# Exploring the Potential of Six Sigma (DMAIC) in Minimizing the Production Defects

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## Abstract

The purpose of this paper was to discuss the broader picture of Six Sigma (DMAIC) implementation in manufacturing. This narrative research was based on secondary data which was collected from the previous empirical studies, case studies and literature reviews. Literature review was presented and discussed in detail. Since, quality & production defects have been the severe problem in manufacturing because their link with cost & reputation; thus it remains the focus of practitioners & researchers. Six Sigma is being used to improve overall quality & to reduce production defects. Therefore, it is of the extreme need to conduct such study in which the benefits of the implementation of Six Sigma are discussed. In the present paper, Six Sigma is discussed but in the future research, other quality practices can be discussed in depth in order to put clearer and broader picture of effectiveness and loopholes. Studies related to the Six Sigma are significantly important in the development of quality management knowledge due to differences of various sectors and their production processes. In this regard, present review was conducted so to put the open and broader picture of the major quality management practice i.e. Six Sigma (DMAIC) comprehensively.

## Keywords
Six sigma; defects; quality management; DMAIC; production.

## 1. Introduction
Since the world's current demands for quality improvement and ever-changing variety of particular qualitative product manufacturing organizations are likely to use adaptation methods and growth strategies to remain important in the competitive setting. The company has been forced to innovate by this situation. They have been given operational excellence by this innovation in their products. Six Sigma stands out from the numerous techniques of organizational excellence as one of the most promising technique. Six Sigma is rightfully considered as the best and most well-known improvement of the quality process strategy. Six Sigma implementation guarantees an organization's extension of the reach and scale of quality standards of both goods and processes. The Six Sigma is, from a point of view, a data-driven approach to analyzing the underlying causes of issues, managing monetary target strategies, by using the DMAIC based approaches to develop process improvement techniques.

The day to day practice to quality has stressed upon on either reducing variation or increasing variation within the process. On the contrary, the consumption of time is in reducing variation as it is requisite for careful identification of the prior selective factors to deduce a proficient solution for improvising wherein the point of quality is not debatable even then time factor is conceded (Muraliraj et al., 2018). In the past decade, the slowdown of economics has pushed to critical sense of surge in organization to increment productivity and reduce costs, without harming existing quality of output (Sreedharan V et al., 2019). As far as quality is concerned, Six Sigma is a comprehensive system for securing and keeping business success sustainable through comprehending data discipline, customer need; to add value by minimizing waste; and intelligent attention to managing, organizing and improvement in process (Knapp, 2015). The method, referred to as one of the best strategies for improving efficiency, is reinforced by the fact that it is based on a primary objective of reducing product and process errors and anomalies, such that the defect rate downgrades to 3.14 defects per million item (DPMO). For a feat so brilliant, the calculation of opportunity must also be on a wide scale, up to millions instead of thousands. The Six Sigma uses different mathematical principles, for the most part, such as Sigma, Gauss's Distribution, Scientific Management, Time & Motion Analysis, and so on. It is also possible to combine Six Sigma with Lean Manufacturing to give birth to Lean Six Sigma (DMAIC). In our article, however, we exclusively chose the Six Sigma (DMAIC) approach to deliver productive production and eliminate diversions. In the present research paper, literature review of above one of the major quality management technique i.e. Six Sigma (DMAIC) has been conducted in the context of different industries.

### 1.1 Overview of Six Sigma
With the advent of modernization, quality management has become a key factor for industries. Therefore, over the course of time, numerous methods have been provided to improve quality. As suggested in the report, enhancing the quality and efficiency of the goods of manufacturing companies is a requirement to be accomplished through realistic work (Mazedul, 2012).The proposed analysis of their work applies a technique to ensure that disadvantages in the working process are established and disintegrated, to accurate working variables and to maintain performance metrics by means of control charts. The application of the basic operating procedure is also improved, prompting efficient use of assets, reducing varieties, and preserving the results' reliability. With the aid of different courses or training courses, these quality assurance tools can be better understood. One of which is the ideals of Six Sigma. The CMMI, which can theoretically boost quality modes when combined with the above approach, is another very common quality enhancement approach. "Failure is a gold mine," as quoted by Juran, demonstrates the value of recognizing one's process failures and learning from them to minimize rejection. And rightly, though, the above-mentioned assertion is backed by a case study from (Peter, 2007). Six Sigma DMAIC and fishbone were used effectively to disintegrate errors in the textile field, using 5S in the process to eliminate additional movement (Vijaykumar, 2016).

The growth of a manufacturing company's procedural activities gives rise to variations and these variations are organized into each procedure. However, these differences can be illustrated and stabilized using the approach of Six Sigma. Processes are calculated and tested in terms of mistakes and drawbacks in Six Sigma. These errors or defects, due to circumstances, are fluctuations in the required performance. The boundaries of these conditions are controlled either consciously or unknowingly by the company. Faulty products (defects) are declared to be products that meet or exceed certain thresholds. Therefore, detecting and minimizing those mistakes is important.

Accomplishing "Six Sigma" means that our procedures convey only 3.4 DPMO- they work optimally, precisely (Bhagare, 2019). Our procedures convey only 3.4 DPMO. This certainly contributes to organizational growth, as it is estimated that 6 Sigma has reduced the cost of waste and rework to approximately USD 427 billion (Vidwans, 2018).

## 1.2 History of Six Sigma

Today, Six Sigma has become one of the most popular and successful ways of worsening defects. However, it was not produced overnight. It was built around the end of the 20th century by Bill Smith, an engineer employed by Motorola. Extreme pressure was foreseen by Motorola due to external rivals, from Japan to be exact, in order to further discover the historical context. Although the precise date of its growth is difficult to find, Six Sigma budded around 1987 when, along with his team, Bill Smith stated many quality-based improvement projects. Finally, to save Motorola's company, they succeeded in developing an approach as a last resort. They called it "Six Sigma" in order to point to the objective of minimizing 6 standard deviations away from the goal variations in the specification of essential procedural indicators.

By implementing a balanced problem-solving approach called MAIC, Sigma gave Motorola a global "blueprint," which: tests, analyses, implements, regulates. MAIC gave the system and individual devices a better connection. So, on academic, rational, and realistic grounds, it was tough for the workers as it could be applied over a wide range of issues without beginning all over again. Eventually, Six Sigma gained managerial support. Motorola obtained significant results, which gained the attention of other organizations. Six Sigma was founded by other organizations with the same business, such as Honeywell and Allied Signal, around 1990 and succeeded. But when General Electric CEO Jack Welch revealed that GE was stepping into the Six Sigma game, the course of events moved from fiddling to full throttle. Prioritizing it for the later five years, after the introduction of Six Sigma, GE saw rapid stock growth even before the results came out. This led to other organizations paying close attention to the strategy. GE also played a crucial role in Six Sigma’s growth. GE decided to add the "Define" phase before MAIC after some projects saw hindrance due to lack of problem understanding. Thus, the now established DMAIC methodology was developed (Antony et al., 2017).

## 1.3 Six Sigma Levels

Depending on the project team, introducing Six Sigma in an organization can or cannot be difficult. Not only does this team specialize in different Six Sigma and TQM skills, but they are also flexible and well qualified. That these team members' qualified versatility earns them the title referring to' belts.' "A" Master "or" Champion "oversees of project. Typically, they are managers who are at the top of their respective fields and are connected to forehand experience in comparable ventures. Then at supervisor and organizational stages, the "Belts" arrive. In projects that are up to their unique skill set, members of each belt group are assigned to "pedagogy ventures". Their workout sessions go hand in hand as well. Various Six Sigma belt levels are available.

a) Champion
b) Master Black Belt
c) Black Belt
d) Green Belt
e) Yellow Belt
f) White Belt

## 1.4 Six Sigma (DMAIC) Methodology

The Six Sigma is administered by the DMAIC process loop in every organization-Define to Measure, then Analyze to Improve and Control. It is easier to be derived from PDCA since it is detailed in the substantial PDCA Plan process. It has now come to be recognized as DMAIC.

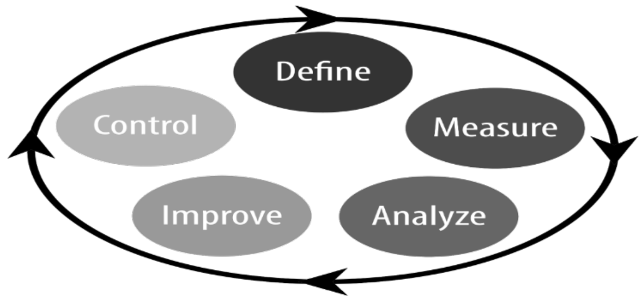


Figure 1. Six Sigma Road map

**1.4.1 Define**

"Define" is the initial step in the DMAIC cycle towards change. The total number of issues to be solved is estimated and sorted. It would be simpler for them to work if the project team had a clear understanding of a given project. Since, they will be able to replicate in their minds the simulation of processes. The specifications of procedures and customers are also seen to be understood by this move. In this case, the problem statement, scope, and targets are set.

**1.4.2 Measure**

The second stage in the DMAIC cycle is "Measure". Procedural status does not need a change yet. In any case, the procedures are made normal before applying the enhancement cycle. Problems uncovered from the defining process are subject to the discovery of their original triggers. This is achieved by using process maps and flow charts, which provide the explanations with weighting.

**1.4.3 Analyze**

The third stage in the DMAIC cycle is "Analyze" which is directly linked to the measurement process. In order to find the different potential triggers, the data collected from the 2nd stage is re-evaluated so that stronger and more accurate data can be obtained from the current one. The key objective set in this process is to figure out from the current data the main cause of disarray and waste. The different methods make use of charts of Pareto, Fishbone Diagram, etc.

**1.4.4 Improve**

The fourth stage in the DMAIC cycle is 'Improve'. In this process, the project team finds the best option to use for remedies to minimize waste and also fix broken machines and workers. However, the remedies put forward must produce a substantial improvement over the data obtained between phases 2. The DoE is a vital instrument for this process.

**1.4.5 Control**

Finally, the fifth and last stage of the DMAIC cycle is 'Order'. After the statement is made and the issue is identified, processes are assessed, preliminary information is reviewed, and the final corrective action is taken to strengthen the system. The control role is to effectively sate the improvement made into the scheme. The SPC is one of the promising instruments used in this process. It is the duty of the SPC to alert management in real-time, whether or not the previously managed process is still under control. Some of the neighboring Lean methodology techniques are 5S, Kanban, Kaizen, Poka-Yoke, etc., which can also be used in this process (Amoorthy & Sankar, 2011).

## 1.5 Six Sigma Tools

It is responsible for the DMAIC technique and predicts Six Sigma, in which both Lean instruments and conventional Sigma instruments are used. This is because those who use them will be offered infinite fruitful results by their mixture. Throughout our research, the key instruments used will revolve around Define stage (SIPOC, VOC, CTQ etc.), Measure Stage (Value Stream Evaluation, Time Trap Evaluation, etc.), Analyze Stage (Pareto Analysis, Fishbones, etc.), Improve Stage (Design of Experiments, Operational Improvement, etc.) and Control Stage (Statistical Process Control, Kanban, Kaizen, etc.).

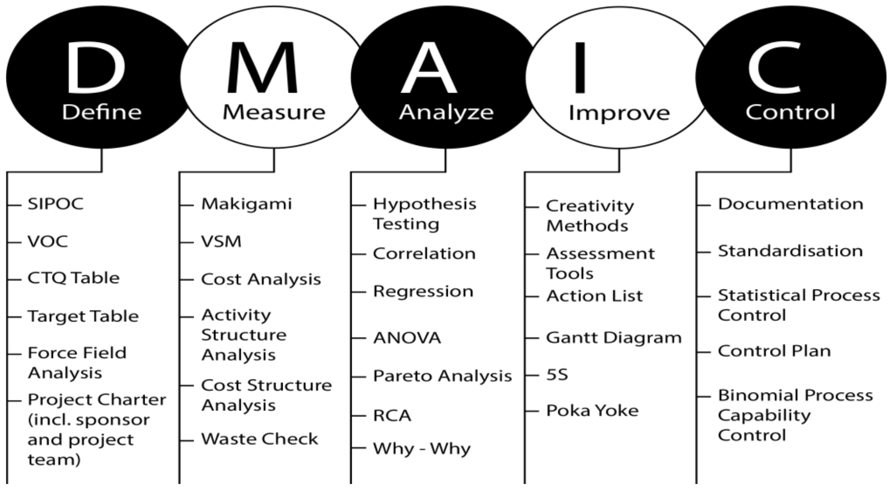


Figure 2. Six Sigma DMAIC Tools

## 2. Research gap

Since, lean is waste elimination technique and its tools have captured the immense attention of businessmen and the academicians. It has been reported that studies lack which examine the six sigma implementation in various sectors. Such studies are significant and need of the hour for the development of lean knowledge because individual sectors have fundamental variance in their construction, production or service processes (Shou et al., 2017). In this regard, present review was conducted so as to put the open and broader picture of one of the major quality management technique i.e. Six Sigma comprehensively.

## 3. Aim and objectives

This research aimed to present the applications of the major quality management technique i.e. Six Sigma (DMAIC) in the various manufacturing sectors along with their effectiveness, impacts and their benefits after implementation. The major objectives of this research are the following:

- To discuss the applications of Six Sigma (DMAIC) in various manufacturing sectors; and
- To highlight the effectiveness of Six Sigma (DMAIC) in improving quality by reducing defects.

## 4. Research Methodology

A narrative literature review was conducted to put the detailed and broader picture of one of the major quality management technique i.e. Six Sigma in terms of its implementation in industrial world. For the analysis of literature, narrative review is used and it enables an extensive understanding of problems and controversies associated with the use of technology and at the same time, it helps to take out the key success factors of adopting and using technologies (Frennert & Östlund, 2018) . By this method, researchers conduct analysis of debates and outcomes of already conducted research; moreover, it helps in figuring out the research gap and future implications (Ferrari, 2015). Present research paper, summarizes the data and evidences as collected from the previously conducted research on the implementation of one of the major quality management technique i.e. Six Sigma.

### 4.1 Data collection and analysis

This narrative research was based on the secondary data which was collected from the previously conducted empirical studies, case studies and literature reviews. Research papers on the implementation of mentioned quality management technique i.e. Six Sigma (DMAIC) were downloaded and most suitable research papers were considered for the literature review. The data was extracted from those papers and was summarized and discussed in detail.

## 5. Literature review & discussions

Six Sigma has been successfully applied in different manufacturing sectors to reduce their bottlenecks and drawbacks since its launch in the late 1980s to this day. The use of Six Sigma ensures a boost to the quality of products in manufacturing firms. Wastage and reworking times are minimized. To produce the best suitable product for their respective clients, staff and executive employees are coordinated to work together in harmony. Since being used by Motorola and upgraded by General Electronics, Six Sigma has been an integral part of active multinational and local operating companies' processes of change. The rise in the adaptation of this technique is due to the fact that rivalry between firms is continuously increasing. This results in the need to find ways to reduce the different costs while retaining the degree of quality and customer satisfaction. This can only be achieved through thorough research and development and the use of quality enhancement and process management analytical and logical methods. (Antony, 2017) lists different case studies and analysis demonstrating the use of Six Sigma in improving the characteristics of their products.

Khan (2018) conducted the preliminary study on lean manufacturing practices about textile manufacturing industry. The author mentioned that he used the Gemba, Waste Relations Matrix, Cause & effect analysis, ranking and statistical techniques to identify and analyse the wastes of lean manufacturing. The seven deadly wastes of lean manufacturing are investigated and defect is identified as the most significant waste in the textile manufacturing industry. The author suggested most relevant lean practices to eliminate /reduce the most significant defect waste of lean manufacturing which include Lean Six Sigma (DMAIC) as well.

A study conducted by McAdam in 2014 reveals the application of Six Sigma theory inside an enterprise and concludes that corporations nevertheless do not use Six Sigma tactics to their maximum degree in support of their organizational objectives. Another research (Kumar, 2009) was done by researching 4 medium-sized companies in the UK. Of the 4, 2 implemented six sigma methodologies in their methods, and 2 did not. Results deciphered that, in comparison to the six sigma users, the 2 companies not using the proposed approach had dramatically reduced process attributes (run time, delivery times, wastage ratio, etc.) and logical attributes (cost, revenue, customer confidence, etc.).

Mughal et. al. (2020) presented the detailed review of previous studies in their study and mentioned that there is tremendous potential about the applications of Six sigma (DMAIC) in Production Systems. The authors have discussed few related case studies about the implementation of Six sigma (DMAIC) in various Production Systems. Mughal et. al. (2020) presented the detailed review of Six sigma (DMAIC) and discussed the applications and benefits of Six sigma (DMAIC) in various Production Systems.

(Prasanna, 2013) conducted extensive work to provide detailed literature on Six Sigma in manufacturing enterprises, highlighting the current role of approach in the industrial environment at the time. By using logically assumed data and circumstances and using the methods of the described methodology, they also assumed a hypothetical case study scenario for Indian industries.

Khan et. al. (2020a) conducted the Preliminary Study on the Identification, Analysis and Elimination of Lean Manufacturing Wastes through Lean Manufacturing Practices at Yarn Manufacturing Industry. The authors have identified the lean manufacturing wastes in yarn manufacturing industry by lean standards and then analysis is performed by using the statistical tools and techniques. The authors, then suggested the most suitable lean practices including six sigma (DMAIC) for eliminating/reducing the most significant wastes in the yarn manufacturing industry.

In the UK aeronautics manufacturing market, a hybrid application of Lean and Six Sigma was made (Thomas, 2016). Due to the use of DMAIC strategy, major upgrades in business execution (e.g.: decrease in development time, on-time in complete conveyance, non-esteem included time, etc.) have been seen. From this contextual study, estimated monetary reserve funds of £ 2 m are accounted for.

Sahito et. al. (2020) conducted the case study at the pharmaceutical plant to Identify, analyses and elimination the Lean Manufacturing Wastes through Lean Manufacturing & Six sigma (DMAIC) Practices. The authors have identified the lean manufacturing wastes in pharmaceutical plant by lean standards and then analysis is performed by using the statistical tools and techniques. Sahito et al. (2020) suggested the most suitable lean practices for eliminating/reducing the most significant wastes at the pharmaceutical plant and compared the pre and post study scenario.

(Dora, 2015) detailed a contextual study of the use of the DMAIC method in SME conditions for food preparation. The developer has used approaches from both Lean and Six Sigma tool kits and the contextual analysis has shown a novel use of DMAIC to decrease overload and adapt to maximize primary concern outcomes. The evaluated reserve funds created from this contextual analysis is accounted for to be over £250k.

Khan et. al. (2020c) conducted the comprehensive review of lean manufacturing in Pakistan. The authors have identified the potential, benefits and applications of lean manufacturing in the various manufacturing sectors of Pakistan. The authors have mentioned the case studies to support the growing awareness and increasing scope of lean manufacturing & Six sigma (DMAIC) in the major industrial sectors of Pakistan.

Thomas et al. (2014) put forward another transitory concept of choosing and implementing DMAIC in UK-based assembly sectors. The paper on SMEs towards DMAIC execution presented research data on characteristics, similarities, and inventiveness. This continued to provide a basis for the use order and portrayed the complex concept of advancing DMAIC in assembling SMEs.

Another analysis was carried out on the basis of a range of DMAIC knowledge in SME circumstances (Agacha, 2006). It was found that the SME's are expected to advance themselves by displaying the corresponding quality characteristics for the successful implementation of the lean assembly worldview. These attributes were generalized as follows: more grounded and submitted administration and board responsibilities, more grounded monetary skills, enhanced employee skills and skills, and a helpful culture of authority.

Rajput et. al. (2020) conducted the case study at the automobile assembling plant to improve the productivity. The authors applied the lean manufacturing and six sigma (DMAIC) tools and techniques to identify the causes of low productivity and proposed the lean manufacturing practices for the expected productivity improvement at the automobile assembling plant. Rajput et al. (2020) compared the pre and post lean productivity to highlight the benefits of the lean manufacturing practice i.e. (takt time) in an automobile assembling plant.

The essential concepts, benefits and subsequent effects of this technique were audited (Henderson, 2000) by benchmarking the actions of one of the pioneers and trailblazers in the application of the process, General Electric. The findings showed that administrative inclusion, instruments and techniques, training, and links to HR-based activities were incorporated into keys for fruitful use.

In the background of the Six Sigma effort, a crucial case study was also carried out, focusing on the footwear industry in Bangladesh. Usage results have resulted in an increase in the quality level of the production line of shoes by mitigating errors. This has been achieved through several numerical methods (Mia, 2017).

In conclusion, Six Sigma is an essential driving force for the achievement of the objectives of manufacturing organizations for products of excellence. And thus, the Six Sigma approach is being implemented by several new manufacturing industries (Singh, 2018).

The global cost of manufacturing high-quality products today exceeds billions annually (Amin, 2015). The fitness of clothing associations relies on different viewpoints such as durability, stamina and increase for high quality goods with a smaller number of imperfections sought after. In every part of a business, quality is of prime significance. Clients request a reward for cash and expect it. Quality and place are interlinked with each other; both the brand name and the company can be harmed by an inferior quality object. So, consistency is goodwill in such a way. And we must identify the defects first in order to eliminate defects in textiles. They are also very different from each other, so comprehensive identification and treatment efforts are required (Sadi, 2018).

Khan et al. (2020d) explored major lean manufacturing practices in the automobile industry and highlighted the applications of popular lean practices including the Six sigma (DMAIC) for the auto industry. The authors mentioned the substantial benefits of the applications of highlighted lean practices in the specific segments of the automobile industry. While a traditional DMAIC-based method is successful in eliminating defects (Loonker, 2016), this was a step further when the current path was implemented with a new addition: Type. This rendered the DMAIC to DMASIC systemic approach, which was easier as it assorted the flaws at priority stages. Although the phase was a theoretical one, it gave an insight into the automatic error classification.

The Indian engineer's recent study (Kumar, 2019) based on the objective of improving the quality of sewed goods. This was done by normalization and redo elimination of stitching methods. For the corresponding feat, different methods were taken from Six Sigma. Pareto Review, which found the 8 major defects in different items made by the department, was the most popular. Most of which was due to faulty machines. His probation also offered an opportunity to standardize procedures that minimize irregularities.

His study on another Indian apparel business (Kankariya, 2017) was carried out. The approach used exclusively was the one discussed in our dissertation so far. Computer locks, fragments, printing mistakes, hook misses were the main defects examined. The defect percentage of total processes inside the plant was decreased by 2.51 percent after using the Six Sigma standard at a mere 3.2: Before= 6.85 percent, After= 4.34 percent.

Another review (Beyene, 2016) explores the work of six alphabetic characters in the DMAIC system to decrease the rate of mis happening in MAA Garments. This is a coherent system for the reduction of deserts through a 5-fold DMAIC approach called Identify, Calculate, Evaluate, Develop and Monitor. In this way, the load up that revolves around decay / removal of 4 basic types of deformities such as stain, skip sew, broken sew, and slip is accessible in the MAA-piece of clothing stitching part. Overall, unexpected six-character instruments have been used in various levels. The identified portion uncovers the devices such as SIPOC that display the methodology map that features suppliers, ins, outs, customers, and the full quality is seen to support this. The limit of the live territory technique was over. Within the evaluating area, unsurprising stitching method assessment, with real social action meetings for the clarification and outcome diagram. By cause and effect evaluation, the most drivers of these defects were seen and Pareto examination was done to identify the most critical combinations of faults, the various secret drivers affecting the distortions by unreported misuse, ANOVA, why-why. After results of experimentation were differentiated by abuse analysis of variation, the enhanced territory focuses on upgrading the various simple drivers that affect the deformities with their parts and levels. The board outline has been modified for the control zone to cope with the variance within the process within good levels. Finally, in order to beat those triggers, some likely strategies are needed. The performance of the planned defect level action strategies within the section is reduced. In addition, because of the normal amount of broken line before enhancement, wherever three.51852 and has been reduced to one.51852 during enhancement, the result was terribly fundamental. At an unclear moment, when the final product emerges from the need, the approximate value of skip sews absolutely decreased from fourteen.8125 to three.8125.

Since the department of yarn dyeing is given little attention when talking about textiles in research work. (Vidwans, 2018), however, applied the use of DMAIC to increase the dyeing area output ratio and the use of machines to dye a yarn cone. The team implemented Lean and DMAIC tools and JMP software by recognizing the shade and depth of the dye vessel as major reasons for drawbacks in order to: increase the use of equipment by 19 percent, increase initial time dying by 5 percent, reruns were reduced from 3.7 times to 3.3 times. Upgrading the 6 σ level (1.98-2.67) achieved all these improvements.

A behavior abstracted to reduce errors in the weaving of textile looms is defined in (Hussain, 2014). In order to obtain useful information about the vulnerabilities, high priority areas were evaluated. The primary aim of that study was to classify all the viable defects along with their areas of concern. Data proved to be useful, as expected, to analyze mistakes and apply techniques for improvement. From there on, to determine the reasons behind the faulty results, which was necessary for improvement, Six Sigma methods such as Pareto and Fishbone were used.

Khan et. al. (2020b) conducted the descriptive analysis of lean manufacturing practices in textile industry. The authors mentioned the most notable global research of lean practices in textile sector and then performed the comprehensive descriptive analysis by considering the major factors. The autors have identified the major lean practices including Gemba, Value stream Mapping (VSM) and Six sigma (DMAIC) in the textile sector generally and its sub sectors specifically.

(Tanvir, 2013) suggested an overview of the application of the fundamental processes, seeking to increase the use of value, reducing odds, and preserving the efficient quality of the gains. The 2 methods used were Pareto inspection and Root-Cause Analysis for this purpose. The outcome of this recognition showed that by restricting reworks, an industry can get higher productivity and profitability with advanced quality items. Advanced internal up-time, in addition. In the report, a standard blueprint was put forward for the change.

(Ajmera, 2017) offers the blueprint of a mixed Lean Sigma such that the final product in the textile company is less defective. The alignment between processes offered better support for the revenue produced, and high-quality stuff at lower prices meant that consumers would be more than happy. The support processes for the textile sector were organized in the following reports, commending past research on the same problems relating to SMEs.This research shows that Lean Sigma consolidates the instruments and strategies of Six Sigma with those of Lean Manufacturing tools and strategies to produce reserve funds and support the apparel market.

## 6. Conclusion

Literature review was conducted on the major quality management technique i.e. Six Sigma (DMAIC) in the context of their application and implementation in various manufacturing sectors. The various literatures throughout the past indicates that many innovative upfronts have been taken to reduce the shortcomings in the manufacturing industries. Due to the lack of awareness about the effectiveness and impact of the quality management technique i.e. Six Sigma (DMAIC), the few companies are still reluctant to adopt them. At the other hand, resistance from employees and top management are also the main hindrances in the way to this change. In this regard, one of the researcher have suggested that the employees must be taught for proper Six Sigma (DMAIC) implementation from the bottom to the top in the execution of an autonomous flow of production as machine operators are the main linkage to perform simple maintenance and fault finding tasks (S. Singh et al., 2020). The Six Sigma, however, remains a critical key-point approach in reducing the defects in the production firms and establishing a framework from improvement and better operative efficiencies. The studies also suggest the complexities in implementation of the discussed methodology within the organization, which are eventually overshadowed by the greater amount of return from the venture.

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## 8. Future implications

In the present paper, the major quality management technique i.e. Six Sigma (DMAIC) are discussed but in the future research, other quality management tools and techniques can be discussed in depth in order to put more clear and broad picture of effectiveness and loopholes. More research papers can be considered in order to draw better and effective conclusion.

## 9. Conflict of interest

There were no conflicts of interest among the authors of the present research paper.

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