Application and Implementation of Six Sigma in Manufacturing Industries: A Review

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Abstract

In the present period of rivalry and financial disturbance, a wide range of organizations are endeavoring hard to control costs, keep up significant levels of profitability, meet changing desires for the customers and accomplish quality benchmarks to support in the market. Six Sigma is an amazing a-list improvement business technique that empowers organizations to utilize basic yet incredible factual strategies to define, measure, analyze, improve and control process for accomplishing operational greatness. The Six Sigma technique is a mind-boggling and adaptable arrangement of accomplishing, keeping up and expanding the business achievement. Six Sigma is predominantly founded on understanding the customer's needs and desire, trained utilization of realities and measurements examination, and capable way to deal with overseeing, improving and setting up a new business, assembling and administration measures. Six Sigma's part in the entirety of this is to assist the board with creating the most extreme worthwhile utilizing least assets. It does this by legitimizing the board. It implies that it applies logical standards to cycles and items. By utilizing the Six Sigma DMAIC approach cycles or items are improved as in they are more successful, more proficient, or both. If no cycle or product exists, or on the off chance that current cycles or products are regarded destroyed, at that point Design for Six Sigma (DFSS) techniques are utilized to make successful and effective cycles or items. Appropriately applied, Six Sigma limits the negative effect of political issues on the organization. Obviously, in any endeavour including individuals, l politics issues can never be wiped out. Indeed, even in the best of Six Sigma organizations there will, in any case, be an intermittent Six Sigma project where information-based discoveries are disregarded because they struggle with the assumptions of an incredible figure in the organization.

Keywords: Six Sigma, DMAIC, RPN, DOE, CSM

1. Introduction

Six Sigma is a business methodology that empowers organizations to build their benefits by enhancing their tasks, improving quality and killing imperfections. Six-Sigma topic turns on the uncommon decrease of inconstancy in the cycles. The organizations that receive a Six Sigma approach should decrease the cycle variation to such a level that the number of blemished parts per 1,000,000 of finished products would be under 3.4. Setting out on a Six Sigma program implies conveying top-quality items and administration while essentially wiping out every single inside inadequacy. Six Sigma tasks and exercises are connected to the high-level objectives of the organization. The objectives of any organizations originate from its three significant voting public: customers, investors and employees. Senior administration interprets these partner based objectives into appropriate measurements. These objectives and measurements are then planned to a procedure for accomplishing them. By tending to all business measures and regarding fabricating as a feature of a bigger framework. Six Sigma gives various advantages to customers. At the point when products configuration cycle abbreviates and activities become more financially savvy, owners or investors will consequently receive more rewards. At the point when employees become more beneficial normally their money related bundle will improve. Along these lines, the reception of Six Sigma implies higher advantages to all partners in the organisation. Six Sigma execution utilizes a five-stage DMAIC system, fairly like Plan-Do-Check-Act critical thinking procedure characterized by Deming. DMADV approach is embraced for new item advancements. From the perspective of the customer of an item or management, 'esteem' can be characterized as any activity or cycle that the customer would pay for.

An engineer whose name Taiichi Ohno defined waste as any human action which retains assets, however, makes no worth. Lean is a production practice that eliminates waste. Toward the start of the 20th century, the automobile industry began a large scale of manufacturing as a choice to create production. The large scale of manufacturing had numerous focal points like high volume, minimal cost and effort, less-skilled workers, and so forth Yet, it additionally had a few hindrances like significant expense of machinery, less assortment, overabundance supplies, need of more specialists, need of additional space to guarantee smooth production and so forth Lean production came as a choice to large scale manufacturing brushing the benefits of the large scale of manufacturing and their production. Lean production ought to be seen as a system for accomplishing esteem initiative. It works

out positively past cost-cutting. To begin with, lean creation drastically raises the limit of worthy quality to a level that large scale manufacturing, can only with significant effort coordinate. Second, lean production offers over-growing item assortment and fast reactions to changing customer tastes, something low-wage large scale manufacturing discovers hard to counter aside from through lower costs. Lean production significantly brings down the measure of high-wage work expected to deliver an item and continues diminishing it through consistent steady improvement. Lean production can completely use robotization from numerous points of view which large scale manufacturing can't. Lean Six Sigma is the mix of Lean production and Six Sigma approach. It draws the ways of thinking, standards and apparatuses of both in its methodology. Lean spotlights on end of waste and non-esteem included exercises by measure enhancement while Six Sigma centres around decrease of cycle variation and henceforth exceptional decrease of imperfections and meeting the necessities of the apparent multitude of all stakeholders. Lean and Six Sigma commend and strengthen each other. Just lean won't carry the cycle under factual control to meet the quality targets while Six Sigma alone won't lessen squander in the cycles. Presently, Lean Six Sigma is a globally settled procedure for improving the hierarchical adequacy as discussed by Womack et al [8].

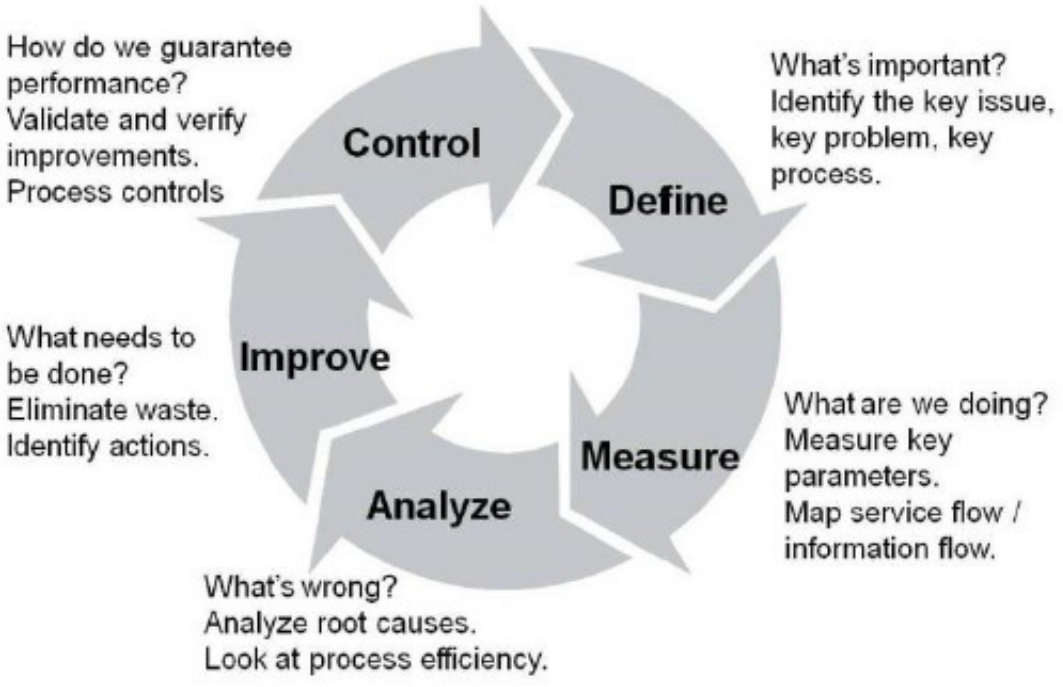

Figure 1: DMAIC Methodology for Six Sigma approach

1.1 DEFINE the problem and scope the work effort of the project team

The depiction of the problem or issue ought to incorporate the torment felt by the customer or potential business just as how long the problem has existed. Consequently, distinguish the customer(s), the project objectives and goal and period to complete the existing problem. The suitable types of issues have boundless extension and scale, from employee problem to issues with the production cycle or publicizing. Despite the kind of issue, it ought to be fundamental—part of a process, consistent state measure wherein the issue is certainly not a one-time occasion, yet has caused torment for a few cycles.

1.2 MEASURE the performance of the present process

Identify the input and output data for measuring the current performance of the industry. Develop a suitable data collection plan and check all the collected data through measurement system analysis. It will help to recognize and analyze the current problem with a possible solution.

1.3 ANALYZE the performance of the present process

Develop the hypotheses test to analyze the present problem through various statistical tools like control chart, Pareto chart, fishbone etc.

1.4 IMPROVE the present problem by selecting a solution

Once the root causes of the present problem are identified the select the best possible solution to overcomes the present problem and check the feasibility of the solution. Conceptualize likely arrangements, organize them dependent on customer necessities, decide, and test to check whether the solution resolves the problem.

1.5 CONTROL the possible solution to achieve the goal or target is met

When the solution has resolved the issue, the improvements must be normalized and supported after some time. The standard-working strategies may require correction, and a control plan ought to be set up to screen progressing execution or performance. The project team changes the normalized enhancements and supporting control plan to the cycle players and finishes off the project.

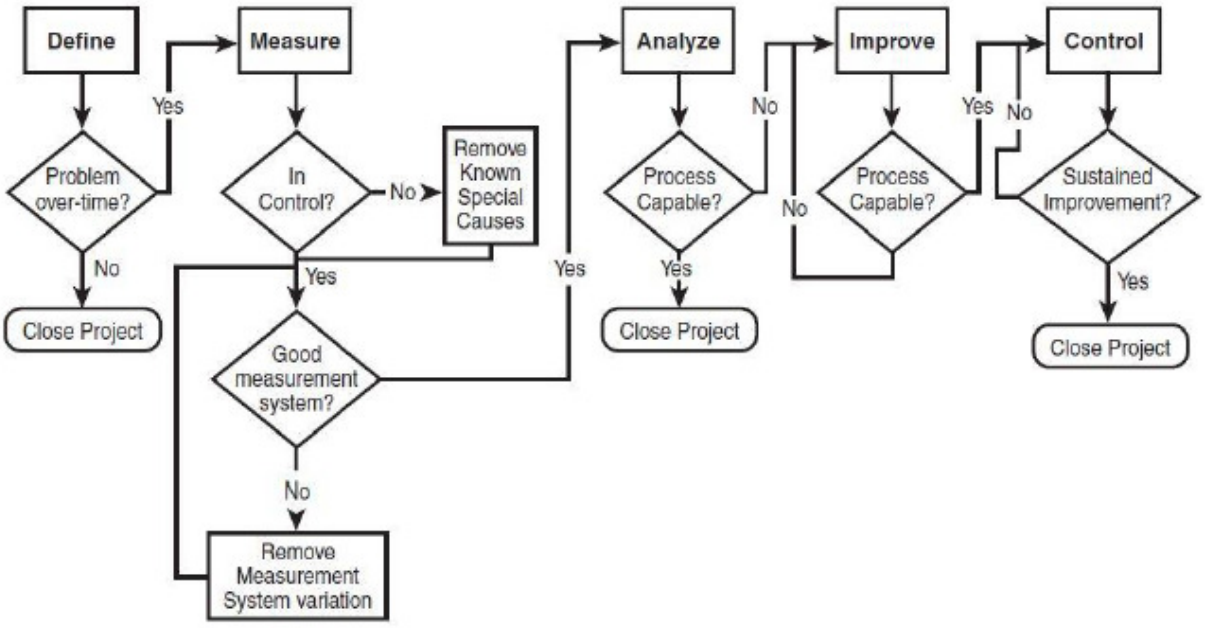

Figure 2: Process Flow diagram of the DMAIC process

2. Detailed Summary of Research work

Raman et.al [1] discussed the benefits of six sigma implementation at the capacitor manufacturing industry. During the research discussed the point of the examination/overview was to give the rundown of the underlying drivers of capacitor dismissal and propose the most doable answer for the decrease. This investigation was important to expand consumer loyalty, decrease in the piece and product return. At first, a process map was reported to distinguish the territories of progress. Circumstances and logical results outline help to additionally break down the main causes. The month to month report of recent long periods of logistics department and warehouse department helped in figuring out the involvement of each root cause. Pareto Chart helped in narrowing down the main causes further. A few mindfulness and gathering conversation with coordinations heads, stockroom heads and senior administrators empowered the definition of improved arrangements and aided in the formation of a new process map. The motivation behind the investigation was to distinguish the purpose behind the dismissal in the capacitor during manufacturing. By applying Six Sigma methodology the capacitor rejection problem has been radically decreased up to 1.84 %

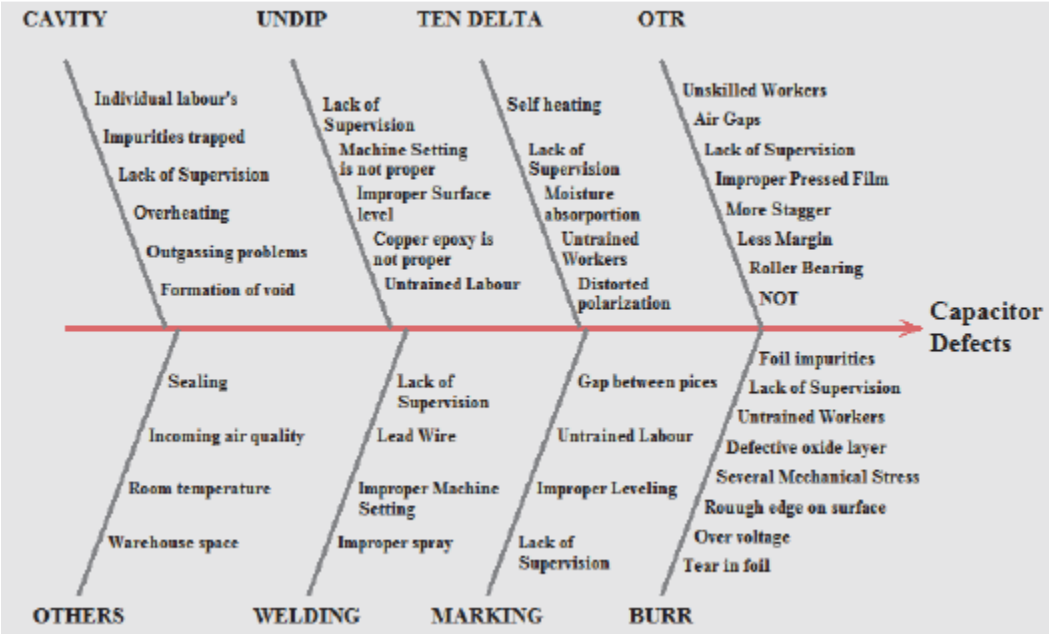

Fig. 3. Fishbone diagram of capacitor rejection problem

Paramesh et.al [2] has executed Six sigma philosophy at cable harness manufacturing industry. The cable harness manufacturing industry has been filling in a quick movement during the ongoing years in India. Cable harnesses are utilized to interface together all the electrical parts dispersed all through any electrical hardware. Cable harnesses producing includes a progression of tasks which are to be completed in an appropriate grouping to make a decent quality bridle. Continuously situation, high volume creation of link saddle with reliable great quality is a troublesome objective to accomplish. Here, the endeavours are proposed to improve the nature of Cable harnesses producing utilizing six sigma procedures. It incorporates an assortment of deformities information, investigation of the imperfections information utilizing FMEA system, deciding the causes and taking remedial activities to wipe out the deformities. Cycle stream outline and assembling lead time are resolved and lean devices, for example, one-piece stream and occupation guidance are executed. There were absolute 26 issues discovered of Cable harnesses dismissal utilizing FMEA and again their RPN esteems are improved as appeared here:

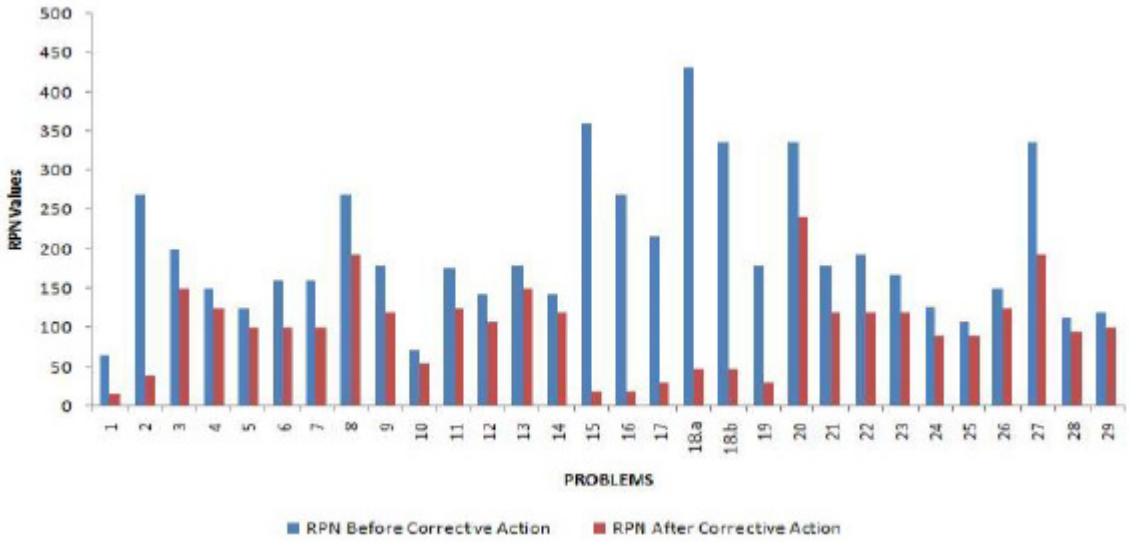

Figure 4: RPN values for problems before and after improvements

Sastry et.al [3] discussed the Six Sigma approach to measure improvement and variety decrease with the use of DMAIC. It shows the use of Six Sigma in Batteries assembling to lessen the creation of abandons like glue dismissal. Six Sigma essentially implies a proportion of value that makes progress toward close flawlessly at numerous associations. Six Sigma is a focused information-driven methodology and technique for disposing of deformities in any cycle from assembling to exchange and from item to support. The battery is an inescapable extra for all autos, as it is the wellspring of intensity for start, lighting and other outer extras. It is a viable work done were at first the level of glue dismissal was almost 3.087%, which decreased to about 2.18% within a month by applying the six sigma. Recommendations have been made at the firm to introduce the sensors like glue sensor, jam recognizing, entryway sensors to lessen the piece further. The table shows the upgrades got in the wake of executing restorative activity plans. By applying Six Sigma glue dismissal has been radically decreased from 3.09% to 2.26%.

Table 1: Improvements to reduce paste rejection

Sl No.	Month	Finished Product (Kg)	Rejection	% Rejection	Target
1	OCT	1551658	48092	3.09	3.00
2	NOV	1513158	40187	2.65	2.75
3	DEC	1217252	27237	2.26	2.5

Desai et.al [4] discussed the implementation and benefit of Six sigma to reduced the failure rate at high testing of the insulator. A genuine instance of the utilization of the DMAIC framework to diminish the pace of high voltage testing of the separator. Through this paper, it will, in general, be communicated that six sigma can be completed on both tremendous similarly as meagre degree associations and assessment, it was found that the result is more observable in little degree than in gigantic extension association. The disappointment rate was improved from 4.2 to 4.8 sigma level

Mamtha et.al [5] executed Six-sigma procedure in reducing rework of the segments which happen due to non-conformance regarding the necessary standard particulars in the manufacture shop. This outcomes in higher revise time; rework cost and brings down consumer loyalty. The Six-sigma DMAIC approach has been utilized for cycle improvement. This outcome in the decrease of the rework time and cost. An expansion in the sigma level from 2.28 to 3.3 and from 3.01 to 3.09 for Left hand and Right-hand Deck individually was accomplished. Six Sigma improves the process execution which prompts unsurprising information and unsurprising yield, prompting better use of assets, diminishes varieties bringing about persistent improvement and keeps up the predictable nature of the cycle yield. The figure shows the root causes by using the fishbone diagram and focus on the failure mode of RPN.

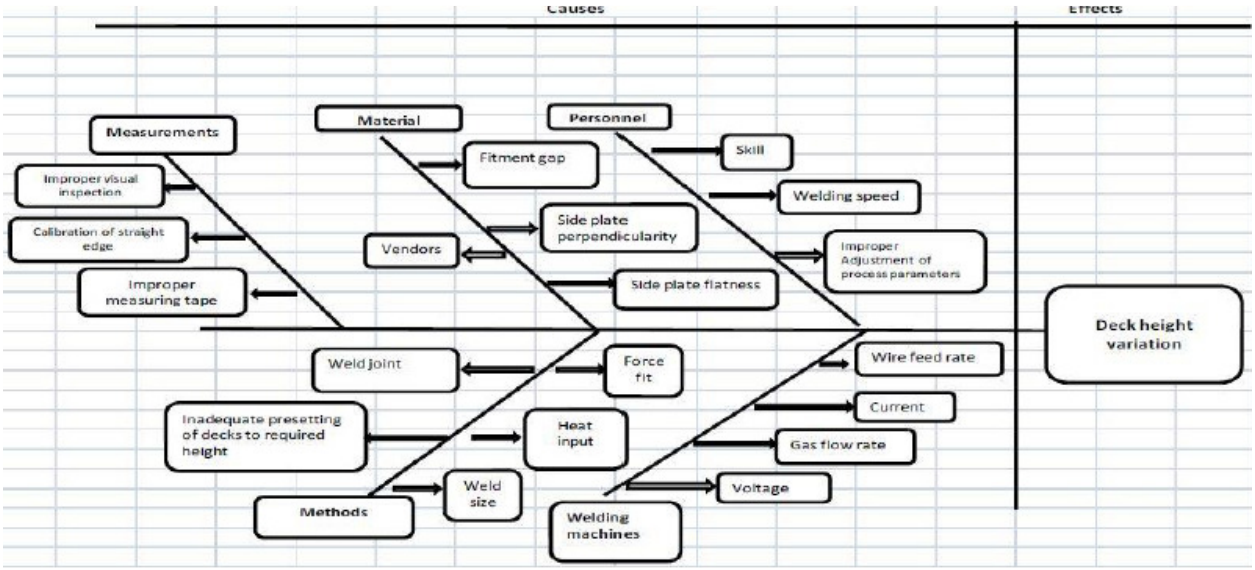

Figure 5: Fishbone diagram for Deck Height Variation for Earth Moving Equipment

Conclusion

From the various research work as cited above, it is amazingly obvious that Six Sigma with the DMAIC approach has exhibited a beneficial technique to give and increment advantage in the manufacturing industry in this competitive world. Besides offering an advantage to the manufacturers, it similarly gives a suitable satisfaction to the customers by fulfilling their necessities and wants for getting the genuine and best result out of Six Sigma it is major that maker and scientists s must use right way of thinking. It would assist with developing industries in the period of an intense rivalry this research paper will be extraordinary assistance to manufacturing industries and specialists to propel and apply Six Sigma in their manufacturing units and can get the best possible outcome. This survey will be an assistance to the different exporting industries and investigators to move and apply Six Sigma in their manufacturing units and can get the valuable and desired result. The other advantages and benefits from this survey paper can be listed as follows-

1) Six Sigma philosophy is helpful in achieving different goals in various types of industries. This strategic tool and technique can be utilized by preset targets and need of the industry. The reviewed survey shows that the six sigma procedure is utilized to decrease rejection, to improve configuration, to diminish process duration and to improve product quality.
2) It is seen that Six sigma technique is actualized by utilization of any quality control devices like circumstances and logical results chart, Pareto graph, FMEA, DOE and so forth in the measure stage and analysis stages.
3) Six sigma technique should begin with an estimation of starting sigma level and after the execution stage, the sigma level ought to be assessed, so net improvement in sigma level can be accomplished.
4) By the survey of these papers, it was seen that Six sigma is a profoundly adaptable technique which can fit any issue of manufacturing industry and by fitting execution stages and control expected outcomes are inferred.
5) Use of Six Sigma in Manufacturing area can reinforce the comprehension of this technique alongside solidifying gains from it. Six Sigma among the little

businesses is a much-anticipated development, which can reinforce their primary concerns other than adding to inspiring worldwide economy. The genuine prerequisite is to put stock in Six Sigma and set up a guide for its execution and continue sincerely to determine benefits out of it in the genuine sense.

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