



# Impact of implementing Six Sigma in the Software Development Process

**Krishna Gudi**  
Research Scholar, Singhania University , Jhunjhunu, Rajasthan  
Assistant Professor, Department of Computer Science  
K S Institute of Technology, Bengaluru.

**Dr. Anup Sharma**  
Research Supervisor ,Singhania University , Jhunjhunu, Rajasthan  
Professor. Department of Computer Science  
Singhania university

**Dr Kailash pareek**  
Assistant professor ,  
Faculty of Education  
IASE deemed to be university sardarshahr, Raj

**Corresponding Author :krishna.gudi@gmail.com**

## **Abstract—**

The business environment and economics of the modern world have helped the software sector to become one of the most strategically important industries. Applications and systems that run on software are the primary motivating factor behind today's company processes. However, the process of developing software has been difficult and difficult due to its complexity. Projects related to software development have the greatest risk of falling behind schedule or being scrapped entirely. Researchers identified three fundamental problems that have a significant role in the failure of software projects. Erroneous assessment, inaccurate reporting of the current state, and poor-quality control are some of the issues. In addition to this, top executives also have a role in the development of software issues. They refuse to accept correct estimates, put detrimental pressure on the timeline that is difficult to meet, and introduce additional requirements while the work is being done on the development. This suggests that software professionals working on software development projects spend the majority of their time dealing with technical concerns, while the management side of the software development process is overlooked to a great degree. In contrast to manufacturing, the process of developing software is inherently intangible and cannot be replicated because of its very nature. When it comes to software development activities, increased degrees of process invisibility, requirement volatility, task unpredictability, and architectural ambiguity provide a number of problems that must be overcome in order to successfully adopt Lean Sigma on software projects. It was observed that the majority of professionals expressed difficulties in the following areas: setting up visual flow, identifying non-value-added activities, identifying bottlenecks and wait time to work items, setting financial benefits, and designing a Lean Sigma framework to apply to the software development process. Nevertheless, there are significant benefits to be gained by applying Lean Sigma principles to the software

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development process. In addition, the findings of the study revealed that the majority of respondents reported experiencing advantages of more than fifty percent in the areas of establishing high priority requirements to deliver value to customers, gaining visibility into all work items, cutting down on the amount of work that needed to be redone, achieving improvements in cycle time and lead time, achieving improvements in quality and productivity, and achieving customer satisfaction. It was also discovered that the software community has a very substantial degree of awareness about Lean and Six Sigma, and that software professionals have a positive attitude towards adopting Lean Sigma in order to enhance the software development process. This was proven to be the case. In conclusion, a conceptual model called Design for Improved Yield and Accuracy (DIYA) was suggested as a means of applying Lean Sigma to the process of developing software. More than two-thirds of the respondents from both the service and product segments were in agreement that the proposed Lean Sigma model holds promise for the software development process and has the potential to bring about changes incrementally leading to better processes for improved quality and productivity. There is no shadow of a doubt that the number of Lean Sigma apps used in the software development process will explode in the years to come.

**Keywords**—*Lean Sigma, Six Sigma, Improved Yield and Accuracy, Software manufacturing.*

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## I. Introduction

Businesses that are focused on the satisfaction of their customers place a significant amount of importance on the quality of the goods or services they provide, and the ability to exercise complete command over that quality confers significant advantages in the struggle against possible rivals. As a result, improving the quality has turned into a crucial component of corporate strategy, which is advantageous to a wide variety of industrial sectors, such as manufacturers, service providers, distributors, health care providers, educators, and even a great deal of governmental organisation. Consequently, in order for any company to be successful in the not-too-distant future, it is necessary to adopt strategies focused at improving the quality. In response to this need, a number of different methods for measuring quality have been developed, the most prominent of which being Six Sigma. In a nutshell, Six Sigma is a management strategy that was developed at Motorola in the [1]. Near the conclusion of the chapter, a concise explanation of how the thesis is organized into chapters is presented for the reader.

Obtaining a sigma level of 3.4 Defects per Million Opportunities (DPMO) or 99.9997 percent accuracy for each product or service that is produced by an organisation is the goal of Six Sigma, which is a project-oriented and statistically driven method to quality assessment and improvement. Defects might range from any broken instrument to an incorrectly generated invoice for the client. Any company that provides customer service is required by law to attend to the

requirements of customers and take steps to ensure that they are satisfied with the assistance they get. Companies in the information technology (IT) industry that provide technical services to clients have the distinct advantage of being in a position to draw closer to those customers, solicit their feedback, and take their opinions into consideration when developing quality improvement initiatives. Lately, a lot of businesses have been pressuring the organisation [2] that supply them with services to use the well-known Six Sigma methods if they want to keep doing business in the future. It is essential for businesses to focus on the quality of their products, as this is the essence of quality and serves as an effective strategy to meet challenges and stay ahead of the competition. Customers have increasingly high expectations regarding the high-quality of the products they purchase, so businesses have no choice but to meet these demands. Any kind of neglect or a lack of emphasis on these variables may represent a substantial danger to the industries and may even threaten the businesses' ability to continue existing. Alternately, businesses often see a decline in their client base as a result of the poor quality of the items or services they provide. Six Sigma has a major emphasis on designing and executing quantitative methods that place an emphasis on refining the process by lowering the number of faults. This is the core focus of the Six Sigma methodology [3]. The statistical interpretation of Six Sigma initiatives is prioritized much above the removal of faults in quality as the consumers see them. The frequency of flaws in the product's final output or the

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overall production yield serves as the primary determinant of the Sigma quality level.

Tab: 1 Sigma Level with yield

Sigma Quality Level (SQL)	Defects Per Million Opportunities (DPMO)	Yield
2	308,000	69%
3	66,800	93.9%
4	6,210	99.4%
5	230	99.977%
6	3.4	99.9997%

### 1.1 Six sigma

Six Sigma does not have a single definition that is regarded as the universal meaning by everyone; rather, it is described in a number of different ways by the practitioners who have contributed to the literature on the subject. As a result of this mismatch, there is a great deal of ambiguity around its description. According to [4], the term "Six Sigma" refers to a "high-performance, data-driven strategy to identifying the core causes of business issues and finding solutions to those problems." In contrast to this, Harry and Schroeder (2000), authors of a popular book on Six Sigma, described Six Sigma as a "business process that allows companies to drastically improve their bottom line by designing and monitoring everyday business activities in ways that minimize waste and resources while increasing customer satisfaction." One way to ensure that both product and process quality are improved is via the use of a method known as Six Sigma, which is a disciplined approach that is based on statistical analysis [5]. The following is how the term "Six Sigma" is defined: "Six Sigma is a statistical measurement of the performance of a process or product." As a quality control method, it tries to decrease the number of flaws or deviations in a process to 3.4 per million possibilities, hence maximizing production and raising the level of customer satisfaction. This is a very near approximation of perfection; in fact, 99.99967 percent of the time, it would be flawless [6]. [7] from the perspective of management strategy, that it is necessary for an organisation to undergo a shift in its culture in order to successfully adopt a new strategy. It is a method for the improvement of company operations, the primary

objective of which is to discover the reasons for faults and the means by which they may be removed from any and all business procedures. The primary purpose of this approach is to place the emphasis on outputs that are vital to the needs of the consumers.

The adoption of Six Sigma is a demanding process that requires massive expenditures of millions of dollars in addition to a lot of hard work and labour. Because of this, practitioners of Six Sigma need scientific expertise that can appropriately guide their efforts to execute the methodology. In addition, it is of the utmost importance to have a solid understanding of the organizational and contextual factors that either help or hinder the successful execution of Six Sigma initiatives. Because there is a dearth of scientific study, there is a barrier to thoroughly exploring the successful implementation techniques. As a consequence, the methods that are implemented, which include trial and error, might result in a larger likelihood of failure for Six Sigma. This indicates that there is an immediate need to carry out further study into Six Sigma. As a result, the primary goals of this study will be to (1) verify the significance of Six Sigma in an efficient quality management process in the Indian information technology (IT) service and manufacturing sector and (2) evaluate the business outcomes that have resulted from the implementation of Six Sigma initiatives.

The information technology industry in India places a significant amount of emphasis on markets in which the expectations of customers are rising and the product's life cycle is shrinking as a direct result of ongoing advancements. The information technology industry is dependent, for its continued existence, on the



development of innovative methods that may be used to enhance product quality in accordance with the requirements of the market. Practitioners of Six Sigma are attempting to blend management concepts with its implementations in order to achieve the goals of higher revenue, reduced costs, and customer satisfaction. Large portions of the information technology sector have not placed the necessary attention on the matter since it is a long-term undertaking that involves forward thinking and expensive costs as well as efforts. Because of this, it is very necessary to do research on the process of implementation as well as the cost-benefit analysis that is related with its implementation in the chosen IT firms. The primary purpose of the research was to explore the antecedent elements determining the efficiency of Six Sigma, the degree of adoption in the information technology sector in Karnataka, as well as the level of awareness and inclination towards adopting it to enhance quality. This study made use of the quantitative research technique since its primary objective was to collect information about the degree to which respondents believed that Six Sigma was successful in enhancing product quality. The quantitative approach was taken into account for this study since the outcomes of the quantitative analysis may be extrapolated to the whole population. A questionnaire was utilized to elicit replies from the respondents, who, in this instance, were workers working in Information Technology organisation who are either directly or indirectly engaged in the implementation of Six Sigma. Through the use of questionnaires, it was possible to investigate the views held by managers and executive staff on the significance of quality, as well as the methods and instruments that are used to enhance quality and conduct data analysis. In order to learn more about the qualities of Six Sigma, we combed through the relevant research and gathered secondary data.

## II. Literature Survey

Lean management is an approach that was developed on factory floors and focuses on achieving continuous improvement via the elimination of waste and inefficiency in the product development process at every available opportunity through the use of value stream mapping (VSM). The practice of examining the development process from idea to launch and meticulously removing any non-value-added activities (wastes) is what value stream mapping helps accomplish. This allows for the development projects to be optimized

and completed more quickly [8]. The goals of lean management are to increase the speed of the production process while simultaneously decreasing the amount of inventory that is utilized in the manufacturing process. It offers tools and strategies for distinguishing between activities in the production process that produce value and those that do not generate any value at all. After that, it makes an effort to get rid of the processes that include activities that do not bring value (wastes) [9].

On the other hand, the objective of Six Sigma is to reduce the number of faults that are determined by the customer to within six standard deviations (3.4 problems per million opportunities). It is a structured approach to the transformation of processes via the use of statistical techniques. Six Sigma is built on a robust cultural foundation, which is absolutely necessary for generating ground-breaking outcomes. Senior executives, sponsors, champions, master black belts (MBBs), black belts (BBs), and green belts (GBs) are some of the members of this robust infrastructure [10]. The manufacturing process is where the Six Sigma methodology has seen the greatest amount of application. It has been put to use as a means of providing a competitive edge in the functioning of various commercial processes. Because of its strategic relevance, Six Sigma is becoming more significant in the context of the global corporate environment. As a result, it has lately emerged as a subject of study in academic institutions and among process practitioners.

Six Sigma is a technique for the improvement of business processes that focuses on determining what is known and what is not known about the many processes that make up an organization's business. Through the use of statistical approach, it enhances the performance of the process. Six Sigma focusses its attention on the most problematic aspects of these processes and, working via problem-solving teams, takes corrective measures. These teams collaborate on various projects with the goal of minimizing process variance and eliminating faults. In addition, the Six Sigma programmed isn't simply about gathering data, monitoring performance, identifying possibilities, and enhancing the process's overall performance. Instead, it is an all-encompassing method for developing and maintaining process 28 excellence. It helps integrate a variety of beneficial management principles and best practices throughout the business, which are typically unconnected from one another. For the implementation of the Six Sigma programmed to be effective, the commitment and participation of senior

management is of the utmost importance [11]. The Lean methodology is a process transformation approach that aims to create goods and services that are quicker, better, and more affordably. It is a method for defining the value that customers receive from a product or service, aligning the activities that create value in the best possible sequence, carrying out the value-added activities in response to requests from customers, and doing so in a manner that is both more efficient and effective.

To put it another way, lean thinking is a method to accomplish more with less resources in order to provide value to the client [12]. On the other side, Six Sigma is a data-based process transformation technique that aims to achieve predictable process performance by minimizing variability in the process and eliminating errors. It is a strategy for the transformation of businesses that focuses on removing the factors that lead to flaws in business procedures in order to maximize the delivery of value to consumers.

While Six Sigma is more concerned with the precision and correctness of the process, Lean is more concerned with how quickly and efficiently the process can be completed. In addition to this, Lean guarantees that limited resources are constantly working on the appropriate tasks, while Six Sigma ensures that things are created correctly from the beginning [13]. The Lean Six Sigma methodology is a combination of the Lean and Six Sigma approaches to problem solving. It employs tools and strategies from both approaches in order to achieve the highest possible level of both speed and accuracy in its results. The goal of the Lean Six Sigma business transformation technique is to maximize shareholder value by increasing productivity, enhancing quality, decreasing costs, and reaching higher levels of customer satisfaction [14]. The elimination of non-value-added tasks from the process, the reduction of defects, the improvement of cycle time, and the speed with which value is delivered to the client are all advantages of implementing Lean Six Sigma [15]. The Lean technique places an emphasis on the use of a minimal number of resources, including money, people, and material, in order to rapidly create and deliver solutions to consumers. Nevertheless, the approach does not have the discipline necessary to consistently generate predictable outcomes. This is due to the fact that the Lean technique entails doing an informal study of the workflow, which is then followed by the quick re-alignment of the process. Although this strategy is

capable of fast achieving process improvement, it is unable to consistently provide the necessary outcomes.

On the other hand, the Six Sigma strategy prioritizes the enhancement of knowledge-gathering procedures as a means of improving product quality. It has been discovered that this results in practices that are more mindful and take more time. The Lean technique and the Six Sigma methodology have been merged in a number of companies in order to speed up the improvement process. When this is done, a synergy between two different ways is created, which leads to more productive and expedient outcomes than would be the case if each of the methods were used on its own [16]. It has been noticed that businesses made significant strides with Six Sigma, and then spent a number of months attempting to cut down on lead time. This information is made clear in GE's Annual Report for the year 2000. Jack Welch made the announcement that one of GE's extra goals is to shorten the lead time. Six Sigma does not directly address the issue of process speed, which accounts for the lack of improvement in lead time seen in businesses that rely only on Six Sigma. These businesses often see a moderate improvement in their work in progress (WIP) and inventory turnover. On the other hand, a significant number of businesses that have not seen significant progress in inventory turns have, in fact, sought to implement Lean practices. These businesses have had some measure of success, but it's been limited to certain domains. According to the findings of the investigation, progress across the whole firm is moving at a snail's pace without Six Sigma. It is not possible to put a process under statistical process control using lean techniques, and the Six Sigma methodology by itself cannot significantly increase the speed of a process. When a corporation applies the Lean techniques and the Six Sigma approaches concurrently, significant gains may be made across the organisation much more quickly. This is because both sets of methodologies focus on eliminating waste. In order to attain greater quality, cheaper costs, and shorter lead times, it is necessary to integrate Lean and Six Sigma improvement approaches [17]. Both Lean methodologies and Six Sigma approaches, when used on their own, are successful. However, there is a possibility that some companies that have implemented Lean or Six Sigma by themselves may, at some point in time, reach a point of diminishing returns. After these companies have addressed big issues and addressed critical inefficiencies in their business processes, it is difficult to make



additional improvements for these companies. They have little choice but to look in other areas for potential sources of competitive advantages. Naturally, Lean firms are looking into Six Sigma strategies, while Six Sigma organisation are looking into Lean procedures. Both of these trends are mutually beneficial.

In order to enhance their processes, lean businesses might take a more scientific approach and make better use of data in their problem-solving and decision-making processes. On the other hand, Six Sigma firms have the ability to eradicate any and all sorts of activities that do not bring value to their company operations in order to enhance their lead time. John H. Sheridan coined the phrase "Lean Sigma" in the year 2000 to refer to a technique for the enhancement of processes that combines the aforementioned two ideas [18]. These days, the corporate transformation technique known as "Lean thinking" as well as the statistical process improvement paradigm known as "Six Sigma" have both seen a great deal of success in a broad variety of sectors. Both of these ideas are powerful drivers of change when used independently as techniques. They have the potential to become a very potent approach for the improvement of processes if they are combined. If the Lean approach is implemented without the Six Sigma quality management system, there will be a lack of tools and strategies to make the most of the potential for improvement. On the other side, if Six Sigma is implemented without Lean thinking, then there will be a vast supply of tools and methods available for the team working on the process improvement to exploit, but there will be no plan to go ahead with the deployment of those tools into a system. The immense potential for attaining operational excellence that lies in creating alignment between the cultural characteristics of the Lean method and the data-driven approach of Six Sigma [19].

In contrast to manufacturing, the process of developing software is inherently non-repeatable and non-tangible due to its nature. Every software

development project is one of a kind and distinctive. The application of Lean Sigma to software development projects is complicated by the increased degrees of task uncertainty, process invisibility, and architectural ambiguity that are inherent in software development operations. As a result, it is necessary to investigate the difficulties involved in putting Lean Sigma into practice in order to enhance the software development process.

- A significant increase in effort is required to implement Lean Sigma in order to enhance the software development process. It is necessary to investigate the benefits that Lean Sigma may bring to the improvement process without compromising the level of quality or productivity already achieved.
- Since Lean and Six Sigma were initially developed for the manufacturing sector, it is necessary to conduct research into the knowledge level and attitude of the software community in India to determine whether or not they are willing to adopt Lean Sigma in order to enhance the software development process.
- It was discovered that there is no universally accepted methodology or structure for putting Lean Sigma into practice. It is necessary to construct it around a particular commercial setting while taking use of the positive aspects of both ideologies. As a result, it is necessary to build the general model for applying Lean Sigma in order to enhance the software development process.

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### III. Materials and Methodology

The essential assumptions that were recognized at the beginning of the study, which define acceptable knowledge and how it is generated, drove the researcher in the development of the research strategy that was employed by the researcher [20]. The research methodologies and procedures that were chosen as part of that plan are built on the basis of the assumptions that were developed over the course of the investigation(Figure. 1).

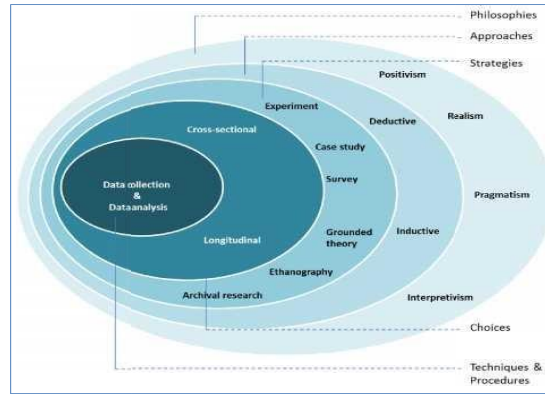


Fig. 1 Onion structure Representation of sale

### 3.1 Qualitative research

The qualitative research technique is an exploratory approach that may be used to identify the issue or establish a strategy for dealing with the problem. Particularly in situations in which the results cannot be predicted and in which it is unclear what to anticipate, this strategy may be helpful. It is based on the socially produced facts and people's opinion, neither of which can be assessed statistically since they are socially built (Noor, 2008). In addition to this, it goes deeply into topics that are of interest and analyses the intricacies that are connected to the situation at hand. In a similar vein, it is more likely to show the attitude, behavior, and

motives of the responder rather than just the specifics of what, where, and when it occurred.

The primary goal of the qualitative research technique is to exhibit a feature of a scenario and to provide research reports that explain the researcher's competence in characterizing an observed phenomenon. This is the primary purpose of the qualitative research method. This approach has a number of notable advantages, the most notable of which are the richness and depth of the investigations. Table 1 provides a concise explanation of the various research approaches.

Tab: 2 Difference between Quantitative and Qualitative research methods

Description	Quantitative	Qualitative
Role	Fact-finding based on evidence or record	Attitude measurement based on opinions, views and perceptions measurement.
Epistemological assumption	Positivism	Phenomenology
Relationship between researcher and subject	Distant	Close
Aims of inquiry	Universality	Particularity
Scope of findings	Nomothetic	Idiographic
Relationship between theory/concept and research	Testing/confirmation	Emergent/development

Nature of data	Hard and reliable	Rich and deep
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**3.1.1 An innovative approach**

In order to arrive at findings for the study, two theoretical research methodologies have been used. Both inductive and deductive techniques are described here. The inductive research methodology may be described as the "logical process of developing the general premise on the basis of the observation of individual facts." The inductive methodology entails the collection of data, its subsequent analysis, and the development of a model based on the findings acquired.

There are a number of research that have been conducted on the efficacy of Six Sigma; however, these studies do not have a clear correlation to the efficacy of Six Sigma in the Indian information technology sector. The examination of a selection of these studies will make it possible to get a deeper comprehension of the fundamental core relationships, linkages, and principles behind the efficacy of Six Sigma. Due to the fact that this investigation was conceived of as quantitative research that would be centered on the gathering and examination of data, the deductive method was chosen as the appropriate method to use. In that strategy, the authors write that "a deductive research approach is suggested to be suitable for scientific research," in which the researcher develops a hypothesis, which is then tested and examined to establish or revise a theory. This strategy was the basis for the strategy that was selected.

The primary objective of this research project was to investigate how successful the Six Sigma strategy was in enhancing the quality of products manufactured or provided by the Indian information technology services sector. As a result, it was vital to identify the variables that contribute to the efficacy of adopting Six Sigma in quality improvement processes and to get an understanding of what the Critical Success Factors are that supports the implementation of Six Sigma.

The primary objectives of this research are to analyses and evaluate the antecedent elements that determine the success of Six Sigma, the degree of

adoption in the Indian IT sector, and awareness and inclination towards adopting it to enhance quality.

This study made use of the quantitative research technique since its primary objective was to collect information about the degree to which respondents believed that Six Sigma was successful in enhancing product quality. Quantitative techniques are used so that the findings of the quantitative analysis may be extrapolated from samples to the whole population. The technique of answer generation known as the questionnaire was used to investigate how the managers and executive staff see the significance of quality, as well as the methods used to enhance quality and the data analysis that is described in the next chapter.

**IV. EXPERIMENTAL RESULTS**

A group of questions that have been arranged in a structured fashion for the purpose of gathering information from respondents is known as a questionnaire. The step of the study design process that involves the creation of the questionnaire is a crucial aspect. When large amounts of data need to be gathered in a relatively short amount of time, the approach of surveying through questionnaire is often utilized. In most cases, a time period of two weeks is adequate to gather data; nevertheless, a buffer period should be taken into consideration in case any returns are received later than expected. This technique is used in the process of data collection for both descriptive and analytical surveys. It is a subjective method in which the respondents' own opinions are taken into consideration. The questions that are posed should be straightforward and straightforward for the responders to understand. The questions may be open-ended, closed-ended, or a combination of the two. It should have concise directions for its completion, together with a variety of answer options and an adequate mechanism for recording the results of the completion.

Tab: 3 Comparison of Fairness, Peak and Average Throughput

Parameters	UFRS	NCRS	RERS
Fairness Index	0.607	0.774	0.64
Peak Throughput	2.56	4.48	3.07
	UE Mb/s	Mb/s	Mb/s
Average	1.07	2.24	1.31
	UE		





Throughput	Mb/s	Mb/s	Mb/s
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It is essential that enough precautions be taken to guarantee that the questions that are posed are founded on the research issue as well as the research purpose. The key benefit is the high validity of the findings that may be obtained in a very short amount of time. Nevertheless, it precludes the possibility of

discussing, clarifying, investigating, or delving further into the topic at hand. In addition, the characteristics of the people who responded have an influence on the reliability of the data. It is possible to distribute questionnaires by hand, by mail, over the phone, or over the internet.

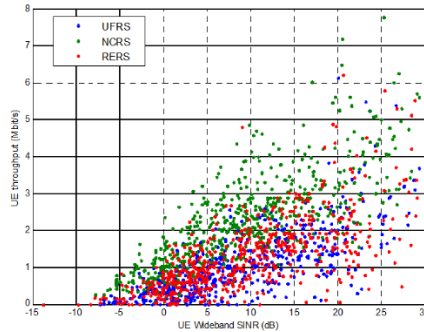


Fig. 2 Throughput mapping

The research tool that was utilized for this study was a questionnaire survey that the participants had to fill out on their own. this approach is an effective way for

collecting data since it ensures the acquisition of meaningful and consistent information. Additionally, the replies are objective, standardized, and comparable.

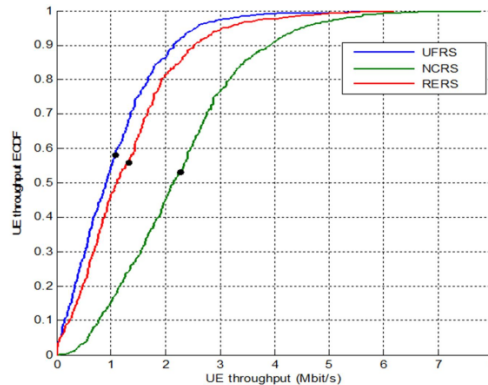


Fig. 3 Peak throughput

The information was obtained from a variety of information technology businesses located in Karnataka over the course of one month. Both personally and by email, a total of one thousand questionnaires were sent

out to various participants. Only 336 of the 500 questionnaires that were returned were full and useful, thus those 336 questionnaires were kept for study while the other questionnaires were thrown away.



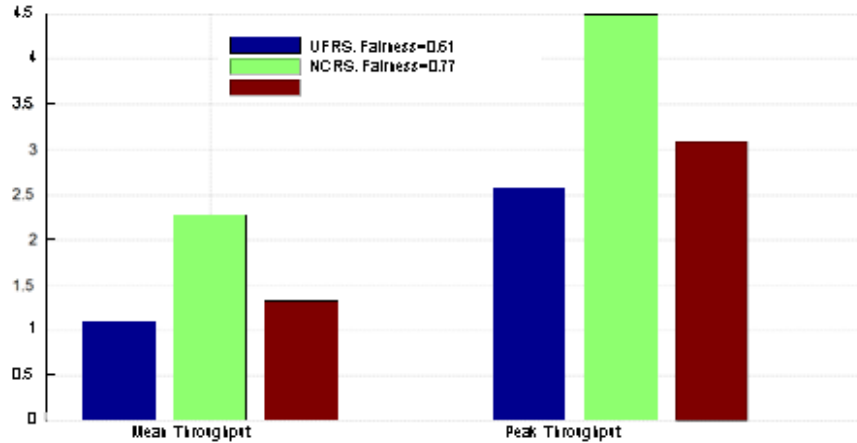


Fig. 4 Mean and peak throughput

It has been demonstrated that Six Sigma is an effective strategy for addressing quality-related issues in a variety of organisation, particularly in manufacturing, but its usefulness in the context of the information technology industry has not yet been widely

established. Due to the fact that Six Sigma is an advanced quality management approach, its usefulness in the IT sector was selected to be the primary focus of this project. In order to accomplish what needed to be done, the following hypotheses were developed.

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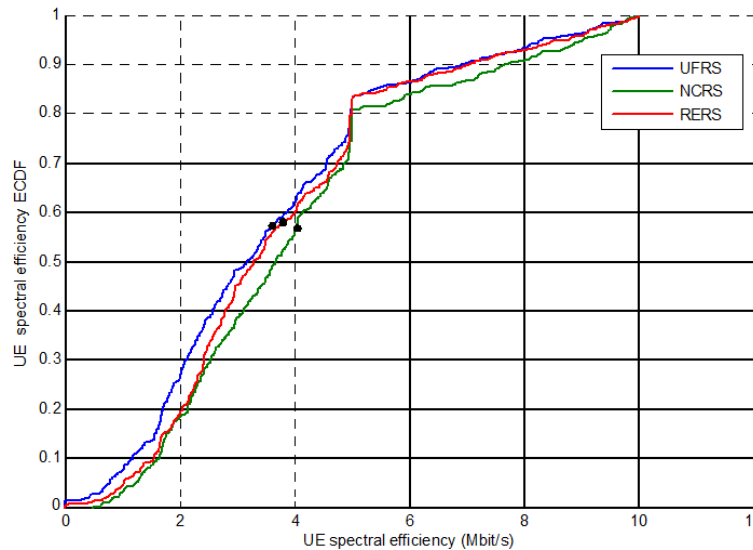


Fig. 5 Spectral efficiency

Aftereffects of implementing Six Sigma's quality management system

The use of Six Sigma may have both physical and intangible effects on the results of a project. The manufacturing, service, and information technology sectors, among others, are taken into consideration. Six Sigma's most significant contributions to the information technology sector have been the shortening of delivery times and the cutting of associated expenses.

**V. CONCLUSION**

Descriptive In order to explain the fundamental aspects of the data that were gathered, statistical analysis was used.

This analysis included summaries of the sample and the measurements, as well as straightforward visual analysis. Calculates standard values and provides a description of the univariate summary of statistics for many variables that are shown in a single table. The presentation of variables may follow either an alphabetical ascending or descending order, or it can follow the order in which they appear by default. The Kaiser-Meyer-Olkin (KMO) metric was used to evaluate the appropriateness of the sampling. It is allowed to have a number that is higher than 0.6. The significance level of the test statistic for sphericity was determined using a Chi-squared transformation of the correlation matrix



determinant as the basis for the calculation. The factorability of the correlation matrix is validated by a Bartlett's test of sphericity result that has a very significant level of significance. To forecast the value of a dependent variable based on the value of an independent variable, a basic linear regression makes advantage of the fact that there is a linear connection between the two variables. The dependent variable is sometimes known as the outcome variable, while the independent variable is also referred to as the predictor variable or the regressor variable. The simple linear regression test was used for the purposes of determining whether or not there were any significant correlations or differences between the variables, as well as to validate the study hypotheses.

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