

**A STUDY ON EFFECTIVENESS OF “SIX SIGMA
IMPLEMENTATION ON PRODUCTIVITY CYCLE IN
“UNITED INDUSTRIES PLASTICS PRIVATE LIMITED” AT
CHENNAI.**

Submitted in partial fulfillment of the requirements for the award of

MASTER OF BUSINESS ADMINISTRATION

by

MOHAMED ASKAR P.K

Register No.41410200



SCHOOL OF MANAGEMENT STUDIES

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade “A” by NAAC | 12B Status by UGC | Approved by AICTE
JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119**

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **MOHAMED ASKAR P.K 41410200** who carried out the project entitled "A STUDY ON EFFECTIVENESS OF "SIX SIGMA IMPLEMENTATION ON PRODUCTIVITY CYCLE IN "UNITED INDUSTRIES PLASTICS PRIVATE LIMITED" AT CHENNAI" under my supervision from January 2023 to May 2023.

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DATE: 05.05.2023



PLACE: Chennai

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ABSTRACT

The project report was undertaken **UNITED INDUSTRIES PLASTICS PRIVATE LTD at SRIPERUMBUDUR**. The main aim of the study on **EFFECTIVENESS OF SIX SIGMA IMPLEMENTATION ON PRODUCTIVITY CYCLE** based on the quality and production in achieving potential growth rate of the company. The research was done by using descriptive research method. The study has been done on the topic, “ A Study on effectiveness of Six Sigma implementation on productivity cycle”, to understand the process and effectiveness of implementing Six Sigma is a disciplined, data driven approach and methodology for eliminating defects (driving towards Six standard deviations between the mean and the nearest specification limits) in any process from manufacturing to transaction and from product and services. The scope of the study is the project will help the management to know the effectiveness level of workers about six sigma methodology. And it also to finding help of the management to implement six sigma model effectively. The main objective of this study is on effectiveness of six sigma on production and quality aspect in **United industries plastics private limited at sriperumbudur**. The data has been collected using questionnaire and it has been analyzed. Analysis of data in a general way involves a number of closely related operations that are performed with the purpose of the collected data and the organizing them in such a manner that answer the research questions. The whole chapter of analysis and interpretation is based on the responses of 110 respondents who were administered with a questionnaire which contain the personal data their views about the effectiveness of six sigma implementation on productivity cycle. In a study it is found that the effectiveness of Six Sigma implementation on productivity cycle at United Industries Plastics Private limited is much effective and it also emphasizes the simplicity of the process and quality of parts and also it has improved the responsibility in achieving targets. From this study it can be concluded that the effectiveness of Six Sigma implementation helps the organization in various multiple aspects.

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CHAPTER 1 - INTRODUCTION

CHAPTER 1

1.1 INTRODUCTION TO THE STUDY

"Perfection is not attainable, but if we chase perfection, we can catch excellence" Six Sigma (6σ) is a set of techniques and tools for process improvement. It was introduced by American engineer Bill Smith while working at Motorola in 1986. Jack Welch made it central to his business strategy at General Electric in 1994.

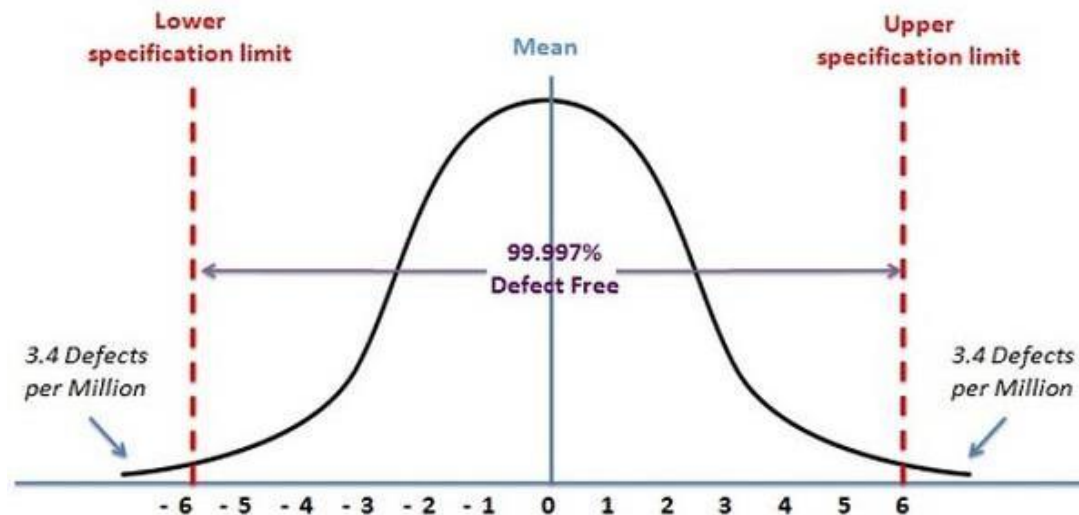
Six Sigma strategies seek to improve the quality of the output of a process by identifying and removing the causes of defects and minimizing impact variability in manufacturing and business processes. It uses a set of quality management methods, mainly empirical, statistical methods, and creates a special infrastructure of people within the organization who are experts in these methods. Each Six Sigma project carried out within an organization follows a defined sequence of steps and has specific value targets, for example: reduce process cycle time, reduce pollution, reduce costs, increase customer satisfaction, and increase profits.

Origin of Six Sigma:

- **critical to quality:** The customer is the start what is important for the customer need to be identified.
- **Defects:** Anything that does not deliver exactly what the customer wants.
- **Process capability:** The processes need to be deliver what the customer wants.
- **Variation:** As it experienced by the customers.
- **Stable operations:** The goal is to secure reliable route that improve the customers experience.
- **Design for Six Sigma:** The design must meet all the customer requirements and the capability of the process.

The term Six Sigma originated from terminology associated with statistical modeling of manufacturing processes. The maturity of a manufacturing process can be described by a sigma rating indicating its yield or the percentage of defect-free products it creates specifically, to within how many standard deviations of a normal distribution the fraction of defect-free outcomes corresponds. A six sigma process is one in which 99.99966% of all opportunities to produce some

feature of a part are statistically expected to be free of defects.. Motorola set a goal of "six sigma" for all of its manufacturing operations, and this goal became a by-word for the management and engineering practices used to achieve it.



Master Black Belt identified by champions, act as in-house coaches on six sigma. They devote 100% of their time to six sigma. They assist champion and guide Black Belts and Green Belts. Apart from statistical tasks ,they spend their time on ensuring consistent application of Six Sigma across various functions and departments.

Black Belt operate under Master Black Belts to apply Six Sigma methodology to specific projects. They devote 100% of their valued time to Six Sigma. They primarily focus on Six Sigma project execution and special leadership with special tasks, whereas Champions and Master Black Belts focus on identifying projects/functions for Six Sigma.

Green Belt are the employees who take up Six Sigma implementation along with their other job responsibilities, operating under the guidance of Black Belts.

Continuous efforts to achieve stable and predictable process results (e.g. by reducing process variation) are of vital importance to business success. Manufacturing and business processes have characteristics that can be defined, measured, analyzed, improved, and controlled. Achieving sustained quality improvement requires commitment from the entire organization, particularly from top-level management.

Features that set Six Sigma apart from previous quality-improvement initiatives include:

- A clear focus on achieving measurable and quantifiable financial returns from any Six Sigma project.
- An increased emphasis on strong and passionate management leadership and support.
- A clear commitment to making decisions on the basis of verifiable data and statistical methods, rather than assumptions and guesswork.

The term "six sigma" comes from statistics and is used in statistical quality control, which evaluates process capability. Originally, it referred to the ability of manufacturing processes to produce a very high proportion of output within specification. Processes that operate with "six sigma quality" over the short term are assumed to produce long-term defect levels below 3.4 {defects per million opportunities (DPMO)}. The 3.4 dpmo is based on a "shift" of ± 1.5 sigma explained by Dr. Mikel J. Harry. This figure is based on the tolerance in the height of a stack of discs. Six Sigma's implicit goal is to improve all processes, but not to the 3.4 DPMO level necessarily. Organizations need to determine an appropriate sigma level for each of their most important processes and strive to achieve these. As a result of this goal, it is incumbent on management of the organization to prioritize areas of improvement

DMAIC

The DMAIC project methodology has five phases:

- Define the system, the voice of the customer and their requirements, and the project goals, specifically.
- Measure key aspects of the current process and collect relevant data; calculate the 'as-is' Process Capability.
- Analyze the data to investigate and verify cause-and-effect relationships.
- Determine what the relationships are, and attempt to ensure that all factors have been considered. Seek out root cause of the defect under investigation. Improve or optimize the current process based upon data analysis using techniques such as design of experiments, poka yoke or mistake proofing, and standard work to create a new, future state process. Set up pilot runs to establish process capability.
- Control the future state process to ensure that any deviations from the target are corrected before they result in defects. Implement control systems such as statistical process control, production boards, visual workplaces, and continuously monitor the process. This process is repeated until the desired quality level is obtained.

DMADV

The DMADV project methodology, known as DFSS ("Design For Six Sigma"), features five phases:

- Define design goals that are consistent with customer demands and the enterprise strategy.
- Measure and identify CTQs (characteristics that are Critical To Quality), measure product capabilities, production process capability, and measure risks.
- Analyze to develop and design alternatives.
- Design an improved alternative, best suited per analysis in the previous step. Verify the design, set up pilot runs, implement the production process and hand it over to the process owner(s).

1.2 INDUSTRY PROFILE

INTRODUCTION

The automotive sector is one of the most important economic catalysts in every country. It creates direct and indirect industry covering almost all products of steel, rubber, plastics and electronics. 66.5 million passengers and commercial vehicles were produced in the world, with the installed capacity of 85 million. A more recent report by OICA (2016) shows that the production has increased by 15% to 78 million vehicles. A typical automotive project will require direct and indirect human resources from many functional organizations and facilities such as workers, suppliers, consultants and partners spread across the country and throughout the world), increased competition, global markets, and more challenging customers are all contributing factors that should be the main focus of today's business environment.

At the product and process development stage, product engineers will start to design hundreds of individual new parts such as doors, hood, roof and tailgate. With the current trend of speed to market, some of the parts are carryover parts especially the inner parts and floors that are hardly noticed by customers (Ghosh and Morita, 2008). Although it saves cost, this concept is a challenge to product engineers to manipulate the new parts that fit together and attach to the existing parts. Later, by using soft tooling process, these parts will be produced and assembled together to form a prototype car. The purpose of prototype car is to check abnormalities to the parts fitting, assembly process, and testing. Concurrently,

production engineers and suppliers use the completed product designs to design and build production tools to suit high volume output. These tools are comprised of dies, molds, and other similar devices that transform raw materials such as steel, rubber, plastics and glass into loose finished parts. In addition, assembly tools will act to weld or fasten two or more parts together into sub-assemblies, main assembly and finally transform into complete products.

KEY FEATURES AND TRENDS IN THE GLOBAL AUTOMOTIVE SECTOR

The starting point is a comparison between the automotive sector and other manufacturing sectors. In some respects, the automotive industry shares several features with other manufacturing sectors. Foreign direct investment (FDI), global production and cross-border trade have increased at an accelerating rate since the late 1980s, facilitated by trade and investment liberalization through World Trade Organization (WTO) agreements. Large emerging such as India, China and Brazil offer large real and potential markets, and have a large surplus of low cost labor. These factors have encouraged large FDI flows into these countries, with the aim of supplying local markets and also exporting back to developed the organization.

MANAGE SOURCE:

Organization of motor vehicle manufacturer's global production statistics increasing retail prices. These measures have impacted negatively on the lower tiers of the supply chain. Wad (2010) also examines the relatively smaller impact felt by developing countries. Firstly, the financial systems of developing countries were on the whole less integrated into the global financial system, and were therefore less exposed to the sophisticated financial instruments that played a key role in triggering the crisis. As a result, consumer credits for automobile purchases were not restricted to the same extent as in developed countries. Also, while in the USA 80% of vehicles are purchased through credit, in China 80% of vehicles are purchased through cash. To the regionalization of assembly, declining local demand eventually forced assemblers to reduce their local production accordingly. However, production and employment have been reduced proportionally more than downward sales in Western Europe, NAFTA, and Japan. In developing countries, production and employment have fallen less than vehicle sales.

HIGH VOLUME AUTOMOTIVE MANUFACTURING

The development costs for automotive models have increased over the years due to the unavoidable resource costs such as raw material, labour and services. Hence, automakers are extensively doing research on how to reduce these costs. One attempt is to reduce the number of platforms, as suggested by Kim (2003). The idea is to have a multiple vehicle variant of a single platform. By implementing this concept, many parts can be shared between car models which reduce the tooling costs tremendously. High Volume Automotive Manufacturing (HVAM) involves many high technology tools ranging from such as dies, jigs and robots. Using this platform commonisation technique undoubtedly reduces cost, time to market and quality as well as more choice to end users.

LOW VOLUME AUTOMOTIVE MANUFACTURING (LVAM)

Automotive manufacturing sector globally is increasingly becoming a competitive industry which requires new car models at a lower cost, but at higher quality (Miguel. 2006). Current market trends require faster product development, lower cost and higher quality products (Nagamaniahat act 2008), Niche car models such as luxury, sports and special purpose vehicles are core of the viable strategies to sustain the market choices, which is achieved through Low Volume Automotive Manufacturing (LVAM), defined as 25,000 – 30,000 unit as per a The norm route of car making process is not inter able to be implemented for LVAM. Because the normal route involves higher costs and longer project scheduling, Niche models of LVAM require high customization, especially when related to design concepts, manufacturing methods.

AUTOMOTIVE DESIGN CONCEPT

Product creation process or design concepts and the states that get insights into opportunities and focus on activities that help to prevent failures (Uetal, 2006) The automotive industry should consider various aspect such as manufacturing. Regulations, suppliers and customers According to Yadav and Goel (2008 vehicle attributes such as fuel economy, emission, vehicle dynamics, performance, NVH (noise, vibration and harshness), aerodynamics, climate control, packaging cot, and weight are the characteristics or requirements needed in automotive industry. Therefore, it is important to integrate these attributes with the identified customer, corporate, and regulatory requirements into a vehicle concept such as LVAM.

PRODUCT /TOOL DESIGN

In automotive industry, there are two types of designs, namely product design and tooling design. Product design is related to the parts of the entire automotive body and chassis structure such as side panel, doors, hood, doors that total up to more than 300 parts). Tooling design is related to the tools required for transforming the material into parts such as dies and mould tooling design is also required for body assembly fixtures fabrication. Normally, the automotive manufacturers design the parts according to their own specifications, and requirements (Park act 2001).

MANUFACTURING

The manufacturing process for automotive industry normally complicated, expensive, long and risky (Nobelius, 2004). However, different companies have various strategies to achieve their goal (Crawford and Bryce, 2003) such as platform sharing (Kim, 2003), data base design (Cleveland, lean manufacturing system (Flores, 2003) and common tooling (Brown, 2004). For LVAM, the manufacturing environment different from the HVAM because the nature of LVAM is slower in production speed compared to mass production, hence, there must be new approach to shorten the processes without compromising on the quality, cost and delivery of the car.

MATERIALS

Material is one of the most important aspects every manufacturing industry. Due the low volume environment, the correct choice of material will definitely become an advantage to this automotive segment generally, the car body and its interior accumulate for about 40 of the total vehicle weight. Multi-material designs provide more opportunities for weight saving and lower cost compared to single-material structures. Multi-material combination method provides opportunities for designers to fully exploit the benefits of material and achieve the optimal production

TOOLING AND PROCESS

In automotive manufacturing plant, there are four major shops that have different functions in the manufacturing processes, stamping shop, body paint shop, and trim and final shop. However, according to Joly and Frein (2008), production process involve three shops the body shop, the paint shop and the assembly shop. This is because the stamping shop in the automotive environment is separated from the main production line and has its own

production line that produces stamped parts. These parts will be transported to the body shop for assembly process the main line based on the scheduled date.

STAMPING

In the stamping shop, stamping dies are required to produce 250-300 of the automotive body in- white parts (Sweeney and Grunewald, 2003). Stamping process transforms flatsheets into a complex geometry parts including various forming, cutting and bending techniques (Shivapuri and Zhang, 2009). According to Nakagawa (2000). In general, metal forming is suitable for high volume production, but not for low volume production This is because each part shape requires individual die to form the geometry resulting in high costs. However, the press sheet forming is still a very practical method to produce a part even for small lot production.

BODY ASSEMBLY

Body assembly is the second process in the automotive production which combines individual parts or components to become a complete body in white. It is a complex architectural systems which requires synchronization and interaction of many components (Mondragon et al., 2009) According to Miguel (2006), modularity is an approach for building a complex product or process by combining smaller subsystems that can be designed independently and then assembled together to become a complete system. This modularity can be applied both in design and in production. modularity in design means the design boundaries of a product and its components; whereas modularity in productions is related to plant design boundaries to cater for manufacturing and assembly requirements such as product variety production flow and quality.

QUALITY

It becomes a difficult task for automotive manufacturers to meet not only the must-be quality but also to reach the level of attractive quality. The automotive manufacturers should consider good/attractive product appearance, high surface quality as well as superior performances in durability, NVH characteristics and crash worthiness.

Another key element in manufacturing is Quality Function Deployment (QFD). QFD is a well structured, cross-functional planning technique that is used to hear the customers' voice throughout the marketing analysis, product planning, design, engineering, manufacturing and supply processes (Bhattacharya et al., 2010). A complete QFD involves the House of Quality

(H00) construction diagram, which helps company views the relationship between the employs.Requirements of the customer and the design characteristics of the new or improved product. It is also considered as crucial for the TOM implementation programme because the function of H00 is to identify what are the customer requirements and then to relate to measurableand prioritized of engineering targets.

SUPPLIERS

Suppliers and manufacturers play important roles in delivering products to customers (Shafia et al., 2009). Effective supplier management is essential in automotive industry which involves materials, components and services because it will determine the performance of the particular manufacturer. According to Udin (2006). The performance of suppliers is critical to the automotive quality and it is directly related to the supplier quality management. For this reason, the automotive industry has developed its own QS 9000 standards to be practised within the automotive supply chain (Nawawi, 2009). In the current global competition environment, suppliers should increase their innovation capabilities by taking the advantages of new technology and work as solution providers rather than just supplying (Mondragon et al., 2009). Another flexible approach is known as supplier park whereby clusters of suppliers are grouped together close to automotive manufacturers' production site (Howard et al, 2006). The objective of a supplier park is to easily integrate orders made by the main automotive production based on production schedules.

1.3 COMPANY PROFILE

HISTORY OF UNITED INDUSTRIES

United Industries Plastic Private Limited is United Group of Industries is promoted by Shri. R. Mahalingam, Pioneer in Plastic Industry having over 30 years of experience. His passion for Professionalism and Loyalty to customers made him to stay ahead of his competitors and become customers preferred choice till date. United Group was found in 1985 as a small injection moulding unit at Chennai with two machines. With commitment to quality and customer service the business started growing at a greater pace. Currently the group employs around 500 people. Now United Industries(UI) is headed by Shri. M Karthik Krishnan, BE, MBA, MFE, S/o Shri. R. Mahalingam. In order to cater to the growing Automotive Segment third plant was started at Pillaipakkam, Chennai with higher tonnage machines (up to 1800 T) and with state of the art facilities. UI caters to Tier 1 vendors of

Hyundai, Ford, Reno-Nissan, Toyota and Daimler. We also cater to TI Cycles, Schneider Electric, Samsung Wheels India, Brakes India and TVS Rubber.

- Indian tier 2 supplier to the Automotive Industry with focus on Injection Moulding and Assembly Process.
- Indian tier 1 supplier to the Home Application with focus on Injection Moulding and Assembly Process.
- Automotive and white goods specialists.

VISION

UNITED INDUSTRIES will be the most preferred source of total plastic injection moulding solutions for its customers within the next 5 years.

MISSION

- Consistent top rating from customers in Q.C.D.S.
- Sales turn over INR 325 cores by 2021-2022.
- Enhance performance through professional management.
- Develop & Manufacture own products.

QUALITY POLICY

We are committed to consciously and continually improve systems & quality of our products through latest quality management systems and to exceed customers requirement in a most cost effective way.

QUALITY OBJECTIVES

- To achieve customer satisfaction as 100%.
- To achieve on time delivery as 100%.
- To achieve customer end rejection as 50 ppm.
- To reduce IN-HOUSE REJECTION.
- To reduce IN-HOUSE BREAKDOWN.

OUR MAJOR MILESTONES

- 1985 - The humble beginning.
- 1988 - Installed first semi auto machine.
- 1996 - Started united plastic company at EKKATUTHANGAL.
- 2000 - Installed 450T machine
- Entered auto parts industry
- 2005 - Started new plat at MANAPAKKAM.Installed 600T machine.
- Achieved sales INR 4.5 Cr INR.
- 2007 - Achieved sales INR 9.0 Cr (USD 3.0 Mn).Started supply to hand automotive.
- 2009 - Achieved ISO 9001 :2008/TS 16949:2009.
- 2010 - New plant started MOULIVAKKAM target sales INR 25 Cr (USD 5 Mn).
- 2011 - Achieved sales INR 43 Cr (USD 6.5 Mn).
- 2012 - Achieved sales INR 59 Cr (USD 11.73 Mn).
- 2014 - New plant at PILLAIPAKKAM up to 1800 ton.
- 2015 - Achieved sales INR 73 Cr (USD 12.58)Mn.
- 2016 - Achieved ISO 9001 : 2008/TS 16949:2009 for united plant 3.
- 2017 - Achieved sales INR 149 Cr (USD 22.24)Mn.
- 2018 - Achieved sales INR 234 Cr (USD 36)Mn.
- 2019 - Achieved sales INR 275 Cr (USD 71)Mn.
- 2020 - Target INR 325 Cr.

1.4 PROBLEM STATEMENT

The research problem of this study is to analyze the effectiveness and practice of six sigma methodology in the organization. To help the management to implement six sigma methodology which will lead to reduce the defects and increase the cycletime on productivity in an organization.

1.5 OBJECTIVES OF THE STUDY

PRIMARY OBJECTIVES

A study on effectiveness on Six Sigma implementation productivity cycle on quality and process based in United Industries Plastics Private Limited at Sriperumbudur.

SECONDARY OBJECTIVIES

To analyse the effectiveness of six sigma implementation on productivitycycle.To improve cycle time time on productivity. To improve the quality of the product.

NEED AND SCOPE OF THE STUDY

1.6 NEED OF THE STUDY

- To make awareness about six sigma benefits among the worker's.
- The company may implement the six sigma principles through source of the standard principle.
- By implementing six sigma methodology the organization could utilize their resource effectively.

1.7 SCOPE OF THE STUDY:

This project will help the management to know the effectiveness level of workers about six sigma methodology. This study will help the management to know about the various typical activities of six sigma. This study will help the workers to have a very clear understanding about the six sigma principles. The finding of the study to help the management to implement six sigma model effectively.

CHAPTER 2 REVIEW OF LITERATURE

CHAPTER 2

REVIEW OF LITERATURE

INTRODUCTION

A Literature survey is a text of an insightful paper, which incorporates the current information including considerable discoveries, just as hypothetical and methodological contributions to a specific point. Literature reviews are auxiliary sources, and don't report new or unique test work. The subject of effectiveness of six sigma implementation on productivity cycle has filled in prominence among researchers examining on inspecting how environmental sustainability process work inside associations, since the execution of production process will fail without the combination of quality practices committed to natural issues.

2.1 REVIEW OF LITERATURE

- **Tapan Vora, 2014.** Six Sigma is used as business improvement method, aimed for achieving defect free quality in products and services. It is considered as the latest tool in respect of quality, widely used worldwide for obtaining the finest quality in products and services. It is modeled and designed in such a way, to acquire huge money oriented results through gain in Productivity and improvement in Quality. According to T Vora, Six Sigma is a quality based tool and a technique, which may be used in any organization to improve the process. It was initially used in manufacturing, but now in all the areas of the organization. It is purely based on the defect rate and it can be measured on a mathematical scale. Six Sigma is based on data and the data's are collected from the actual process involved in the industry. It is a financially achievable model and is a result based procedure. Six Sigma develops a culture of everlasting, slow and steady, and an upward improvement that leads to finer services and improves the organization's competitive position in the world market. Six Sigma is based on facts and use a systematic methodology that is used to create an unimaginable type of performance in the business. It basically focuses on customer wants and needs. It is used to solve difficult problems when the major reasons of the problem or its answer is not known. Metrics used in six sigma projects should be simple and meaningful, easy to apply and be related to key customer and business requirements. Many organizations use the goal of organization with acronym SMART

to characterize good measures and act as indicators. The goal attained in the process should be simple, it can be measurable in terms of units, it should be attainable with available resources and methods, and it has to be reliable in its results and must be time oriented. A process which is done with help of Six Sigma principles and procedures are known as finest class in Quality. Then the process will be free from flaws, errors and mistakes and products and process will attain world class in terms of quality.

- **Hamada M.A, 2014.** The term "Sigma" originates from statistics and is widely applicable to statistical methods of quality control and in process control, and also it examines the capability of the process. According to Hamada, process capability is the capacity of the processes to produce substantially good amount of output in manufacturing and other industries within the specified requirements. Six Sigma is applicable in every organization where operations and processes are involved. An operation is where input gets converted into a product or service through a process. Processes which are operating with Six Sigma quality in a short period are assumed to produce defects less than 3.4 Defects in one Million times. To generate meaningful process performance an orderly and systematic process is needed. We have to sort out every customer of the system and identify their requirements and expectations. The opinions and requirements of the customer are identified through market survey, called as voices and should be given prime importance. In this method, we have to define the process in the whole amount of work that is responsible for the product or service. It is expected that, we have to identify the particular performance and measurements, and evaluate the output, to make sure their usefulness. Six Sigma aim is to improve all processes, to the level of 3.4 defects in one million as a count. Organizations are expected to identify a sigma level for all important processes and they should try to achieve their results. As a result, it is necessary on part of management of the organization to identify pain areas which requires improvement. Identifying the pain area is the most important task in the first define phase of the process. Once the area is identified, we will be able to measure the current performance. Measurement about capability will give a clear picture of sigma value of the present process. Improvements are designed based on the current sigma value.

- **Elliot Boldt, 2013.** It is observed that the product and service quality of depends on customer satisfaction and is the foundation for any organization. The existence of an organization is based on the number of customers and their loyalty. Organizations should identify the needs of the customer and satisfy the demands. According to Elliot Boldt, all organizations identifies various types of needs for its customers. It is required to identify what the customer wants and provide it immediately at the lowest cost. Also, we have to ensure that products and services are of high quality and are reliable for the purpose. TQM and all other related techniques like ISO and Six Sigma, works on the principle of defect free product and services. Customer satisfaction can be achieved by providing the requirements, based on the choice of the customer. Identification of needs and wants of the user, is the primary duty of any product or service provider. We have to keep the requirement of change, technologically, politically, and socially. Also, we should have more advanced knowledge about the customer's needs, we have to predict what is the need of customer, his wants in next year or even in ten years. An organization which lags behind the needs will definitely be overtaken by the competitor. All the organizations have to update themselves, regarding the latest requirements in terms of products and also services. The attainment of these abilities requires an organized approach from the management. This approach has to be taken by the entire organization. There should be a total commitment from the top to bottom in achieving the change. This involves an approach for managing for total quality, managing for effective and complete involvement in each and every activity and person at all levels in the organization. This approach will give a total transformation of the existing management culture. There should be sudden change in the culture of the firm and should be felt by all employees of the organization
- **Prabir K B, 2012.** Six Sigma should work based on customer expectations. The needs and wants of the customer should be identified based on market survey for the purpose. According to Prabir, Six Sigma is based on the importance given to the customer and purely based on data and its management, and are found to be important in achieving the finest quality. During the Total Quality Management era of 1980's and 1990's, number of companies wrote quality procedures and documents to satisfy customer expectations and requirements. The Quality manuals documented gives a clear picture regarding the importance of customers. Customers were considered as

the driving force behind any kind of business. Customers bring the business and acts as even marketing managers for the business. Focusing on customer requirements is the most important element of TQM and Six Sigma. An organization exists due to its customers. The growth of the organization depends on the size of the esteemed customers and based on their loyalty. The loyalty depends on the duration by which the customer is with the same supplier. Though, there is movement of customers from one supplier to another, there should be sufficient number of customers with each supplier. The fundamental principle of any business is to create customers and then retain them. The detainment of Customer is possible only by the satisfaction and delight, and should be the fundamental behind any business. The business should be able to identify need and customer expectations. Customer needs are sorted out and expressed as Voice of Customers. In the initial define phase, the project charter is prepared and is purely based on the wants of the customer. It usually begins by explaining what parameters are important in measuring business performance.

- **Reliance Industries Limited 2008-2009** Annual Report of, organization's effort towards Six Sigma implementation is mentioned. In 2008-09, 63 Six Sigma projects were completed leading to financial benefits (annualized) amounting to Rs.67 crore. Presently, 528 Black Belts and Green Belts are associated in Six Sigma projects at different sites. For the success of the projects, 1817 team members and supervisory personnel are providing active support.
- **In Ultimate Six Sigma (PHI, 2007)** Author emphasizes using Six Sigma for Business Excellence.
- **Tata McGraw-Hill, 2004)** "The Toyota Way" shows the way of Lean organization. Many of the lean tools can be used in Six Sigma projects. The process excellence journey starts with Lean and completes with Six Sigma. (Liker, Jeffrey K. The Toyota Way,. Author also describes how concepts of Toyota Production Systems are extended to Supply chain of Toyota. Just in time concept can be adopted in manufacturing industry.
- **Mikel Harry, Richard Schroeder, Currency, New York, 2005)** Jack Welch, Ex-CEO of GE "The only way I see to get more productivity is by getting people involved and excited about their jobs. It's matter of understanding customer needs instead of

making something and putting it in to a box” (Six Sigma-A Breakthrough Management Strategy

- **Young Hoon Kwak, Frank T. Anbari, 2004.** 3.2 Key elements of successful six sigma applications. In paper “Benefits, obstacles, and future of six sigma approach”, the authors identified four key elements of successful six sigma applications.
- **A case study of General Electric** (Eckes, George, The Six Sigma Revolution, John Wiley & Sons, Inc, 2001) gives us knowledge regarding problems & solutions for Six Sigma deployment. A Six Sigma Approach developed by GE was customer focused which starts with determining customer needs and ends with meeting or exceeding customer expectation. This approach is also suitable for manufacturing and customer centric service industry.
- Also he advises that ultimate goal shall be customer satisfaction. Author Keki R. Bhote also gives importance to employee involvement. Giving reference to Maslow’s theory he suggests that employees will get motivated if all their needs get satisfied. Though Author gives reasons for failure of Six Sigma Implementation in an organization, he doesn’t give any plan for successful implementation.
- George Byrne, Dave Lubowe, Amy Blitze, in their paper “Driving Operational Innovation using Lean Six Sigma” IBM Institute for Business Value, 2007 Around the world, CEOs are searching for blockbuster products and services, making major operational changes, and even redesigning their fundamental business models. This trend toward broad-based innovation was evident in the 2006 IBM Global CEO Study. Based on in-depth conversations with 765 corporate and government leaders worldwide, the study found that CEO innovation priorities were spread across all of these different dimensions.
- And yet CEOs ranked an “unsupportive culture and climate” as their biggest obstacle to innovation success.
- Their organizations lacked the processes, discipline and organizational mindset to foster meaningful innovation on a continuous basis. This emphasizes the need to understand culture & climate of an organization and the country in which the organization is situated while implementing Six Sigma. Caulcutt, Roland (2001) in his paper titled “Why is Six Sigma so successful?”, Journal of Applied Statistics, 28: 3,

301- 306 has mentioned how Six Sigma was contributing organizations to become more successful.

- “Many other organizations have adopted a Six Sigma approach, but these particular companies have publicized their success and have publicly emphasized the part played by Six Sigma in the achievement of this success. None more so than General Electric (GE), as its Annual Report for 1998 states very clearly:
- we plunged into Six Sigma with a company-consuming vengeance just over three years ago. We have invested more than a billion dollars in the effort, and the financial returns have now entered the exponential phase more than three quarters of a billion dollars saving beyond our investment in 1998, with a billion and a half in sight for 1999.
- GE is perhaps best known for its manufacturing divisions, but Six Sigma has been very successfully applied in GE Capital, which yielded a substantial proportion of GE profit in 1998. Clearly, Six Sigma can be implemented in a non-manufacturing environment. Furthermore, it can be successful in many countries. Several of the Six Sigma companies are truly global. They have implemented Six Sigma throughout the company, not just in their home country, as Black and Decker make clear in their annual report for 1999:
- Having begun, in late 1998, to coordinate Six Sigma strategies and measurements on a worldwide basis, our experience clearly shows that the potential benefits are enormous in terms of productivity improvement, product quality, customer satisfaction, more efficient capital spending, and overall corporate profitability.
- Management involvement and organizational commitment Six sigma requires top management dedication and contribution to resources and effort. A good example is General Electric’s former CEO Jack Welch’s involvement. He was charismatic and influential enough to restructure the business and change the attitudes of the employees toward six sigma. The organizations’ CEOs are often involved in the successful implementation of six sigma. Organizational infrastructure needs to be established with well trained individuals ready for action. Implementation of six sigma projects means commitment of resources, time, money, and effort from entire organization.

- Project selection, management, and control skills Six sigma projects have to be carefully reviewed, planned, and selected to maximize the benefits of implementation. The project has to be feasible, organizationally and financially beneficial, and customer oriented. There has to be a clear set of measures and metrics to incorporate customer requirements.
- The project has to be reviewed periodically to evaluate the status of the project as well as the performance of six sigma tools and techniques being implemented. The project should be well documented to track project constraints, mainly cost, schedule, and scope. There should also be a lessons learned mechanism to capture the key issues of previous projects.
- Encouraging and accepting cultural change: People facing cultural change and challenges due to the implementation of six sigma must understand the change first. This requires having a clear communication plan and channels, motivating individuals to overcome resistance, and educating senior managers, employees, and customers on the benefits of six sigma. Announcing the results of six sigma projects including successes, obstacles, and challenges will help future projects to avoid making similar mistakes and adopt only the very best practices.
- Continuous education and training: Education and training give a clear sense for people to better understand the fundamentals, tools, and techniques of six sigma. Training is part of the communication techniques to make sure that managers and employees apply and implement the complex six sigma techniques effectively. There is usually a ranking of expertise identified by the belt system. Four different Belt levels (Master, Black, Green, Yellow) make sure that establishment and execution of six sigma projects are done seamlessly.
- The curriculum is customized and needs to be provided by identifying key roles and responsibilities of individuals implementing six sigma projects. Organizations need to continuously learn and adapt the latest trends and techniques that are outside the six sigma domain that might be useful to complement the six sigma approach. The authors found that selection of knowledgeable, well-respected employees for Black Belt assignments was a **critical success factor for six sigma projects**.

CHAPTER 3 RESEARCH METHODOLOGY

CHAPTER 3

RESEARCH METHODOLOGY

3.1 RESEARCH DESIGN

The research adopted descriptive research design to this study. Descriptive research design is a fact finding investigation which adequate interpretations. In this research the study, the researcher describes about the level of employee engagement at the organizations. So the descriptive research is the most suitable research design to this study. To achieve the objective two methods of research design has been used.

Descriptive research design - The descriptive research design is also called as explanatory design. This is the one that simply describes something such as demographic characteristics. The descriptive study is typically concerned with determining frequency with which something occurs or how two variables vary together.

3.2 SAMPLE DESIGN

Sample design is the theoretical basis and the practice means by generalizing from characteristics of relatively few for the comprising populations. It is the method by which the sample is chosen. Random sampling method used to collect data.

POPULATION

A research population is also known as a well-defined collection of individuals or objects known to have similar characteristics. The entire group of people or objects is which the researcher wishes to generalize the study findings. Population for the study consists of employees of united industries plastic pvt ltd.

TARGET RESPONDENTS

The Target Respondents of this research are employees of united industries plastic pvt ltd. The respondents are from production and quality. The number of entities available, in the defined population is its size. The population size for the survey is about 110 people.

SAMPLING METHOD & TYPES

Collecting data about each and every unit of the population is called census method. The approach, where only a few units of population under study are considered for analysis is called sampling method. There are two main categories under which various sampling method can be put. The two categories are

1. Probability sampling
2. Non-probability sampling

The sampling method adopted for the study is convenience sampling under non-probability sampling. convenience sampling is a non-probability sampling technique where subjects are selected because of their convenient accessibility and proximity to the researcher. Convenience sampling (also known as availability sampling) is a specific type of non probability sampling method that relies on data collection from population members who are conveniently available to participate in study. Convenience sampling is a type of sampling where the first available primary data source will be used for the research without additional requirements. In other words, this sampling method involves getting participants wherever you can find them and typically wherever is convenient. In convenience sampling no inclusion criteria identified prior to the selection of subjects. All subjects are invited to participate.

3.3 DATA COLLECTION

PRIMARY DATA

Primary data is the original data collected by the researcher first hand. It is collected for the first time through field survey. These are those that are gathered specifically, for the problem at hand. The various sources for collecting primary data are questionnaire, observation, interview etc. The primary source used for the study is questionnaire.

The research approach:

- survey method

The research instrument:

- Questionnaire

The respondents:

- The employees of the organization.

DATA SOURCES

Depending on the nature of the information to be gathered, different instruments are used to conduct the assessment such as records, surveys, interview or questionnaires. The tool used for this study is a questionnaire.

3.4 QUESTIONNAIRE CONSTRUCTION

The questionnaire is a structured technique for collecting primary data in a survey. It is a series of written or verbal questions for which the respondent provides answers. A well designed questionnaire motivates the respondent to provide complete and accurate information. In this project, the questionnaire is used as a data instrument for collecting the primary data.

TYPES OF QUESTIONNAIRE

CLOSED FORMAT QUESTIONS

Multiple choice questions, where respondents are restricted to choose among any of the given multiple-choice answers are known as closed format or closed-ended questions. There is no fixed limit as to how many multiple choices should be given; the number can be even or odd. One of the main advantages of including closed format questions in your questionnaire design is the ease at performing preliminary analysis. These questions are ideal for calculating statistical data and percentages, as the answers set is known. Closed ended questions can also be asked to different groups at different intervals to efficiently track their opinion about a product/service/company over time.

SCALE USED FOR QUESTIONNAIRE DEVELOPMENT

A Likert scale typically contains an odd number of options, usually 5 to 7. One end is labeled as the most positive end while the other one is labeled as the most negative one with the label of 'neutral' in the middle of the scale. The phrases 'purely negative' and 'mostly negative' could also have been 'extremely disagree' and 'slightly disagree'.

This Project uses 1 phrase which is spread over 5 options.

- 5 Strongly Agree
- 4 Agree
- Neutral
- Disagree
- 1 Strongly Disagree

VARIABLE USED TO CONSTRUCT QUESTIONNAIRE

The following 4 factors with its listed questions are the variables used to construct the Questionnaire,

- Quality
- Process Improvement
- Production
- Personal Accomplishment

3.5 SAMPLE SIZE

It refers to the number of elements of the population to sample. The sample size chosen for the survey is 110.

3.6 STATISTICAL TOOLS APPLIED

The tool chosen for data collection is questionnaire. The questionnaire is a set of structured question in which the answer is collected by respondents. It is one of the simplest and one of the most commonly used for data collections.

INFERENCEAL ANALYSIS

Inferential analysis is concerned with statistics making predictions or inferences about a population from observations and analysis of a sample.

- Statistical Tools

Data Analysis is the act of transforming data with the aim of extracting useful information and facilitating conclusions. The data analysis tools used in this study are:

- Regression Analysis
- Correlation
- Chi-Square Test

STATISTICAL TOOLS:

1. REGRESSION ANALYSIS:

It is a statistical measure that attempts to determine the strength of the relationship between one dependent variable (usually denoted by Y) and a series of other changing variables (known as independent variables). The two basic types of regression are linear regression and multiple regression. Linear regression uses one independent variable to explain and/or predict the outcome of Y, while multiple regression uses two or more independent variables to

predict the outcome. The general form of each type of regression is:

Linear Regression: $Y = a + bX + u$

Multiple Regression: $Y = a + b_1X_1 + b_2X_2 + b_3X_3 + \dots + b_tX_t + u$ Where:

Y = the variable that we are trying to predict
 X = the variable that we are using to predict
 a = the intercept

b = the slope

u = the regression residual.

In multiple regressions, the separate variables are differentiated by using sub scripted numbers.

2. CORRELATION:

Correlation is used to test relationships between quantitative variables or categorical variables. In other words, it's a measure of how things are related. The study of how variables are correlated is called correlation analysis. A correlation coefficient is a way to put a value to the relationship. Correlation coefficients have a value of between -1 and 1. A

"0" means there is no relationship between the variables at all, while -1 or 1 means that there is a perfect negative or positive correlation. The most common correlation coefficient is the Pearson Correlation Coefficient. It's used to test for linear relationships between data.

3. CHI -SQUARE TEST

The Chi-Square Test of Independence determines whether there is an association between categorical variables (i.e., whether the variables are independent or related). It is a non-parametric test. This test is also known as: Chi-Square Test of Association. This test utilizes a contingency table to analyse the data. A contingency table (also known as a cross tabulation, crosstab, or two-way table) is an arrangement in which data is classified according to two categorical variables. The categories for one variable appear in the rows, and the categories for the other variable appear in columns. Each variable must have two or more categories. Each cell reflects the total count of cases for a specific pair of categories

CHAPTER 4 DATA ANALYSIS AND INTERPRETATION

TABLE 4.1

4.1 PERCENTAGE ANALYSIS

Gender Of The Employee

S.NO	GENDER	RESPONDENTS	PERCENTAGE
1	MALE	86	85%
2	FEMALE	15	15%
	TOTAL	110	100%

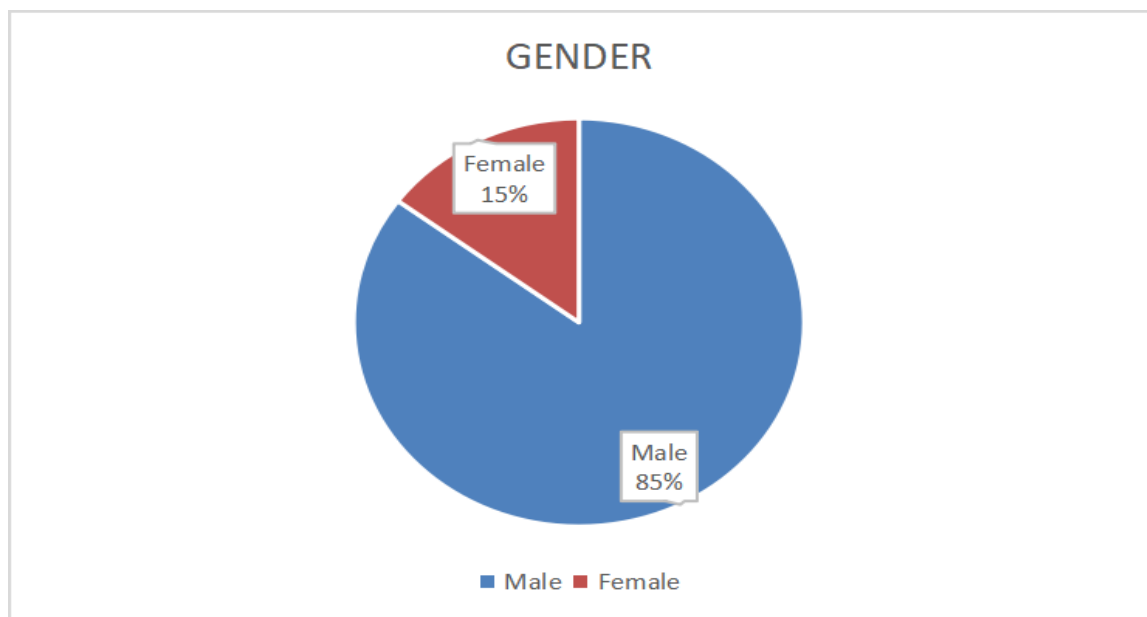


Chart 4.1 Gender of the Employee

INFERENCE:

From the above data are we observing that respondents of male for the research are (85%) and the female were (15%)s.

TABLE 4.2

Age of the Employee

S.NO	AGE	RESPONDENTD	PERCENTAGE
1	20<=25	58	57%
2	26<=30	38	38%
3	30<=35	5	5%
	TOTAL	110	100%

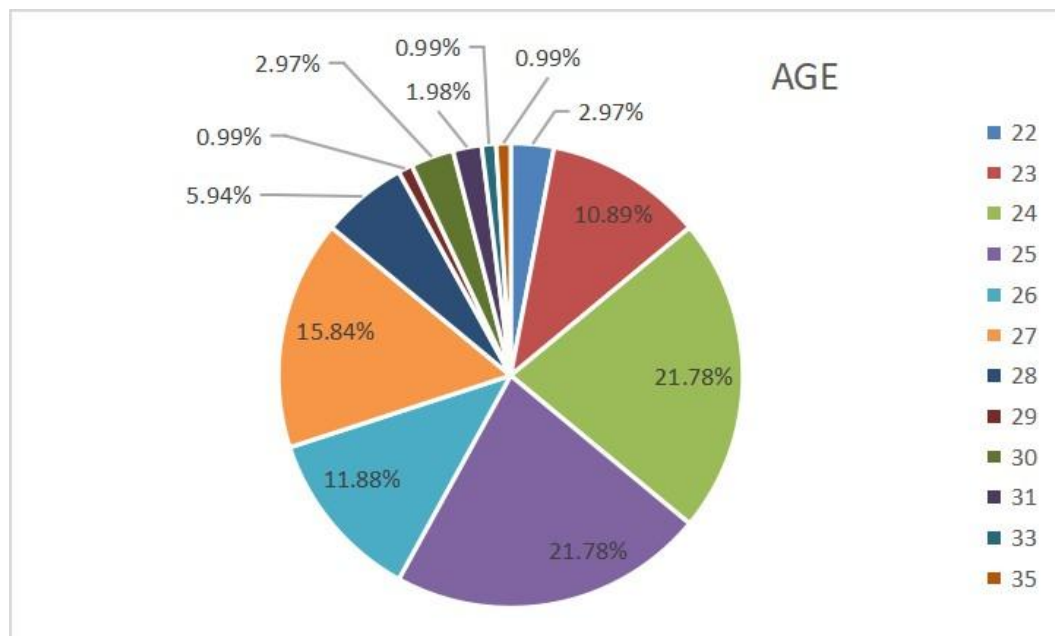


Chart 4.2 Age of the employee

INFERENCE:

From the above data are observe between 20-25 years employee are working in organization (58%).

TABLE 4.3

Working experiences of the employee

S.NO	WORK EXPERIENCES	RESPONDENTS	PERCENTAGE
1	Below 1 years	26	26%
2	Above 1 years	59	58%
3	Above 3 years	15	15%
4	More than 5 years	1	1%
	TOTAL	110	100%



Chart 4.3 Work experiences of the employee

INFERENCE:

From the above data are observe between Above 1 years employee are working in organization (59%).

TABLE 4.4

Higher education of the employee

S.NO	HIGHER EDUCATION	RESPONDENTS	PERCENTAGE
1	HSC	4	4%
2	UG	66	65%
3	PG	31	31%
	TOTAL	110	100%

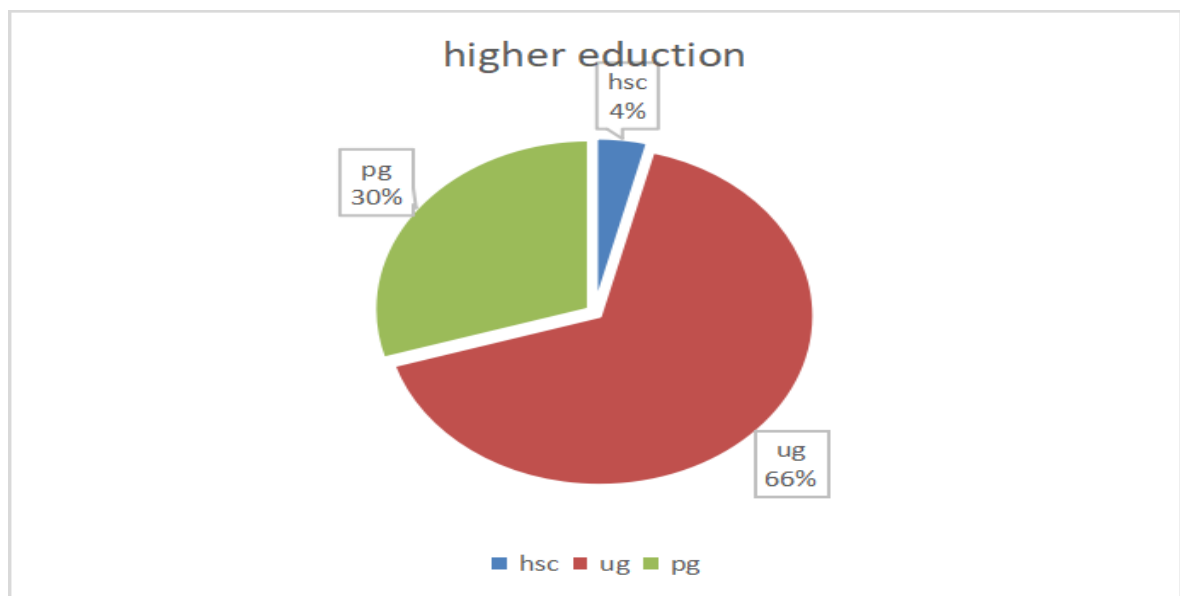


Chart 4.4 Higher education of the employee

INFERENCE:

From the above data are observe that respondents of under graduation employee are working in organization (66%).

TABLE 4.5

Processes to make improvement on business

S.NO	PROCESS IMPROVEMENT	RESPONDENTS	PERCENTAGE
1	STRONGLY AGREE	25	25%
2	AGREE	41	40%
3	NEUTRAL	22	22%
4	DISAGREE	11	11%
5	STRONGLY DISAGREE	2	2%
	TOTAL	110	100%

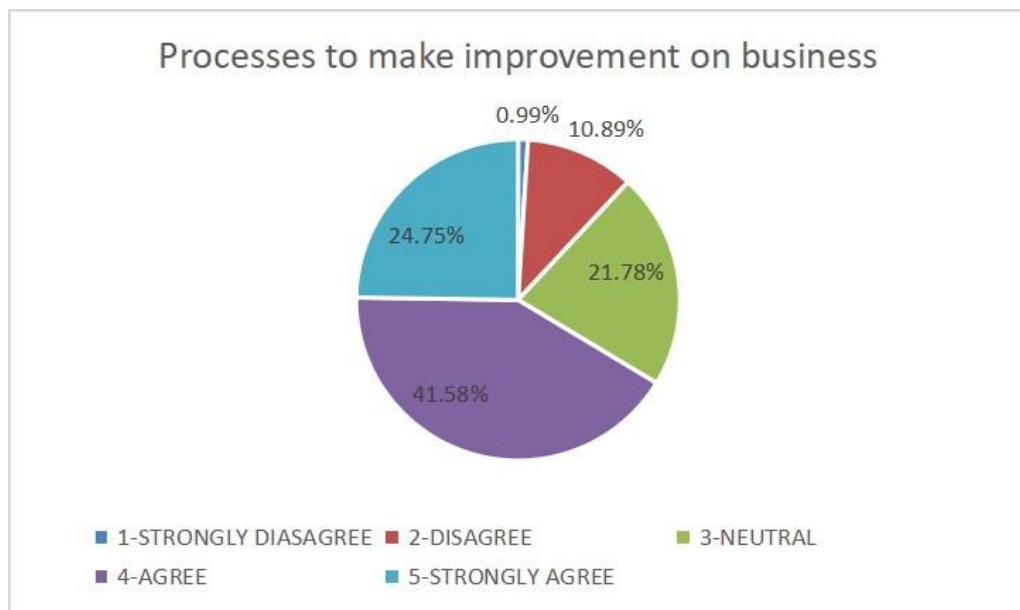


Chart 4.5 Processes to make improvement on business

INFERENCE:

From the above table 41% are agreeing with process to make improvement on business and their responsibilities to make improvement in achieving the positive result in six sigma.

TABLE 4.6

Production of processes to make an effort

S.NO	PRODUCTION ONPROCESS	RESPONDENTS	PERCENTAGE
1	STRONGLY AGREE	25	25%
2	AGREE	44	44%
3	NEUTRAL	26	25%
4	DISAGREE	4	4%
5	STRONGLY DISAGREE	2	2%
	TOTAL	110	100%

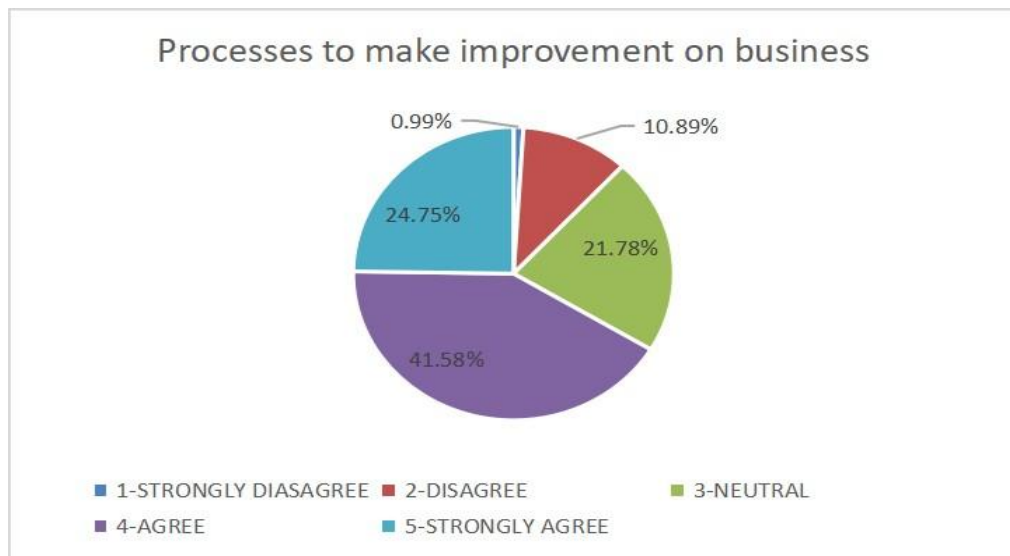


Chart 4.6 Production of processes to make an effort

INFERENCE:

From the above table 44% are agreeing with production of process to make effort and their responsibilities to make production process in achieving the positive result in six sigma projects.

TABLE 4.7

Coordinate in the product development process

S.NO	PRODUCT DEVELOPMENT PROCESS	RESPONDENTS	PERCENTAGE
1	STRONGLY AGREE	24	25%
2	AGREE	41	40%
3	NEUTRAL	20	20%
4	DISAGREE	13	13%
5	STRONGLY DISAGREE	3	2%
	TOTAL	110	100%

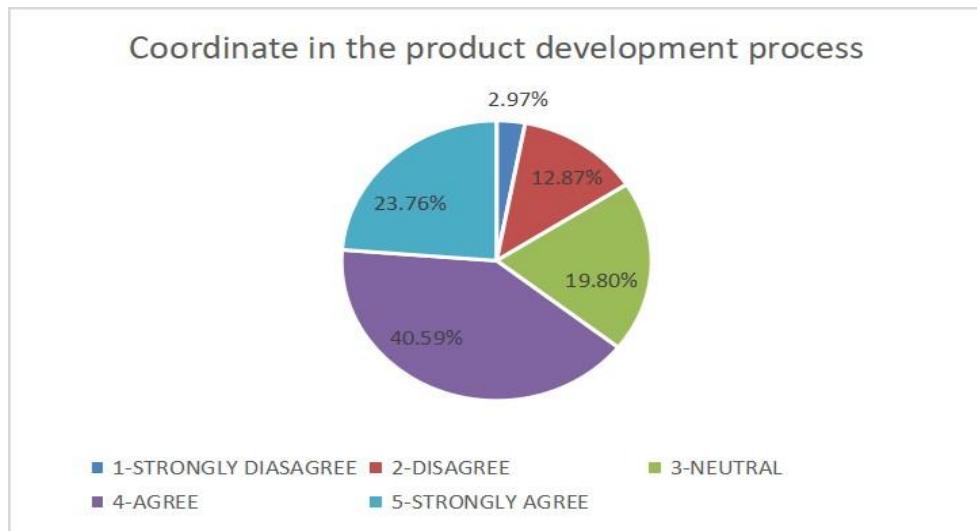


Chart 4.7 Production of processes to make an effort

INFERENCE:

From the above table 40% are agreeing with coordinate in the product development process and their responsibilities to make product development is achieving the positive result in six sigma projects.

TABLE 4.8

Quality improvement process are much better

S.NO	QUALITY IMPROVEMENT PROCESS	RESPONDENTS	PERCENTAGE
1	STRONGLY AGREE	22	22%
2	AGREE	34	34%
3	NEUTRAL	34	34%
4	DISAGREE	9	8%
5	STRONGLY DISAGREE	2	2%
	TOTAL	110	100%

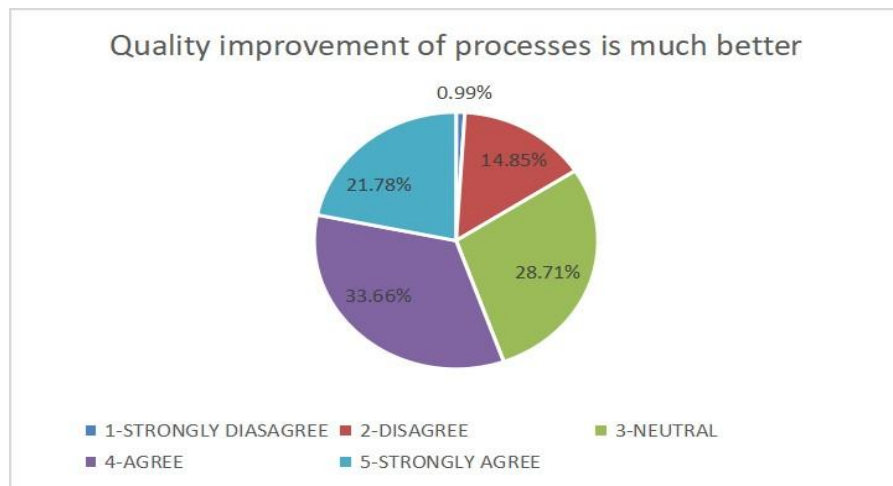


Chart 4.8 Quality improvement process are much better

INFERENCE:

From the above table 34% of agreeing and neutral with quality improvement of processes is much better and their responsibilities to quality improvement is achieving the positive result in six sigma projects.

TABLE 4.9

Quality of new products has increased over in the year

S.NO	QUALITY OF PRODUCT HAS INCREASED	RESPONDENTS	PERCENTAGE
1	STRONGLY AGREE	22	22%
2	AGREE	34	34%
3	NEUTRAL	34	34%
4	DISAGREE	9	8%
5	STRONGLY DISAGREE	2	2%
	TOTAL	110	100%

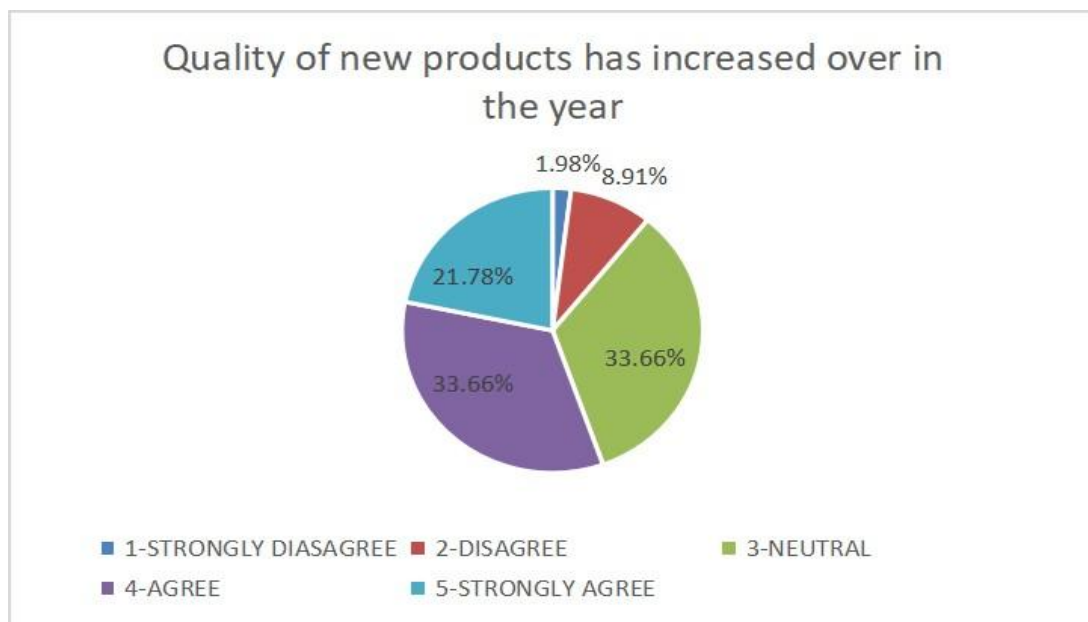


Chart 4.9 Quality of new product has increased over in the year

INFERENCE:

From the above table 34% of agreeing and neutral with quality of new product has increased in the year and their responsibilities of quality of new product has increased in the year is achieving the positive result in six sigma projects.

TABLE 4.10

Quality of new product in relation to cost

S.NO	QUALITY OF NEWPRODUCT IN COST	RESPONDENTS	PERCENTAGE
1	STRONGLY AGREE	13	13%
2	AGREE	37	37%
3	NEUTRAL	42	42%
4	DISAGREE	6	6%
5	STRONGLY DISAGREE	3	2%
	TOTAL	110	100%

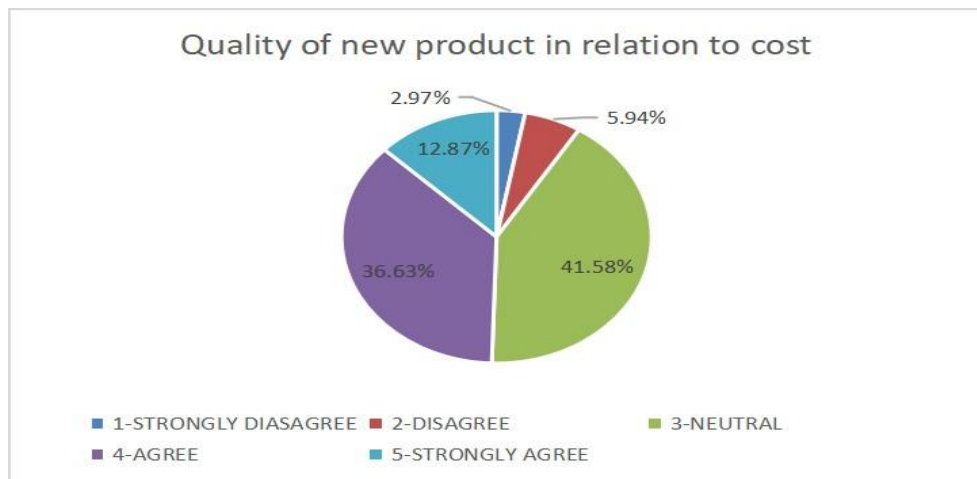


Chart 4.10 Quality of new product in relation to cost

INFERENCE:

From the above table 42% of neutral with quality of new product in related cost and their responsibilities of quality of new product cost is achieving the positive result in six sigma projects.

TABLE 4.11

Statistical techniques to reduce variance in processes

S.NO	REDUCE VARIANCEIN PROCESSES	RESPONDENTS	PERCENTAGE
1	STRONGLY AGREE	17	17%
2	AGREE	27	27%
3	NEUTRAL	48	48%
4	DISAGREE	7	7%
5	STRONGLY DISAGREE	2	1%
	TOTAL	110	100%

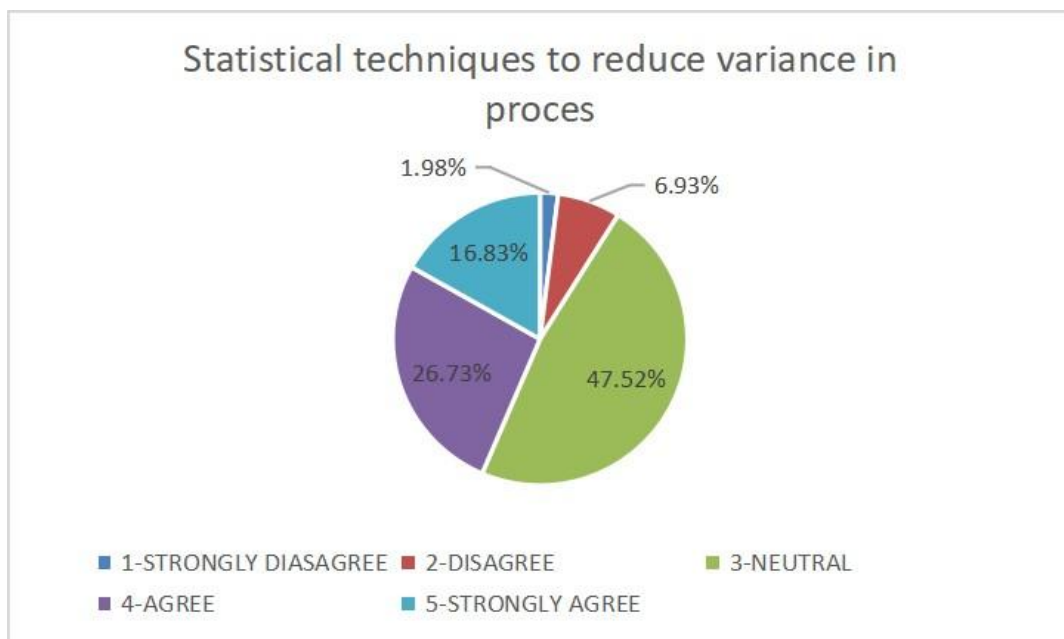


Chart 4.11 Statistical techniques to reduce variance in processes

INFERENCE:

From the above table 48% of neutral with statistical techniques reduce the variance in processes and their responsibilities of reduce the variance in processes is achieving the positive result in six sigma projects.

TABLE 4.12

Feeling of personal accomplishment

S.NO	PERSONAL ACCOMPLISHMENT	RESPONDENTS	PERCENTAGE
1	STRONGLY AGREE	12	12%
2	AGREE	28	28%
3	NEUTRAL	46	46%
4	DISAGREE	7	7%
5	STRONGLY DISAGREE	8	7%
	TOTAL	110	100%

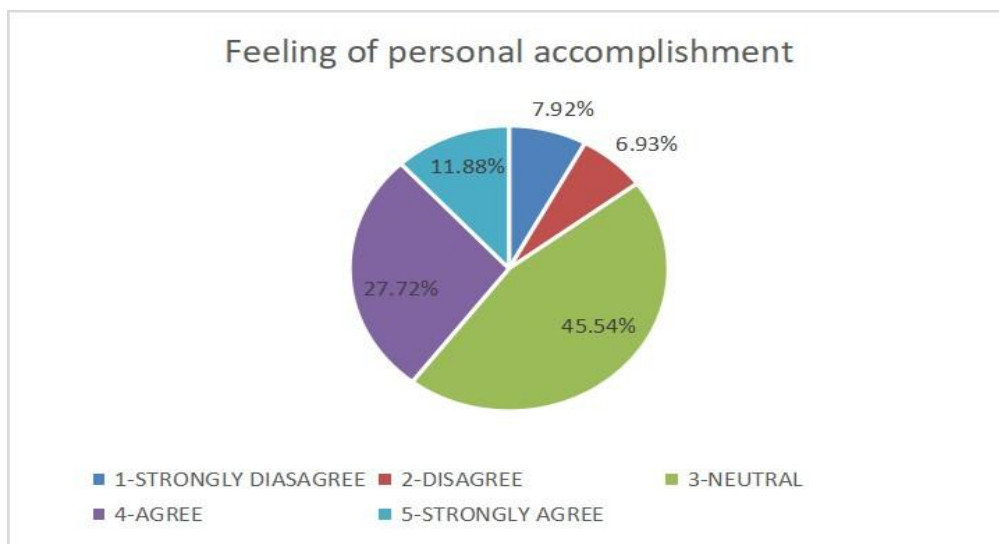


Chart 4.12 Feeling of personal accomplishment

INFERENCE:

From the above table 46% of neutral with feeling of personal accomplishment and their responsibilities of feeling of personal accomplishment is achieving the positive result in six sigma projects.

TABLE 4.13

Satisfied with your current job

S.NO	SATISFIED WITH CURRENT JOB	RESPONDENTS	PERCENTAGE
1	STRONGLY AGREE	17	17%
2	AGREE	27	27%
3	NEUTRAL	37	37%
4	DISAGREE	10	10%
5	STRONGLY DISAGREE	10	9%
	TOTAL	110	100%

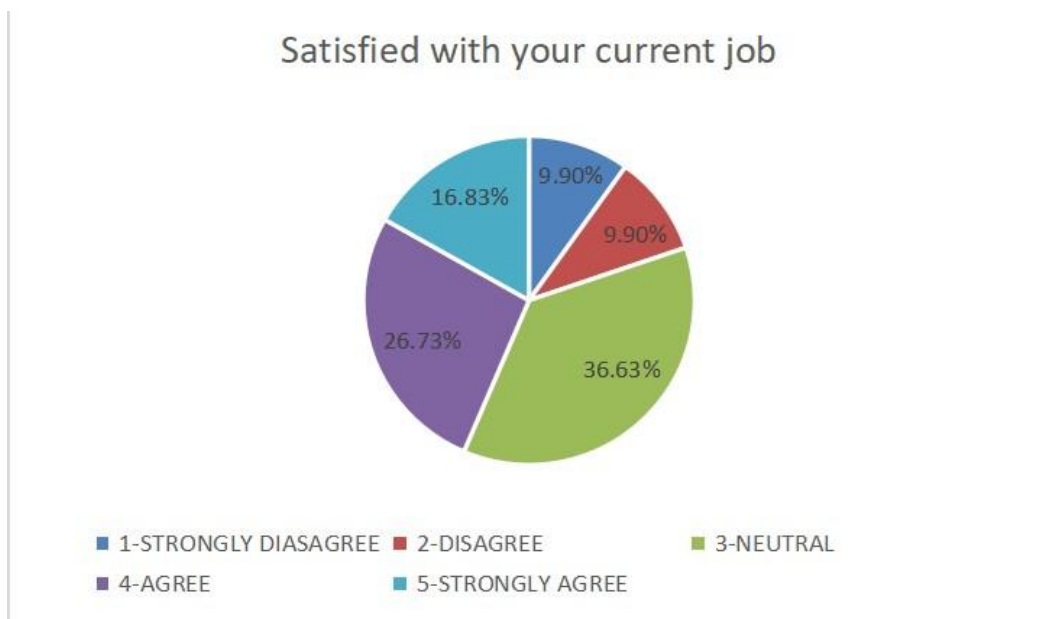


Chart 4.13 Satisfied with your current job

INFERENCE:

From the above table 37% of neutral with satisfied with current job and their responsibilities of satisfied with current job is achieving the positive result in six sigma projects.

TABLE 4.14

ROI has improved

S.NO	ROI HAS IMPROVED	RESPONDENTS	PERCENTAGE
1	STRONGLY AGREE	15	15%
2	AGREE	34	34%
3	NEUTRAL	32	32%
4	DISAGREE	14	14%
5	STRONGLY DISAGREE	6	5%
	TOTAL	110	100%

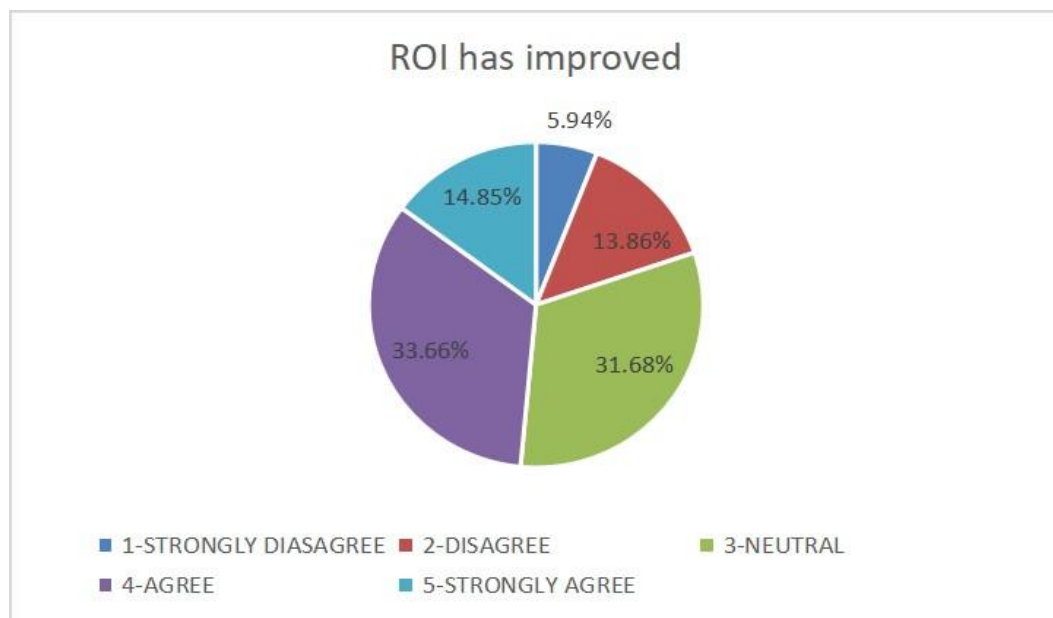


Chart 4.14 ROI has improved

INFERENCE:

From the above table 34% of agreeing with ROI has improved and their responsibilities of ROI has improved is achieving the positive result in six sigma projects.

TABLE 4.15

Quality improvement is best

S.NO	QUALITY IMPROVEMENT IS BEST	RESPONDENTS	PERCENTAGE
1	STRONGLY AGREE	21	21%
2	AGREE	39	39%
3	NEUTRAL	27	27%
4	DISAGREE	11	11%
5	STRONGLY DISAGREE	3	2%
	TOTAL	110	100%

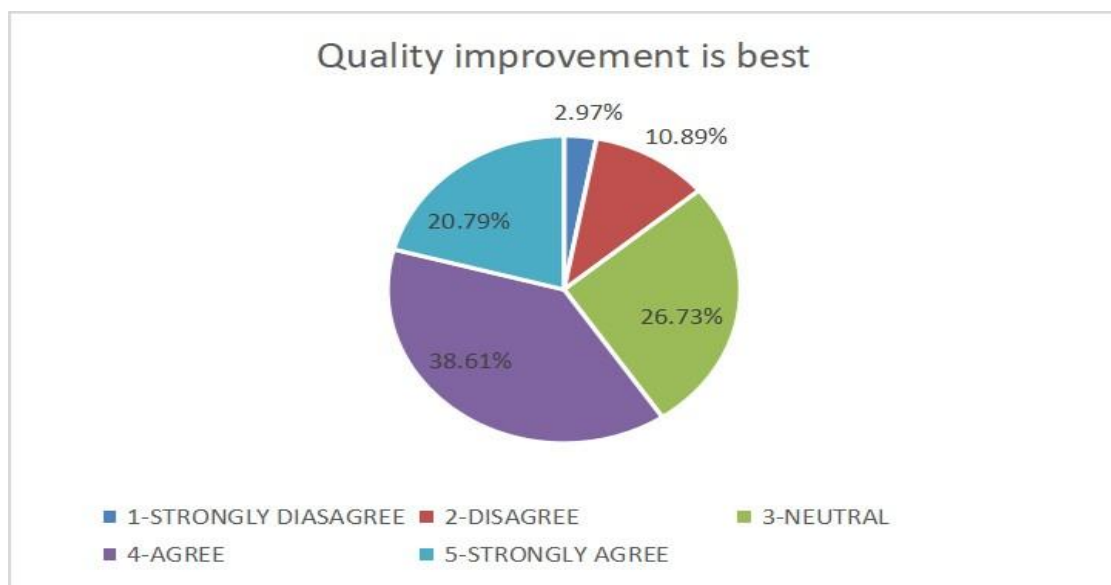


Chart 4.15 Quality improvement is best

INFERENCE:

From the above table 39% of agreeing with quality improvement is best and their responsibilities of quality improvement is achieving the positive result in six sigma projects.

TABLE 4.16

Productivity is Improved

S.NO	PRODUCTIVITY IMPROVED	RESPONDENTS	PERCENTAGE
1	STRONGLY AGREE	22	22%
2	AGREE	31	31%
3	NEUTRAL	31	31%
4	DISAGREE	12	12%
5	STRONGLY DISAGREE	5	4%
	TOTAL	110	100%

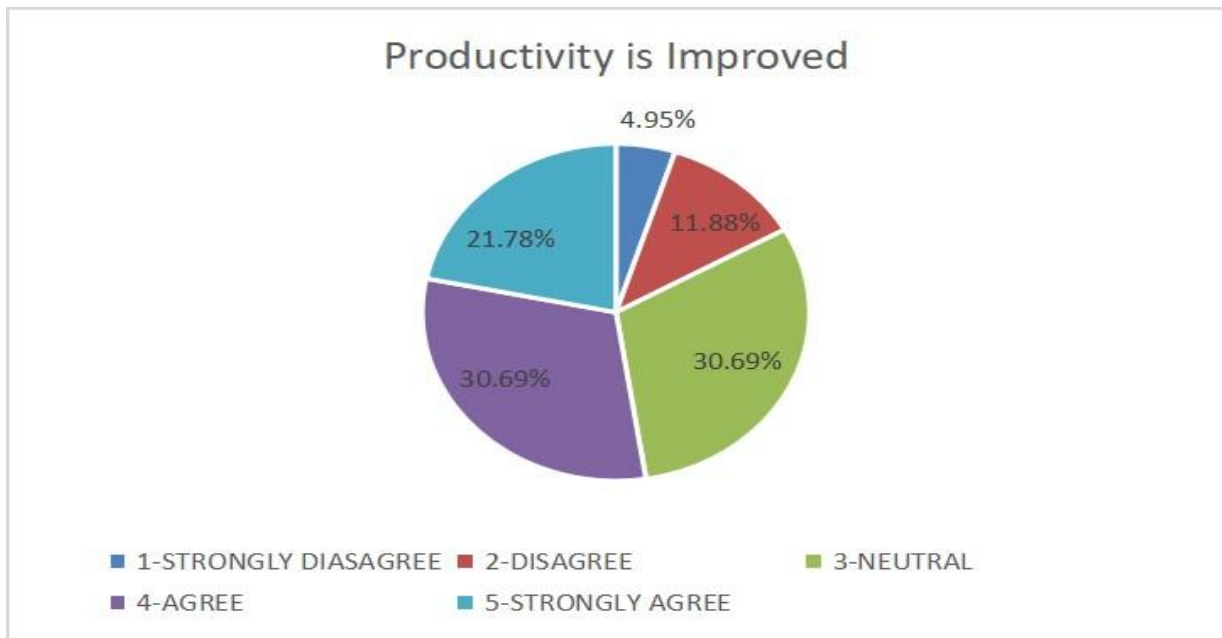


Chart 4.16 Productivity is Improved

INFERENCE:

From the above table 31% of agreeing and neutral with productivity is improved and their responsibilities of productivity improved is achieving the positive result in six sigma projects.

TABLE 4.17

Long term defect levels below "3.4" in six sigma quality

S.NO	DEFECT LEVEL OF SIX SIGMA	RESPONDENTS	PERCENTAGE
1	STRONGLY AGREE	30	30%
2	AGREE	30	30%
3	NEUTRAL	30	30%
4	DISAGREE	7	7%
5	STRONGLY DISAGREE	4	3%
	TOTAL	110	100%

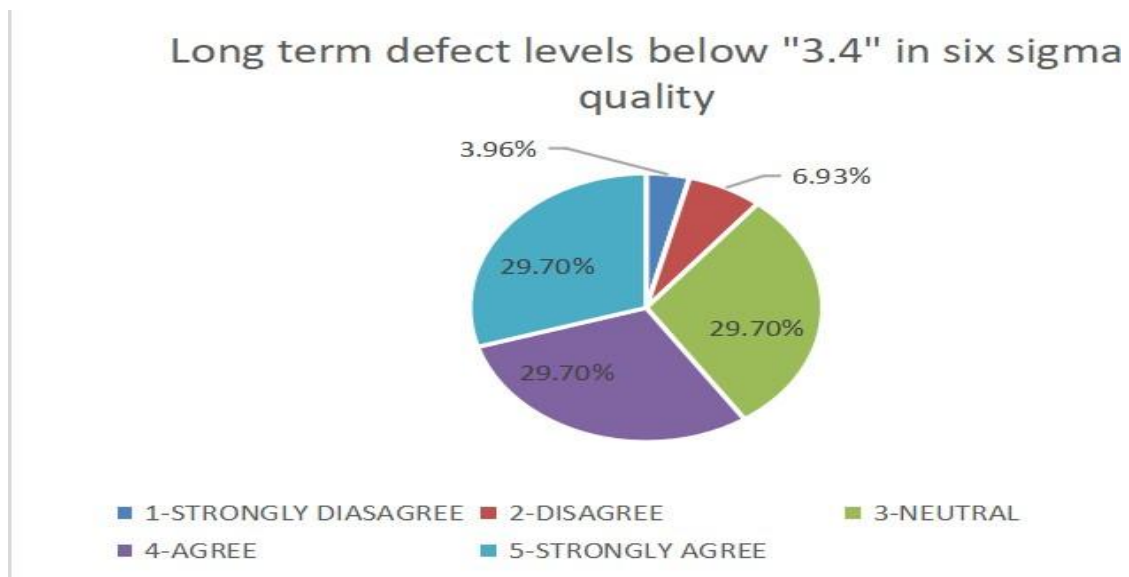


Chart 4.17 Long term defect levels below "3.4" in six sigma quality

INFERENCE:

From the above table 30% of strongly agreeing, agreeing and neutral with Long term defect levels below "3.4" in six sigma quality and their responsibilities of Long term defect levels below "3.4" in six sigma quality is achieving the positiveresult in six sigma projects.

INTERPETATION:

4.2 CORRELATION:

Null Hypothesis (H0): There is no significant Correlation between Process to Make Improvement, Product Development Process and Quality Improvement.

Alternative Hypothesis (H1): There is no significant Correlation between Process to Make Improvement, ProductDevelopment Process and Quality Improvement.

Correlations

	process	production	quality
process Pearson Correlation	1	.033	.159
Sig. (2-tailed)		.746	.115
N	100	100	100
production Pearson Correlation	.033	1	.112
Sig. (2-tailed)	.746		.269
N	100	100	100
quality Pearson Correlation	.159	.112	1
Sig. (2-tailed)	.115	.269	
N	100	100	100

Table 4.2.1 Showing the Correlation Table of Process to Make Improvement, Product Development Process and Quality Improvement.

INFERENCE:

As the sign. value is r value is 0.033 . There is a positive relationship between Process to Make Improvement, Product Development Processand Quality Improvement.

4.2 CORRELATION

Null Hypothesis (H0): There is no significant difference between Quality Improvement and Personal Accomplishment

Alternative Hypothesis (H1): There is significant difference between Quality Improvement and Personal Accomplishment.

Correlations

		quality	personal accomplish ment
quality	Pearson Correlation	1	.111
	Sig. (2-tailed)		.274
	N	100	100
personal accomplishment	Pearson Correlation	.111	1
	Sig. (2-tailed)	.274	
	N	100	100

Table 4.2.1 Showing the Correlation Table of Quality Improvement and Personal Accomplishment.

INFERENCE:

As the sign.value r value is 0.111. There is a positive relationship between Quality Improvement and Personal Accomplishment.

4.3 CHI SQUARE TEST

Null Hypothesis (H0): There is no significant difference between Productivity Improved and Quality of New Products.

Alternative Hypothesis (H1): There is significant difference between Productivity Improved and Quality of New Products.

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
production * quality	100	100.0%	0	0.0%	100	100.0%

production * quality Cross tabulation

Count

	quality										Total
	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	
production 1.00	0	0	1	2	2	0	0	0	0	0	5
2.00	0	1	2	2	4	1	2	0	0	0	12
3.00	0	0	4	5	4	10	2	3	2	0	30
4.00	1	0	6	2	8	3	4	3	2	2	31
4.00	2	1	2	3	4	1	5	3	1	0	22
Total	3	2	15	14	22	15	13	9	5	2	100

Chi-Square Tests

	Value	df	Asymp. Sig.(2-sided)
Pearson Chi-Square	37.373 ^a	36	.406
Likelihood Ratio	40.158	36	.291
Linear-by-Linear Association	1.235	1	.266
N of Valid Cases	100		

a. 48 cells (96.0%) have expected count less than 4. The minimum expected count is .10.

Table 4.3.1 Showing the Chi Square Test of Productivity Improved and Quality of New Products.

INFERENCE:

As the sign.value is 0.406 (>0.05) Null Hypothesis is accepted. There is a significant difference relationship between productivity Improved and Quality of New Product.

Null Hypothesis (H0): There is no significant difference between ProductivityImproved and Personal Accomplishment.

Alternative Hypothesis (H1): There is significant difference between Productivity Improved and Personal Accomplishment.

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
personal accomplishment * production	100	100.0%	0	0.0%	100	100.0%

personal accomplishment * production Cross tabulation Count

		production					Total
		1.00	2.00	3.00	4.00	4.00	
personal accomplishment	1	0	1	5	2	0	8
	2	0	2	1	1	3	7
	3	4	5	11	11	15	46
	4	1	4	8	11	3	27
	5	0	0	5	6	1	12
Total		5	12	30	31	22	100

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.139 ^a	16	.139
Likelihood Ratio	24.422	16	.063
Linear-by-Linear Association	.202	1	.653
N of Valid Cases	100		

a. 18 cells (72.0%) have expected count less than 4. The minimum expected count is .34.

Table 4.3 Showing the Chi Square Test of Productivity Improved and personal Accomplishment.

INFERENCE:

As the sign.value is 0.139 (>0.05) Null Hypothesis is accepted. There is a significant difference relationship between productivity Improved and Personal Accomplishment.

4.4 REGRESSION ANALYSIS:

Null Hypothesis (H0) : There is no significant influence of process on Productivity and quality.

Alternative Hypothesis (H1) : There is a significant influence of process on Productivity and quality..

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	production, quality ^b		Enter

- a. Dependent Variable: process
- b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.159 ^a	.025	.005	.59780	.025	1.264	2	97	.287

- a. Predictors: (Constant), production, quality

Table 4.4. Showing the Model Summary Of Process to Make Improvement, Productivity Can Be Improved, Quality Improved.

ANOVA^a

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	.903	2	.452	1.264	.287 ^b
Residual	34.665	97	.357		
Total	34.568	99			

- a. Dependent Variable: process
- b. Predictors: (Constant), production, quality

Table 4.4.1 Showing the ANOVA Table of Process to Make Improvement, Productivity Can Be Improved, Quality Improved.

Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	3.080	.454		6.784	.000
quality	.186	.120	.157	1.556	.123
production	.008	.054	.015	.152	.880

a. Dependent Variable: process

Table 4.4.2. Showing the coefficient Table of Process to Make Improvement, Productivity Can Be Improved, Quality Improved.

INFERENCE

Thus, H_0 is rejected and Alternative Hypothesis is accepted and there is a positive relationship among Process to Make Improvement, Productivity Can Be Improved, Quality Improved.

CHAPTER 5 FINDINGS AND DISCUSSION

5.1 SUMMARY OF FINDING

- Majority of 86 percent of the respondents are male.
- Majority of 58 percent of the respondents are between 21-25 years of age.
- Majority of 59 percent of the respondents are above 1 year.
- Majority of 66 percent of the respondents are under graduations.
- Majority of 41 percent of the respondents process to make an important.
- Majority of 44 percent of the respondents are production of process to make an important.
- Majority of 40 percent of the respondents are product development process.
- Majority of 34 percent of the respondents are quality improvement processare much better.
- Majority of 34 percent of the respondents are quality of new products has increased over in the year.
- Majority of 42 percent of the respondents are quality of new product in relationto cost.
- Majority of 48 percent of the respondents are statistical techniques to reducevariance in processes.
- Majority of 46 percent of the respondents are feeling of personalaccomplishment.
- Majority of 37 percent of the respondents are Satisfied with your current job.
- Majority of 34 percent of the respondents are ROI has improved.
- Majority of 39 percent of the respondents are quality improvement is best.
- Majority of 31 percent of the respondents are productivity is Improved.
- Majority of 37 percent of the respondents are Satisfied with your current job.
- Majority of 34 percent of the respondents are ROI has improved.
- Majority of 30 percent of the respondents are long term defect levels below "3.4" in six sigma quality.
- There is a positive relationship between Process to Make Improvement, Product Development Processand Quality Improvement.
- There is a positive relationship between Quality Improvement and Personal Accomplishment.
- There is a significant difference relationship between productivity Improved and Quality of New Product
- There is a significant difference relationship between productivity Improved and Personal Accomplishment.
- and there is a positiverelationship among Process to Make Improvement, Productivity Can Be Improved,Quality Improved

5.2 SUGGESTIONS

- From correlation analysis it is found that , There is a positive relationship between Quality Improvement and Personal Accomplishment. so, The management can focus the Quality Improvement and Personal Accomplishment.
- From multiple correlation analysis it is found that ,there is a positive relationship between Process to Make Improvement, Product Development Process and Quality Improvement. So, The management can focus the Process to Make Improvement, Product Development Process and Quality Improvement.
- From Chi Square test is found that ,there is a positive relationship between Productivity Improved and Quality of New Product. So, The management can focus the Productivity Improved and Quality of New Product.

5.3 LIMITATIONS OF STUDY

To time constraint is considered as a major limitations to collect data from all 110 employees. To respondents may have some bias in answering the questions. The sample size being limited to middle and lower management may not accurately represent the entire organizations.

5.4 CONCLUSION

It has often been said that six sigma customer driven. Six Sigma is defined as 3.4 defect per one million products or service processes, where anything not acceptable to the end customer is considered a defects. Detailed analysis has been performed to rectify the problems of rejection of cylinder lines due to the variations in quality characteristics of the manufactured units. The effectiveness of this project has been considered as successful because the critical factor for the process were found and controlled. This Six Sigma improvement methodology viz DMAIC Project shows that the performance of the firm is increased to a better level as regards to enhancement in customers' (both internal and external) satisfaction development of specific methods to redesign and organize a process with a view to reduce errors and the defects. Development of more efficient, reliable, capable and consistent manufacturing process and more better overall process performance, creation and continuous improvement. Finally, effectiveness of Six Sigma implementation can be helpful in reducing the nonconforming units or improving the organization quality and production process.

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ANNEXURE - I

QUESTIONNAIRE

A STUDY ON EFFECTIVENESS OF SIX SIGMA IMPLEMENTATION ON PRODUCTIVITY CYCLE IN UNITED INDUSTRIES PLASTICS PRIVATE LIMITED, CHENNAI

Dear Respondents,

I am **MOHAMED ASKAR P.K**, doing my MBA programme in Sathyabama University, Chennai. Kindly complete all the questions listed below which will be helpful for my project work. The responses will not be linked to any individual and data obtained will be kept confidential and I assure you that this data is collected solely for the purpose of academic study alone.

Thank you in advance for sparing your valuable time. Please read the following statements and choose the number on the scale that best matches your perception level.

- 1) Name
- 2) Age
- 3) Gender
Male Female
- 4) How many years have you been employed at your company?
a) Below 1 year b) Above 1years c) Above 3 years d) More than 5 years
- 5) What is your highest education?
a) Hsc b) under graduation c) post graduation d) others
- 6) We constantly study and review our key business processes to make improvements
a) agree b) disagree c) neutral d) strongly agree e) strongly disagree
- 7) Overall, in the product or service design process, we make an effort, to include only the steps which are clearly needed.
a) agree b) disagree c) neutral d) strongly agree e) strongly disagree
- 8) Multiple departments (such as R&D, marketing and sales, and manufacturing) coordinate in the product/service development process.
a) agree b) disagree c) neutral d) strongly agree e) strongly disagree
- 9) In comparison to competition, quality improvements of processes at my company are much better.
a) agree b) disagree c) neutral d) strongly agree e) strongly disagree

- 10) Customer Satisfaction with quality of our products and services has increased overin this year
a) agree b)disagree c) neutral d) strongly agree e) strongly disagree
- 11) Quality of new products is emphasized in relation to cost or schedule objectives.
a) agree b) disagree c) neutral d) strongly agree e) strongly disagree
- 12) We make extensive use of statistical techniques to reduce variance in processes
a) agree b)disagree c) neutral d) strongly agree e) strongly disagree
- 13) Your work gives a feeling of personal accomplishment
a) agree b)disagree c) neutral d) strongly agree e) strongly disagree
- 14) You are satisfied with your current job
a) agree b)disagree c) neutral d) strongly agree e) strongly disagree
- 15) In terms of profitability, our ROI (return on investment) has improved
a) agree b)disagree c) neutral d) strongly agree e) strongly disagree
- 16) Quality improvement at this company is best
a) agree b)disagree c) neutral d) strongly agree e) strongly disagree
- 17) Productivity can be improved by introducing behaviour practices. At your company productivity is improved
a) agree b)disagree c) neutral d) strongly agree e) strongly disagree
- 18) Processes that operate with “six sigma quality” over the short term are assumed to produce long-term defect levels below 3.4 defects per million opportunities (DPMO)
a) agree b)disagree c) neutral d) strongly agree e) strongly disagree

ANNEXURE - II

A STUDY ON EFFECTIVENESS OF “SIX SIGMA IMPLEMENTATION ON PRODUCTIVITY CYCLE”

Mohamed Askar. PK, PG scholar, MBA department, Sathyabama University

DR.K.Santhanlaxmi, Assistant professor, MBA department, Sathyabama University

ABSTRACT

The main aim of the study on EFFECTIVENESS OF SIX SIGMA IMPLEMENTATION ON PRODUCTIVITY CYCLE based on the quality and production in achieving potential growth rate of the company. The research was done by using descriptive research method. The study has been done on the topic, — A Study on effectiveness of Six Sigma implementation on productivity cycle, to understand the process and effectiveness of implementing Six Sigma is a disciplined, data driven approach and methodology for eliminating defects (driving towards Six standard deviations between the mean and the nearest specification limits) in any process from manufacturing to transaction and from product and services. The scope of the study is the project will help the management to know the effectiveness level of workers about six sigma methodology.. The data has been collected using questionnaire and it has been analyzed. Analysis of data in a general way involves a number of closely related operations that are performed with the purpose of the collected data and the organizing them in such a manner that answer the research questions. The whole chapter of analysis and interpretation is based on the responses of 110 respondents administered with a questionnaire which contain the personal data their views about the effectiveness of six sigma implementation on productivity cycle. In a study it is found that the effectiveness of Six Sigma implementation on productivity cycle at United Industries Plastics Private limited is much effective and it also emphasis the simplicity of the process and quality of parts and also it has improved the responsibility in achieving targets. From this study it can be concluded that the effectiveness of Six Sigma implementation helps the organization in various multiple aspects.

INTRODUCTION

The term "six sigma" comes from statistics and is used in statistical quality control, which evaluates process capability. Originally, it referred to the ability of manufacturing processes to produce a very high proportion of output within specification. Processes that operate with "six sigma quality" over the short term are assumed to produce long-term defect levels below 3.4{defects per million opportunities (DPMO)}. The 3.4 dpmo is based on a "shift" of ± 1.5 sigma explained by Dr. Mikel J. Harry. This figure is based on the tolerance in the height of a stack of discs. Six Sigma's implicit goal is to improve all processes, but not to the 3.4 DPMO level necessarily. Organizations need to determine an appropriate sigma level for each of their most important processes and strive to achieve these. As a result of this goal, it is incumbent on management of the organization to prioritize areas of improvement.

Origin of Six Sigma:

- critical to quality: The customer is the start what is important for the customer need to be identified. Defects: Anything that does not deliver exactly what the customer wants.
- Process capability: The processes need to be deliver what the customer wants.
- Variation: As it experienced by the customers.
- Stable operations: The goal is to secure reliable roust that improve the customers experience.
- Design for Six Sigma: The design must meet all the customer requirements and the capability of the process.

Six Sigma strategies seek to improve the quality of the output of a process by identifying and removing the causes of defects and minimizing impact variability in manufacturing and business processes. It uses a set of quality management methods, mainly empirical, statistical methods, and creates a special infrastructure of people within the organization who are experts in these methods. Each Six Sigma project carried out within an organization follows a defined sequence of steps and has specific value targets, for example: reduce process cycle time, reduce pollution, reduce costs, increase customer satisfaction, and increase profits.

OBJECTIVES

PRIMARY OBJECTIVES:

A study on effectiveness on Six Sigma implementation productivity cycle on quality and process.

SECONDARY OBJECTIVES:

To analyse the effectiveness of six sigma implementation on productivity cycle. To improve cycle time on productivity. To improve the quality of the product.

NEED FOR THE STUDY

- To make awareness about six sigma benefits among the worker's.
- The company may implement the six sigma principles through source of the standard principle.
- By implementing six sigma methodology the organization could utilize their resource effectively.

SCOPE OF THE STUDY

This project will help the management to know the effectiveness level of workers about six sigma methodology. This study will help the management to know about the various typical activities of six sigma. This study will help the workers to have a very clear understanding about the six sigma principles. The finding of the study to help the management to implement six sigma model effectively.

REVIEW OF LITERATURE

Tapan Vora, 2014. Six Sigma is used as business improvement method, aimed for achieving defect free quality in products and services. It is considered as the latest tool in respect of quality, widely used worldwide for obtaining the finest quality in products and services. It is modeled and designed in such a way, to acquire huge money oriented results through gain in Productivity and improvement in Quality.

Hamada M.A, 2014. The term "Sigma" originates from statistics and is widely applicable to statistical methods of quality control and in process control, and also it examines the capability of the process. According to Hamada, process capability is the capacity of the processes to produce substantially good amount of output in manufacturing and other industries within the specified requirements. Six Sigma is applicable in every organization where operations and processes are involved.

Elliot Boldt, 2013. It is observed that the product and service quality of depends on customer satisfaction and is the foundation for any organization. The existence of an organization is based on the number of customers and their loyalty. Organizations should identify the needs of the customer and satisfy the demands. According to Elliot Boldt, all organizations identifies various types of needs for its customers. It is required to identify what the customer wants and provide it immediately at the lowest cost. Also, we have to ensure that products and services are of high quality and are reliable for the purpose.

Mikel Harry, Richard Schroeder, Currency, New York, 2005) Jack Welch, Ex-CEO of GE —The only way I see to get more productivity is by getting people involved and excited about their jobs. It's matter of understanding customer needs instead of 18 making something and putting it in a boxl (Six Sigma-A Breakthrough Management Strategy.

METHODOLOGY

Research Design: The research design was based on descriptive study.

Sampling Design: This is a convenience sampling under non probability sampling.

Data Collection:

Primary Data: It is collected by Questionnaire and Personal Interview.

Secondary Data: It is collected from journals, organization records, Organization website.

Structure of Questionnaire: Multiple choice questions and Likert Scale question.

Sample size: Sample size of 110 employees working in manufacturing industry.

Period of study: The period of study is carried out from January 2023 to March 2023.

Analytical Tools: In this study Regression Analysis, Correlation, Chi-Square Test is used as analytical tools for analysis.

DATA ANALYSIS

CORRELATION:

Null Hypothesis (H0): There is a negative relationship between Process to Make Improvement, Product Development Process and Quality Improvement.

Alternative Hypothesis (H1): There is positive relationship between Process to Make Improvement, Product Development Process and Quality Improvement.

	Process	production	quality
process Pearson Correlation	1	.033	.159
Sig. (2-tailed)		.746	.115
N	100	100	100
production Pearson Correlation	.033	1	.112
Sig. (2-tailed)	.746		.269
N	100	100	100
quality Pearson Correlation	.159	.112	1
Sig. (2-tailed)	.115	.269	
N	100	100	100

Showing the Correlation Table of Process to Make Improvement, Product Development Process and Quality Improvement.

INFERENCE:

As the sign. value is r value is 0.033 . There is a positive relationship between Process to Make Improvement, Product Development Process and Quality Improvement.

CHI SQUARE Analysis:

Null Hypothesis (H0): There is no significant difference between Productivity Improved and Quality of New Products.

Alternative Hypothesis (H1): There is significant difference between Productivity Improved and Quality of New Products.

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
production * quality	100	100.0%	0	0.0%	100	100.0%

production * quality Cross tabulation

Count

	quality										Total
	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	
production 1.00	0	0	1	2	2	0	0	0	0	0	5
2.00	0	1	2	2	4	1	2	0	0	0	12
3.00	0	0	4	5	4	10	2	3	2	0	30
4.00	1	0	6	2	8	3	4	3	2	2	31
4.00	2	1	2	3	4	1	5	3	1	0	22
Total	3	2	15	14	22	15	13	9	5	2	100

Chi-Square Tests

	Value	df	Asymp. Sig.(2-sided)
Pearson Chi-Square	37.373 ^a	36	.406
Likelihood Ratio	40.158	36	.291
Linear-by-Linear Association	1.235	1	.266
N of Valid Cases	100		

a. 48 cells (96.0%) have expected count less than 4. The minimum expected count is .10

INFERENCE:

As the calculated P value is less than 0.05 Null Hypothesis is rejected. There is a significant difference relationship between productivity Improved and Quality of New Product.

REGRESSION ANALYSIS:

Null Hypothesis (H0): There is no significant influence of process on Productivity and quality.

Alternative Hypothesis (H1): There is a significant influence of process on Productivity and quality.

Variables Entered/Removed

Model	Variables Entered	Variables Removed	Method
1	production, quality ^b		Enter

a. Dependent Variable: process

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.159 ^a	.025	.005	.59780	.025	1.264	2	97	.287

a. Predictors: (Constant), production, quality

Showing the Model Summary Of Process to Make Improvement, Productivity Can Be Improved, Quality Improved.

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.903	2	.452	1.264	.287 ^b
	Residual	34.665	97	.357		
	Total	34.568	99			

- a. Dependent Variable: process
- b. Predictors: (Constant), production, quality

Showing the ANOVA Table of Process to Make Improvement, Productivity Can Be Improved, Quality Improved.

Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	3.080	.454		6.784	.000
Quality	.186	.120	.157	1.556	.123
Production	.008	.054	.015	.152	.880

- a. Dependent Variable: process

Showing the coefficient Table of Process to Make Improvement, Productivity Can Be Improved, Quality Improved.

INFERENCE

Thus, Ho is rejected and Alternative Hypothesis is accepted and there is a positive relationship among Process to Make Improvement, Productivity Can Be Improved, Quality Improved.

SUGGESTION

- From correlation analysis it is found that ,There is a positive relationship between Process to Make Improvement, Product Development Process and Quality Improvement so, The management can focus the Process to Make Improvement, Product Development Process and Quality Improvement.
- From regression analysis it is found that ,there is a positive relationship between Process to Make Improvement, Product Development Process and Quality Improvement. So, The management can focus the Process to Make Improvement, Product Development Process and Quality Improvement.
- From Chi Square test is found that, there is a positive relationship between Productivity Improved and Quality of New Product. So, The management can focus the Productivity Improved and Quality of New Product.

CONCLUSION

It has often been said that six sigma customer driven. Six Sigma is defined as 3.4 defect per one million products or service processes, where anything not acceptable to the end customer is considered a defects. Detailed analysis has been performed to rectify the problems of rejection of cylinder lines due to the variations in quality characteristics of the manufactured units. The effectiveness of this project has been considered as successful because the critical factor for the process were found and controlled. This Six Sigma improvement methodology viz DMAIC Project shows that the performance of the firm is increased to a better level as regards to enhancement in customers (both internal and external) satisfaction development of specific methods to redesign and organize a process with a view to reduce errors and the

defects. Development of more efficient, reliable, capable and consistent manufacturing process and more better overall process performance, creation and continuous improvement. Finally, effectiveness of Six Sigma implementation can be helpful in reducing the nonconforming units or improving the organization quality and production process.

REFERENCE

- **Keki R. Bhote**, Ultimate Six Sigma, PHI India, 2007
- **Mikel Harry, Richard Schroeder**, Six Sigma- The Breakthrough Management Strategy, Currency, New York, 2005
- **Tapan Vora, 2014**, According to T Vora, Six Sigma is a quality based tool and a technique, which may be used in any organization to improve the process.
- **Hamada M.A, 2014**, According to Hamada, process capability is the capacity of the processes to produce substantially good amount of output in manufacturing and other industries within the specified requirements