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# Review of Six Sigma Methodology and Future Scope

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***Abstract:-****This article is an attempt to review and portrays how the six sigma methodology is studied by various scholars and researchers.*
*Modernisation, Exalt Technology, and raised worldly customer demand change the way of managing trade. The financial conditions and improvement towards better efficiency of a manufacturing sector totally depends upon continuous improvement in achieving less variation, cost and high quality of end products. Six sigma method become the best powerful strategy to sustain in a market for achieving manufacturing superiority. In manufacturing sectors it is very difficult to control cost and to uphold high productivity and completing the changing expectations of the customers. On implementing six sigma, manufacturing excellence and high level of quality and productivity can be achieved. Six sigma is a smarter approach to manage a business/organisation. It is a customer focused continuous improvement strategy and discipline that minimizes defects and variation towards an achievement of 3.4 defects per million opportunities in product design, production, and administrative processes. Six sigma is a technique to increase quality and profitability by eliminating and removing causes of defects during manufacturing. Six sigma is a data driven fact based technique. The objective of this article is to present an overview of six sigma DMAIC (Define, Measure, Analyse, Improve and Control)methodology. The problem solving steps used for six sigma methodology are also studied in brief. As a lone authoritative account of the DMAIC method does not exist, the article uses a large number of sources, consisting of prescriptive accounts of the method in the practitioner literature.*

***Keywords: Six sigma, DMAIC, DOE, Quality management***

## I. Introduction

Six sigma is a powerful philosophy contains several tools for improving quality, productivity, profitability and market competitiveness for any corporation in a holistic manner. Six sigma is focused on reducing process variation using problem solving and statistical tools. Six sigma is focused on reducing variation using a problem solving approach and statistical tools. Six sigma is a customer focused continuous improvement strategy and discipline that minimizes defects and variation towards an achievement of 3.4 defects per million opportunities in product design, production, and administrative processes. It is focused on customer satisfaction and cost reduction by reducing variation in processes.

Six sigma is also a methodology using a metric based on standard deviation. The goals of Six Sigma include developing a world-class culture, developing leaders, and supporting long-range objectives. There are numerous benefits of Six Sigma including stronger knowledge of products and processes, a reduction in defects, an increased customer satisfaction level that generates business growth and improves profitability, an increased communication and teamwork, and a common set of tools [7]. Companies should continuously strive for improving themselves. Organizations should focus on the performance characteristics of business processes or systems to identify and eliminate defects that are of critical importance to customers. Six Sigma is a business strategy that enables organizations to increase their profits by optimizing their operations, improving quality and eliminating. It is a work philosophy to achieve, maximize and maintain commercial success by understanding needs of the customer [33]. Six Sigma system has gained popularity as an efficient tool used to most comprehensively assess the quality of bank products and services, as well as the level of customer satisfaction. The system can be widely used particularly in the service industries.

Six sigma is mainly based on service efficiency, as well as on intangible asset maintenance processes. In the financial sector, six sigma is mainly used in quality management processes, which are based on timely detection of potential defects [34]. Six sigma is a business system with many statistical aspects, and it naturally fits business systems of most companies, it is an improvement drive which has the ability to introduce a common metric of customer-perceived quality which should be applicable to any size and type of organization. Six Sigma is a business strategy that focuses on improving customer requirements understanding, business systems, productivity, and financial performance [38]. The implementation of Six Sigma involves both management and technical components. The management components include selection of the right people for Six Sigma

program, selection of the right process metrics, provision of training and education. On the other hand, the technical components take into account the use of statistical tools and process improvement to reduce output variation [16]. To improve understanding of how six sigma can be used for higher education process improvement toward achievement of quality, a number of models are presented. Six sigma principles such as process improvement, reducing waste and continuous improvement aligns closely with the mission of higher education institutions and accreditation agencies. Using six sigma tools such as statistical process control, lean manufacturing, failure mode and effects analysis can help in the development of sustainable higher quality educational process [8]. Six - sigma is a quality management strategy, which can be used to achieve the goal of engineering education. It provides a scientific and statistical basis for quality assessment for all processes through measurement of quality level [5]. For a six sigma process, 6 standard deviations each may be fitted between the mean and the upper and lower specification limits. Six sigma is also a disciplined and data-driven approach that repetitive work processes function in the best possible manner. The primary goal of six sigma is to minimize defect levels in the outcome of a work process; a defect being anything that causes customer dissatisfaction. Maximizing customer satisfaction leads to improved bottom-line performance and global competitive position [6].Six-sigma practice is interwoven with many TQM principles, such as customer focus, data based management and decision, improved design and manufacturing capability, and a supportive work culture and employees. The efforts aim to drastically reduce defect levels to only a few DPMO for strategic products and processes. This daunting task is attained by following DMAIC approach i.e. Define, Measure, Analyze, Improve and control [1]. Six sigma can be viewed as a metric, a mindset, and a methodology. It is a new, emerging, approach to quality assurance and quality management with emphasis on continuous quality improvements. The main goal of this approach is reaching level of quality and reliability that will satisfy and even exceed demands and expectations of today's demanding customer [5]. Six Sigma was born approximately two decades ago as a process improvement philosophy to help improve business financial performance. It was developed in industry and spread largely by professional consultants. Since its introduction it has found its way into most sectors of today's business.

## II. Literature Review

Frank T. Anbari and Young HoonKwak (2004) address the elements of strategic selection and effective management of Six Sigma projects. They considers the organizational structure used and the roles of various participants in achieving technical, financial and customer satisfaction objectives of each six sigma project. Factors influencing the success of six sigma projects include management commitment, organizational involvement, project governance, project selection, planning, implementation methodology, project management and control, cultural change, and continuous training [1].

Joan Burtner (2004) describes that six sigma is a proven methodology for improving business processes. Six sigma quality improvement techniques have also been successfully applied in service sector and very recently in education enterprise. Author implemented six sigma involving a systems approach to problem solving and emphasized on three C's: Common metrics, constant communication and culture change. According to author the benefits of Six Sigma can be translated to the educational environment by viewing the production of qualified engineering graduate as a result of defect free process. Issues of customer retention (students are the customers), cycle-time reduction (students graduate in the shortest possible time), and market share growth (the number of graduates from the school of engineering increases) have direct application to the engineering education enterprise [2].

M. Soković et al. (2006) presented a Six Sigma project, undertaken within company for production automotive parts, which deals with identification and reduction of production cost in the debarring process for gravity die-castings and improvement of quality level of produced parts. The author finds that six sigma is an effective way to find out where are the greatest process needs and which are the softest points of the process. Also, six sigma provide measurable indicators and adequate data for analytical analysis. Systematic application of Six Sigma DMAIC tools and methodology within an automotive parts production results with several achievements [3].

Jayanta K. Bandyopadhyah and Robert Lichman (2007) attempts to develop a model for six sigma approach to improve quality and productivity in institute of higher education in the United States. They conclude that six sigma approach to processes improvement focuses on achieving higher standard for quality of faculty and staff, and delivery facilities such as class rooms, libraries and educational technology [4].

Raid Al-Aomar (2007) in his article focuses on the use of simulation, lean and six sigma to achieve results in process management by getting benefits in terms of minimized risk, cost and accuracy. Through the synergy of lean and six sigma, lean six sigma provides a set of methods for both manufacturing and transactional processes

to reduce variability and waste and achieve better performance. Simulation based lean six sigma approach is a modelling environment for translating the process map of six sigma and the value stream map of lean into a dynamic and realistic representative of underlying process. Application of Simulation based lean sigma approach in a medical (dental) clinic legacy environment led to an optimized clinic design that is verified to meet customers and stake holder's requirement while being lean, accurate and cost effective [5].

Kifayah Amar and Douglas Davis (2008) presents a review of Six Sigma focusing on implementation frameworks or models in the literature. The work is a part of a research project aimed at developing a Lean Six Sigma implementation framework for Indonesian SMEs. They states thata temporal dimension is an important feature of an effective implementation plan aimed at introducing an innovation at an industry level [6].

Elizabeth Cudney and Rodney Kestle (2008) states that lean six sigma is a growing methodology throughout all industries, now it is necessary to add the methodology to university curriculums. However, due to the semester time length restrictions and manageability of lean six sigma projects, it is necessary to develop fully supportive case studies to facilitate the instruction. This research paper highlights the work performed to develop a lean six sigma case study for classroom instruction. The primary objective was to develop a fully integrated and self-contained case study that would enhance student's learning of the lean six sigma methodology [7].

Roger L. Hayen (2008) presents the application of the Six Sigma methodology to a business problem that emerges with an information technology solution as the best alternative. They conclude that Six Sigma methodology shares a number of problem solving techniques and methods with prior approaches to IT problem solving [8].

Andrew Thomas et al. (2008) discusses about design, development and implementation of an integrated LSS model. The authors work in this paper builds upon the SME six sigma model that has been successfully implemented in number of SME's. The model combines contemporary lean and six sigma strategies and offers practicing production/process/manufacturing managers and engineers with a strategic framework for increasing productive efficiency and output [9].

Behnam Nakhai and Joao S. Neves (2009) evaluate the contributions of six sigma methodology to the improvement of service quality. This study aims to explore the challenges of six sigma in reaching a much wider field of application. They conclude that six sigma can be extended to many service operations if new concepts and tools are developed and if the training of black belts is modified to address areas that are critical-to-service-quality (CTSQs) [10].

Adan Valles et al. (2009) presents a Six Sigma project conducted at a semiconductor company dedicated to the manufacture of circuit cartridges for inkjet printers. They are tested electrically in the final stage of the process measuring electrical characteristics to accept or reject them. The authors conclude that six sigma implementation can be helpful in reducing the nonconforming units or improving the organization quality and personal development [11].

Darshak A. Desai (2009) presents an analysis of the impact of Six Sigma on developing economy like India. The paper provides an insight into what kind of benefits Indian industries are gaining from six sigma as a whole. The paper further highlights similarity and differences of benefit gained by different scales and sectors of Indian industries through six sigma. The author conclude that based on the analysis of this study, individual industry according to their size and type of operations can expect some specific benefits from Six Sigma implementation. The Six Sigma programme can be initiated with some specific benefits in view based on industry operations [12].

Mohamed Gamal Aboe lmaged (2009) in this paper aims to clarify emerging aspects and trends of Six Sigma literature over 17 years, from 1992 to 2008. The study observed that six sigma research is difficult to confine to specific discipline since it is scattered across various journals from various domains and fields. Six sigma research is empirical in nature which reinforces the use of real-world data [13].

VenkateswarluPulakanam and Kevin E. Voges (2010) in this paper we reviewed empirical studies which are published in research journals. These studies were undertaken in UK, USA, Canada, India, Brazil, Singapore and Taiwan and cover all industry sectors including healthcare, financial institutions, information technology. They also include large as well as SME sectors. The study conclude that sixsigma is only a distant second to Lean in terms of popularity and it is more popular with larger organizations than with SMEs [14].

Prabhakar Kaushik and Dinesh Khanduja (2010) states that globalization, growing competition among institutions, emergence of new technologies, changing socio-economic profiles of nations and knowledge driven economies have created a scenario where quality in education is beginning to occupy the centre stage. They apply the six sigma to increase the pass percentage of a technical institute. After applying six sigma it is found that sigma level of the institute increased from 2.28 to 4.17 and significantly resulted in increasing the passing rate of students [15].

Dr. Erick C. Jones *et al* (2010) describes a framework for how industrial engineering can support the many traditional (Champion, sponsor, Master Black Belt, Black Belt, and Green Belt) and non-traditional roles (financial representative, statistician, change agent, and activity-based accountant) within six sigma organizations as well as the linkages between these roles. The framework shows that IEs can play all six sigma roles and additional roles such as statistician, lean leader, economic auditor and consultant [16].

P. K. Shetty *et al.* (2010) presents results of an analysis of higher education and research scenario in ten state universities of India during 2000 to 2006. Calcutta University ranked first in terms of published research articles, on an average 664 articles in a year in peer reviewed national and international journals. Similarly Madras, Punjab, Rajasthan, Mysore, Guwahati, Pune, Mumbai, Patna and Sikkim Manipal Universities published 600, 582, 538, 328.33, 221, 184.33, 112.5, 47 and 5 articles respectively. The ratio of number of faculty to research publication varied from 1:0.05 to 1:1.9 in the selected universities. University of Madras, Panjab, Rajasthan and Calcutta have ratio more than 1:1. University of Madras received the maximum research funds of 41.46 crore rupees and ranked first among the selected ten universities. Considering the overall performance of universities in our analysis, Calcutta University and Madras University captured the first two places respectively [17].

Peteu Andreea Jenica et al. (2010) demonstrate how business environment and performance can be improved in an organization by using and implementing lean six sigma methodology and creating an organizational framework for their employees. Large organizations are turning their attention on the importance and role of knowledge on the efficiency and competitiveness. The main reason for this is concern over the knowledge management, an idea in which creativity and innovation can be promoted and the knowledge extracted so as to increase the overall performance of organization, whether it is public, private or non-profit sector. Lean six sigma can be a management approach of an organization focused on quality and continuous improvement, based on the participation of all its employees which aims to ensure long term success [18].

Jayesh Pathak, Tushar N. Desai (2011) presents methodologies of six sigma and differentiate it with total quality management (TQM). They also explain strengths and barriers of Indian industries in implementing Six Sigma. The paper also explains key factors for implementing a successful Six Sigma program, benefits of implementing Six Sigma program, some common myths of Six Sigma as well as obstacles and challenges of Six Sigma methods. Successful implementation of Six Sigma quality management at an organization leads to process variations, quality and productivity improvement, bottom line results improvement & competitive position of the industry [19].

Paul Murphree et al. (2011) look at the practical steps that is needed to be taken to sustain lean six sigma projects even after they are considered closed. LSS is being applied increasingly in health care quality improvement efforts that focus on a defined problem within an organization. Still there is a decline in gains supported through these projects. Authors studied that the reason for this decline is Learning and integration are not specifically addressed which should be done prior to final phase of the project. Thus authors in this article suggests that by applying ADLI (approach, deployment, learning and integration) evaluation tool as a check list at the conclusion of the project may help maintenance of the improvement which are overlooked by health care organizations at the conclusion of the project [20].

Lixia Wang, Iftikhar Hussain (2011) study that the experience of 6 sigma in Banking Sector is relatively new but its impact over banking performance is significant. Many banks like Citi Bank, Bank of America, China construction bank, Minsheng bank, industrial bank etc. have attained greater performance goals after implementing six sigma. Authors also studied about the various factors like supportive organizational culture, training and development, avoiding short centric approach affect the implementation of six sigma in banking industry. The implementation of knowledge management strategy will enhance individual knowledge management capabilities as well as organizational. Authors study that knowledge management along with 6 sigma tools play an important role in enhancing the quality of operations in banks [21].

Arash Shahin, Rezvan Jaberi (2011) proposed an integrative model of leagile production and to examine its influence on the quality of products based on six sigma approach. In this model three strategies of postponement, mass customization and modularization are included with an executive algorithm. The proposed

model has been examined using three main products of the Ghods Manufacturing Group, which is a manufacturer of truck body parts, from March to July 2008. The product waiting time (lean production indicator), warehousing time (agile manufacturing of the studied processes has been evaluated for all the three products which showed considerable improvement [22].

Raj, Razaq (2011)discusses the significant challenges higher education institutions face in developing e-learning environments. They also considered the gaps in the research in this sector, in particular, as to how the e-learning tools can be used to enhance university student learning. Empirical study was conducted and a number of challenges were discussed to ensure that universities capitalize on the opportunities presented by advances in technology to engage students [23].

Hsiang-Chin Hung (2011) apply six sigma to manufacturing processes in the food industry to reduce quality cost. The DMAIC (define-measure-analyze-improve-control) approach has been followed here to solve an underlying problem of reducing process variation and the associated high defect rate. The author conclude that the commercial food processing industry has a strong link to quality practices. However, the food processing industry has also been characterized as being conservative and slow to change. Understanding the quality practices in food processing requires an understanding of how the consumer, the nature of food, and the regulatory environment interact to affect the industry [24].

Maruf Hasan (2012) studied the advantages and challenges of implementing six sigma in service organizations. After analysis author conclude that it is challenging as many service processes are intangible to measure. Data are also difficult to gather since it is mainly based on face-to-face interviews and surveys. However, many service organizations are training employees to gain greater knowledge in six sigma [25].

Qun Zhang et al. (2012) review the published literature related to lean six sigma from start to date. They did a review study of 116 papers related to lean six sigma from well-known database searches like Science Direct, EBSCO host, Emerald and Google scholars. The review of literature found that Lean six sigma is mostly implemented in health industry. The research on LSS is on initial stage. LSS has been equally beneficial both for manufacturing or service concerns and large or small scale organizations. Lean Six Sigma framework in SME organizations is needed [26].

Torki M. Al-Fawwaz and Ahmad Badah (2012) utilizes sigma to evaluate the administrative performance of vocational and technical training institutions in Jordan. The study recommends that the vocational training corporations should use six sigma system in the affiliated vocational and technical institutes and to work on the development of organizational culture based on principles of cooperation and to work in team spirit and maintain on the time and apply Six Sigma methodology to Solve problems and adopt it in the training operations [27].

Dr. P.Ramasubramanian (2012) in his paper states that the quality of education is more important to the customers of the educational institutions such as students, parents and the organizations where they are getting employment. Institutions can also improve their chances of attracting students by improving the levels of service. This paper narrates the implementation of six sigma in a technical institution, the benefits of implementation and how six sigma may be used to improve the performance of all institutional operations from student graduation to recruitment, including all the processes. The author believes that the general trend is right and believes that Six Sigma is the best strategy for quality education system for its quality improvement [28].

Nurul Fadly Habidin et al. (2012) examine the relationship of Lean Six Sigma (LSS) practices and organizational performance in Malaysian automotive industries. A Conceptual model using Structural Equation Modeling (SEM) has been proposed. The authors conclude that many researchers and practitioners look for implementation of LSS as their organization strategy for quality and performance improvement. However, no previous study had tried to investigate the critical success factors of LSS and the relationship between LSS practice and organizational performance, especially in automotive industry [29].

K.G. Durga Prasad *et al* (2012) states that six sigma is a powerful tool to achieve customer satisfaction by improving the processes in any system, which may be production or service sector.They define the methodology and tool used in the six sigma process. The present paper demonstrates the novel application of six sigma approach for improving the quality in an Engineering Educational institution by eliminating the failure causes. The six sigma approach proposed in the paper assures quality in education, desired placements in reputed companies, opportunity of higher studies, developing prospective entrepreneurs and higher percentage of pass outs [30].

Stukalina, Yulia (2012) discusses the importance of using regular educational environment evaluation, which involves students' indirect participation in decision-making, as one of the most essential quality assurance activities associated with higher school improvement. It also emphasizes the significance of measuring student satisfaction in education, student satisfaction and student motivation being the result of student interactions with the educational environment in the form of students' perceptions of the educational services [31].

Thong-NgeeGoh (2012) addressed some practical Issues in the application of lean six sigma to service systems. The author says that there are a number of issues related to the nature of service systems that must be resolved before the full benefits of lean six sigma can be realized. Author conclude that it is only an organization with a critical mass of individuals with statistical thinking that could bring out the true power of Lean Six Sigma [32].

Raghunath A, Dr. Jayathirtha R V (2013) discussed the barriers for implementation of six sigma by small and medium enterprises. In this article they have discussed some of the issues and factors that are acting as barriers for adoption of six sigma by SMEs. According to them there are some technological, organizational and financial limitations of SMEs that act as barriers for six sigma implementation [33].

J. Erina, I. Erins (2013) estimate six sigma implementation in Latvian commercial banks and identify the perceived benefits of its implementation. To achieve the goals, the authors have developed the questionnaire and adapted it for the employees of Latvian commercial banks. The questions are related to Six Sigma implementation and its perceived benefits. The authors have come to the conclusion that there are different attitudes to Six Sigma benefits and critical success factors in the Latvian commercial banking sector [34].

Punitha Jayaraman et al. (2013) implement the six sigma methodology in reducing defects in maintenance projects of a software industry. They states how a Software process can use a systematic methodology to move towards world-class quality level. The DMAIC (Define–Measure–Analyze–Improve–Control) approach has been followed here to solve the underlying problem of reducing the customer reported defects in user acceptance testing phase of the software development lifecycle [35].

Arun Vijay (2013) in his study manage the quality of higher education in India by taking student rating as a measurement. This study was conducted among the Physical Therapy students with an objective to capture the overall experience related to various aspects of their Academic environment including teaching and learning process adopted in their college. This study brings a new, innovative student driven quality rating system for the higher education institutions in India [36].

Md. Enamul Kabir *et al* (2013) presents this paper to study and evaluate processes of the case organization, to find out current sigma level and finally to improve existing sigma level through productivity improvement. The research work has been carried out in a fan manufacturing company to show how to improve its productivity and quality by using Six-sigma. After implementing six-sigma a perfect synchronization among cost, quality, production time and control time will be observed [37].

Nayan J. Prajapati and Darshak A. Desai (2014) in this paper review the impact and practices of six sigma implementation on the exporting industries. The study concludes that Six Sigma is indeed a business strategy that can provide a breakthrough improvement in the competitive era. This study will help exporting unit motivate and apply six sigma at their organization and earn high benefits [38].

R.SuryaKiran *et al* (2014) in this paper focuses on the merger of the six sigma with the service quality for the improvement of the services for the service sectors. After this study they found problems, outcomes and the benefits obtained through the implementation of the six sigma for the service sector. They also found the significant and the insignificant contribution concerned with the implementation of the six sigma towards the service quality [39].

Dr. Quamrul H. Mazumder (2014) addressed the methodology and tools forapplying six sigma in higher education quality improvement process. These tools can be used by higher education institutions to better understand the higher education process and how it can be improved to meet the desired quality goals. He conclude that variations of quality may be due to lack of understanding of how students learn and adapting to different learning styles of students. After identification of the issues and defining the problems, a solution can be developed using six sigma approaches and models presented in the paper [40].

Timothy Chow and Craig G. Downing (2014) implementing six sigma Improvement methodology in academia for improving retention of first-year college students in an academic institution. They communicating the factors involved in student-retention research, improvement strategies, and results attributed to selected courses of action with both internal and external audiences can be daunting. They conclude that our experience in implementing six sigma for improving first-year student-retention process could assist others and serve as a

reference to stimulate thinking about finding creative ways to address the student-retention challenge that affects colleges and universities across the nation [41].

T. M. Al Muhareb *et al.* (2014) built a model based on Lean six sigma methodologies and applied it in the departure area at KKIA (King Khalid International Airport) in order to assess it. This model of Lean-six-sigma as a managerial procedure is mostly focused on the change management culture that requires high level of planning, organizing, modifying, and controlling in order to benefit from strengths as well as revoke weaknesses [42].

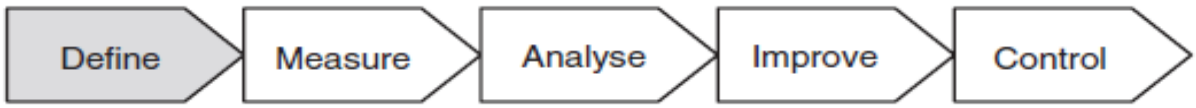
Ramanan Lakshminarayanan *et al* (2014) addressed the employability issue of engineering graduates. They states that quality of outputs from the academic Institutions in the form of students and their lower level of employability not only raises the question on very existence of academic Institutions and formal education system itself for common good of the society. They conclude that approaches and best practices from the industry shall largely benefit the educational Institutions in solving many of the quality related issues towards employability [43].

Anthony Oko and Parminder Singh Kang (2015) addressed the problem of ineffective and inefficient admission process in the higher education institute. To improve the admission process six sigma based DMAIC methodology was used. After implementation test result show high improvement in the process. The improved process will give more values to customers, who are the candidates seeking admission in the college [44].

## III. Six Sigma Methodologies

The primary objective of six sigma methodology is the implementation of measurement based strategy, which focuses on process and sub-processes improvement through the application of Six Sigma best practice such as DMAIC and DMADV. The Six Sigma DMAIC (Define, Measure, Analyse, Improve, and Control) method is applied for improving existing processes and looking for incremental improvement. The six sigma DMADV (Define, Measure, Analyse, Design, and Verify) is applied for developing new processes or products at six sigma quality level [7].

**DMAIC Methodology**




**Define**: Define stage are primarily for data collection which influences the management of the project start and terms of reference. Tools for data collection:-D1: IPO Diagram, D2: SIPOC Diagram, D3: Flow Diagram, D4: CTQ Tree&D5: Project Charter.

**Measure**: This stage includes selecting the measurement factors to be improved and providing a structure to evaluate current performance as well as assessing, comparing and monitoring subsequent improvements and their capability. The important tools for measurement should include:-M1: Check Sheets, M2: Histograms, M3: Run Charts, M4: Scatter Diagrams, M5: Cause and Effect Diagrams, M6: Pareto Charts, M7: Control Charts, M8: Flow Process Charts&M9: Process Capability Measurement.

**Analyse**: This stage includes centres in determining the root cause of problems (defects) understanding why defects have taken place as well as comparing and prioritising opportunities for advance betterment. The important tools for analysis should include:-A1: Process Mapping, A2: Regression Analysis, A3: RU/CS Analysis (Resource Utilisation and Customer Service), A4: SWOT Analysis, A5: PESTLE Analysis (Political, Economic, Social, Technical, Legal and Environmental), A6: The Five Whys, A7: Interrelationship Diagram, A8: Overall Equipment Effectiveness&A9: TRIZ: Innovative Problem Solving.

**Improve**:This step focuses on the use of experimentation and statistical techniques to generate possible improvements to reduce the amount of quality problems and/or defects. The important tools for improvement should include:-I1: Affinity Diagram, I2: Nominal Group Technique, I3: SMED, I4: Five-S, I5: Mistake Proofing, I6: Value Stream Mapping, I7: Brainstorming, I8: Mind Mapping&I9: Force Field Diagram.

**Control**: This last stage within the DMAIC process ensures that the improvements are sustained and that ongoing performance is monitored. Process improvements are also documented and institutionalised. The key tools for Control should include:-C1: Gantt Chart, C2: Activity Network Diagram, C3: Radar Chart, C4: PDCA Cycle, C5: Milestone Tracker Diagram&C6: Earned Value Management.

## IV. Conclusion and Scope for Future

Six sigma is a powerful tool to achieve customer satisfaction by improving the processes in any system, which may be production or service sector. The present article demonstrates how the vast topic of six sigma methodology is studied by various scholars and researchers in a way of learning six sigma and DMAIC methodology of six sigma in more detail.
Six Sigma has already emerged as one of the most effective business strategies in the large organizations, worldwide. Small industries are inherently capable of adopting Six Sigma as breakthrough strategy but they need to show the roadmap. Literature review has also yielded little evidence of any such implementation in a small or medium scale industry. It can be concluded that Six Sigma is not only a strategic tool, but it can be used as a process improvement tool as well. It can also lead us to intangible savings such as reduction in consumer complaints and inspection is avoided during assembly.
Application of Six Sigma in Small scale Industries has large scope, but due to lack of knowledge and awareness on latest quality tools and statistical techniques among the management, its implementation is very limited. In this context, application of Six Sigma methodology on one of the chronic problems uncovered the scope of following further study and research in industries.
Six Sigma can also be implemented over Small and Medium-Sized Enterprises such as foundries, power looms, rolling mills etc. to improve the productivity level.

Application of DMAIC methodology at other areas such as, accounts receivable, shortening development time of the new products, reducing customer complaints etc. and ultimately deploying Six Sigma company-wide.

Six Sigma implications can be studied and explored over different service organizations like healthcare, safety care, transportation, traffic management etc.

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