IDEAL SCHOOL OF ENGINEERING

SUB: INDUSTRIAL ENGG. & QUALITY CONTROL – 6th Sem.

Chapter: QUALITY MANAGEMENT CONCEPTS

TOTAL QUALITY MANAGEMENT

Definition of TQM

Total Quality Management is defined as a customer-oriented process and aims for continuous improvement of business operations. It ensures that all allied works (particularly work of employees) are toward the common goals of improving product quality or service quality, as well as enhancing the production process or process of rendering of services. However, the emphasis is put on fact-based decision making, with the use of performance metrics to monitor progress.

The key principles of Total Quality Management

Commitment from the management:

- *Plan (drive, direct)*
- *Do (deploy, support, and participate)*
- *Check (review)*
- *Act (recognize, communicate, revise)*

Employee Empowerment

- *Training*
- *Excellence team*
- *Measurement and recognition*
- *Suggestion scheme*

Continuous Improvement

- *Systematic measurement*
- *Excellence teams*
- *Cross-functional process management*
- *Attain, maintain, improve standards*

Customer Focus

- *Partnership with Suppliers*
- *Service relationship with internal customers*
- *Customer-driven standards*
- *Never compromise quality*

Benefits of Total Quality Management

The benefits arising from the implementation of a Total Quality Management in an organization are:

- *This will increase the awareness of quality culture within the organization.*
- *A special emphasis on teamwork will be achieved.*
- *TQM will lead to a commitment towards continuous improvement.*

Essential requirements for successful implementation of TQM

- ***Commitment:*** *Quality improvement (in all aspect) must be everyone's job in the organization. An apparent commitment from the top management, breaking down the barriers for continuous quality improvement and steps required to provide an environment for changing attitudes must be provided. Training and support for this should be extended.*
- ***Culture:*** *There should be proper training to effect the changes in attitude and culture.*
- ***Continuous Improvement:*** *Recognize improvement as a continuous process, and not merely a one-off program.*
- ***Customer Focus:*** *Perfection in service with zero defectives and full satisfaction to end-user whether it's internal or external.*
- ***Control:*** *Ensure monitoring and control checks for any deviation from the intended course of implementation.*

1. *Plan*
2. *Do*
3. *Check*
4. *Act*

This also referred to as the PDCA cycle.

Planning Phase: *This phase is the most crucial phase of total quality management. Under this phase, employees have to come up with their respective queries and problems which need to be addressed. The employees apprise the management of different challenges which they are facing in their day to day operations and also analyze the root cause of the problem. They need to do the required research and collect significant data which would help them find solutions to all the problems.*
Doing Phase: *In this phase, a solution for the identified problems in the planning phase is developed by the employees. Strategies are devised and implemented to crack down the challenges faced by employees. The efficiency and effectiveness of solutions and strategies are also evaluated in this stage.*
Checking Phase: *Under this phase, a comparison analysis of before and after is*

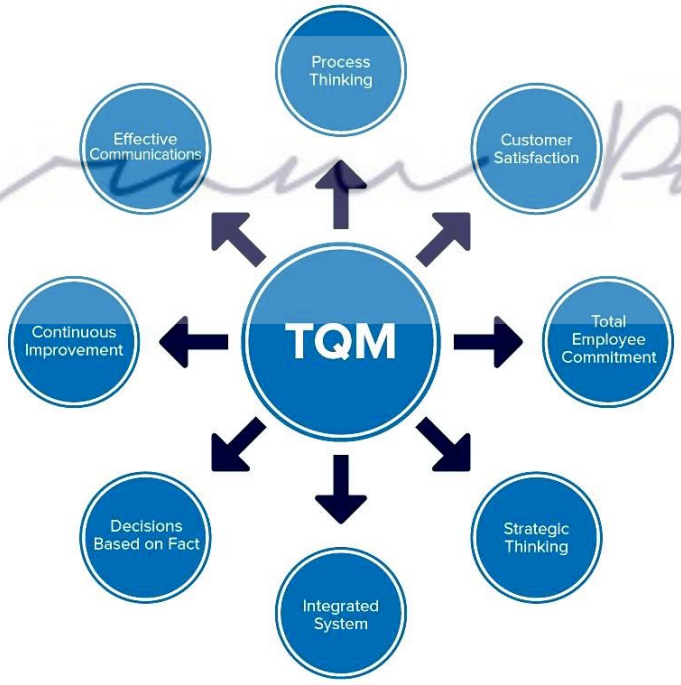
done in order to assess the effectiveness of the processes and measure the results.

Acting Phase: *This is the last phase of the cycle, in this phase employees document their results and prepare themselves to address other problems.*

Beliefs about Total Quality Management

Following are the universal Total Quality Management beliefs:

- *Satisfaction of the customer/owner is the measure of quality.*
- *Everyone is an owner.*
- *Continuous Quality improvement must be there.*
- *Analysis of the processes is the key to quality improvement.*
- *Constant TQM is not possible without consistent, active and enabling leadership by managers at all levels.*
- *It is important to incessantly improve quality of the products and services which we are supposed to provide to our customers/owners.*



ISO 9000

The ISO 9000 series is an integrated, global system for optimizing the quality effectiveness of a company or organization by creating a framework for continuous improvement. It is a guide for implementing quality management in an organization. ISO 9000 is thus primarily concerned with quality management. The definition of 'quality' in ISO 9000 refers to all the features of a product or a service which are required by the customer. Quality management means what the organization does to ensure that its products conform to the customer's requirements.

ISO 9000 series of Standards

The ISO 9000 family contains these standards:

- *ISO 9001:2015: Quality Management Systems - Requirements*
- *ISO 9000:2015: Quality Management Systems - Fundamentals and Vocabulary (definitions)*
- *ISO 9004:2018: Quality Management - Quality of an Organization - Guidance to Achieve Sustained Success (continuous improvement)*
- *ISO 19011:2018: Guidelines for Auditing Management Systems*

ISO 9000 history and revisions: ISO 9000:2000, 2008, and 2015

ISO 9000 was first published in 1987 by the International Organization for Standardization (ISO), a specialized international agency for standardization composed of the national standards bodies of more than 160 countries. The standards underwent major revisions in 2000 and 2008. The most recent versions of the standard, ISO 9000:2015 and ISO 9001:2015, were published in September 2015.

ASQ administers the U.S. Technical Advisory Groups and subcommittees that are responsible for developing the ISO 9000 family of standards. In its standards development work, ASQ is accredited by ANSI.

ISO 9000:2000

ISO 9000:2000 refers to the ISO 9000 update released in the year 2000.

The ISO 9000:2000 revision had five goals:

- *Meet stakeholder needs*
- *Be usable by all sizes of organizations*
- *Be usable by all sectors*
- *Be simple and clearly understood*
- *Connect quality management system to business processes*

ISO 9000:2000 was again updated in 2008 and 2015. ISO 9000:2015 is the most current version.

ISO 9000:2015 principles of Quality Management

The ISO 9000:2015 and ISO 9001:2015 standards are based on seven quality management principles that senior management can apply to promote organizational improvement.

ISO 9000 Quality Management Principles

1. *Customer focus*

   - ✓ *Understand the needs of existing and future customers*
   - ✓ *Align organizational objectives with customer needs and expectations*
   - ✓ *Meet customer requirements*
   - ✓ *Measure customer satisfaction*
   - ✓ *Manage customer relationships*
   - ✓ *Aim to exceed customer expectations*
   - ✓ *Learn more about the customer experience and customer satisfaction*

2. *Leadership*

   - ✓ *Establish a vision and direction for the organization*
   - ✓ *Set challenging goals*
   - ✓ *Model organizational values*
   - ✓ *Establish trust*
   - ✓ *Equip and empower employees*
   - ✓ *Recognize employee contributions*
   - ✓ *Learn more about leadership*

3. *Engagement of people*

- ✓ *Ensure that people's abilities are used and valued*
- ✓ *Make people accountable*
- ✓ *Enable participation in continual improvement*
- ✓ *Evaluate individual performance*
- ✓ *Enable learning and knowledge sharing*
- ✓ *Enable open discussion of problems and constraints*
- ✓ *Learn more about employee involvement*

4. *Process approach*

- ✓ *Manage activities as processes*
- ✓ *Measure the capability of activities*
- ✓ *Identify linkages between activities*
- ✓ *Prioritize improvement opportunities*
- ✓ *Deploy resources effectively*
- ✓ *Learn more about a process view of work and see process analysis tools*

5. *Improvement*

- ✓ *Improve organizational performance and capabilities*
- ✓ *Align improvement activities*
- ✓ *Empower people to make improvements*
- ✓ *Measure improvement consistently*
- ✓ *Celebrate improvements*
- ✓ *Learn more about approaches to continual improvement*

6. *Evidence-based decision making*

- ✓ *Ensure the accessibility of accurate and reliable data*
- ✓ *Use appropriate methods to analyze data*
- ✓ *Make decisions based on analysis*
- ✓ *Balance data analysis with practical experience*
- ✓ *See tools for decision making*

7. *Relationship management*

- ✓ *Identify and select suppliers to manage costs, optimize resources, and create value*
- ✓ *Establish relationships considering both the short and long term*
- ✓ *Share expertise, resources, information, and plans with partners*
- ✓ *Collaborate on improvement and development activities*
- ✓ *Recognize supplier successes*
- ✓ *Learn more about supplier quality and see resources related to managing the supply chain*

ISO 14000

ISO 14000 is defined as a series of international environmental management standards, guides, and technical reports. The standards specify requirements for establishing an environmental management policy, determining environmental impacts of products or services, planning environmental objectives, implementing programs to meet objectives, and conducting corrective action and management review.

ISO 14000 facts

- *ISO 14000 standards and practices can be applied to any organization, regardless of size or industry.*
- *ISO 14001:2015 is the most popular standard of the ISO 14000 family, which also includes the following standards:*
- *ISO 14004:2016 - Environmental Management Systems - General Guidelines On Implementation*
- *ISO 14006:2011 - Environmental Management Systems - Guidelines For Incorporating Ecodesign*
- *ISO 14015:2001 - Environmental Management - Environmental Assessment Of Sites And Organizations (EASO)*
- *ISO 14020:2000 - Environmental Labels And Declarations - General Principles*
- *ISO 14031:2013 - Environmental Management - Environmental Performance Evaluation - Guidelines*
- *ISO 14040:2006 - Environmental Management - Life Cycle Assessment - Principles And Framework*
- *ISO 14050:2009 - Environmental Management - Vocabulary*
- *ISO 14063:2006 - Environmental Management - Environmental Communication - Guidelines And Examples*
- *ISO 14064:2006 - Greenhouse Gases Standards*
- *ISO 19011:2018 - Guidelines For Auditing Management Systems*
- *Find more standards in the ISO 14000 family*

ISO 14000 history

History of ISO 14000

- *The first environmental management system standard, BS 7750, was published in 1992 by the BSI group.*
- *In 1996, the International Organization for Standardization (ISO) created the ISO 14000 family of standards.*
- *ISO 14001 underwent revision in 2004.*
- *The current revision of ISO 14001 was published in September 2015.*

Comparison between ISO 9000 & ISO 14000

Standard	ISO 9000	ISO 14000	ISO 26000
General description	Quality management systems standard	Environmental management systems standard	Guidance on social responsibility
Third-party certification	Yes	Yes	No
Key elements	• Quality management system • Management responsibility • Resource Management • Product realization • Measurement, analysis and improvement	• Environmental policy • Planning • Implementation and operation • Checking • Management review	• The SR context in which all organisations operate • SR principles relevant to organisations • Guidance on core SR subjects/issues • Guidance for organisations implementing SR

JUST IN TIME

What is Just in Time?

Just in Time (JIT), as the name suggests, is a management philosophy that calls for the production of what the customer wants, when they want it, in the quantities requested, where they want it, without it being delayed in inventory.

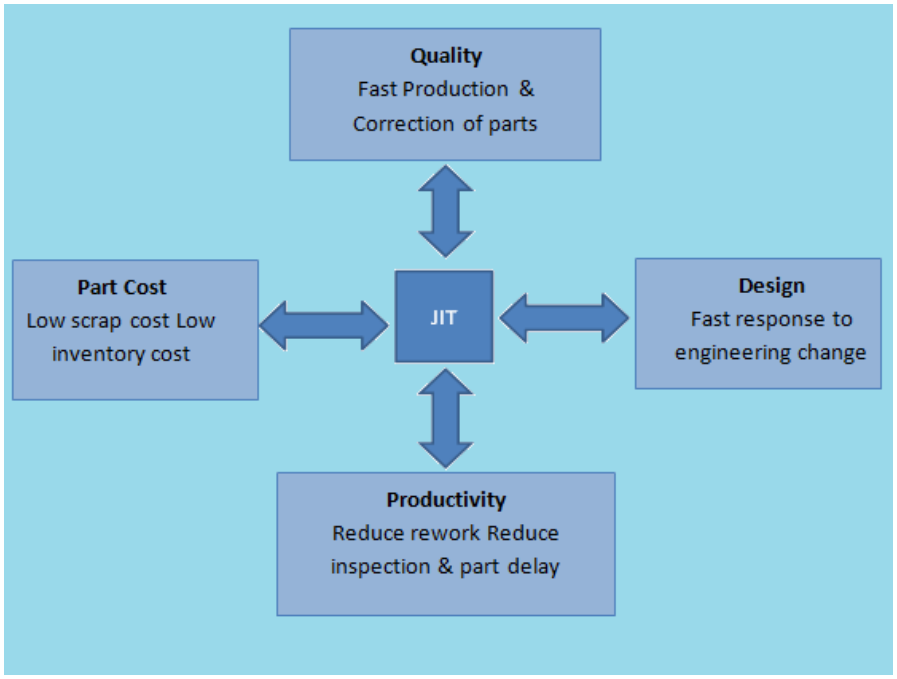
So instead of building large stocks of what you think the customer might want you only make exactly what the customer actually asks for when they ask for it. This allows you to concentrate your resources on only fulfilling what you are going to be paid for rather than building for stock.

Within a Just in Time manufacturing system, each process will only produce what the next process in sequence is calling for.

Elements involved in JIT

Continuous improvement:

- ✓ *Attacking fundamental problems and anything that does not add value to the product.*
- ✓ *Devising systems to identify production and allied problems.*
- ✓ ***Simplicity:*** *Simple systems are simple & easy to understand, easily manageable and the chances of going wrong are very low.*
- ✓ ***A product:*** *oriented layout for less time spent on materials and parts movement.*
- ✓ *Quality control at source to ensure every worker is solely responsible for the quality of their own produced output.*



Eliminating waste: *There are seven types of waste:*

1. *Waste from product defects.*
2. *Waste of time.*
3. *Transportation waste.*
4. *Inventory waste.*
5. *Waste from overproduction.*
6. *Processing waste.*

Waste minimization is one of the primary objectives of Just In Time system. This needs effective inventory management throughout the whole supply chain. Initially, a manufacturing entity will seek to reduce inventory and enhance operations within its own organization. In an attempt to reduce waste attributed to ineffective inventory management, SIX principles in relation to JIT have been stated by Schniededans and they are:

- ✓ *Reduce buffer inventory.*
- ✓ *Try for zero inventory.*
- ✓ *Search for reliable suppliers.*
- ✓ *Reduce lot size and increase the frequency of orders.*
- ✓ *Reduce purchasing cost.*
- ✓ *Improve material handling.*

BENEFITS OF JUST IN TIME

1. ***Reduction in the order to payment timeline****; cash, as they say is king in business. Many businesses will suffer with cash flow problems as they will often have to purchase large amounts of raw materials prior to manufacturing and subsequent payment by the customer. Often this gap is many months. Through implementing JIT you are able to considerably reduce that time period.*
2. ***Reduction in Inventory costs****; one of the main aims with any JIT implementation is to improve stock turns and the amount of stock being held. Personal experience has seen reductions of more than 90% stock in some industries. Along with the reduction in the stock come many other associated benefits.*
3. ***Reduction in space required****; by removing large amounts of stock from the system and moving processes closer together we will often see a significant reduction in the amount of floor space being used. Results from 100's of projects run within companies in the UK through the Manufacturing Advisory Service saw average reductions of 33% for simple 5 day implementation projects.*
4. ***Reduction in handling equipment and other costs****; if you don't have to move large batches there is less need for complex machinery to move them and all of the associated labor and training.*

5. ***Lead time reductions****; one of the most significantly impacted areas is that of the time it takes for products to flow through the process. Instead of weeks or months most JIT implementations result in lead times of hours or a few days.*
6. ***Reduced planning complexity****; the use of simple pull systems such as Kanban, even with your suppliers, can significantly reduce the need for any form of complex planning. With many implementations the only planning is the final shipping process.*
7. ***Improved Quality****; the removal of large batch manufacturing and reduction in handling often results in significant quality improvements; often in the region of 25% or more.*
8. ***Productivity increases****; to achieve JIT there are many hurdles that must be overcome with regards to how the process will flow. These will often result in productivity improvements of 25% upwards.*
9. ***Problems are highlighted quicker****; often this is cited as being a negative aspect of JIT in that any problems will often have an immediate impact on your whole production process. However this is the perfect way to ensure that problems are highlighted and solved immediately when they occur.*

Advantages & Disadvantages of Just-In-Time Systems

Advantages of Adopting Just-In-Time include:

- *Just-in-time approach keeps stock holding costs to a minimum level. The released capacity results in better utilization of space and bears a favourable impact on the insurance premiums and rent that would otherwise be needed to be made.*
- *The just-in-time approach helps to eliminate waste. Chances of expired or out of date products; do not arise at all.*
- *As under this management method, only essential stocks which are required for to manufacturing are obtained, thus less working capital is required. Under this approach, a minimum re-ordering level is set, and only when that level is reached, order for fresh stocks are made and thus this becomes a boon to inventory management too.*
- *Due to the abovementioned low level of stocks held, the ROI (Return On Investment? of the organizations be high in general.*
- *As this approach works on a demand-pull basis, all goods produced would be sold, and thus it includes changes in demand with unanticipated ease. This makes JIT appealing today, where the market demand is fickle and somewhat volatile.*
- *JIT emphasizes the 'right-first-time' concept, so that rework costs and the cost of inspection is minimized.*

- *By following JIT greater efficiency and High-quality products can be derived.*
- *Better relationships are fostered along the production chain under a JIT system.*
- *Higher customer satisfaction due to continuous communication with the customer.*
- *Just In Time adoption result in the elimination of overproduction.*

Disadvantages of Adopting JIT Systems

- *JIT approach states ZERO tolerance for mistakes, making re-work difficult in practice, as inventory is kept to a minimum level.*
- *A successful application of JIT requires a high reliance on suppliers, whose performance is outside the purview of the manufacturer.*
- *Due to no buffers in JIT, production line idling and downtime can occur which would have an unfavourable effect on the production process and also on the finances.*
- *Chances are quite high of not meeting an unexpected increase in orders as there will be no excess inventory of finished goods.*
- *Transaction costs would be comparatively high depending upon the frequency of transactions.*
- *JIT may have certain negative effects on the environment due to the frequent deliveries as the same would result in higher use and cost of transportation, which in turn would consume more fossil fuels.*

SIX SIGMA

Six Sigma is a disciplined, statistical-based, data-driven approach and continuous improvement methodology for eliminating defects in a product, process or service. It was developed by Motorola and Bill Smith in the early 1980's based on quality management fundamentals, then became a popular management approach at General Electric (GE) with Jack Welch in the early 1990's. The approach was based on the methods taught by W. Edwards Deming, Walter Shewhart and Ronald Fisher among many others. Hundreds of companies around the world have adopted Six Sigma as a way of doing business.

Sigma represents the population standard deviation, which is a measure of the variation in a data set collected about the process. If a defect is defined by specification limits separating good from bad outcomes of a process, then a six sigma process has a process mean (average) that is six standard deviations from the nearest specification limit. This provides enough buffer between the process natural variation and the specification limits.

For example, if a product must have a thickness between 10.32 and 10.38 inches to meet customer requirements, then the process mean should be around 10.35, with a standard deviation less than 0.005 (10.38 would be 6 standard deviations away from 10.35), assuming a normal distribution.

Six Sigma can also be thought of as a measure of process performance, with Six Sigma being the goal, based on the defects per million. Once the current performance of the process is measured, the goal is to continually improve the sigma level striving towards 6 sigma. Even if the improvements do not reach 6 sigma, the improvements made from 3 sigma to 4 sigma to 5 sigma will still reduce costs and increase customer satisfaction.

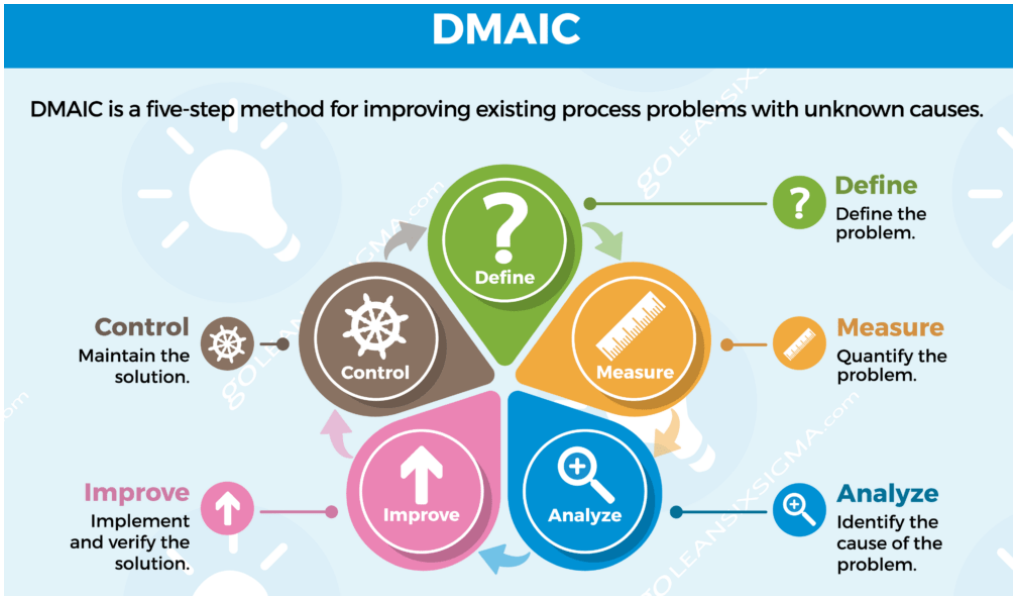
Sigma Level	Defects per Million	Yield
6	3.4	99.99966%
5	230	99.977%
4	6,210	99.38%
3	66,800	93.32%
2	308,000	69.15%
1	690,000	30.85%

Methodologies of Six Sigma

There are two major methodologies used within Six Sigma, both of which are composed of five sections, according to the 2005 book "JURAN Institute Six Sigma Breakthrough and Beyond" by Joseph A. De Feo and William Barnard.

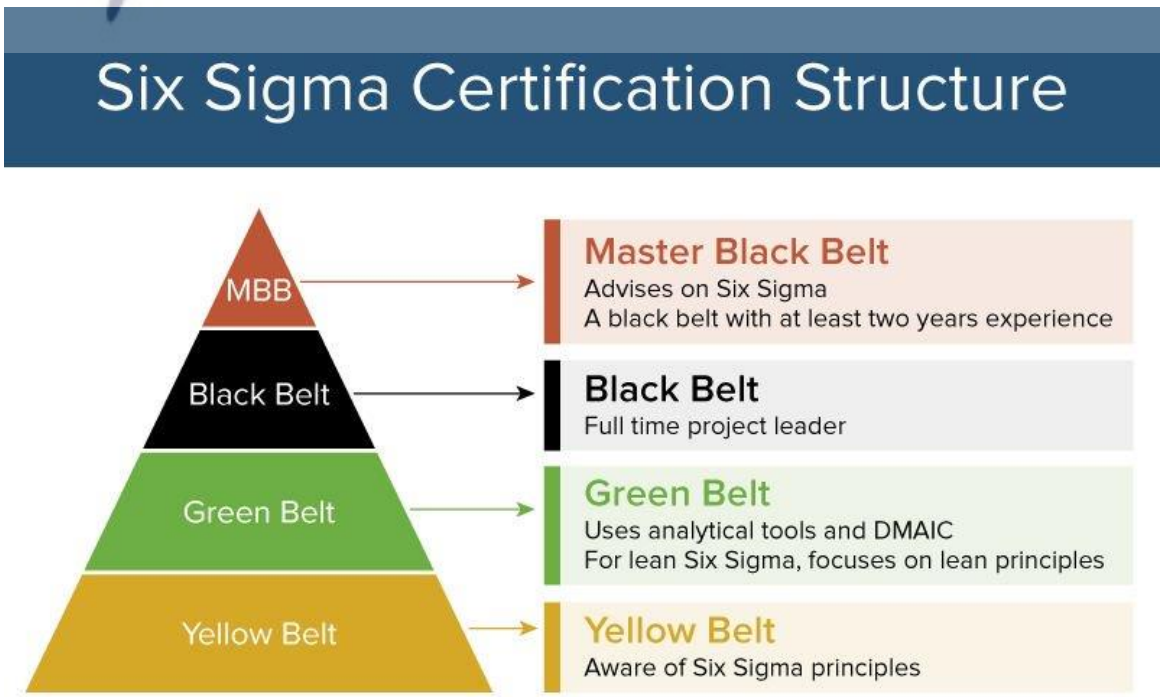
***DMAIC**: The DMAIC method is used primarily for improving existing business processes. The letters stand for:*

- ***D**efine the problem and the project goals*
- ***M**easure in detail the various aspects of the current process*
- ***A**nalyze data to, among other things, find the root defects in a process*
- ***I**mprove the process*
- ***C**ontrol how the process is done in the future*



DMADV: *The DMADV method is typically used to create new processes and new products or services. The letters stand for:*

- ***D****efine the project goals*
- ***M****easure critical components of the process and the product capabilities*
- ***A****nalyze the data and develop various designs for the process, eventually picking the best one*
- ***D****esign and test details of the process*
- ***V****erify the design by running simulations and a pilot program, and then handing over the process to the client*



There are also many management tools used within Six Sigma. Some examples include the following.

Five Whys

This is a method that uses questions (typically five) to get to the root cause of a problem. The method is simple: simply state the final problem (the car wouldn't start, I was late to work again today) and then ask the question "why," breaking down the issue to its root cause. In these two cases, it might be: because I didn't maintain the car properly and because I need to leave my house earlier to get to work on time.

CTQ Tree

The Critical to Quality (CTQ) Tree diagram breaks down the components of a process that produces the features needed in your product and service if you wish to have satisfied customers.

LEAN MANUFACTURING (LEAN PRODUCTION)

Lean manufacturing is a methodology that focuses on minimizing waste within manufacturing systems while simultaneously maximizing productivity.

Also known as lean production, or just lean, the integrated sociotechnical approach is based on the Toyota Production System and is still used by that company, as well as myriad others, including Caterpillar Inc. and Nike.

Lean manufacturing is based on a number of specific principles, such as Kaizen, or continuous improvement.

Lean manufacturing was introduced to the Western world via the 1990 publication of The Machine That Changed the World, which was based on a five-year, $5 million MIT study of the future of the automobile that detailed Toyota's lean production system. Since that time, the lean principles have profoundly influenced manufacturing concepts throughout the world, as well as industries outside of manufacturing, including healthcare, software development and service industries.

The benefits of lean includes:

- ✓ *reduced lead times*
- ✓ *reduced operating costs*
- ✓ *improved product quality*

FIVE PRINCIPLES OF LEAN MANUFACTURING

1. Identify value from the customer's perspective. *Value is created by the producer, but it is defined by the customer. In other words, companies need to understand the value the customer places on their products and services, which, in turn, can help them determine how much money the customer is willing to pay.*

The company must strive to eliminate waste and cost from its business processes so that the customer's optimal price can be achieved at the highest profit to the company.

2. Map the value stream. *This principle involves recording and analyzing the flow of information or materials required to produce a specific product or service with the intent of identifying waste and methods of improvement. The value stream encompasses the product's entire lifecycle, from raw materials through to disposal.*

Companies must examine each stage of the cycle for waste -- or muda in Japanese. Anything that does not add value must be eliminated. Lean thinking recommends supply chain alignment as part of this effort.

3. Create flow. *Eliminate functional barriers and identify ways to improve lead time to ensure the processes are smooth from the time an order is received through to delivery. Flow is critical to the elimination of waste. Lean manufacturing relies on preventing interruptions in the production process and enabling a harmonized and integrated set of processes in which activities move in a constant stream.*

4. Establish a pull system. *This means you only start new work when there is demand for it. Lean manufacturing uses a pull system instead of a push system.*

With a push system, used by manufacturing resource planning (MRP) systems, inventory needs are determined in advance and the product is manufactured to meet that forecast. However, forecasts are typically inaccurate, which can result in swings between too much inventory and not enough, as well as subsequent disrupted schedules and poor customer service.

In contrast to MRP, lean manufacturing is based on a pull system in which nothing is bought or made until there is demand. Pull relies on flexibility and communication.

5. Pursue perfection with continual process improvement, or kaizen. *Lean manufacturing rests on the concept of continually striving for perfection, which entails targeting the root causes of quality issues and ferreting out and eliminating waste across the value stream.*

<u>The eight wastes of lean production</u>

The Toyota Production System laid out seven wastes, or processes and resources, that don't add value for the customer. These seven wastes are:

- *unnecessary transportation;*
- *excess inventory;*
- *unnecessary motion of people, equipment or machinery;*
- *waiting, whether it is people waiting or idle equipment;*
- *over-production of a product;*
- *over-processing or putting more time into a product than a customer needs, such as designs that require high-tech machinery for unnecessary features; and*

- *Defects, which require effort and cost for corrections.*

SEVEN LEAN MANUFACTURING TOOLS AND CONCEPTS

Lean manufacturing requires a relentless pursuit of reducing waste. Waste is anything that customers do not believe adds value and for which they are not willing to pay. This requires continuous improvement, which lies at the heart of lean manufacturing.

Other important concepts and processes lean relies on include:

- *Heijunka: production leveling or smoothing that seeks to produce a continuous flow of production, releasing work to the plant at the required rate and avoiding interruptions.*
- *Kanban: a signal -- either physical, such as tag or empty bin, or electronically sent through a system -- used to streamline processes and create just-in-time delivery.*
- *Jidoka: A method of providing machines and humans with the ability to detect an abnormality and stop work until it can be corrected.*
- *Andon: A visual aid, such as a flashing light, that alerts workers to a problem.*
- *Poka-yoke: A mechanism that safeguards against human error, such as an indicator light that turns on if a necessary step was missed, a sign given when a bolt was tightened the correct number of times or a system that blocks a next step until all the previous steps are completed.*
- *5S: A set of practices for organizing workspaces to create efficient, effective and safe areas for workers and which prevent wasted effort and time. 5S emphasizes organization and cleanliness.*
- *Cycle time: How long it takes to produce a part or complete a process.*

ASSIGNMENT QUESTIONS

i. *Define Total Quality Management*
ii. *What are the key principle s o f Total Quality Management*
iii. *State the essential requirements of TQM*
iv. *Describe briefly about ISO 9000. State its principles of Quality Management. Mention its 5 goals.*
v. *Describe briefly about ISO 14000.*
vi. *Compare ISO 9000 with ISO 14000.*
vii. *What are the elements of JIT Technique?*
viii. *What are the benefits of JIT Technique?*
ix. *What are the advantages of JIT.*
x. *What are the Dis-advantages of JIT*
xi. *What are the five principles of Lean Manufacturing?*

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