 years (26.5%), finally above 16 more (26.5%). At the same time Years of experience of the member's respondent from the study sample that the 5 years or less (41.2%), and experience from 6 -10 years (32.4%), from 11-15 years (5.9%), finally above 16 more (20.6%).

Finally, the analysis of the Specialty Job represents that the (44.1%) from the sample of the study are Managerial and (55.9%) are Medical.

Table (3-2)

Descriptive sample of the demographic variables of the study from patients

No.	Variables	Categorization	Frequency	Percent
1	Age	30 years or less	45	43.7
		From 31 – 40 Years	30	29.1
		From 41 – 50 years	21	20.4
		51 Years More	7	6.8
Total			103	100%
2	Gender	Male	53	51.5
		Female	50	48.5
Total			103	100%
3	Educate Level	BSc or less	71	68.9
		High Diploma	30	29.1
		Master	1	1
		PhD	1	1
Total			103	100%
4	Experience	5 Years or Less	42	40.8
		From 6 – 10 Years	34	33
		From 11 – 15 years	17	16.5
		16 Years More	10	9.7
Total			103	100%
5	Monthly income	200 or less	25	24.3
		From 200 – 400 Dinar	53	51.5
		From 400 – 600 Dinar	18	17.5
		600 and More Dinar	7	6.8
Total			103	100%

Table (3-2) the results of descriptive analysis of demographic variables of respondent members of the study sample. The table shows that the (93.2%) of the sample ranged below (51) years. On the other side the (51.5%) of the study sample is male and (48.5%) is Female. The educational level; all members of the study

sample have a scientific qualification which is a good sign in adopting the high educational qualifications to accomplish their work.

Descriptive analysis for the Years of experience of the member's respondent from the study sample. The table shows that the experience of 5 years or less (40.8%), and experience from 6 -10 years (33%), from 11-15 years (16.5%), finally above 16 more (9.7%).

Finally, the analysis of the Monthly income represents that the (24.3%) from the sample of the study the monthly income range (200 or less) and (51.5%) the monthly income range (200 – 400 Dinar), (17.5%) the monthly income range (400 – 600 Dinar) and (6.8%) the monthly income range (600 and More Dinar)

(3-5): Study Tools and Data Collection

The current study is two fold, theoretical and practical. In the theoretical side, the researcher relied on the scientific studies that are related to the current study. Whereas in the practical side, the researcher relied on descriptive and analytical methods using the practical manner to collect, analyze data and test hypotheses.

The data collection, manners analysis and programs used in the current study are based on two sources:

1. Secondary sources: books, journals, theses to write the theoretical framework of the study.

2. Primary source: questionnaires that was designed to reflect the study objectives and questions.

In this study, both primary and secondary data were used. The data collected for the model were through questionnaire. After conducting a thorough review of the literature pertaining to business Intelligence, Decision Support and Quality of Decision Making, the researcher formulated the questionnaire instrument for this study.

The ***first questionnaire*** (employers' staff working in AL-Mowasah Hospital) instrumental sections are as follows:

Section One: ***Demographic variables***. The demographic information was collected with closed-ended questions, through (6) factors (Age; Gender; Education level; Experience; Years of Service and Specialty Job)

Section Two: ***Lean Six Sigma***. This section measured the Lean Six Sigma through (5) dimensions (Top management involvement and support; Quality-driven organizational culture; Customer involvement; Process management & implementation of other quality improvement programs) and (32) items (6) for each three first dimensions, (8) for Process management and (6) for implementation of other quality improvement programs on a Likert-type scale as follows:

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

The ***Second questionnaire*** (patients) instrumental sections are as follows:

Section One: ***Demographic variables***. The demographic information was collected with closed-ended questions, through (5) factors (Age; Gender; Education level; Experience; monthly income)

Section Two: ***Patients satisfaction for AL-Mowasah Hospital services***. This section measured the Patients satisfaction for AL-Mowasah Hospital services through (3) dimensions (Room services; Interpersonal skills & Technical quality) and (20) items (5) for Room services, (10) for Interpersonal and (5) for Technical quality on a Likert-type scale as follows:

Very Good	Good	Fair	Poor	Very Poor
5	4	3	2	1

(3-6): Statistical Treatment

The data collected from the responses of the study questionnaire were used through *Statistical Package for Social Sciences* (*SPSS*) & Amos for analysis and conclusions. Finally, the researcher used the suitable statistical methods that consist of:

- *Percentage and Frequency*.
- *Cronbach Alpha reliability* (α) to measure strength of the correlation and coherence between questionnaire items.
- *Arithmetic Mean* to identify the level of response study sample individuals to the study variables.

- *Standard Deviation* to Measure the responses spacing degree about Arithmetic Mean.
- *One sample t-test.*
- Simple Regression analysis to Measure the impact of study variables on testing the direct effects.
- Chi^2 to test the different between employees and admitted patients in AL-Mowasah Hospital about Application Lean Six Sigma Principles.
- Relative commitment and satisfaction, assigning due to:

$$\text{Class Interval} = \frac{\text{Maximum Class} - \text{Minimum Class}}{\text{Number of Level}}$$

$$\text{Class Interval} = \frac{5-1}{3} = \frac{4}{3} = 1.33$$

The Low degree from 1- less than 2.33

The Medium degree from 2.33 – 3.66

The High degree from 3.67 and above.

(3-7): Validity and Reliability

(3-7-1): Validation

To test the questionnaire for clarity and to provide a coherent research questionnaire, a macro review that covers all the research constructs was accurately performed by academic reviewers from Middle East University specialized in Business Administration, Marketing, and information system. Some items were added, based on their valuable recommendations. Some others were reformulated to become more accurate and that is expected therefore to enhance the research instrument. The academic reviewers are (5) and the overall percentage of respond is (100%), (see appendix "2").

(3-7-2): Study Tool Reliability

The reliability analysis applied to the level of Cronbach Alpha (α) is the criteria of internal consistency which was at a minimum acceptable level (Alpha ≥ 0.60) suggested by (Sekaran, 2003).

These results are the acceptable levels as suggested by (Sekaran, 2003). The results were shown in Table (3-3).

Table (3-3)

Reliability of Questionnaire Dimensions

No.	*Dimensions*	*Alpha Value (α)*
1	Lean Six Sigma	0.919
1 - 1	Top management involvement and support	0.877
1 - 2	Quality-driven organizational culture	0.820
1 - 3	Customer involvement	0.819
1 - 4	Process management	0.761
1 - 5	implementation other quality improvement	0.763
2	Admitted patient's satisfaction	0.882
2 - 1	Room services	0.727
2 - 2	Interpersonal skills	0.799
2 - 3	Technical quality	0.783

CHAPTER FOUR

Analysis Results & Hypotheses Test

(4-1): Introduction

(4-2): Descriptive analysis of study variables

(4-3): Study Hypotheses Test

(4-1): Introduction

According to the purpose of the research and the research framework presented in the previous chapter, this chapter describes the results of the statistical analysis for the data collected according to the research questions and research hypotheses. The data analysis includes a description of the Means and Standard Deviations for the questions of the study; one sample t-test and Multi, Simple Linear Regression analysis used.

(4-2): Descriptive analysis of study variables

(4-2-1): *Lean Six Sigma (Top management involvement and support)*

The researcher used the arithmetic mean, standard deviation, item importance and application level as shown in Table (4-1).

Table (4-1)

Arithmetic mean, SD, item importance and application level of Top management involvement and support

No.	Top management involvement and support	Mean	standard deviation	Item importance	application level
1	Our hospital top management (i.e. top executives and major department heads) assumes responsibility for quality performance	3.88	0.69	1	High
2	Our hospital top management provides personal leadership for quality service and quality improvement.	3.50	0.99	2	Medium
3	Our hospital top management is evaluated for quality performance.	3.26	0.90	4	Medium
4	Major department heads within our hospital participate in the quality improvement process	2.85	1.33	6	Medium
5	Quality issues are reviewed in our hospital management meetings	3.44	0.93	3	Medium
6	Our hospital top management has objectives for quality performance	3.18	1.19	5	Medium
General Arithmetic mean and standard deviation		3.35	1.00		

Table (4-1) Clarifies the application level of Top management involvement and support, where the arithmetic means range between (2.85 - 3.88) compared with General Arithmetic mean amount of (3.35). We observe that the highest mean for the item "***Our hospital top management (i.e. top executives and major department heads) assumes responsibility for quality performance***" with arithmetic mean (3.88), Standard deviation (0.69). The lowest arithmetic mean was for the item "***Major department heads within our hospital participate in the quality improvement process***" With Average (2.85) and Standard deviation

(1.33). In general, it appears that the application level of Top management involvement and support in AL-Mowasah Hospital under study from the study sample viewpoint was Medium.

(4-2-2): *Lean Six Sigma (Quality-driven organizational culture)*

The researcher used the arithmetic mean, standard deviation, item importance and application level as shown in Table (4-2).

Table (4-2)

Arithmetic mean, SD, item importance and application level of Quality-driven organizational culture

No.	Quality-driven organizational culture	Mean	standard deviation	Item importance	application level
7	Quality data (error rates, defect rates, scrap, defects, cost of quality, etc.) are available in our hospital.	2.82	0.80	5	Medium
8	Quality data are available to managers, supervisors, and other employee	3.41	1.05	1	Medium
9	Quality data are available to hourly/nonsupervisory workers	2.59	0.92	6	Medium
10	Quality data are timely	2.94	1.10	4	Medium
11	Quality data are used as tools to manage quality	3.15	0.89	2	Medium
12	Quality data are used to evaluate supervisory and managerial performance	3.15	0.99	2	Medium
General Arithmetic mean and standard deviation		3.01	0.96		

Table (4-2) clarifies the application level of Quality-driven organizational culture, where the arithmetic means range between (2.59 - 3.41) compared with General Arithmetic mean amount of (3.01). We observe that the highest mean for the item "***Quality data are available to managers, supervisors, and other employee***" with arithmetic mean (3.41), Standard deviation (1.05). The lowest arithmetic mean was for the item "***Quality data are available to hourly/nonsupervisory workers***" With Average (2.59) and Standard deviation (0.92). In general, it appears that the application level of Quality-driven organizational culture in AL-Mowasah Hospital under study from the study sample viewpoint was Medium.

(4-2-3): *Lean Six Sigma (Customer involvement)*

The researcher used the arithmetic mean, standard deviation, item importance and application level as shown in Table (4-3).

Table (4-3)

Arithmetic mean, SD, item importance and application level of Customer involvement

No.	Customer involvement	Mean	standard deviation	Item importance	application level
13	We frequently are in close contact with our customers	3.76	0.85	1	High
14	Our customers seldom visit our hospital	3.62	0.82	3	Medium
15	Our customers give us feedback on quality and delivery performance	3.65	1.01	2	Medium
16	Our customers are actively and directly involved in current and future service offerings	3.12	1.23	5	Medium
17	Our customers frequently share current and future demand information with hospital departments	3.38	1.30	4	Medium
18	We regularly conduct customer satisfaction survey	2.82	1.40	6	Medium
General Arithmetic mean and standard deviation		3.39	1.10		

Table (4-3) clarifies the application level of Customer involvement, where the arithmetic means range between (2.82 - 3.76) compared with General Arithmetic mean amount of (3.39). We observe that the highest mean for the item "***We frequently are in close contact with our customers***" with arithmetic mean (3.76), Standard deviation (0.85). The lowest arithmetic mean was for the item "***We regularly conduct customer satisfaction survey***" With Average (2.82) and Standard deviation (1.40). In general, it appears that the application level of Customer involvement in AL-Mowasah Hospital under study from the study sample viewpoint was Medium.

(4-2-4): *Lean Six Sigma (Process management)*

The researcher used the arithmetic mean, standard deviation, item importance and application level as shown in Table (4-4).

Table (4-4)

Arithmetic mean, SD, item importance and application level of Process management

No.	Process management	Mean	standard deviation	Item importance	application level
19	Processes in our hospital are designed to be ‘‘mistake-proof’’ to minimize the chances of errors	3.00	1.13	6	Medium
20	We dedicate a portion of everyday solely to maintenance	2.82	1.29	8	Medium
21	We usually meet the service schedule everyday	2.88	1.04	7	Medium
22	Our hospital conducts preventive equipment maintenance	3.68	0.91	1	High
23	Clear work or process instructions are given to employees	3.35	1.20	3	Medium
24	Our hospital floors are well organized and clean	3.65	1.23	2	Medium
25	A large number of the equipment or processes on the hospital floor are currently under statistical process control.	3.21	0.81	5	Medium
26	We make extensive use of statistical techniques to reduce variance in processes	3.26	1.11	4	Medium
General Arithmetic mean and standard deviation		3.23	1.09		

Table (4-3) clarifies the application level of Process management, where the arithmetic means range between (2.82 - 3.68) compared with General Arithmetic mean amount of (3.23). We observe that the highest mean for the item "***Our***

hospital conducts preventive equipment maintenance" with arithmetic mean (3.68), Standard deviation (0.91). The lowest arithmetic mean was for the item "***We dedicate a portion of everyday solely to maintenance***" With Average (2.82) and Standard deviation (1.29). In general, it appears that the application level of Process management in AL-Mowasah Hospital under study from the study sample viewpoint was Medium.

(4-2-5): *Lean Six Sigma (implementation of other quality improvement programs)*

The researcher used the arithmetic mean, standard deviation, item importance and application level as shown in Table (4-5).

Table (4-5)

Arithmetic mean, SD, item importance and application level of implementation of other quality improvement programs

No.	implementation of other quality improvement programs	Mean	standard deviation	Item importance	application level
27	In our hospital, continuous improvement projects are conducted by following a formalized procedure (such as DMAIC—Define, Measure, Analyze, Improve and Control).	2.56	0.79	5	Medium
28	We use a structured approach to manage quality improvement activities	2.74	0.93	4	Medium
29	We have a formal planning process to decide the major quality improvement projects	3.15	0.78	1	Medium
30	All improvement projects are reviewed regularly during the process	3.12	0.91	2	Medium
31	We keep records about how each continuous improvement project is conducted	3.03	1.06	3	Medium
32	In our hospital, the service design process follows a formalized procedure	2.09	0.97	6	Medium
General Arithmetic mean and standard deviation		2.78	0.91		

Table (4-5) clarifies the application level of implementation of other quality improvement programs, where the arithmetic means range between (2.09 - 3.15) compared with General Arithmetic mean amount of (2.78). We observe that the highest mean for the item "***We have a formal planning process to decide the major quality improvement projects***" with arithmetic mean (3.15), Standard deviation (0.78). The lowest arithmetic mean was for the item "***In our hospital, the service design process follows a formalized procedure***" With Average (2.09)

and Standard deviation (0.97). In general, it appears that the application level of implementation of other quality improvement programs in AL-Mowasah Hospital under study from the study sample viewpoint was Medium.

(4-2-6): *Patient's satisfaction for AL-Mowasah Hospital services (Room services)*

The researcher used the arithmetic mean, standard deviation, item importance and satisfaction level as shown in Table (4-6).

Table (4-6)

Arithmetic mean, SD, item importance and level of Room services satisfaction

No.	Room services satisfaction	Mean	standard deviation	Item importance	satisfaction level
1	The level of cleanliness and overall condition of the toilets, showers, and floors of the hospital is	3.70	1.00	3	High
2	Level of the safety of your hospital room is	3.69	0.83	4	High
3	Level of satisfaction with meals that were provided is	3.62	0.84	5	Medium
4	Level of comfort in sleeping in your room is	3.83	0.82	1	High
5	Level of satisfaction with your hospital room is	3.73	0.77	2	High
General Arithmetic mean and standard deviation		3.71	0.85		

Table (4-6) clarifies the satisfaction level of Room services, where the arithmetic means range between (3.62 - 3.83) compared with General Arithmetic

mean amount of (3.71). We observe that the highest mean for the item "***Level of comfort in sleeping in your room is***" with arithmetic mean (3.83), Standard deviation (0.82). The lowest arithmetic mean was for the item "***Level of satisfaction with meals that were provided is***" With Average (3.62) and Standard deviation (0.84). In general, it appears that the satisfaction level of Room services in AL-Mowasah Hospital under study from the study sample viewpoint was high.

(4-2-7): *Patient's satisfaction for AL-Mowasah Hospital services (Interpersonal skills)*

The researcher used the arithmetic mean, standard deviation, item importance and satisfaction level as shown in Table (4-7).

Table (4-7)

Arithmetic mean, SD, item importance and level of Interpersonal skills satisfaction

No.	Interpersonal skills satisfaction	Mean	standard deviation	Item importance	satisfaction level
6	The level of communication between your self and doctors are	3.73	0.84	6	High
7	The level of communication between your self and nursing staff are	3.87	0.89	1	High
8	Nursing staff answers to your questions	3.83	0.98	3	High
9	Nursing staff effort to make your visit comfortable and pleasant	3.69	1.00	7	High
10	Friendliness and courtesy shown to you by nurses	3.63	0.91	9	Medium
11	The medical staff who treat you give you respect	3.77	0.87	4	High
12	The confidence and trust in medical staff Treating you	3.85	0.88	2	High
13	Doctors usually spend plenty of time with you	3.58	0.90	10	Medium
14	The receptionist explain things quietly	3.75	0.83	5	High
15	The medical knowledge of physician staff at this hospital	3.69	0.87	7	High
General Arithmetic mean and standard deviation		3.74	0.90		

Table (4-7) clarifies the satisfaction level of Interpersonal skills, where the arithmetic means range between (3.58 - 3.87) compared with General Arithmetic mean amount of (3.74). We observe that the highest mean for the item "***The level of communication between your self and nursing staff are***" with arithmetic mean (3.87), Standard deviation (0.89). The lowest arithmetic mean was for the

item "***Doctors usually spend plenty of time with you***" With Average (3.58) and Standard deviation (0.90). In general, it appears that the satisfaction level of Interpersonal skills in AL-Mowasah Hospital under study from the study sample viewpoint was high.

(4-2-8): *Patient's satisfaction for AL-Mowasah Hospital services (Technical quality)*

The researcher used the arithmetic mean, standard deviation, item importance and satisfaction level as shown in Table (4-8).

Table (4-8)

Arithmetic mean, SD, item importance and level of Technical quality satisfaction

No.	Technical quality satisfaction	Mean	standard deviation	Item importance	satisfaction level
16	The medical knowledge of nursing staff at this hospital	3.61	0.88	4	Medium
17	Training, skill and experience of the nursing staff	3.76	0.94	2	High
18	Doctor advice you about ways to avoid illness and stay healthy	3.59	0.91	5	Medium
19	Doctors are good about explaining the reason of medical tests	3.78	0.90	1	High
20	Quality of treatment you receive	3.67	0.88	3	High
General Arithmetic mean and standard deviation		3.68	0.90		

Table (4-8) clarifies the satisfaction level of Technical quality, where the arithmetic means range between (3.59 - 3.78) compared with General Arithmetic

mean amount of (3.68). We observe that the highest mean for the item "***Doctors are good about explaining the reason of medical tests***" with arithmetic mean (3.78), Standard deviation (0.90). The lowest arithmetic mean was for the item "***Doctor advice you about ways to avoid illness and stay healthy***" With Average (3.59) and Standard deviation (0.91). In general, it appears that the satisfaction level of Technical quality in AL-Mowasah Hospital under study from the study sample viewpoint was high.

(4-2-9): *General satisfaction for AL-Mowasah Hospital services*

The researcher used the arithmetic mean, standard deviation, item importance and satisfaction level as shown in Table (4-9).

Table (4-9)

Arithmetic mean, SD, item importance and level of General satisfaction

No.	General satisfaction	Mean	standard deviation	Item importance	satisfaction level
21	Attention by the medical and administrative staff at AL-Mowasah Hospital	3.62	0.84	3	Medium
22	Accuracy of the information given for you about your Health status	3.50	0.81	5	Medium
23	Interest in your condition and your Health status	3.54	0.84	4	Medium
24	Actions taken toward your Health status	3.83	0.66	2	High
25	Ease of access and inquire about all the reports on your condition of your Health status	3.85	0.87	1	High
General Arithmetic mean and standard deviation		3.67	0.81		

Table (4-9) clarifies the level of General satisfaction, where the arithmetic means range between (3.50 - 3.85) compared with General Arithmetic mean amount of (3.67). We observe that the highest mean for the item "***Ease of access and inquire about all the reports on your condition of your Health status***" with arithmetic mean (3.85), Standard deviation (0.87). The lowest arithmetic mean was for the item "***Accuracy of the information given for you about your Health status***" With Average (3.50) and Standard deviation (0.81). In general, it appears that the General satisfaction level in AL-Mowasah Hospital under study from the study sample viewpoint was high.

(4-3): Study Hypotheses Test

The researcher in this part tested the main hypotheses, through one sample t-test, Simple multi, linear Regression analysis with (F) test using ANOVA table and path analysis as follows:

Ho_1: AL-Mowasah Hospital is committed to Application Lean Six Sigma Principles (***Top management involvement and support; Quality-driven organizational culture; Customer involvement; Process management & implementation of other quality improvement programs***) to patient satisfaction at level ($\alpha \leq 0.05$).

To test this hypothesis the researcher uses the one sample t-test to ensure the AL-Mowasah Hospital committed to Application Lean Six Sigma Principles. As shown in Table (4-10).

Table (4-10)

One sample t-test to ensure the AL-Mowasah Hospital committed to Application Lean Six Sigma Principles

	Mean	S.D	T	DF	Sig*
Application Lean Six Sigma Principales	3.15	1.01	16.358	33	0.000

From table (4-10) the researcher observes that AL-Mowasah Hospital is committed to Application Lean Six Sigma Principles. The ***T*** was (16.358) at level ($\alpha \leq 0.05$). and that confirms valid first hypotheses, and accepted hypothesis:

AL-Mowasah Hospital is committed to Application Lean Six Sigma Principles at level ($\alpha \leq 0.05$).

To ensure the AL-Mowasah Hospital is committed to Application each Lean Six Sigma Principles. The researcher divides this hypothesis into five sub-hypotheses, and uses the one sample t-test to test each sub-hypothesis, as a follows:

$Ho_{1\text{-}1}$: AL-Mowasah Hospital is committed to Top management involvement and support at level ($\alpha \leq 0.05$).

To test this hypothesis the researcher uses the one sample t-test to ensure the AL-Mowasah Hospital committed to top management involvement and support. As shown in Table (4-11).

Table (4-11)

One sample t-test to ensure the AL-Mowasah Hospital committed to top management involvement and support

	Mean	S.D	T	DF	Sig*
Top management involvement and support	3.35	1	2.550	33	0.016

From table (4-11) the researcher observes that AL-Mowasah Hospital is committed to top management involvement and support. The ***T*** was (2.550) at level ($\alpha \leq 0.05$). and that confirms valid sub-first hypotheses, and accepted hypothesis:

AL-Mowasah Hospital committed to top management involvement and support at level ($\alpha \leq 0.05$).

$Ho_{1\text{-}2}$: AL-Mowasah Hospital committed to Quality-driven organizational culture at level ($\alpha \leq 0.05$).

To test this hypothesis the researcher uses the one sample t-test to ensure the AL-Mowasah Hospital committed to Quality-driven organizational culture. As shown in Table (4-12).

Table (4-12)

One sample t-test to ensure the AL-Mowasah Hospital committed to Quality-driven organizational culture

	Mean	S.D	T	DF	Sig*
Top management involvement and support	3.01	0.96	2.271	33	0.000

From table (4-12) the researcher observes that AL-Mowasah Hospital is committed to Quality-driven organizational culture. The ***T*** was (2.271) at level ($\alpha \leq 0.05$). And that confirms valid sub-second hypotheses, and accepted hypothesis:

AL-Mowasah Hospital committed to Quality-driven organizational culture at level ($\alpha \leq 0.05$).

$Ho_{1\text{-}3}$: AL-Mowasah Hospital committed to Customer involvement at level ($\alpha \leq 0.05$).

To test this hypothesis the researcher uses the one sample t-test to ensure the AL-Mowasah Hospital committed to Customer involvement. As shown in Table (4-13).

Table (4-13)

One sample t-test to ensure the AL-Mowasah Hospital committed to Customer involvement

	Mean	S.D	T	DF	Sig*
Customer involvement	3.39	1.1	2.808	33	0.008

From table (4-13) the researcher observes that AL-Mowasah Hospital is committed to Customer involvement. The ***T*** was (2.808) at level ($\alpha \leq 0.05$). And that confirms valid sub-third hypotheses, and accepted hypothesis:

AL-Mowasah Hospital committed to Customer involvement at level ($\alpha \leq 0.05$).

$Ho_{1-4:}$ AL-Mowasah Hospital committed to Process management at level ($\alpha \leq 0.05$).

To test this hypothesis the researcher uses the one sample t-test to ensure the AL-Mowasah Hospital committed to Process management, as shown in Table (4-14).

Table (4-14)

One sample t-test to ensure the AL-Mowasah Hospital committed to Process management

	Mean	S.D	T	DF	Sig*
Process management	3.23	1.09	2.254	33	0.031

From table (4-14) the researcher observes that AL-Mowasah Hospital is committed to Process management. The ***T*** was (2.254) at level ($\alpha \leq 0.05$). And that confirms valid sub-fourth hypotheses, and accepted hypothesis:

AL-Mowasah Hospital committed to Process management at level ($\alpha \leq 0.05$).

$Ho_{1\text{-}5}$: AL-Mowasah Hospital committed to implementation of other quality improvement programs at level ($\alpha \leq 0.05$).

To test this hypothesis the researcher uses the one sample t-test to ensure the AL-Mowasah Hospital committed to implementation of other quality improvement programs. As shown in Table (4-15).

Table (4-15)

One sample t-test to ensure the AL-Mowasah Hospital committed to implementation of other quality improvement programs

	Mean	S.D	T	DF	Sig*
implementation of other quality improvement programs	2.78	0.91	2.087	33	0.045

From table (4-15) the researcher observes that there is committed from AL-Mowasah Hospital committed to implementation of other quality improvement programs. The ***T*** was (2.087) at level ($\alpha \leq 0.05$). And that confirms valid sub-fifth hypotheses, and accepted hypothesis:

AL-Mowasah Hospital committed to implementation of other quality improvement programs at level ($\alpha \leq 0.05$).

Ho_2: There is a positive impact of Lean Six Sigma Principles (***Top management involvement and support; Quality-driven organizational culture; Customer involvement; Process management & implementation of other quality improvement programs***) on admitted patient's satisfaction in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

To test this hypothesis, the researcher uses the multiple regression analysis to ensure the impact of Lean Six Sigma Principles on admitted patient's satisfaction in AL-Mowasah Hospital, as shown in Table (4-16).

Table (4-16)

Multiple regression analysis test results of the impact of Lean Six Sigma Principles on admitted patient's satisfaction in AL-Mowasah Hospital

	(R)	(R^2)	F Calculate	DF	Sig*	β		T Calculate	Sig*
admitted patient's satisfaction	0.573	0.328	25.738	5	0.000	Top management involvement and support	0.145	3.930	0.000
				28		Quality-driven organizational culture	0.305	5.452	0.000
						Customer involvement	0.189	3.508	0.001
						Process management	0.141	3.575	0.001
				33		implementation of other quality improvement programs	0.342	6.357	0.000

* the impact is significant at level ($\alpha \leq 0.05$)

From table (4-16) we observe that there is a significant impact of Lean Six Sigma Principles on admitted patient's satisfaction in AL-Mowasah Hospital. The ***R*** was (0.573) at level ($\alpha \leq 0.05$). Whereas the R^2 was (0.328). This means the (0.328) of admitted patient's satisfaction in AL-Mowasah Hospital changeability's results from the changeability in Lean Six Sigma Principles. As ***β*** was (Top management involvement and support = 0.145; Quality-driven organizational culture = 0.305; Customer involvement = 0.189; Process management = 0.141 and implementation of other quality improvement programs = 0.342) this means the increase of one unit in admitted patient's satisfaction in AL-Mowasah Hospital

concerned will increase Lean Six Sigma Principles value (Top management involvement and support = 0.145; Quality-driven organizational culture = 0.305; Customer involvement = 0.189; Process management = 0.141 and implementation of other quality improvement programs = 0.342). Confirms significant impact F calculate was (25.738) and its significance at level ($\alpha \leq 0.05$), and that confirms valid second main hypothesis, accepted hypothesis:

There is a positive impact of Lean Six Sigma Principles (Top management involvement and support; Quality-driven organizational culture; Customer involvement; Process management & implementation of other quality improvement programs) on admitted patient's satisfaction in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

To ensure the impact of Application each Lean Six Sigma Principles on admitted patient's satisfaction in AL-Mowasah Hospital. The researcher divides this hypothesis into five sub hypotheses, and uses the simple regression analysis to test each sub-hypothesis, as a follows:

$Ho_{2\text{-}1}$: There is a positive impact of Top management involvement and support on admitted patient's satisfaction in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

To test this hypothesis, the researcher uses the simple regression analysis to ensure the impact of Top management involvement and support on admitted patient's satisfaction in AL-Mowasah Hospital. As shown in Table (4-17).

Table (4-17) Simple Regression Analysis test results of the impact of Top management involvement and support on admitted patient's satisfaction in AL-Mowasah Hospital Amman

	(R)	(R^2)	F Calculate	Sig*	β	T Calculate	Sig*
Admitted patient's satisfaction	0.687	0.473	54.654	0.000	0.468	7.393	0.000

* the impact is significant at level ($\alpha \leq 0.05$)

From table (4-17) the researcher observes that there is a significant impact of Top management involvement and support on admitted patient's satisfaction in AL-Mowasah Hospital. The ***R*** was (0.687) at level ($\alpha \leq 0.05$), whereas the R^2 was (0.473). This means the (0.473) of admitted patient's satisfaction in AL-Mowasah Hospital Amman changeability's results from the changeability in Top management involvement and support. As ***β*** was (0.468) this means the increase of one unit in Top management involvement and support will increase admitted patient's satisfaction in AL-Mowasah Hospital value (0.468). Confirms significant impact F Calculate was (54.654) and it's significance at level ($\alpha \leq 0.05$), and that confirms valid sub-first hypotheses, and accepted hypothesis:

There is a positive impact of Top management involvement and support on admitted patient's satisfaction in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

Ho2-2: There is a positive impact of Quality-driven organizational culture on admitted patient's satisfaction in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

To test this hypothesis, the researcher uses the simple regression analysis to ensure the impact of Quality-driven organizational culture on admitted patient's satisfaction in AL-Mowasah Hospital, as shown in Table (4-18).

Table (4-18) Simple Regression Analysis test results of the impact of Quality-driven organizational culture on admitted patient's satisfaction in AL-Mowasah Hospital Amman

	(R)	(R^2)	F Calculate	Sig*	β	T Calculate	Sig*
Admitted patient's satisfaction	0.526	0.277	23.328	0.000	0.553	4.830	0.000

* the impact is significant at level ($\alpha \leq 0.05$)

From table (4-18) the researcher observes that there is a significant impact of Quality-driven organizational culture on admitted patient's satisfaction in AL-Mowasah Hospital. The ***R*** was (0.526) at level ($\alpha \leq 0.05$), whereas the R^2 was (0.277). This means the (0.277) of admitted patient's satisfaction in AL-Mowasah Hospital Amman changeability's results from the changeability in Quality-driven organizational culture. As ***β*** was (0.553) this means the increase of one unit in Quality-driven organizational culture will increase admitted patient's satisfaction in AL-Mowasah Hospital value (0.553). Confirms significant impact F Calculate

was (23.328) and its significance at level ($\alpha \leq 0.05$), and that confirms valid sub-second hypotheses, and accepted hypothesis:

There is a positive impact of Quality-driven organizational culture on admitted patient's satisfaction in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

$Ho_{2\text{-}3}$: There is a positive impact of Customer involvement on admitted patient's satisfaction in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

To test this hypothesis, the researcher uses the simple regression analysis to ensure the impact of Customer involvement on admitted patient's satisfaction in AL-Mowasah Hospital. As shown in Table (4-19).

Table (4-19) Simple Regression Analysis test results of the impact of Customer involvement on admitted patient's satisfaction in AL-Mowasah Hospital Amman

	(R)	(R^2)	F Calculate	Sig*	β	T Calculate	Sig*
Admitted patient's satisfaction	0.500	0.250	20.281	0.000	0.542	4.503	0.000

* the impact is significant at level ($\alpha \leq 0.05$)

From table (4-19) the researcher observes that there is a significant impact of Customer involvement on admitted patient's satisfaction in AL-Mowasah Hospital. The ***R*** was (0.500) at level ($\alpha \leq 0.05$). Whereas the R^2 was (0.250). This means the (0.250) of admitted patient's satisfaction in AL-Mowasah Hospital

Amman changeability's results from the changeability in Customer involvement. As ***β*** was (0.542) this means the increase of one unit in Customer involvement will increase admitted patient's satisfaction in AL-Mowasah Hospital value (0.542). Confirms significant impact F Calculate was (20.281) and it's significance at level ($\alpha \leq 0.05$), and that confirms valid sub-third hypotheses, and accepted hypothesis:

There is a positive impact of Customer involvement on admitted patient's satisfaction in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

$Ho_{2\text{-}4}$: There is a positive impact of Process management on admitted patient's satisfaction in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

To test this hypothesis, the researcher uses the simple regression analysis to ensure the impact of Process management on admitted patient's satisfaction in AL-Mowasah Hospital, as shown in Table (4-20).

Table (4-20) Simple Regression Analysis test results of the impact of Process management on admitted patient's satisfaction in AL-Mowasah Hospital Amman

	(R)	(R^2)	F Calculate	Sig*	β	T Calculate	Sig*
Admitted patient's satisfaction	0.569	0.324	29.255	0.000	0.258	5.409	0.000

* the impact is significant at level ($\alpha \leq 0.05$)

From table (4-20) the researcher observes that there is a significant impact of Process management on admitted patient's satisfaction in AL-Mowasah Hospital. The ***R*** was (0.569) at level ($\alpha \leq 0.05$), whereas the R^2 was (0.324). This means the (0.324) of admitted patient's satisfaction in AL-Mowasah Hospital Amman changeability's results from the changeability in Process management. As ***β*** was (0.258) this means the increase of one unit in Process management will increase admitted patient's satisfaction in AL-Mowasah Hospital value (0.258). Confirms significant impact F Calculate was (29.255) and its significance at level ($\alpha \leq 0.05$), and that confirms valid sub-fourth hypotheses, and accepted hypothesis:

There is a positive impact of Process management on admitted patient's satisfaction in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

Ho2-5: There is a positive impact of implementation of other quality improvement programs on admitted patient's satisfaction in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

To test this hypothesis, the researcher uses the simple regression analysis to ensure the impact of implementation of other quality improvement programs on admitted patient's satisfaction in AL-Mowasah Hospital, as shown in Table (4-21).

Table (4-21) Simple Regression Analysis test results of the impact of implementation of other quality improvement programs on admitted patient's satisfaction in AL-Mowasah Hospital Amman

	(R)	(R^2)	F Calculate	Sig*	β	T Calculate	Sig*
Admitted patient's satisfaction	0.377	0.142	10.098	0.002	0.264	3.178	0.002

* the impact is significant at level ($\alpha \leq 0.05$)

From table (4-21) the researcher observes that there is a significant impact of implementation of other quality improvement programs on admitted patient's satisfaction in AL-Mowasah Hospital. The ***R*** was (0.377) at level ($\alpha \leq 0.05$). Whereas the R^2 was (0.142). This means the (0.142) of admitted patient's satisfaction in AL-Mowasah Hospital Amman changeability's results from the changeability in implementation of other quality improvement programs. As ***β*** was (0.264) this means the increase of one unit in implementation of other quality improvement programs will increase admitted patient's satisfaction in AL-Mowasah Hospital value (0.264). Confirms significant impact F Calculate was (10.098) and it's significance at level ($\alpha \leq 0.05$), and that confirms valid sub-fourth hypotheses, and accepted hypothesis:

There is a positive impact of implementation of other quality improvement programs on admitted patient's satisfaction in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

Ho_3: There is a positive impact of Lean Six Sigma on admitted patient's satisfaction (***Room services; Interpersonal skills and Technical quality***) in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

To ensure the impact of Lean Six Sigma on each admitted patient's satisfaction factor in AL-Mowasah Hospital. The researcher divides this hypothesis into three sub hypotheses, and uses the simple regression analysis to test each sub-hypothesis, as a follows:

$Ho_{3\text{-}1}$: There is a positive impact of Lean Six Sigma on admitted patient's satisfaction about Room services in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

To test this hypothesis, the researcher uses the simple regression analysis to ensure the impact of Lean Six Sigma on admitted patient's satisfaction about Room services in AL-Mowasah Hospital. As shown in Table (4-22).

Table (4-22) Simple Regression Analysis test results of the impact of Lean Six Sigma on admitted patient's satisfaction about Room services in AL-Mowasah Hospital

	(R)	(R^2)	F Calculate	Sig*	β	T Calculate	Sig*
admitted patient's satisfaction about Room services	0.532	0.283	18.717	0.000	0.346	10.427	0.000

* the impact is significant at level ($\alpha \leq 0.05$)

From table (4-22) the researcher observes that there is a significant impact of Lean Six Sigma on admitted patient's satisfaction about Room services in AL-Mowasah Hospital. The ***R*** was (0.532) at level ($\alpha \leq 0.05$). Whereas the R^2 was (0.283). This means the (0.283) of admitted patient's satisfaction about Room services in AL-Mowasah Hospital Amman changeability's results from the changeability in Lean Six Sigma. As ***β*** was (0.346) this means the increase of one unit in Lean Six Sigma will increase admitted patient's satisfaction about Room services in AL-Mowasah Hospital value (0.346). Confirms significant impact F Calculate was (18.717) and it's significance at level ($\alpha \leq 0.05$), and that confirms valid sub-first hypotheses, and accepted hypothesis:

There is a positive impact of Lean Six Sigma on admitted patient's satisfaction about Room services in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

Ho3-2: There is a positive impact of Lean Six Sigma on admitted patient's satisfaction about Interpersonal skills in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

To test this hypothesis, the researcher uses the simple regression analysis to ensure the impact of Lean Six Sigma on admitted patient's satisfaction about Interpersonal skills in AL-Mowasah Hospital. As shown in Table (4-23).

Table (4-23) Simple Regression Analysis test results of the impact of Lean Six Sigma on admitted patient's satisfaction about Interpersonal skills in AL-Mowasah Hospital

	(R)	(R^2)	F Calculate	Sig*	β	T Calculate	Sig*
admitted patient's satisfaction about Interpersonal skills	0.205	0.042	8.929	0.003	0.237	2.988	0.003

* the impact is significant at level ($\alpha \leq 0.05$)

From table (4-23) the researcher observes that there is a significant impact of Lean Six Sigma on admitted patient's satisfaction about Interpersonal skills in AL-Mowasah Hospital. The ***R*** was (0.205) at level ($\alpha \leq 0.05$), whereas the R^2 was (0.042). This means the (0.042) of admitted patient's satisfaction about Interpersonal skills in AL-Mowasah Hospital Amman changeability's results from the changeability in Lean Six Sigma. As ***β*** was (0.237) this means the increase of one unit in Lean Six Sigma will increase admitted patient's satisfaction about Interpersonal skills in AL-Mowasah Hospital value (0.237). Confirms significant

impact F Calculate was (8.929) and its significance at level ($\alpha \leq 0.05$), and that confirms valid sub-Second hypotheses, and accepted hypothesis:

There is a positive impact of Lean Six Sigma on admitted patient's satisfaction about Interpersonal skills in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

$Ho_{3\text{-}3}$: There is a positive impact of Lean Six Sigma on admitted patient's satisfaction about Technical quality in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

To test this hypothesis, the researcher uses the simple regression analysis to ensure the impact of Lean Six Sigma on admitted patient's satisfaction about Technical quality in AL-Mowasah Hospital, as shown in Table (4-24).

Table (4-24) Simple Regression Analysis test results of the impact of Lean Six Sigma on admitted patient's satisfaction about Technical quality in AL-Mowasah Hospital

	(R)	(R^2)	F Calculate	Sig*	β	T Calculate	Sig*
admitted patient's satisfaction about Interpersonal skills	0.368	0.136	31.848	0.000	0.307	5.643	0.000

* the impact is significant at level ($\alpha \leq 0.05$)

From table (4-24) the researcher observes that there is a significant impact of Lean Six Sigma on admitted patient's satisfaction about Technical quality in AL-Mowasah Hospital. The ***R*** was (0.368) at level ($\alpha \leq 0.05$), whereas the R^2 was

(0.136). This means the (0.136) of admitted patient's satisfaction about Technical quality in AL-Mowasah Hospital Amman changeability's results from the changeability in Lean Six Sigma. As ***β*** was (0.307). This means the increase of one unit in Lean Six Sigma will increase admitted patient's satisfaction about Technical quality in AL-Mowasah Hospital value (0.307). Confirms significant impact F Calculate was (31.848) and its significance at level ($\alpha \leq 0.05$), and that confirms valid sub-third hypotheses, and accepted hypothesis:

There is a positive impact of Lean Six Sigma on admitted patient's satisfaction about Technical quality in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

Ho_4: There is no significant different between employees and admitted patients in AL-Mowasah Hospital about Application Lean Six Sigma Principles at level ($\alpha \leq 0.05$).

To test this hypothesis, the researcher uses the Chi^2 to identify the difference between employees and admitted patients in AL-Mowasah Hospital about Application Lean Six Sigma Principles, as shown in Table (4-25).

Table (4-25)

Difference between employees and admitted patients in AL-Mowasah Hospital about Application Lean Six Sigma Principles

Variables	employees		admitted patients		Chi^2 Calculate	Chi^2 Tabulated	Sig*
	Mean	S.D	Mean	S.D			
Lean Six Sigma Principles	1.01	3.15	3.67	0.57	73.900	101.879	0.671

Table (4-25) illustrates the differences between employees and admitted patients in AL-Mowasah Hospital about Application Lean Six Sigma Principles, the results showed that there is no significant statistical difference between employees and admitted patients in AL-Mowasah Hospital about Application Lean Six Sigma Principles. The value of Chi^2 Calculate (73.900) compared with the values of Chi^2 Tabulated. As shown in the table (4-25). That assures the hypothesis and accepted:

There is no significant difference between employees and admitted patients in AL-Mowasah Hospital about Application Lean Six Sigma Principles at level ($\alpha \leq 0.05$).

The researcher calculates the level of Lean Six Sigma to AL-Mowasah Hospital before implemented the current study A shown in Table (4-26).

Table (4-26)

Level of Lean Six Sigma to AL-Mowasah Hospital

Lean Six Sigma for Employees		Lean Six Sigma for Patients	
Before	After	Before	After
2.9	3.25	2.66	3.75

To indicate the level of Lean Six Sigma to AL-Mowasah Hospital as sample responses from staff and patients. Results of the analysis showed that the level of Lean Six Sigma to AL-Mowasah Hospital, where that level was considered ideal for Lean Six Sigma is a (5) and subtracting this level of averages for each dimension of Lean Six Sigma, both from the staff and patients perspective. Then divided the result by the number of members of the study sample and multiple in 1,000,000. As shown in Table (4 - 27).

Table (4-27)

AL-Mowasah Hospital Lean Six Sigma Level

Lean Six Sigma Principles	Employees perspective	Lean Six Sigma Level	admitted patients perspective	Lean Six Sigma Level
Top management involvement and support	3.35	3.37	3.62	3.75
Quality-driven organizational culture	3.01	3.25	3.50	3.62
Customer involvement	3.39	3.37	3.54	3.62
Process management	3.23	3.25	3.83	3.75
implementation of other quality improvement programs	2.78	3.25	3.85	3.75
Total	3.15	3.25	3.68	3.75

Table (4 - 28) showed the Number of defects per million opportunities and the level of sigma

Table (4 - 28)

Number of defects per million opportunities and the level of sigma

Cpk	Sigma level	defects per million opportunities	Cpk	Sigma level	defects per million opportunities
1.042	3.125	52,100	52,100	0	933,200
1.083	3.25	40,100	40,100	0.125	915,450
1.125	3.375	30,400	30,400	0.25	894,400
1.167	3.5	22,700	22,700	0.375	869,700
1.208	3.625	16,800	16,800	0.5	841,300
1.25	3.75	12,200	12,200	0.625	809,200
1.292	3.875	8,800	8,800	0.75	773,400
1.333	4	6,200	6,200	0.875	734,050
1.375	4.125	4,350	4,350	1	691,500
1.417	4.25	3,000	3,000	1.125	645,650
1.458	4.375	2,050	2,050	1.25	598,700
1.5	4.5	1,300	1,300	1.375	549,750
1.542	4.625	900	900	1.5	500,000
1.583	4.75	600	600	1.625	450,250
1.625	4.875	400	400	1.75	401,300
1.667	5	230	230	1.875	354,350
1.708	5.125	180	180	2	308,500
1.75	5.25	130	130	2.125	265,950
1.792	5.375	80	80	2.25	226,600
1.833	5.5	30	30	2.375	190,800
1.875	5.625	23.4	23.4	2.5	158,700
1.917	5.75	16.7	16.7	2.625	130,300
1.958	5.875	10.1	10.1	2.75	105,600
2	6	3.4	3.4	2.875	84,550
			1	3	66,800

CHAPTER FIVE

Results, Conclusions and Recommendations

(5 -1): Results

(5-2): Conclusions

(5-3): Recommendations

(5 -1): Results

1. The application level of Top management involvement and support in AL-Mowasah Hospital under study from the study sample viewpoint was Medium.
2. The application level of Quality-driven organizational culture in AL-Mowasah Hospital under study from the study sample viewpoint was Medium.
3. The application level of Customer involvement in AL-Mowasah Hospital under study from the study sample viewpoint was Medium.
4. The application level of Process management in AL-Mowasah Hospital under study from the study sample viewpoint was Medium.
5. The application level of implementation of other quality improvement programs in AL-Mowasah Hospital under study from the study sample viewpoint was Medium.
6. The satisfaction level of Room services in AL-Mowasah Hospital under study from the study sample viewpoint was high.
7. The satisfaction level of Interpersonal skills in AL-Mowasah Hospital under study from the study sample viewpoint was high.
8. The satisfaction level of Technical quality in AL-Mowasah Hospital under study from the study sample viewpoint was high.
9. The General satisfaction level in AL-Mowasah Hospital under study from the study sample viewpoint was high.

10. AL-Mowasah Hospital is committed to Application Lean Six Sigma Principles at level ($\alpha \leq 0.05$).

11. There is a positive impact of Lean Six Sigma Principles (Top management involvement and support; Quality-driven organizational culture; Customer involvement; Process management & implementation of other quality improvement programs) on admitted patient's satisfaction in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

12. There is a positive impact of Top management involvement and support on admitted patient's satisfaction in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

13. There is a positive impact of Quality-driven organizational culture on admitted patient's satisfaction in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

14. There is a positive impact of Customer involvement on admitted patient's satisfaction in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

15. There is a positive impact of Process management on admitted patient's satisfaction in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

16. There is a positive impact of implementation of other quality improvement programs) on admitted patient's satisfaction in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

17. There is a positive impact of Lean Six Sigma on admitted patient's satisfaction about Room services in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

18. There is a positive impact of Lean Six Sigma on admitted patient's satisfaction about Interpersonal skills in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

19. There is a positive impact of Lean Six Sigma on admitted patient's satisfaction about Technical quality in AL-Mowasah Hospital at level ($\alpha \leq 0.05$).

20. There is no significant different between employees and admitted patients in AL-Mowasah Hospital about Application Lean Six Sigma Principles at level ($\alpha \leq 0.05$).

(5-2): Conclusions

1. Quality is a significant element of production or services in keeping the customers satisfied.

2. Quality management involves the formulation of strategies, setting goals and objectives, planning and implementing the plans; and using control systems for monitoring feedback and taking corrective actions.

3. The quality assurance philosophy opined that quality is created in the design stage and not the control stage and that problems associated with quality are caused by poor process design.

4. Total Quality management is aimed at the satisfaction of customers needs in an efficient, reliable and profitable way. It involves a radical direction through which an organization perform her day to day operations in other to ensure that

quality is put at the top of mind of every employee and departments in which they operate.

5. Six Sigma is statistical terms means 3.4 defects per million opportunities. Early in its development, a team at Motorola developed a four-phase process for improving the quality of its products looking at ‘‘Definition,’’ ‘‘Analysis,’’ ‘‘Optimization,’’ and ‘‘Control’’.

6. The differentiates six sigma from other improving methodologies is the packaging of quality tools and philosophies, the focus on cost reduction and organization.

7. The main effort in the six sigma methodology is to reduce process variation and consistently meet or exceed customer expectations and requirements.

8. Lean Management is a philosophy emphasizing on the reduction of wastes. The elimination of waste leads to improved quality, and decreased production time and cost. In comparison, Lean Management is the more process-driven quality control initiative, while Six Sigma is more data-driven.

(5-3): Recommendations

1. Interest in the concept of Lean Six Sigma and the emphasis on the possibility of its use in AL-Mowasah Hospital because of its importance in terms of science by reducing medical errors and improving the quality of services provided, which fit with the expectations of the beneficiaries.

2. Commitment and support of the leadership of the AL-Mowasah Hospital to work the concept of lean Six Sigma contributes to planning for all risk assessment.

3. Leadership commitment and support of AL-Mowasah Hospital for quality can determine the extent to which the objectives and the statement of deviations.

4. Adoption the AL-Mowasah Hospital, lean Six Sigma approach because of its importance in the development of risk management and control systems in the hospital.

5. Availability and allocation of financial resources for the use and development of the concept of lean Six Sigma in AL-Mowasah Hospital.

6. Development funds (complaints and suggestions), to develop and improve the performance and service provided.

7. Work on investment in training and acquisition of knowledge workers in the field of lean Six Sigma and the fundamentals upon which the lean Six Sigma and its importance and interest for AL-Mowasah Hospital.

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Appendices

Appendix (1)

Names of arbitrators

No.	Name	Specialization	University
1	Prof.Dr. Kamel AL-Mugrabi	Business Administration	MEU
2	Dr. Laith AL-Rubaie	Marketing	MEU
3	Hamza khraim	Marketing	MEU
4	Hamid Shaibi	Business Administration	MEU
5	Amjad Twaqat	Business Administration	MEU

Appendix (2)
Questionnaire to employee

The researcher purposed to explore the "*Application of Lean Six Sigma to Optimize Admission Waiting Time at AL-Mowasah Hospital*"

This Questionnaire is designed to collect information about your Opinion in AL-Mowasah Hospital. I would be very grateful if you could answer ALL questions as completely and accurately as possible.

Thanks for answer all the items in the Questionnaire

Basil Asfour

First Section: Demographics Information

الجزء الأول: الخصائص الديمغرافية

(1) Age:				(1) العمر			
30 years or less	☐	From 31– 40 Years	☐	☐	من 31 - 40 سنة	☐	30 سنة فأقل
From 41– 50 Years	☐	51 Years More	☐	☐	51 سنة فأكثر	☐	من 41 - 50 سنة

(2) Gender:				(2) الجنس			
Male	☐	Female	☐	☐	أنثى	☐	ذكر

(3) Educate Level:				(3) المستوى التعليمي			
BSc or less	☐	High Diploma	☐	☐	دبلوم عالٍ	☐	بكالوريوس فأقل
Master	☐	PhD			دكتوراه	☐	ماجستير

(4) Experience:				(4) الخبرة العملية			
5 years or less	☐	– 10 Years From 6	☐	☐	من 6 - 10 سنة	☐	5 سنوات فأقل
From 11 – 15 Years	☐	16 Years More	☐	☐	16 سنة فأكثر	☐	من 11 - 15 سنة

(5) Years of Service:				(5) عدد سنوات الخدمة			
5 years or less	☐	– 10 Years From 6	☐	☐	من 6 - 10 سنة	☐	5 سنوات فأقل
From 11 – 15 Years	☐	16 Years More	☐	☐	16 سنة فأكثر	☐	من 11 - 15 سنة

(6) Specialty Job:				(6) الإختصاص الوظيفي			
Managerial	☐	Medical	☐	☐	طبي	☐	إداري

Second Section: Lean Six Sigma

No	Item	بدائل الإجابة Answer alternatives				
		Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Our hospital top management (i.e. top executives and major department heads) assumes responsibility for quality performance					
2	Our hospital top management provides personal leadership for quality service and quality improvement.					
3	Our hospital top management is evaluated for quality performance.					
4	Major department heads within our hospital participate in the quality improvement process					
5	Quality issues are reviewed in our hospital management meetings					
6	Our hospital top management has objectives for quality performance					
7	Quality data (error rates, defect rates, scrap, defects, cost of quality, etc.) are available in our hospital.					
8	Quality data are available to managers, supervisors, and other employee					
9	Quality data are available to hourly/nonsupervisory workers					
10	Quality data are timely					
11	Quality data are used as tools to manage quality					
12	Quality data are used to evaluate supervisory and managerial performance					
13	We frequently are in close contact with our customers					
14	Our customers seldom visit our hospital					
15	Our customers give us feedback on quality and delivery performance					
16	Our customers are actively and directly involved in current and future service offerings					
17	Our customers frequently share current and future demand information with hospital departments					
18	We regularly conduct customer satisfaction survey					

No	Item	بدائل الإجابة Answer alternatives				
		Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
19	Processes in our hospital are designed to be ‘‘mistake-proof’’ to minimize the chances of errors					
20	We dedicate a portion of everyday solely to maintenance					
21	We usually meet the service schedule everyday					
22	Our hospital conducts preventive equipment maintenance					
23	Clear work or process instructions are given to employees					
24	Our hospital floors are well organized and clean					
25	A large number of the equipment or processes on the hospital floor are currently under statistical process control.					
26	We make extensive use of statistical techniques to reduce variance in processes					
27	In our hospital, continuous improvement projects are conducted by following a formalized procedure (such as DMAIC—Define, Measure, Analyze, Improve and Control).					
28	We use a structured approach to manage quality improvement activities					
29	We have a formal planning process to decide the major quality improvement projects					
30	All improvement projects are reviewed regularly during the process					
31	We keep records about how each continuous improvement project is conducted					
32	In our hospital, the service design process follows a formalized procedure					

Appendix (3)
Questionnaire to Patients

The researcher purposed to explore the "*Application of Lean Six Sigma to Optimize Admission Waiting Time at AL-Mowasah Hospital*"

This Questionnaire is designed to collect information about your Opinion in AL-Mowasah Hospital. I would be very grateful if you could answer ALL questions as completely and accurately as possible.

Thanks for answer all the items in the Questionnaire

Basil Asfour

First Section: Demographics Information

الجزء الأول: الخصائص الديمغرافية

(1) Age:				(1) العمر			
30 years or less	☐	From 31– 40 Years	☐	☐	من 31 - 40 سنة	☐	30 سنة فأقل
From 41– 50 Years	☐	51 Years More	☐	☐	51 سنة فأكثر	☐	من 41 - 50 سنة

(2) Gender:				(2) الجنس			
Male	☐	Female	☐	☐	أنثى	☐	ذكر

(3) Educate Level:				(3) المستوى التعليمي			
BSc or less	☐	High Diploma	☐	☐	دبلوم عالٍ	☐	بكالوريوس فأقل
Master	☐	PhD	☐	☐	دكتوراه	☐	ماجستير

(4) Experience:				(4) الخبرة العملية			
5 years or less	☐	– 10 Years From 6	☐	☐	من 6 - 10 سنة	☐	5 سنوات فأقل
From 11 – 15 Years	☐	16 Years More	☐	☐	16 سنة فأكثر	☐	من 11 - 15 سنة

(5) Monthly income:				(5) الدخل الشهري			
200 or less	☐	From 200– 400 Dinar	☐	☐	من 200 - 400 دينار	☐	أقل من 200 دينار
From 400 – 600 Dinar	☐	600 and More Dinar	☐	☐	أكثر من 600 دينار	☐	من 400 - 600 دينار

Second Section: Patients satisfaction for AL-Mowasah Hospital services

No	Item	بدائل الإجابة Answer alternatives				
		Very Poor	Poor	Fair	Good	Very Good
1	The level of cleanliness and overall condition of the toilets, showers, and floors of the hospital is					
2	Level of the safety of your hospital room is					
3	Level of satisfaction with meals that were provided is					
4	Level of comfort in sleeping in your room is					
5	Level of satisfaction with your hospital room is					
6	The level of communication between your self and doctors are					
7	The level of communication between your self and nursing staff are					
8	Nursing staff answers to your questions					
9	Nursing staff effort to make your visit comfortable and pleasant					
10	Friendliness and courtesy shown to you by nurses					
11	The medical staff who treat you give you respect					
12	The confidence and trust in medical staff Treating you					
13	Doctors usually spend plenty of time with you					
14	The receptionist explain things quietly					
15	The medical knowledge of physician staff at this hospital					
16	The medical knowledge of nursing staff at this hospital					
17	Training, skill and experience of the nursing staff					
18	Doctor advice you about ways to avoid illness and stay healthy					
19	Doctors are good about explaining the reason of medical tests					
20	Quality of treatment you receive					

Second Section: Please indicate the General satisfaction

No	Item	بدائل الإجابة Answer alternatives				
		Very Poor	Poor	Fair	Good	Very Good
21	Attention by the medical and administrative staff at AL-Mowasah Hospital					
22	Accuracy of the information given for you about your Health status					
23	Interest in your condition and your Health status					
24	Actions taken toward your Health status					
25	Ease of access and inquire about all the reports on your condition of your Health status					