

UNIT-II

Fundamentals of Management for Engineers

Contents-Unit-2

- Introduction to Operations Management,
- Types of Plant Layout,
- Introduction to Total Quality Management (TQM),
- Total Quality Management Models,
- Benefits of TQM,
- Basics of Six Sigma and
- Lean Manufacturing.

Operations Management is:

The **business function** responsible for **planning** , **coordinating** , and **controlling** the ***resources*** needed to **produce products** and services for a company

Operations Management is:

- A management function
- An organization's core function
- In every organization whether Service or Manufacturing, profit or Not for profit

What is Role of OM?

OM Transforms inputs to outputs

Inputs are resources such as People, Material, and Money

Outputs are goods and services

OM's Transformation Process



Transformation Process of a Canned Food Processor

<u>Inputs</u>	<u>Processing</u>	<u>Outputs</u>
<ul style="list-style-type: none">• Raw vegetables• Metal sheets• Water• Energy• Labor• Building• Equipment	<ul style="list-style-type: none">• Cleaning• Making cans• Cutting• Cooking• Packing• Labeling	Canned vegetables

Transformation Process of a Hospital

Inputs	Processing	Outputs
<ul style="list-style-type: none">• Doctors, nurses• Hospital• Medical Supplies• Equipment• Laboratories	<ul style="list-style-type: none">• Examination• Surgery• Monitoring• Medication• Therapy	Healthy patients

OM's Transformation Role'

▪ To add value

-Increase product value at each stage

-Value added is the net increase between output product value and input material value

▪ Provide an efficient transformation

-Efficiency – means performing activities well for least possible cost

Concept of Plant Layout

Plant layout is a plan for effective utilisation of facilities for the manufacture of products; involving a most efficient and economical arrangement of machines, materials, personnel, storage space and all supporting services, within available floor space.

“Plant layout is a plan of optimum arrangement of facilities including personnel, equipment’s, storage space, material handling equipment and all other supporting services along with the decision of best structure to contain all these facilities.”

Objectives/Advantages of Plant Layout

1. Streamline flow of materials through the plant
2. Minimise material handling
3. Facilitate manufacturing progress by maintaining balance in the processes
4. Maintain flexibility of arrangements and of operation
5. Maintaining high turnover of in-process inventory
6. Effective utilisation of men, equipment and space
7. Increase employee morale
8. Minimise interference (i.e. interruption) from machines
9. Reduce hazards affecting employees
10. Hold down investment (i.e. keep investment at a lower level) in equipment.

Principles of Plant Layout

(i) Principle of Minimum Movement:

Materials and labour should be moved over minimum distances; saving cost and time of transportation and material handling.

(ii) Principle of Space Utilization:

All available cubic space should be effectively utilized – both horizontally and vertically.

(iii) Principle of Flexibility:

Layout should be flexible enough to be adaptable to changes required by expansion or technological development.

(iv) Principle of Interdependence:

Interdependent operations and processes should be located in close proximity to each other; to minimize product travel.

(v) Principle of Overall Integration:

All the plant facilities and services should be fully integrated into a single operating unit; to minimize cost of production.

(vi) Principle of Safety:

There should be in-built provision in the design of layout, to provide for comfort and safety of workers.

(vii) Principle of Smooth Flow:

The layout should be so designed as to reduce work bottlenecks and facilitate uninterrupted flow of work throughout the plant.

(viii) Principle of Economy:

The layout should aim at effecting economy in terms of investment in fixed assets.

(ix) Principle of Supervision:

A good layout should facilitate effective supervision over workers.

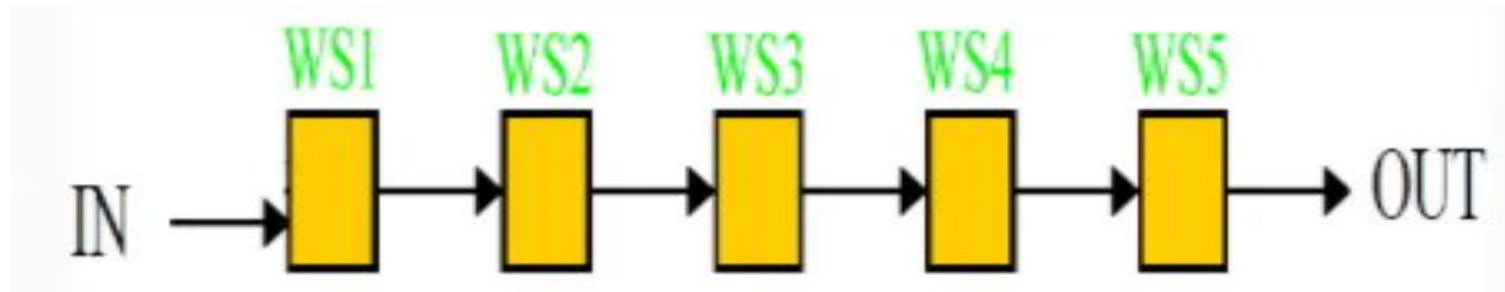
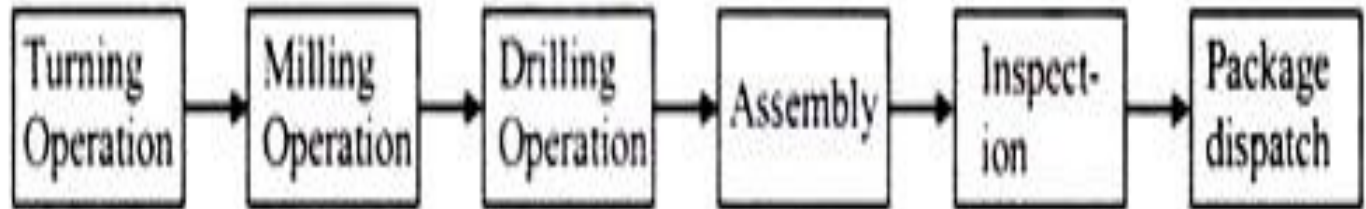
(x) Principle of Satisfaction:

A good layout should boost up employee morale, by providing them with maximum work satisfaction.

Types of Plant Layout

Product Layout (or Line Layout):

- In this type of layout, all the machines are arranged in the sequence, as required to produce a specific product.
- It is called line layout because machines are arranged in a straight line.
- The raw materials are fed at one end and taken out as finished product to the other end.
- Special purpose machines are used which perform the required jobs (i.e. functions) quickly and reliably.



○ **Product A**



○ **Product B**



Advantages of Product Layout:

1. Reduced material handling cost due to mechanized handling systems and straight flow
2. Perfect line balancing which eliminates bottlenecks and idle capacity.
3. Short manufacturing cycle due to uninterrupted flow of materials
4. Simplified production planning and control; and simple and effective inspection of work.
5. Small amount of work-in-progress inventory
6. Lesser wage cost, as unskilled workers can learn and manage production.

Disadvantages of Product Layout:

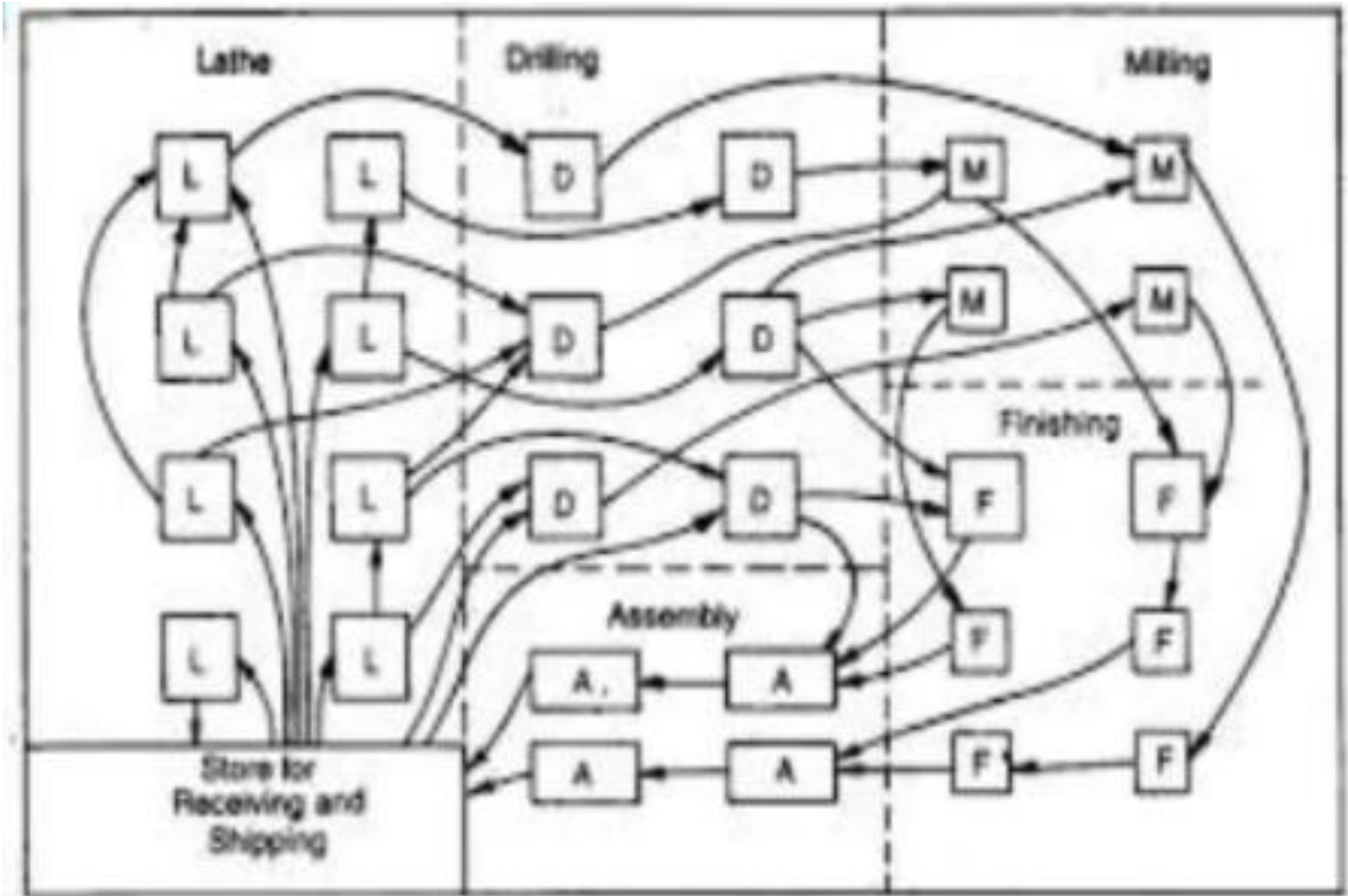
1. Lack of flexibility of operations, as layout cannot be adapted to the manufacture of any other type of product.
2. Large capital investment, because of special purpose machines.
3. Dependence of whole activity on each part; any breakdown of one machine in the sequence may result in stoppage of production.
4. Same machines duplicated for manufacture of different products; leading to high overall operational costs.
5. Delicate special purpose machines require costly maintenance / repairs.

Product layout is suitable in the following cases:

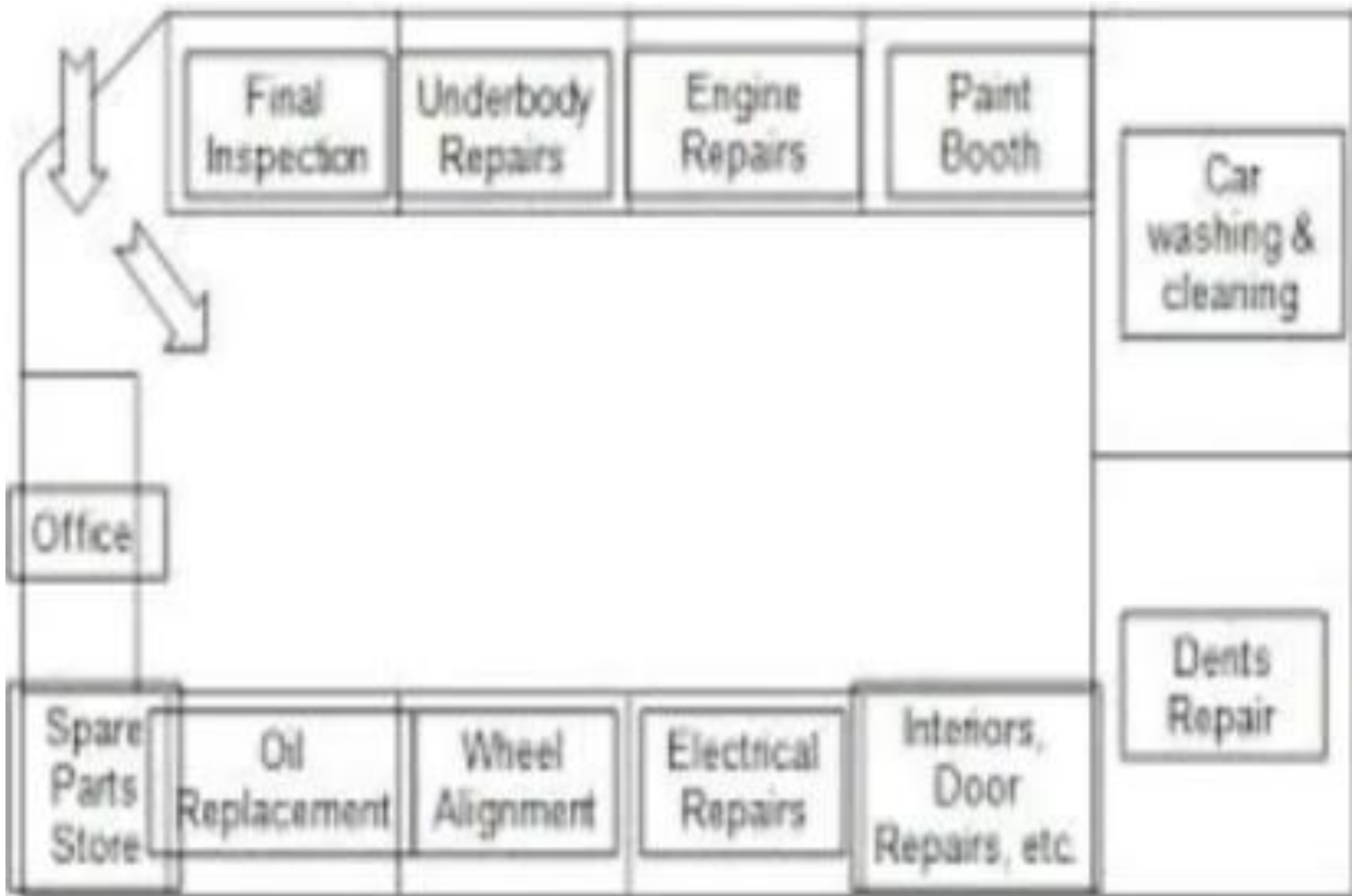
1. Where one or few standardized products are manufactured.
2. Where a large volume of production of each item has to travel the production process, over a considerable period of time.
3. Where time and motion studies can be done to determine the rate of work.
4. Where a possibility of a good balance of labour and equipment exists.
5. Where minimum of inspection is required, during sequence of operations.
6. Where materials and products permit bulk or continuous handling by mechanical parts.
7. Where minimum of set-ups are required.

Process Layout (or Functional Layout):

In this type of layout, all machines performing similar type of operations are grouped at one location i.e. all lathes, milling machines etc. are grouped in the shop and they will be clustered in like groups.



Process Layout (or Functional Layout)



Process Layout (or Functional Layout) of Car Service

Advantages of Process layout :

1. Greater flexibility with regard to work distribution to machinery and personnel. Adapted to frequent changes in sequence of operations.
2. Lower investment due to general purpose machines; which usually are less costly than special purpose machines.
3. Higher utilisation of production facilities; which can be adapted to a variety of products.
4. Variety of jobs makes the work challenging and interesting.
5. Breakdown of one machine does not result in complete stoppage of work.

Disadvantages of Process layout :

1. Backtracking and long movements occur in handling of materials. As such, material handling costs are higher.
2. Mechanisation of material handling is not possible.
3. Production planning and control is difficult
4. More space requirement; as work-in-progress inventory is high-requiring greater storage space.
5. As the work has to pass through different departments; it is quite difficult to trace the responsibility for the finished product.

Process layout is suitable in the following cases, where:

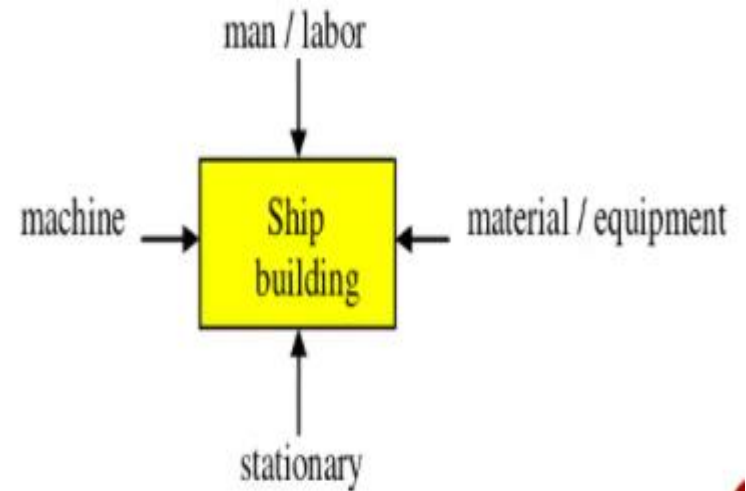
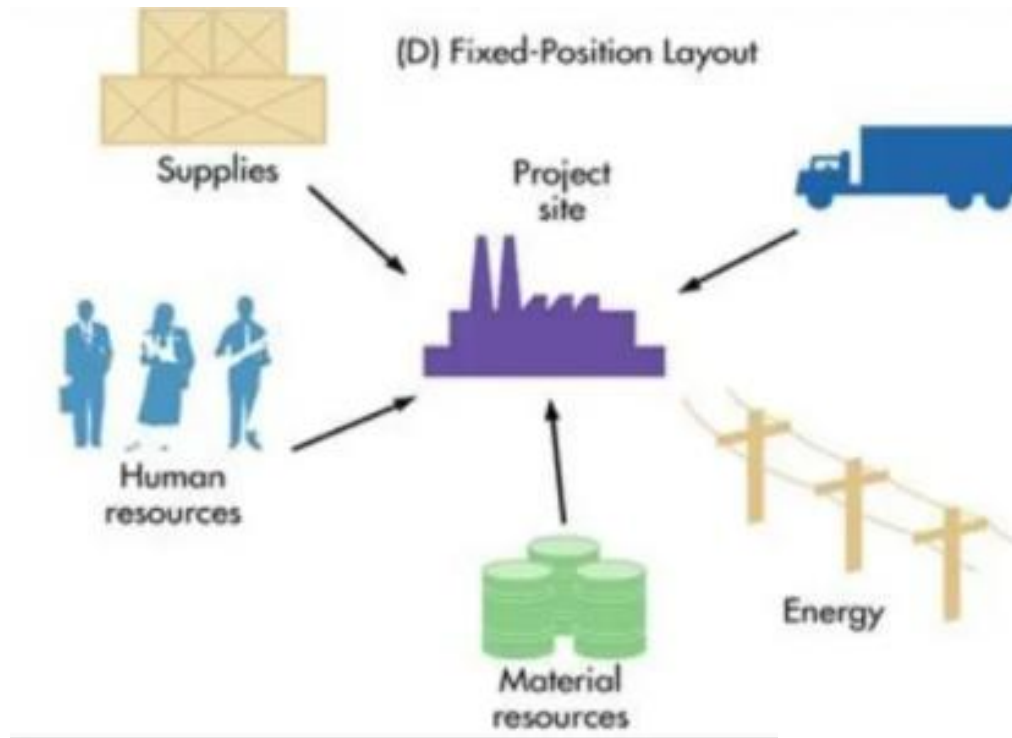
1. Non-standardised products are manufactured; as the emphasis is on special orders.
2. It is difficult to achieve good labour and equipment balance.
3. Production is not carried on a large scale.
4. It is difficult to undertake adequate time and motion studies.
5. It is frequently necessary to use the same machine or work station for two or more difficult operations.
6. During the sequence of operations, many inspections are required.
7. Process may have to be brought to work, instead of “**vice-versa**”; because materials or products are too large or heavy to permit bulk or continuous handling by mechanical means.

Fixed Position Layout:

It is also called stationary layout. In this type of layout men, materials and machines are brought to a product that remains in one place owing to its size.

Ship-building, air-craft manufacturing, wagon building, heavy construction of dams, bridges, buildings etc. are typical examples of such layout.

This type of layout is not relevant for small scale entrepreneur



ADAVANTAGES OF FIXED POSITION LAYOUT

1. It saves time and cost involved on the movement of work from one workstation to another.
2. The layout is flexible as change in job design and operation sequence can be easily incorporated.
3. It is more economical when several orders in different stages of progress are being executed simultaneously.
4. Adjustments can be made to meet shortage of materials or absence of workers by changing the sequence of operations.

DISADVANTAGES OF FIXED POSITION LAYOUT

1. Production period being very long, capital investment is very heavy
2. Very large space is required for storage of material and equipment near the product.
3. As several operations are often carried out simultaneously, there is possibility of confusion and conflicts among different workgroups.

SUITABILITY OF FIXED POSITION LAYOUT

1. Manufacture of bulky and heavy products such as locomotives, ships, boilers, generators, wagon building, aircraft manufacturing, etc.
2. Construction of building, flyovers, dams.

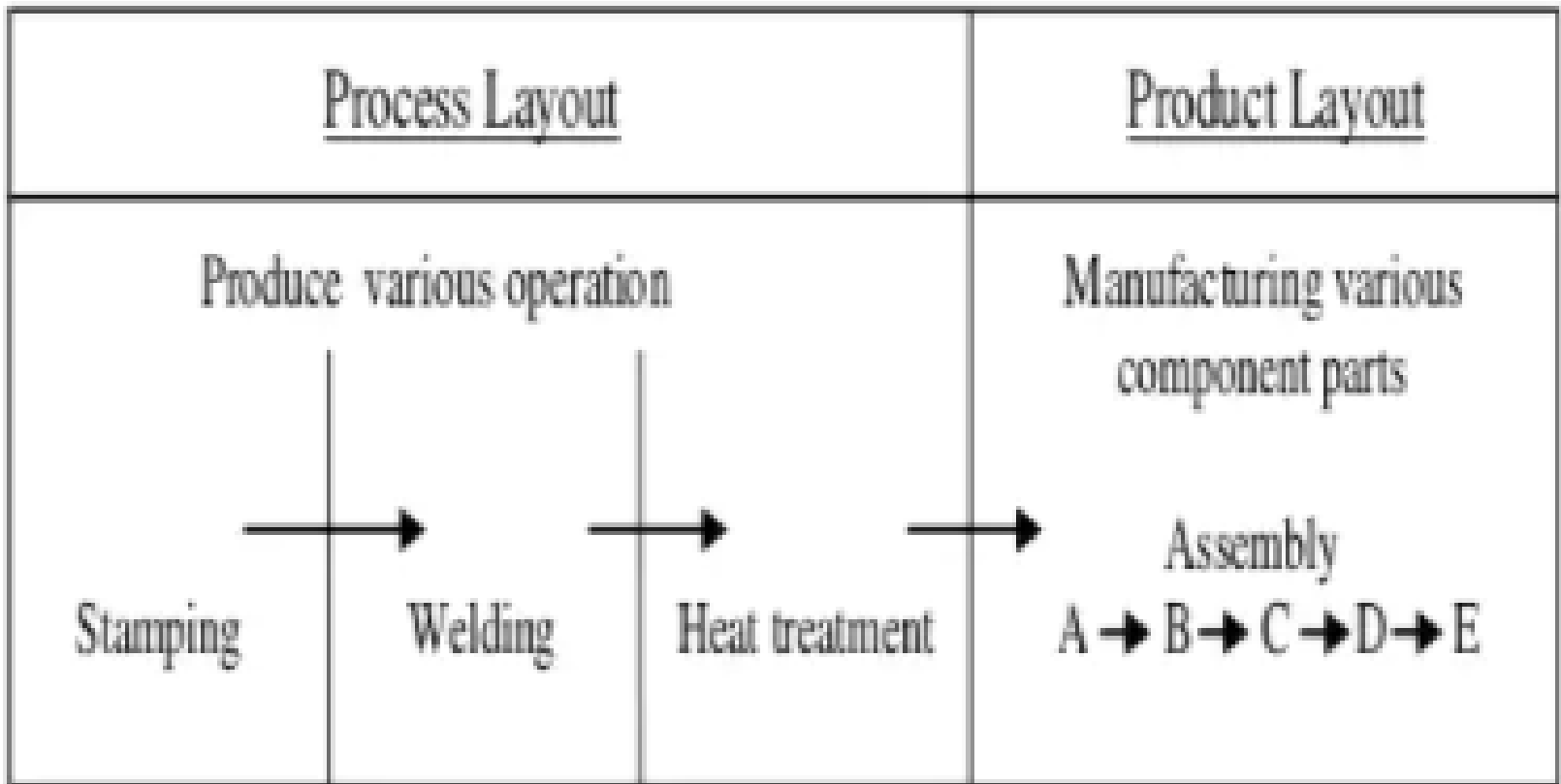
Combination Layout:

In practice, plants are rarely laid out either in product or process layout form. Generally a combination of the two basic layouts is employed; to derive the advantages of both systems of layout. For example, refrigerator manufacturing uses a combination layout.

Process layout is used to produce various operations like stamping, welding, heat treatment being carried out in different work centres as per requirement. The final assembly of the product is done in a product type layout.

e.g. for industries involving the fabrication of parts and assembly, fabrication tends to employ the process layout, while the assembly areas often employ the product layout.

In soap, manufacturing plant, the machinery manufacturing soap is arranged on the product line principle, but ancillary services such as heating, the manufacturing of glycerin, the power house, the water treatment plant etc. are arranged on a functional basis.



Total Quality Management (TQM)

Total Quality Management (TQM) is a management framework based on the belief that an organization can build long-term success by having all its members, from low-level workers to its highest ranking executives, focus on improving quality and, thus, delivering customer satisfaction.

TQM requires organizations to **focus on continuous improvement**, or kaizen. It focuses on process improvements over the long term, rather than simply emphasizing short-term financial gains.

Importance of TQM

TQM can have an important and beneficial effect on employee and organizational development. By having all employees focus on quality management and continuous improvement, companies can establish and uphold cultural values that create long-term success to both customers and the organization itself. TQM's focus on quality helps identify skills deficiencies in employees, along with the necessary training, education or mentoring to address those deficiencies.

With a focus on [teamwork](#), TQM leads to the creation of cross-functional teams and knowledge sharing. The increased communication and coordination across disparate groups deepens institutional knowledge and gives companies more flexibility in deploying personnel.

Benefits of TQM

Less product defects. One of the principles of TQM is that creation of products and services is done right the first time. This means that products ship with fewer defects, which reduce product recalls, future customer support overhead and product fixes.

Satisfied customers. High-quality products that meet customers' needs results in higher customer satisfaction. High customer satisfaction, in turn, can lead to increased market share, revenue growth via upsell and word-of-mouth marketing initiated by customers.

Lower costs. As a result of less product defects, companies save cost in customer support, product replacements, field service and the creation of product fixes. The cost savings flow to the bottom line, creating higher profit margins.

Well-defined cultural values. Organizations that practice TQM develop and nurture core values around quality management and continuous improvement. The TQM mindset pervades across all aspects of an organization, from hiring to internal processes to product development.

Total Quality Management Models

TQM is a combined effort of both top level management as well as employees of an organization to formulate effective strategies and policies to deliver high quality products which not only meet but also exceed customer satisfaction.

TQM enables employees to focus on quality than quantity and strive hard to excel in whatever they do. According to TQM, customer feedbacks and expectations are most essential when it comes to formulating and implementing new strategies to deliver superior products than competitors and eventually yield higher revenues and profits for the organization.

Credits for the process of TQM go to many philosophers and their teachings. Drucker, Juran, Deming, Ishikawa, Crosby, Feigenbaum and many other individuals who have in due course of time studied organizational management have contributed effectively to the process of TQM

Following are the various models of total quality management:

- Deming Application Prize
- Malcolm Baldrige Criteria for Performance Excellence
- European Foundation for Quality Management
- ISO quality management standards

The Deming Prize

- The Deming Prize is the Japanese national prize for quality and it is not available internationally.
- There are a number of prize categories. Prizes are awarded to a large corporation, a division, a factory and to medium and small companies.
- There is also a Deming prize for individuals who have made an outstanding contribution to statistical theory.

The Malcolm Baldrige National Quality Award (United States)

- The Malcolm Baldrige National Quality Award is the US equivalent of the prestigious Japanese Deming Prize. The award was established by the US Congress in 1987 and was named in honour of former Secretary of State Malcolm Baldrige who was a keen proponent of quality management as the key to national prosperity.
- The award is designed to recognize US companies that excel in quality achievement and quality management.
- The awards are given annually in the following categories: **manufacturing, service, and small businesses.**

The Malcolm Baldrige National Quality Award (United States)

In 1999, additional awards were introduced in health care and education. The award concentrates on:

- results and service;
- the involvement of a variety of trade and professional groups;
- innovative approaches to quality;
- human resources and a customer focus;
- the importance of sharing information.

The European Quality Award

- The award aims to recognize organizations that are paying exceptional attention to total quality, and to encourage others to follow their example.
- It is a single annual award presented to the most successful exponent of TQM in Western Europe and in addition there are a number of European Quality Prizes for companies who have demonstrated excellence in their management of quality.

ISO9000

➤ The ISO9000 series is the world's major quality standard with some 350,000 users worldwide. It was first published in the UK in 1979 under the title 'Quality Systems' and was known until the mid-1990s in the UK as BS5750.

➤ ISO9000 is concerned with quality management, defined as the means by which an organization employs its resources to meet its customer and regulatory requirements and the mechanisms it employs to make continuous improvements.

What is Six Sigma?

- ✓ It is a methodology for continuous improvement.
- ✓ It is a methodology for creating products/ processes that perform at high standards.
- ✓ It is a set of statistical and other quality tools arranged in unique way.
- ✓ It is a way of knowing where you are and where you could be.
- ✓ It is a Quality Philosophy and a management technique.

Six Sigma is not:

- A standard
- A certification
- Another metric like percentage

Two meanings of sigma

- ❑ The term “sigma” is used to designate the distribution or spread about the mean (average) of any process or procedure.
- ❑ For a process, the sigma capability (z-value) is a metric that indicates how well that process is performing. **The higher the sigma capability, the better.** Sigma capability measures the capability of the process to produce defect-free outputs. A defect is anything that results in customer dissatisfaction.

Why should I use Six Sigma?



Quality

**Process
Improvement**

**Time
Reduction**

**Customer
Satisfaction**

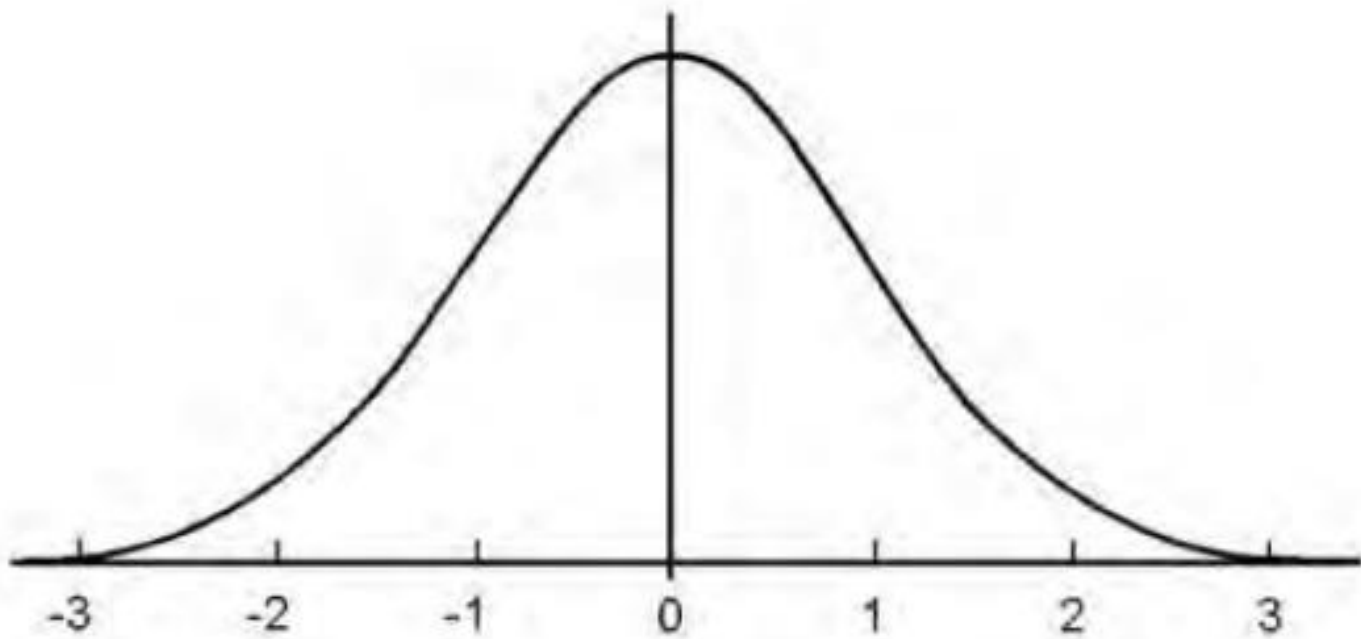
Growth

Money



Defect at Sigma Scale

Sigma	% Good	% Bad	DPMO
1	30.9%	69.1%	691,462
2	69.1%	30.9%	308,538
3	93.3%	6.7%	66,807
4	99.38%	0.62%	6,210
5	99.977%	0.023%	233
6	99.9997%	0.00034%	3.4



The Normal Curve

APPROACHES OF SIX SIGMA

- **DMAIC APPROACH**

THIS IS ORGANIZATIONAL BASED

- **DMADV APPROACH**

THIS IS BASED ON CUSTOMER NEEDS AND SATISFACTIONS

DMAIC

Six Sigma Improvement Methodology

What is DMAIC ?

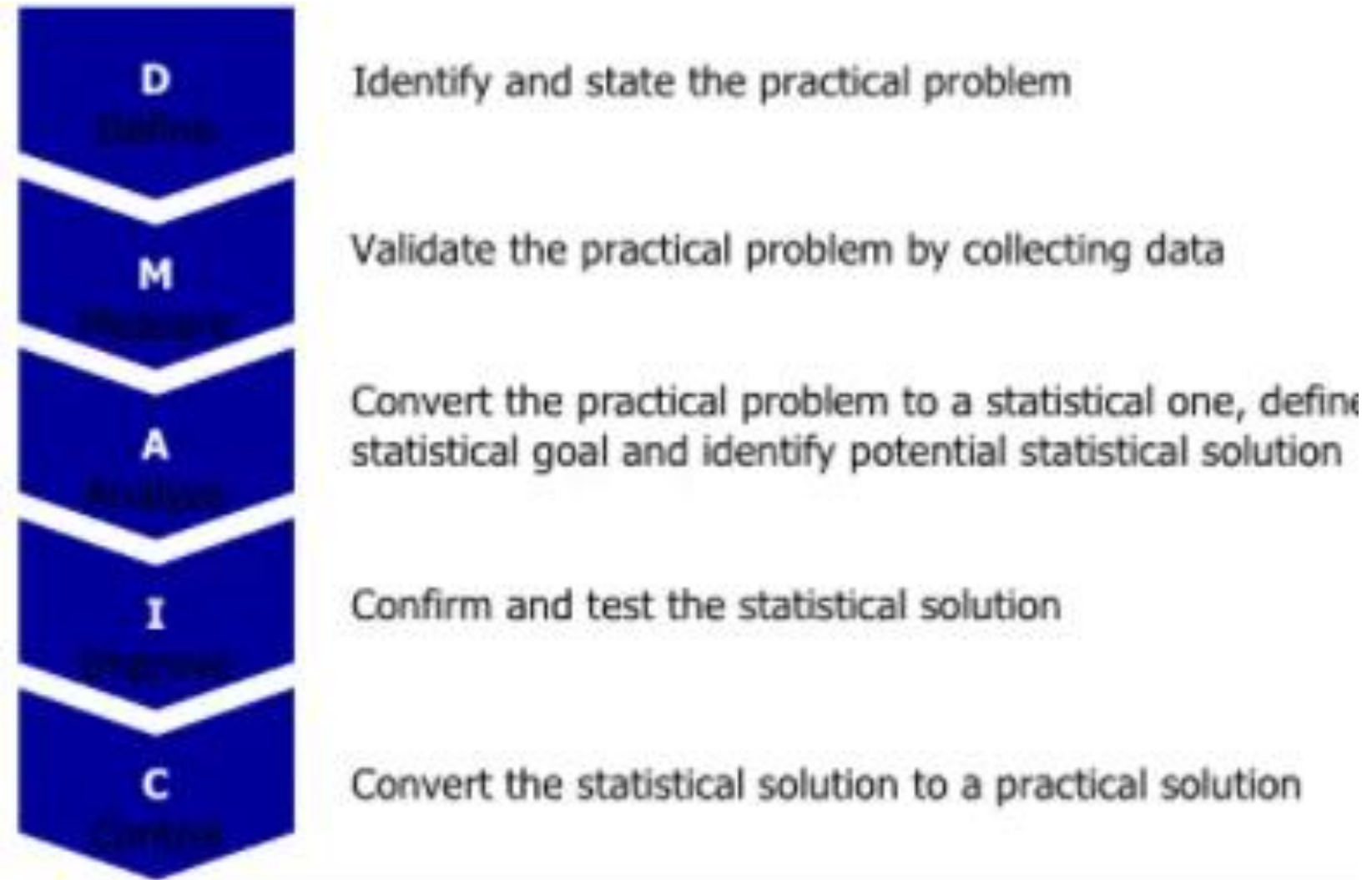
- A logical and structured approach to problem solving and process improvement
- An iterative process (continuous improvement)
- A quality tool with focus on change management

E Effectiveness = Q Quality Improvement x A Acceptance

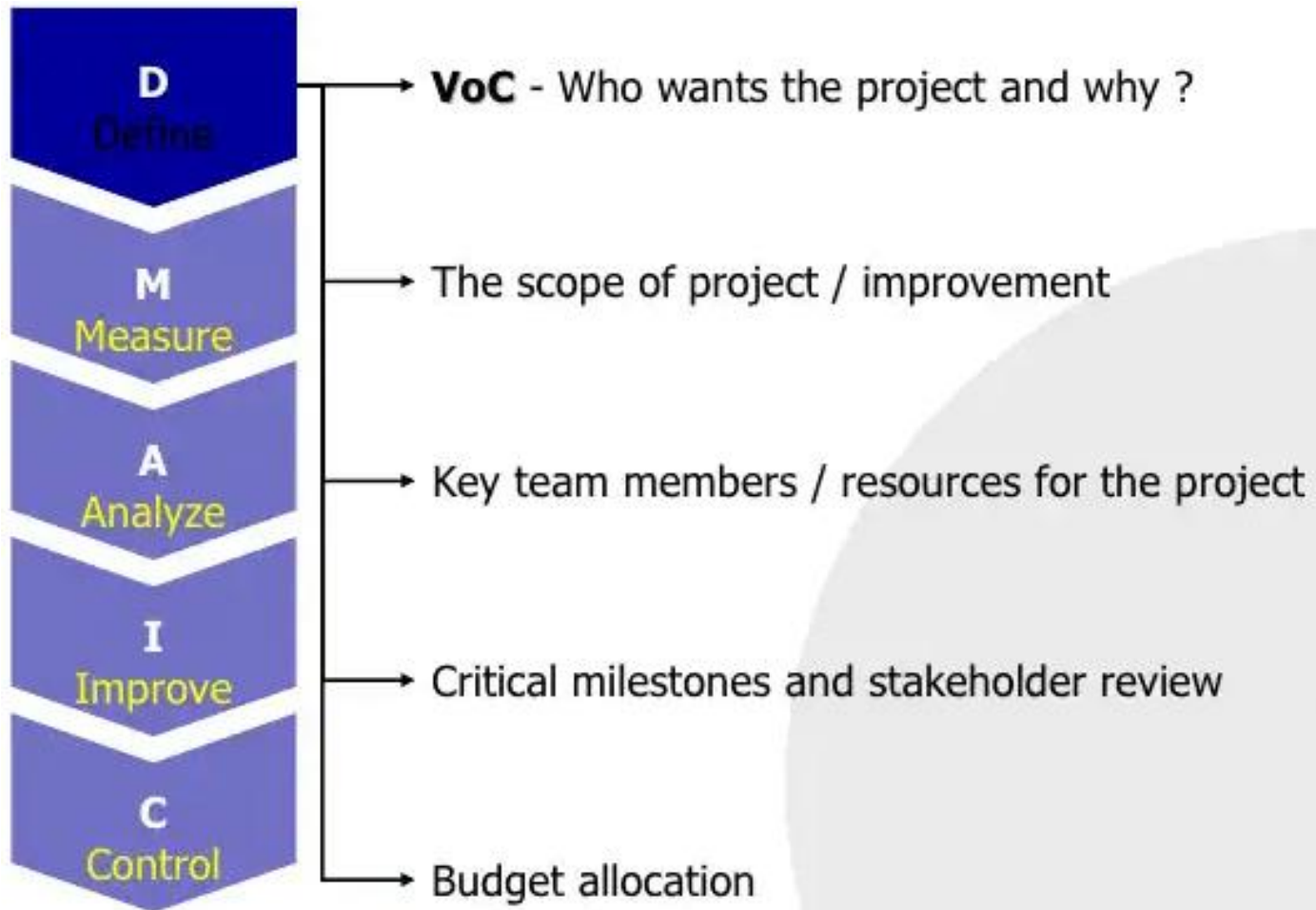
The Approach



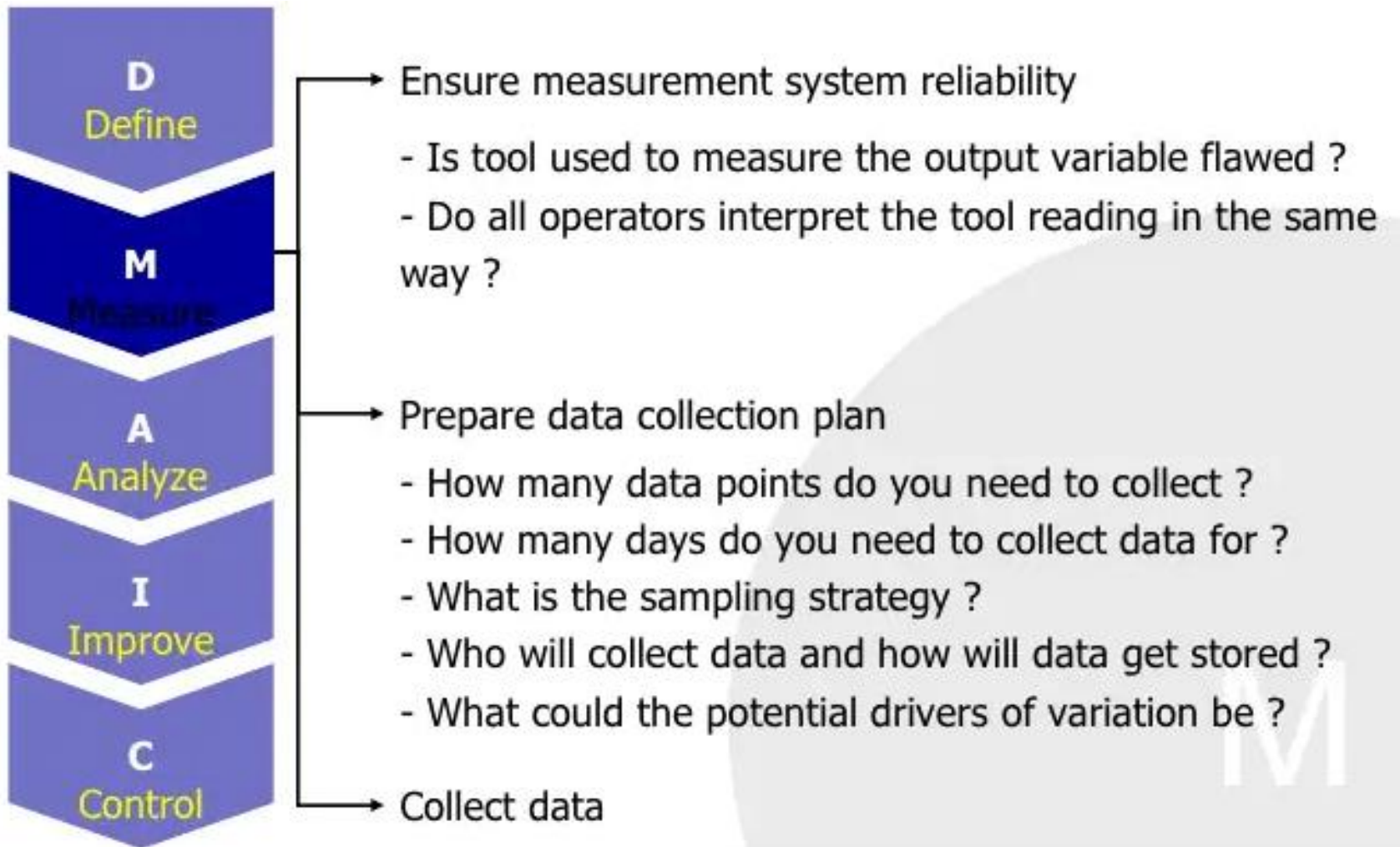
Methodology



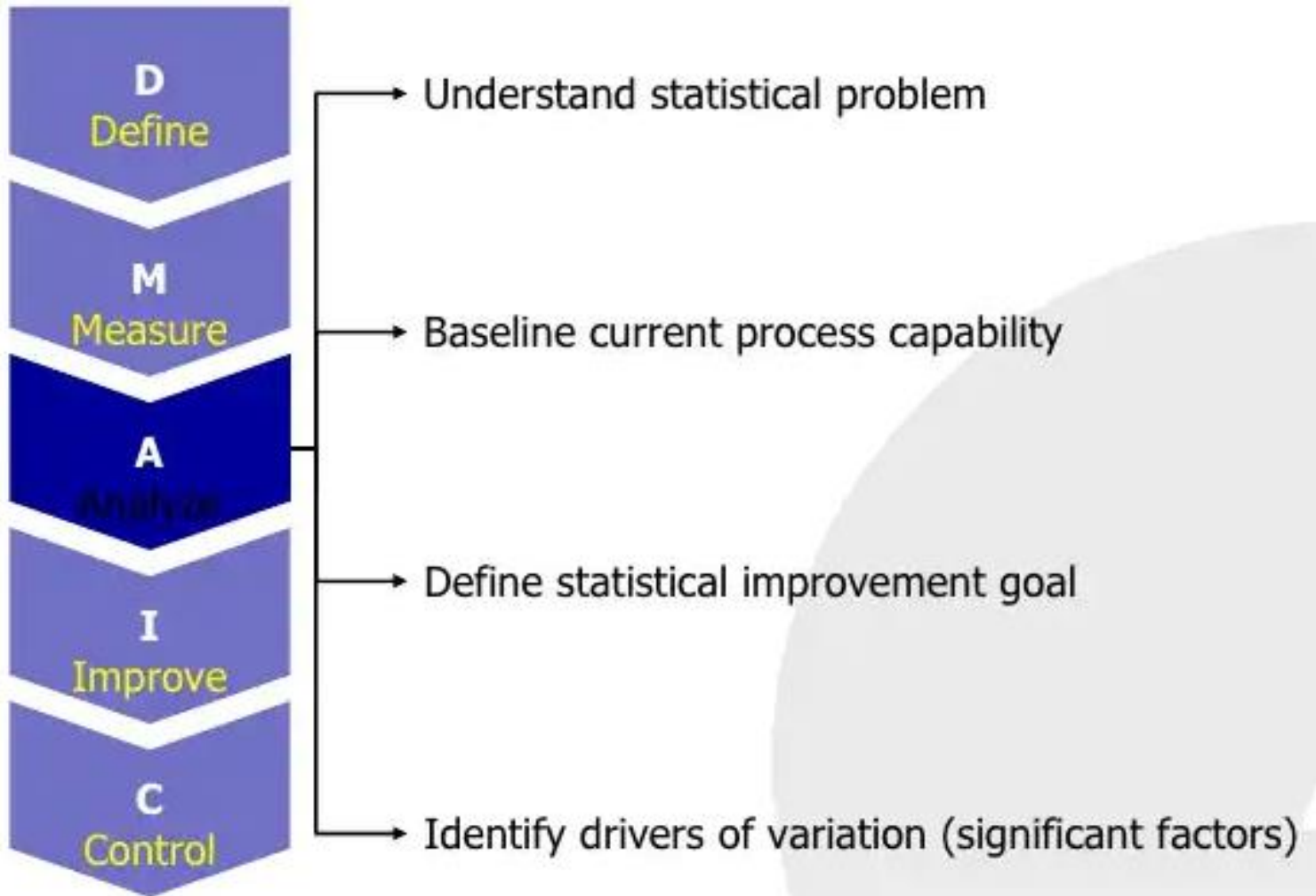
Define



Measure



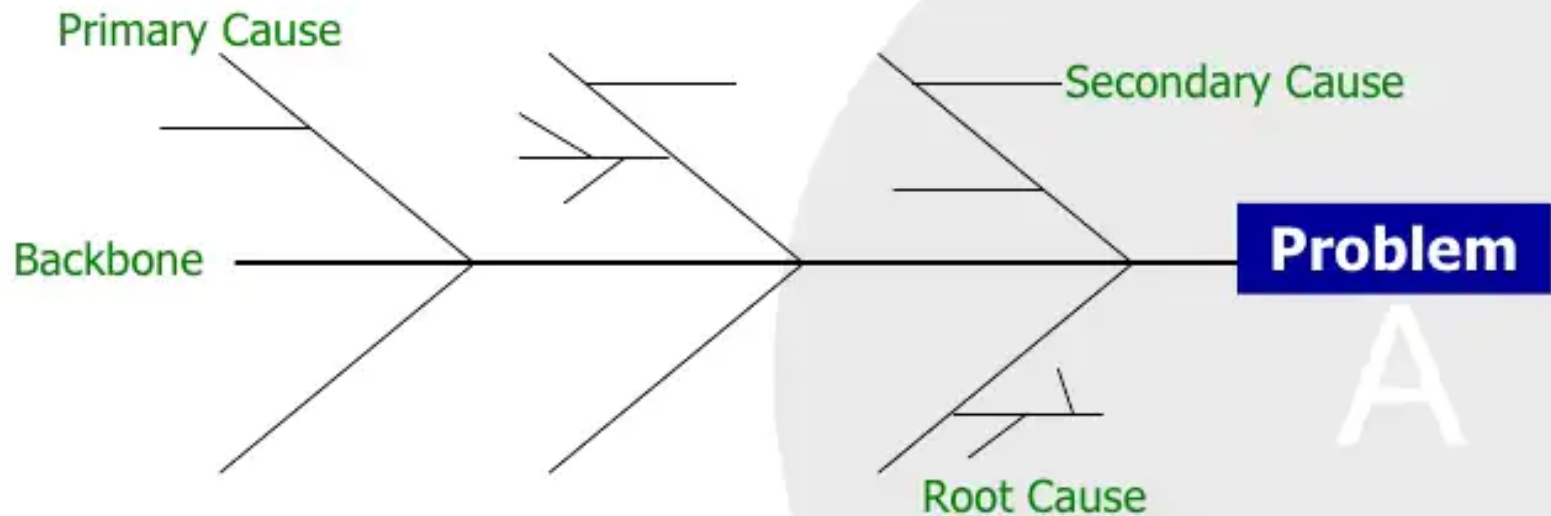
Analyze



Analyze – Identify Drivers of Variation

Root Cause Analysis (fish bone)

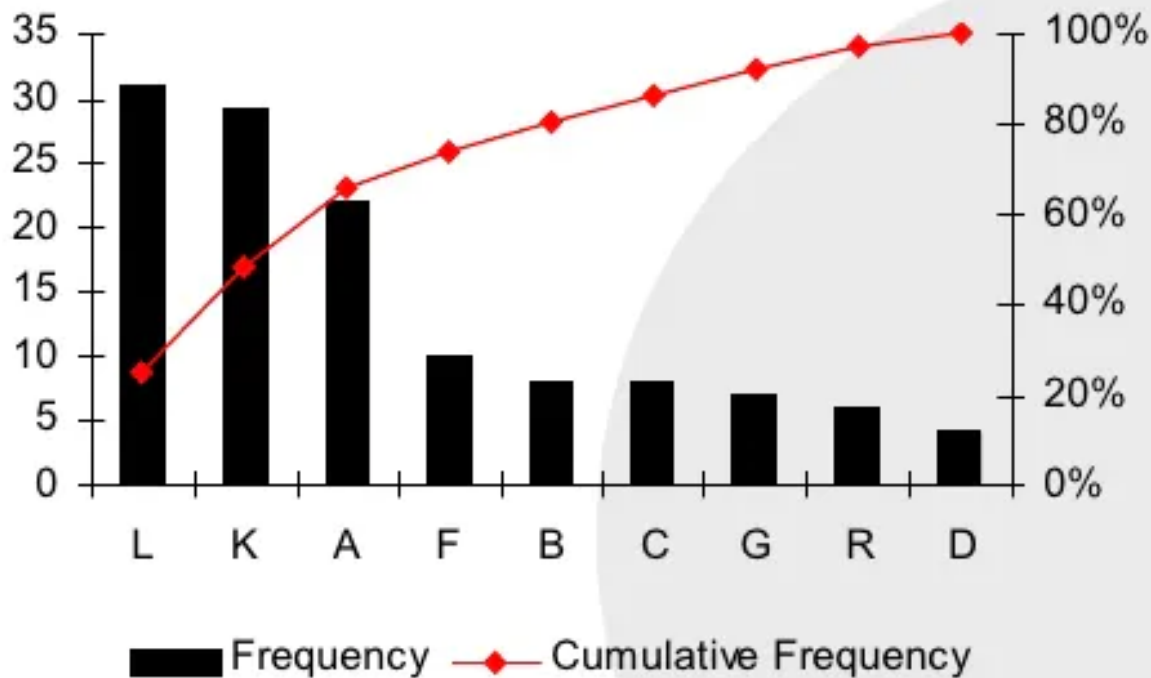
- A brainstorming tool that helps define and display major causes, sub causes and root causes that influence a process
- Visualize the potential relationship between causes which may be creating problems or defects



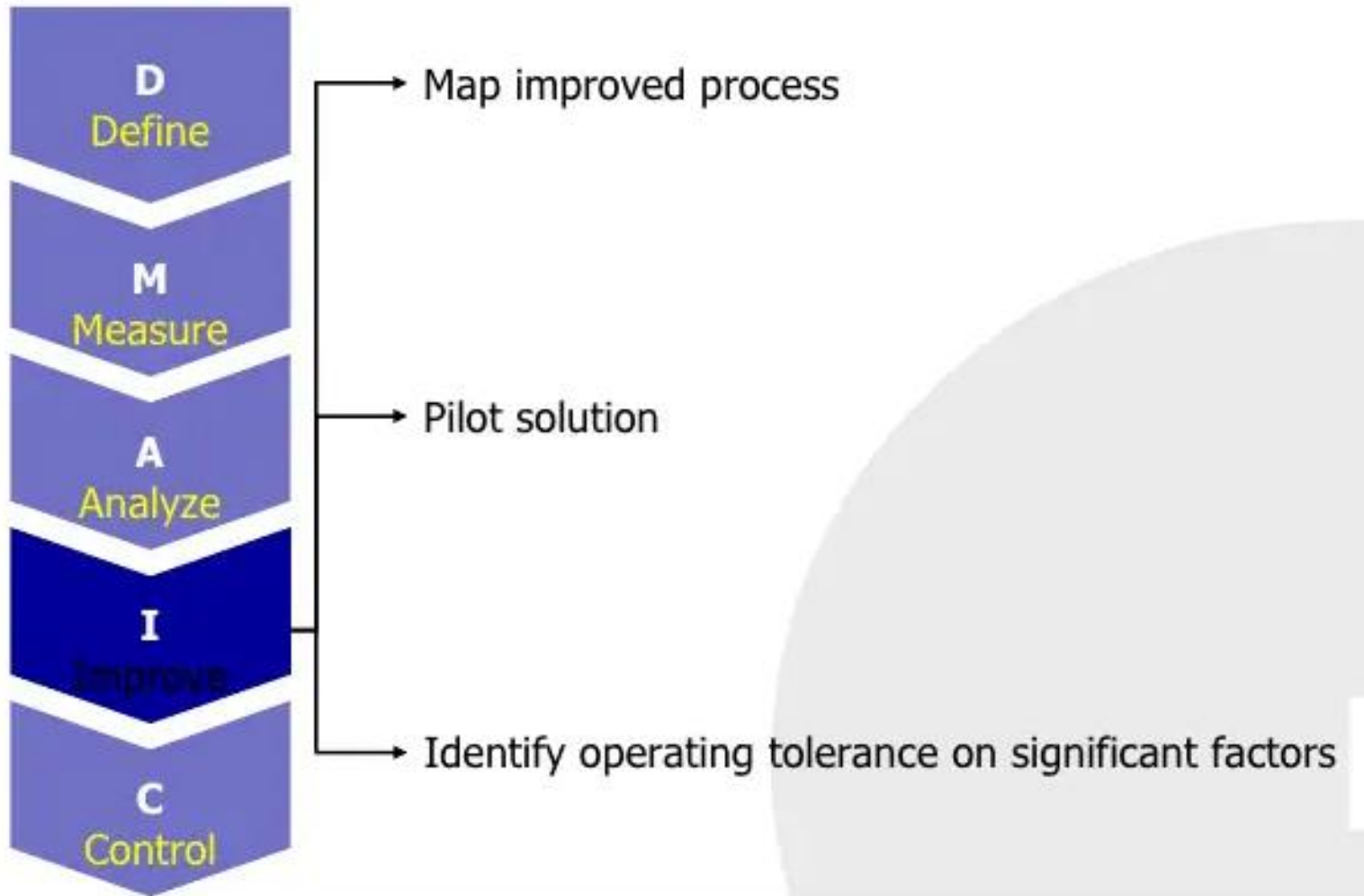
Analyze – Identify Drivers of Variation

Pareto Chart

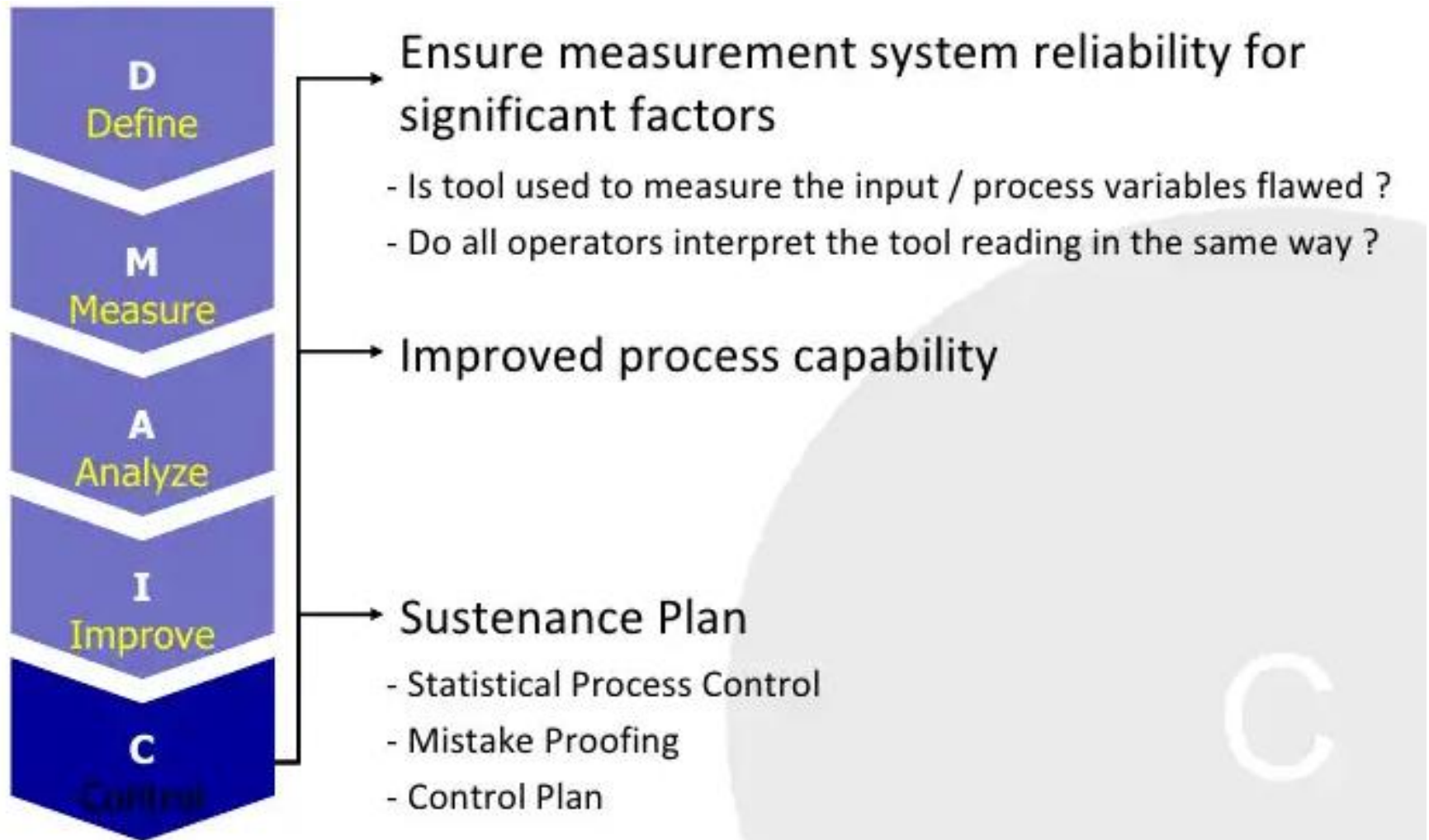
- Pareto principle states that disproportionately large percentage of defects are caused due to relatively fewer factors (generally, 80% defects are caused by 20% factors)



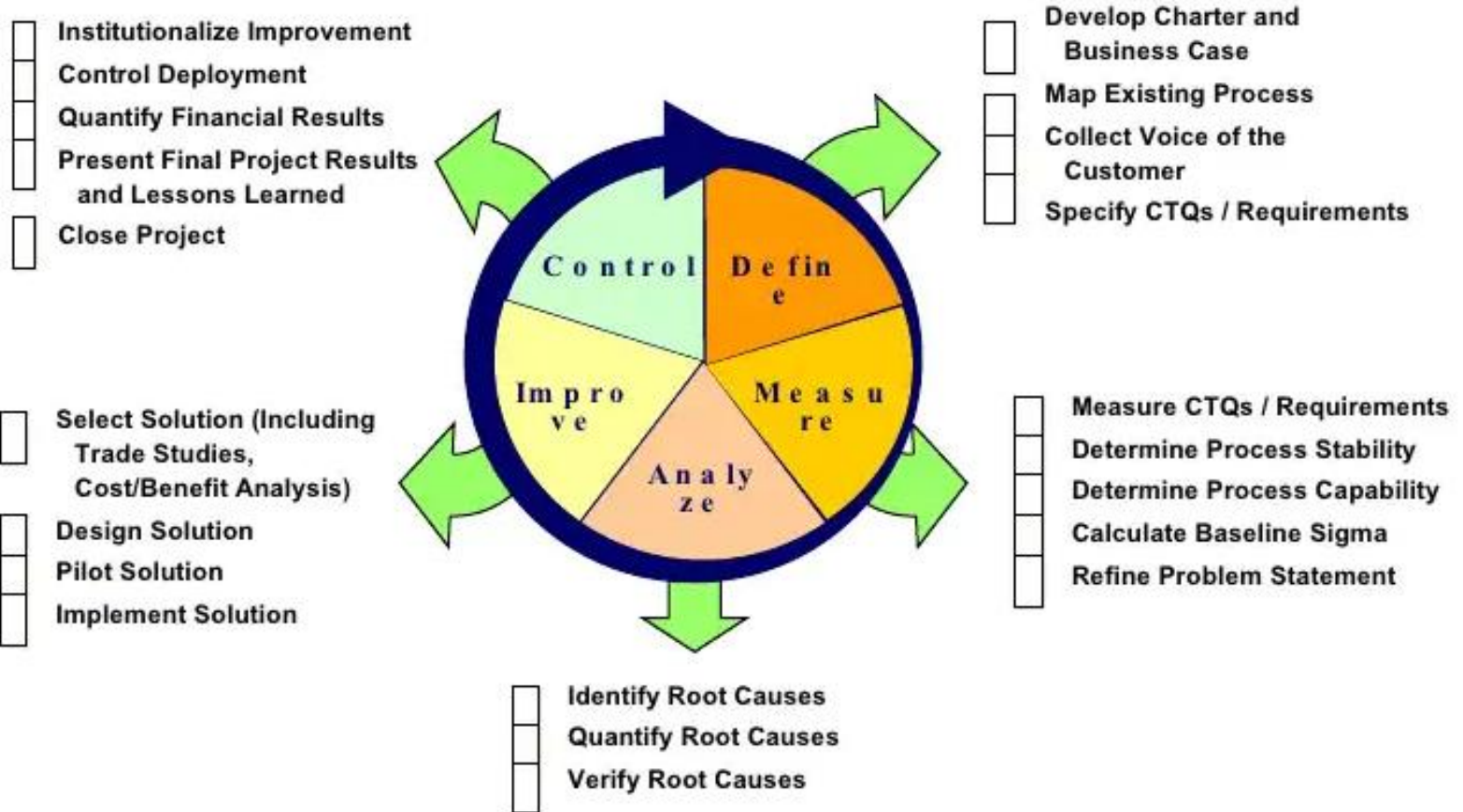
Improve



Control



6σ DMAIC Process



DMAIC = Define, Measure, Analyze, Improve and Control

DMAIV Explanation

Define : company must identify the customer and which type of a product and hope from it. These are analyze by using flow cause/effect diagrams, check sheets, PARETO analysis.

Measure : company will collect the baseline data to determine where the process stands as compare to where it needs to be. And also see the critical to quality characteristics an estimate current process capability. Then find out the current sigma level according to those identified characteristic that are mostly important to the customer

Analyze : this shows the amount of improvement necessary to make the Critical to quality characteristics the best in the industry. For this phase company use some descriptive statistical methods like mean, mode, median...etc.

Improve : Implement the suggested improvements into his phase And also test possible solutions to the process problem. Collect data from the all possible solutions and test them on a small scale and run a cost/benefit analysis of implementing the solution. Then choose the best solution and create a plan for implement the solution.

Improvement cycle

- PDCA cycle



Control : measures are implemented to ensure improvements are maintained. To monitor the process improvements, basically use tools like statistically process control charts. These charts have three limits, the centre line for the average. Monitor the process to ensure that the process is in the control limits.

Benefits of the Six Sigma Method

- ✓ Eliminating 'Gut Feeling' Decisions
- ✓ Establishing a Qualified Team
- ✓ Improving the Quality
- ✓ Customer Satisfaction
- ✓ Removing Waste
- ✓ Increasing Productivity

Lean Manufacturing

Definition

- Lean Manufacturing – A way to eliminate waste and improve efficiency in a manufacturing environment.
- Lean focuses on flow, the value stream and eliminating MUDA, the Japanese word for waste.
- Lean manufacturing is the production of goods using less of everything compared to traditional mass production: less waste, human effort, manufacturing space, investment in tools, inventory, and engineering time to develop a new product.

Lean and Just-in-Time

- Lean was generated from the Just-in-time (JIT) philosophy of continuous and forced problem solving.
- Just-in-time is supplying customers with exactly what they want when they want it.
- With JIT, supplies and components are “pulled” through a system to arrive where they are needed when they are needed.

What is Waste?

Waste is anything that happens to a product that does not add value from the customer's perspective.

Products being stored, inspected or delayed, products in queues, and defective products do not add value



Seven Wastes

1. **Overproduction** – producing more than the customer orders or producing early. Inventory of any kind is usually waste.
2. **Queues** – idle time, storage, and waiting are wastes.
3. **Transportation** – moving material between plants, between work centers, and handling more than once is waste.
4. **Inventory** – unnecessary raw material, work-in-process (WIP), finished goods, and excess operating supplies.
5. **Motion** – movement of equipment or people.
6. **Over processing** – work performed on product that adds no value.
7. **Defective product** – returns, warranty claims, rework and scrap.

Lean Principles

Five main Lean principles were associated with it, briefly described below, and those are: Value, Value Stream, Flow, Pull and Perfection.

1. Value :

- Express the capacity of accurately specify value from the customer perspective, or what he's willing to pay, for both products and services.
- Lean manufacturing defines the value of a product with the customer point of view.
- Customer don't mind how hard you work to create the product.
- Customer will evaluate the product by looking at how well this going to fulfill their requirements.
- Customer don't need to pay for the defects that removed from production lines.

2. Value Stream

Identify the value stream of specific activities, from raw material to final goods, required for the development of a product or service, removing non-value-adding waste along that path.

3. Flow

Make the product or service flow without interruptions across the entire value stream.

4. Pull System

The production is authorized (pulled) by the customer, as opposite to a push system where the finished goods are pushed to the customer.

5. Perfection

Constantly identify and remove any kind of waste along the value stream to achieve perfection.

Cycle concept of Lean Manufacturing

- ✓ Identifying causes (Every problem in the system has a cause for it)
- ✓ Finding root causes (sometimes one or more root causes for a problem)
- ✓ Finding solution (how to overcome this problem)
- ✓ Implementing (implement the solution and to make sure that you achieve your objectives)
- ✓ Will go on and on again and again
- ✓ This process will be continuous until there are wastes to be removed.

Lean Manufacturing Advantages and Disadvantages

Advantages:

1. Increased overall productivity
2. Reduced amount of floor space required
3. Reduced manufacturing lead time
4. Improved flexibility to react to changes
5. Improved quality

Disadvantages:

1. Difficulty involved with changing processes to implement lean principals
2. Long term commitment required
3. Very risky process - expect supply chain issues while changing over to lean.