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Applying Of Lean Six Sigma For Improvement Product Quality

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Abstract : As a result of the technological developments in the present time, the need to apply Lean Six Sigma the approach has become an urgent need in industries, especially in developing and industrially developed countries, because the role of six sigma lean is to reduce quality costs. The modern approach to quality management focuses on improving the quality of products and processes in a way that leads to producing intact and flawless products. Thus, quality, along with cost, is one of the most important factors of success at the moment, as failure in quality will lead to additional costs for enterprises as a result of poor quality in their products, which negatively affects consumer satisfaction. Six-Sigma has been critical over the past two decades for its outstanding successes in many production and service companies, through the application of Lean Six-Sigma, where it contributes to improving product quality and significantly reducing quality deviations**.**

INTRODUCTION: Lean Six Sigma is one of the latest approaches to reach a high degree of quality, as quality along with cost is one of the most important factors of success at the moment. Moreover , since product development is one of the challenges faced by economic units, the introduction of new products and the ability to develop them and increase their quality is still also a major reason for a success . The profits of application of Lean Six Sigma method leads to optimal use of resources, identifies deviations in the process, eliminates damage and reduces costs simultaneously, which in turn increases production, and improves the performance of the manufacturing process are strategies that drives business towards understanding all requirements. However, approaches to improve the performance of both businesses and processes have evolved over recent decades. They has extended to include management, objectives and results to total quality control, comprehensive quality management, then the theory of limitations, the approach of excluding loss, knowledge management, then the integration between the Six-Sigma and finally high-performance organizations. Hence all these approaches have appeared as a measure of quality and a system of improvement where this includes identifying the most important factors of quality that are determined by the client, through which the changes of the process are reduced, capacity improved, increased stability, and design systems to achieve the goal of Lean Six Sigma .

1. Research Problem

Lean Six-Sigma contributes to improving product quality and significantly reducing quality deviations, applying this approach to number of defective units does not exceed (3.4) defective units per million units produced where it is considered very high and successful.

The problem of study can be formulated by asking:

What are the requirements and obstacles to the application of Lean Six-Sigma in Iraqi industrial companies ?

2. Significance of the Study

The significance of the study lays in showing the impact of the Lean Six-Sigma in achieving the quality of production and reducing costs in Iraqi industrial companies . This study also derives its significance from the importance of Lean Six-Sigma method, which is the latest approach that leads to the highest quality and lower costs to the lowest level . It also stressed the importance of expanding in application of the Lean Six-Sigma to achieve benefit by reducing quality costs, which reflects positively on the survival of the facility.

3.Objectives of the Study

The main objective of the study is to apply the Lean Six- Sigma approach for the purpose of reducing the cost of the product and achieving competitive advantage. This objective can be achieved by the following sub-targets:

1. Clarifying Lean Six-Sigma approach and its role in reducing costs, as well as to clarify the impact of this approach on increasing production efficiency, improving production quality by understanding and applying the Lean Six- Sigma approach and the financial benefits gained from its applying.
2. Shifting from traditional styles in reducing costs to the Lean Six-Sigma approach , a rich accounting method that provides productive efficiency and quality improvement .
3. Lean Six-Sigma is aimed at avoiding the largest possible error in all industrial activities .
4. Achieving production quality and reduction costs, as well as increased customer satisfaction and reducing the necessary time cycle and reducing defects .

4. Study Hypothesis

The study is based on the basic hypothesis that the use of Lean Six Sigma approach leads to the harmonization of improving the quality level to increase customer satisfaction and reduce the quality costs represented by internal and external failure by reducing defects in production. In such way a company can enter the competition market by reducing costs and increasing quality.

5. Methodology

The methodology of the study derives its importance from the subject where it aims to formulate the theoretical framework by compiling the relevant scientific material in question in order to achieve the objectives of the study in which the researcher relied on the inductive approach and the inferring approach.

Section One

Concept and Principles of Lean Six- Sigma

Lean Six-Sigma is considered the main pillars of this study due to their importance in implementing continuous improvement . When considering the introduction of modern technologies that are affected by improvement when integrating Lean Six-Sigma, the need to understand the affiliation of these methodologies to each other and how to deal with them in the industrial field and the goal of the work is to find the effect of analyzing the integration of tool foundations for lean six-Sigma that enhances the working environment and highlight the importance of using the priority matrix. The first is seen the flow of the process against time and efficiency related to value-added activities, and the methods of improving the performance of both business and operations have evolved over the last decades .The encompass management, objectives and results, total quality control, then comprehensive quality management, six-Sigma , the theory of limitations, the methodology of excluding loss and then managing knowledge , the combination of the Lean Six-Sigma and the LSS exclusion approach and finally high-performance organizations. Some of these approaches focus on performance efficiency, some focus on performance effectiveness, and others focus on developing the organization's knowledge capabilities and then developing intellectual capital for self-development and sustainability. In order to achieve self-development and sustainability, perhaps the approach of the Lean Six-Sigma in its five stages, which includes (definition, measurement, analysis, improvement, censorship) is the latest of these philosophies .

1.The Concept of Six-Sigma

According to Allen Lean Six-Sigma is an organized method of problem-solving to improve the strategic system and develop new products and services and rely on scientific statistical methods to make significant reductions in the proportions of specific defects of the consumer. Bass defined it as a method of data control, aimed at generating near-perfect production methods where the defect rate does not exceed (3.4) per million opportunities. While Goetsch defined it as a strategy within the context of overall quality, the goal moves to a much higher level than the quality achieved by many economic units in the context, in other words, it is an innovative way to pursue a high level of quality under the umbrella of overall quality.

Alongside , Kwak also explained that Six-Sigma is the entrance to DMAIC for problem solving, as this portal includes five basic steps: identification, measurement, analysis, development and control as DMAIC is the road map for six-sigma in continuous improvement. In the same vain, Krajewski defines the Six-Sigma as a comprehensive and flexible system to achieve sustainability and the highest success in the business field during the reduction of defects and changes (Fleih and Khatham, 2019:60). Finally Al- Shamari (2014: 288)sees that companies seek to apply the Six- Sigma approach based on performance control and activities, and it is a way to provide businesses with the tools to improve the capacity of operations in these businesses and this an administrative approach aimed at eliminating negative impacts on the productive process of companies .

2.Concept of Lean Six-Sigma

Burk defines the Lean Six-Sigma as a philosophy of improving all management systems and any business where it has progress and growth, which requires a continuous effort of the production process as it seeks to eliminate damage by using Six-Sigma tools, which enhances value in acting Six-Sigma forward by increasing speed and identifying and removing the steps of the process that do not add value . He further adds that Lean Six-Sigma is a new organizational change and a way to improve and enhance the units' capabilities highly to improve efficiency and efficiency ((Fleih and Khazem, 2019:63). Reijns defined it as a methodology that allows economic units to maximize shareholder value by accelerating the rate of improvement in customer satisfaction and quality cost.

Moreover , Longo(2012:167) defines it as a methodology to make production processes more effective and efficient by focusing and reducing deviations and errors in production processes, as this methodology relies on the accuracy of process measurements and variable results to look for factors that meet customer requirements. He adds that it as a means of improving the quality of products to meet the customers' demands and thus improve profitability, and control the statistical process and enhance competitive position.Thus , it can be viewed as methodology based on a critical set of tools that enable the company to achieve the desired goals, and can be a guide that help the company to deliver better performance compared to competitors .

While , Arthur defines it as a methodology based on statistical methods where it focuses on the quality of products through the efforts of teams to improve performance through the methodology of eliminating waste and reducing inequality .In this regard , it combines the concepts of Lean and six –Sigma. Alongside , Nikilas (2010:35) maintains that it is fatal philosophy to improve the quality, productivity and competitive advantage of any organization in the market. After all these definitions , we can consider that Lean Six-Sigma is a method based on reducing defects and mistakes in the work environment, and in accordance with simple and sophisticated methods of analyzing complex relationships as well as the result and discovering opportunities for improvement within the company.

2. Aims of Lean Six-Sigma

Lean Six-Sigma aims to reduce variations and deviations in the production process, thereby improving product quality, reducing barriers between managers and employees, allowing employees to give their ideas and opinions and work to provide service at the specified time and place. It also aims to continuous development the skills of operators and service providers for the purpose of achieving continuous communication for improvement and growth, achieving the best levels and service for beneficiaries as much as possible, better and optimal use of available resources and reducing costs and taking the opinions of beneficiaries to meet their requirements. In addition, the graceful six-way block approach constantly seeks to know the extent to which managers and employees in the field can work according to this approach and how they maintain the right products and services with the right quality and accuracy to maintain cost reduction and know the flexibility of the work and deal with the various circumstances facing the company(Rashed ,2016:32).

Al-Janabi (2018:159) Lean Six-Sigma also aim to reduce costs through the following:

a. **Removal** of waste in the production process (waste is any activity within the process is not necessary for manufacturing product or service).
b. Repairing production processes and thus providing costs that the company may incur .
c. Solve problems caused by the productive process.(Problems with defects in a product or service that cost the company a lot of money).
d. Reduce contrast, disadvantages, loss and improve current processes, and that these sub-actions can be done in the context of developing production processes.
e. Continued success in obtaining market share, delighting customers, high profits and shareholders, and finally achieving the benefits of competitiveness in the market.

4. Principles of Lean Six-Sigma

The principles of Lean Six-Sigma converge from the principles of Lean and combine the best in the two approaches in an orderly framework, Lean reduces and eliminates loss of processes and Six-Sigma reduces and eliminates defects and differences . However , the total improvement is done by the following :

a. Take care in choosing business and adopting the right improvement strategy for each business.
b. Focus on improving the entire business.
c. Use the DMAIC model to guide the business.
d. The possibility of dealing with a wide range of problems as well as large totals of economic unit experiences.

Section Two

Lean Six-Sigma Approach

Lean Six-Sigma approach represents an approach that focuses on improving quality and reducing contrast and eliminates of waste. It is a concept that combines two important improvement programmers, Six-Sigma and Lean , where the two concepts were previously seen as distinctive and similar to improvement until the late 1990s, but now many organizations have begun to integrate them together into one concept, the Lean Six-Sigma . The philosophies of Lean and Six-Sigma are strong philosophies and are supported by many tools to improve the quality and productivity of any organization in the market, as the philosophy of Lean is based on eliminating waste and improving flow using different methods . The Six-Sigma focus on reducing the disparity and difference in processes using statistical tools and problem solving tools .The development of both concepts ,in the early part of this century, by practitioners take advantage of their strengths with the advanced method of processes and simple reforms provided by the concept of Lean. Moreover , through the two approaches, the Lss concept has been crystallized. Such concept provides a more robust approach to improving the quality of existing products and processes using the six-step DMAIC method , which was established based on an improvement cycle.

Al-Nuami (2019:135)lists these five steps as following :

1. Measurement : It is the determination of the customer's wishes or needs and to assess how they fail to meet those expectations so that they can be avoided, while setting the basic measures of the process for future comparison. An appropriate scale is selected that is required to assess success in specific and designed projects. This stage requires selecting the appropriate quality characteristics for processes and outputs that fulfill the wishes of the consumer, identifying defects resulting from the processes and inputs that contribute to these defects, and knowing the exact

impact of reducing and deleting defects on the company's profits and reducing costs. It is noticed that measuring defects affect quality properties, so sigma level of processes can be determined as based on the number of defects that are for comparison with improvement projects. This phase requires data collection to solve the problem and measure exactly what happened, as the problem is converted into a function for measuring defects and during this stage the company must have the ability to measure the outputs of operations(Cho, et al., 2011: 617) .

2. Improvement :It is the process of making changes to the product or service, after identifying the main causes of the problem. It begins by improving processes as a set of ideas is developed to get rid of the main causes of the problem where the solutions formulated are tested and implemented and this phase relates to the selected characteristics of the performance of the product that must improve to reach the goal and the characteristics work to diagnose and reveal the main sources of difference and then reveal the variables of the main process.

3. The definition : It is that Lean Six-Sigma is a statistical method that helps to measure and grade the level of quality improvement. During this phase, the main objective of improvement is identified where Six-Sigma team identifies projects that need to be improved based on the company's objectives, consumer needs and requirements and determines critical quality characteristics that have an impact on product quality and processes. This creates a picture of the processes that are required to be improved. Since Six-sigma's goal is to reduce defects by solving the problems causing them, therefore, the introduction of the problem is important for the successful application of the Lean Six-Sigma approach.

4.Analysis: It is the identification of the internal causes of problems.

5. Control : It is monitoring the mode of steering and guidance programs under the application to ensure continuity of improvements.

Characteristics of the Lean Six-Sigma

Lean Six-Sigma is a work philosophy as it acquires properties in technology and growing interest in financial and legal fields, marketing or other company jobs . It also achieves direct benefits in manufacturing activities, storage and delivery. We can say that Lean Six-Sigma is a holistic and flexible system to maintain business success. It is also the smartest business management method that places customers in the first arrangement and depends on the use of information and facts in order to reach better solutions through the design and control of everyday business activities so that the losses are reduced with meeting customer needs and achieve their convictions . However , Flieh and Khadam (2019: 54) sustain that such case can be achieved by improve the use of equipment and improve critical response times for customer requests and reduce errors and rejects.

According to Al- Shamari (2014:289) Lean Six – Sigma team consists of the following :

1. Executive Leaders

They are the ones who can pick the best elements to do what they want to accomplish and have sufficient restraint while providing the motivation, direction and planning necessary for the success of the Lean Six – Sigma approach. Most team leaders focus on improving the design process or redesigning the process and taking care of attempts related to customer opinion polling systems, measurement, or process management. The role of team leader is critical in maintaining the progress of the project and ensuring that progress continues(Hickey, 2012:53).

2. Black Belt

The head of the black belt is responsible for the long-term technical vision of Six – Sigma , technological development and identification and delivery of new methods, procedures and tools to the company to meet the needs of the company's various projects. The head of the black belt is the technological expert responsible for transferring knowledge of Six – Sigma , either through classroom training or through on-the-job guidance.

3.Green Belt

The green belt is an assistant of the black belt in the career field where they work part-time with rate of 25% . They usually do specific functions. They apply the Six – Sigma tools to study and solve the chronic problems of the project and they can help black belt in collecting and download data and perform other experiments or tasks in the project .

4. Sponsor or Supporter

The sponsor or support is usually the executive director who is support by the black belt or other working teams in Six – Sigma ;thus, his presence is very important because he is ultimately responsible for the continuation of the work in Six – Sigma . The sponsor must be highly located in the organization or company and is usually a member of the board of directors or the steering committee.

Factors of the success of Lean Six – Sigma in Industrial Companies

In the past two decades, the information and services sector has become a major factor in the economies of developed countries as well as for developing countries. Interest in institutions providing information-related services and knowledge management has increased due to their ownership of a society that wishes to receive these services, so the

application of the Six Sigma approach helps institutions and companies in one way or another. Sangwan (2014:871) refers to these ways as flowing:

1.Training of employees must be sufficient for effective application to the Lean Six Sigma.
2. The organization should properly adopt the culture and values of overall quality.
3. The Six Sigma should be focused on the beneficiary.
4.The company must has appropriate measuring tools for all operations in it.
5. Demonstrate the company's ability to determine the financial savings it earns from the Lean Six Sigma application.
6. Correct understanding from the management of the company for all the operations, activities and services of the company.
7. Availability of an administrative hierarchy for accredited employees, whether it be the certificate of sponsor or hero.
8. Work on the possibility of fragmenting all technical processes and information services to intervene in some parts of them and change their course in a way that allows for continuous development and improvement and a decrease in the number of insignificant processes by eliminating them in a systematic scientific manner, leading to faster service delivery than before.
9. Reduce the disparity in the performance of the services in the company, leading to a high level of expectations of the beneficiaries and thus stability in the provision of services provided to them.

Furthermore , it can be said that companies can increase their work efficiency if they rely on the Lean Six - Sigma approach as well as reliability and effectiveness in internal processes, services and activities. This contributes to serving all parties related to the company and improving knowledge through the company's use of a range of tools and techniques that contribute to solving problems that lead to the creation of a kind of job satisfaction for employees and the effectiveness of administrative decisions strongly is based on data, facts and numbers and works to reduce costs. The application of the Six - Sigma approach also increases understanding of customers' needs and expectations, especially critical and urgent needs, and these are important characteristics in measuring the service provided to beneficiaries and seeking their satisfaction.

Steps to apply Lean Six – Sigma in Industrial Companies

Step 1: Identify the project of Lean Six – sigma

The administration reviews the list of six Sigma projects and selects a good and implementable project according to the available possibilities and ease of dealing, and this project must have a real benefit for the company and customers.

Step 2: The formation of the Six Sigma Team

The organization's success in its application of the Six Sigma six-pack approach depends heavily on the unique organization based on the mathematical bundles system(Bu-Jalal and Shuadrer, 2017:76).

Step 3: Continuous improvement to the Six -Sigma project

It is the creation of a kind of continuous improvement and development within the administrative and technical work system of the company, where industrial companies are always in need to a lot of attention whether administratively, technically, technically, financially and humanly . Furthermore , the application of the Six Sigma approach helps create an unconventional approach to improving performance and developing services for the beneficiary community, as well as the need to pay attention to human resource development(Heuring, 2005:132).

Step 4: Team training

It is a priority in the Six Sigma application process where training is focused on the DMAIC process and its tools. However such step requires intervention from the company's senior management by creating a unit for continuing education and training of employees.

Step 5: Build up Six Sigma team

There are common names and titles called members of the Six Sigma team usually consists of : hero or sponsor , black belt (The Head)and green belt

Lean Six-Sigma and Lean Production

Lean production methods have traditionally focused on eliminating seven types of waste, classified as defects including overproduction, transportation, waiting time, inventory, movement and processing. While Six-Sigma seeks to improve the quality of process outputs by identifying and eliminating the causes of defects and errors and reducing variation in manufacturing processes or even service enterprise operations. Lean production aims to achieve a continuous flow by tightening the links between operational steps, while the Six –Sigma focuses on reducing the process of difference, in all its forms, between the steps of the process to enable those linkages to be tightened (Asmal ,2006 :72) . The principles of Lean production reveal the sources of the variation process and six-sigma process aims at reducing this disparity to enable an effective cycle of repeated improvements which directed towards the same goal continuous flow similar to those used in Lean –Sigma .

Recommendations

1.Companies should seek to shift from traditional methods of cost rationalization to modern methods and techniques such as Lean Six-Sigma for the purpose of meeting the multiple needs and desires of customers so that the company with its products can achieve competitive advantage.

2. Economic units in general should seek in particular to pay attention to the requirements of implementing the Six-Sigma approach .

3. Companies should seek to external consultants to get knowledge and training on Lean Six-Sigma .

4. Changing the style of cooperation to be familiar with modern technologies and approaches to keep pace with rapid economic changes and transformations.

5. Companies need to provide the necessary financial allocations for quality events, including the establishment of quality programs such as Lean Six-Sigma.

6. The Senior management of companies should adopt lean six-Sigma standards by forming an integrated team to implement this approach, provide all the elements and components related to them, and improve the level and quality of training courses for employees to ensure their success and benefit from them for the purpose of reducing defects and enhancing the working environment with the concept of quality, discrimination and upgrading the level of products.

7. The management of companies should focus on discussing the contents of quality reports and notes and studying and examining the causes of damage to production and defective units in the first place to reduce defects and reduce losses.

8. Companies should apply statistical methods in quality control.

Conclusion

Lean Six-Sigma helps enterprises to improve product quality and processes in such a way that they produce sound, flawless products from the first time of production, resulting in lower overall quality costs .Thus , to achieve this goal, the use of Lean Six-Sigma in reducing defects is one of the latest approaches. The main objective of the study is to apply the Lean Six-Sigma approach and to achieve that goal through several sub-objectives:

1. Clarifying that the Lean Six-Sigma in reducing costs as well as clarifying the impact of this method in increasing productivity efficiency, improving production quality by understanding and applying the Lean Six-Sigma and its financial benefits.
2. Shifting from traditional cost-cutting methods to lean six-Sigma accounting method that provides productive efficiency and quality improvement.
3. Lean Six Sigma aims to avoid the greatest possible error rate in all activities.
4. Achieving production quality and reducing costs, increasing customer satisfaction , reducing the necessary time cycle as well as, reducing defects.
5. Economic units seek to apply the Lean Six-Sigma approach, which is based on monitoring performance, activities and daily work to reach a high degree of quality in which losses and defective opportunities are reduced in such a way as to meet the needs of the consumer.
6. The financial benefits of the application of the Lean Six-Sigma approach are one of the most important reasons why large international companies have applied this approach.

References

Arthur, Jay . Lean Six Sigma, McGraw-Hill eBooks", Chicago San Francisco Lisbon London Madrid edition Mexico City, Milan New Delhi San Juan Seoul Singapore Sydney Toronto, Second edition, 2011.

Al-Nuami , Ali . Six-Sigma as Modern Approach to the Face of Defects. Scientific Conference of The University of Zaytouna, 2007.

Al-Janabi , Mohmed .The Lean Approach . Iraq , Tikrit University, 2018.

Al- Shamari , Mohmed , Six- Sigma Approach and its Role in Improving Product Quality and Reducing Costs : Applied Research at The General Cement Company . University of Karbala, Faculty of Management and Economics, 2014. .

Asmal , Omer . Six sigma Technology and Its Applicability in the General Company for the Manufacture of Medicines and Medical Supplies in Nineveh. Unpublished Master's Thesis , Faculty of Management and Economics, Mosul University, Iraq, 2006 .

Bu-Jalal , Suma and Fatom Shuadrer . Performance of bank operations according to Six-Sigma Strategy : A Case Study . Faculty of Economic Sciences, Algeria , 2017.

Cho, et al, . Selection of Six Sigma Key Ingredients in Korean Companies. The TQM journal, vol. 23, No. 6, 2011.

Hickey, Alban .Lean Six Sigma in Services, Lean Six Sigma spreading its message beyond manufacturing into services . Adaptive HVM Ltd., Unit 19 Docklands Innovation Park, East Wall Road Dublin, 2012.

Flieh, Mohmed and Ashuk Khatham . Use Lean Six-Sigma to Reduce Competitive Advantage Applied research at The General Company for Electrical Industries, Faculty of Commerce and Economics, Volume 11, Issue 1, Iraq, 2019.
Longo, Eugenio, Principles of Lean Six Sigma and CAPA, Industrial Advisor &Visiting Professor for Universities, Printed in the U.S.A, 2012.
Rashed , Ali . The Ability to Apply the Lean Six –Sigma requirements and their Role in Distinguishing the Performance of Organizations : A Survey of the Opinions of a Sample of Administrative Leaders. Master Thesis, Faculty of Management and Economics, Tikrit University, 2016.
Sangwan, Kilman . Lean Manufacturing: Literature review and Research Issues. International Journal of Operations and Production , 2014.

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