

PRODUCTION AND QUALITY MANAGEMENT

(N SCHEME)

SUBJECT WITH CODE: 4020440 & PRODUCTION AND QUALITY MANAGEMENT

SCHEME: N SCHEME

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DEPARTMENT: MECHANICAL ENGINEERING

UNIT NO	UNIT NAME
1	Process planning and selection
2	Basic concepts of TQM
3	TQM tools
4	Statistical fundamentals and Control charts
5	Lean manufacturing concept

REVOLUTION THROUGH TECHNOLOGY

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UNIT-1

PROCESS PLANNING AND SELECTION

1.PRODUCTION:

Production is the method of turning raw materials or inputs into finished goods or products in a manufacturing process.

Types,

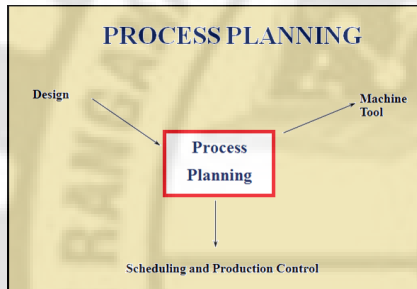
- 1) Mass production
- 2) Batch production
- 3) Job order production

Summary

	Job	Batch	Flow/Line/Mass	Mass Customization
Main Feature	<ul style="list-style-type: none"> ■ Single one-off items 	<ul style="list-style-type: none"> ■ Group of identical products pass through each stage together 	<ul style="list-style-type: none"> ■ Mass production of standardized products 	<ul style="list-style-type: none"> ■ Flow production with many standardized components but customized differences too
Essential Requirements	<ul style="list-style-type: none"> ■ Highly skilled workforce 	<ul style="list-style-type: none"> ■ Labor and machines must be flexible to switch to making batches of other designs 	<ul style="list-style-type: none"> ■ Specialized, often expensive, capital equipment – but can be very efficient ■ High steady demand for standardized product 	<ul style="list-style-type: none"> ■ Many common components ■ Flexible and multi-skilled workers ■ Flexible equipment – often CAM to allow for variations in the product
Main Advantages	<ul style="list-style-type: none"> ■ Able to undertake specialist projects or jobs, often with high value added ■ High levels of worker motivation 	<ul style="list-style-type: none"> ■ Some economies of scale ■ Faster production with lower unit costs than job production ■ Some flexibility in design of product in each batch 	<ul style="list-style-type: none"> ■ Low unit costs due to constant working of machines, high labor productivity and economies of scale ■ JIT stock management easier to apply than with other methods 	<ul style="list-style-type: none"> ■ Combines low unit costs with flexibility to meet customers' individual requirements
Main Limitations	<ul style="list-style-type: none"> ■ High unit production costs ■ Time consuming ■ Wide range of tools and equipment needed 	<ul style="list-style-type: none"> ■ High levels of stocks at each production stage ■ Unit costs likely to be higher than with flow production 	<ul style="list-style-type: none"> ■ Inflexible – often very difficult and time consuming to switch from one type of product to another ■ Expensive to set up flow-line machinery and each section needs to be carefully synchronized 	<ul style="list-style-type: none"> ■ Expensive product redesign may be needed to allow key components to be switched to allow variety ■ Expensive flexible capital equipment needed

2. PROCESS PLANNING

Process planning **deals with the selection of the processes and the determination of conditions of the processes**. The particular operations and conditions have to be realised in order to change raw material into a specified shape. All the specifications and conditions of operations are included in the process plan.



2.1 FACTORS AFFECTING PROCESS PLANNING

Factors affecting Process Planning

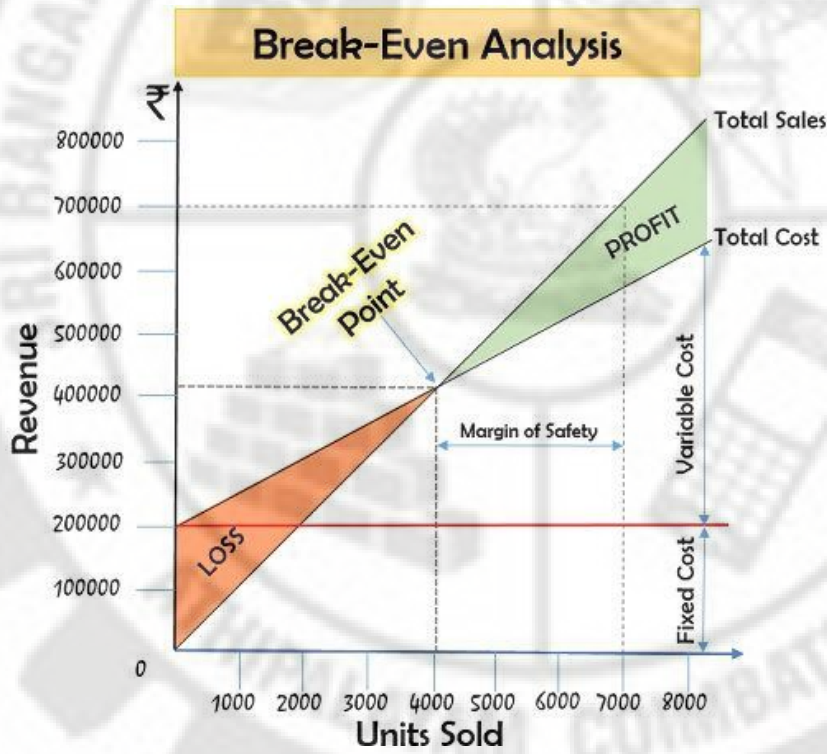
1. Volume of Production.
2. Delivery dates of components or products.
3. Process capability of the machines.
4. Skill of manpower.
5. Material.
6. Surface Finishing.
7. Accuracy required.

2.2 PROCESS PLANNING PROCEDURE

1. Preparation of Working Drawing
2. Make or Buy Decision
3. Process Selection
4. Machine Capacity

- 5. Process and Equipment Selection Procedure
- 6. Selection of Material, Jigs, etc.
- 7. Preparation of Documents.

2.3 BREAK EVEN ANALYSIS



$$\text{Break-Even Quantity} = \text{Fixed Costs} / (\text{Sales Price Per Unit} - \text{Variable Costs Per Unit})$$

2.4 METHOD OF PROCESS PLANNING

mal, feature recognition

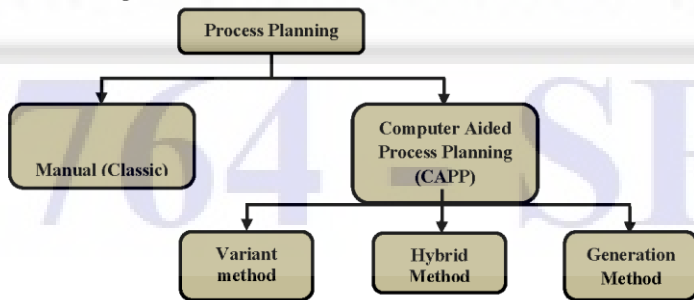


Figure 1: Process Planning

2.5 MANUAL PROCESS PLANNING

2.6 CAPP

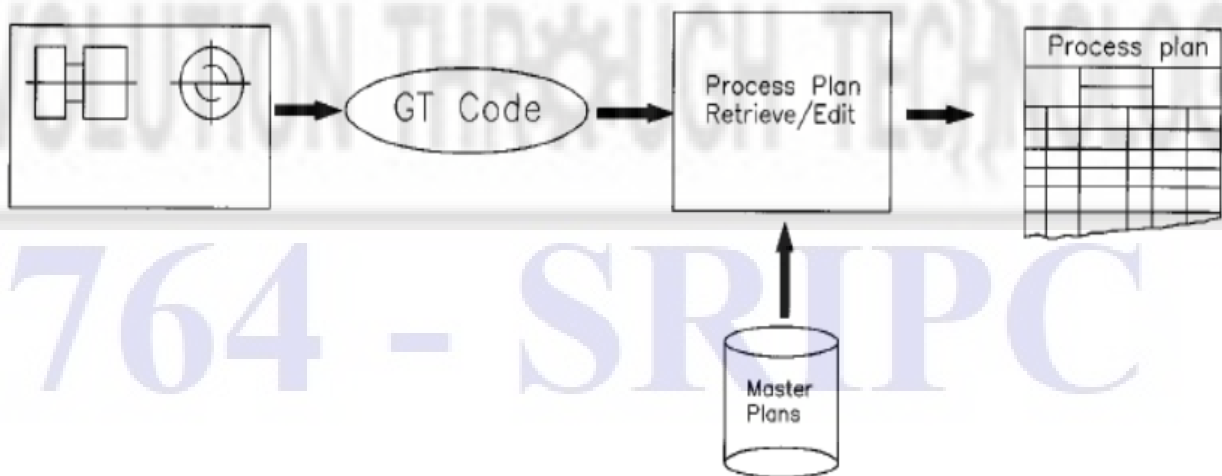
Main Steps of CAPP Systems

- Identification of part specifications.
- Selection of blanks or stock.
- Selection of machining operations.
- Selection of machine tools.
- Selection of cutting tools.
- Calculation of cutting parameters.
- Generation of setup plans.
- Selection of work holding devices (fixtures).
- Calculation of times and costs.
- Generation of process plans

2.3.1 RETRIEVAL TYPE PROCESS PLANNING

The variant approach, which is also called retrieval approach, uses a group technology (GT) code to select a generic process plan from the existing master process plans developed for each part family and then edits to suit the requirement of the part.

Variant approach is commonly implemented with GT coding system. Here, the parts are segmented into groups based on similarity and each group has a master plan.



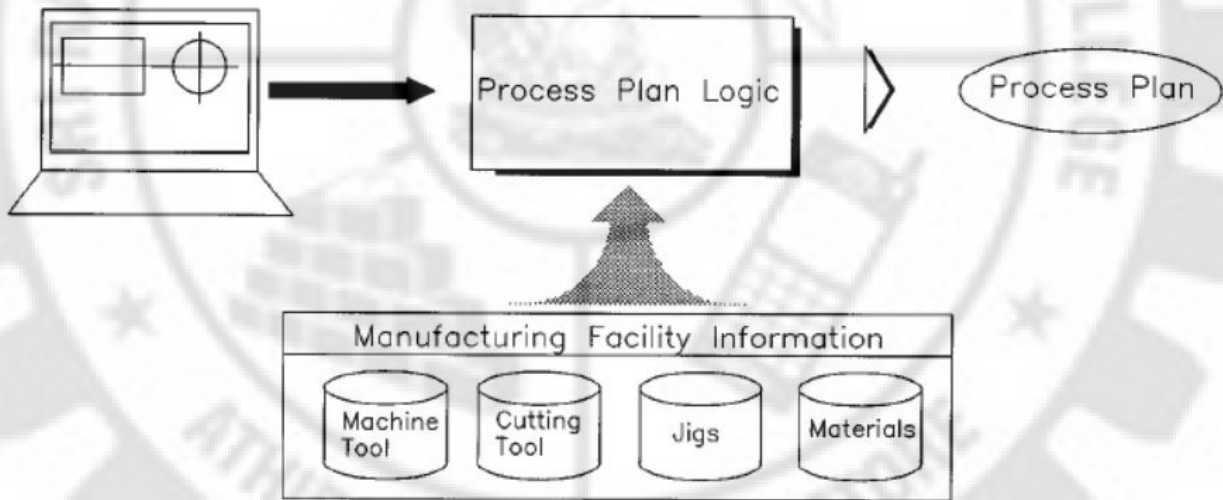
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2.3.2 GENERATIVE TYPE PROCESS PLANNING

In a generative approach, a process plan for each component is created from scratch without human intervention. These systems are designed to automatically synthesize process information to develop a process plan for a part

Generative CAPP systems contain the logic to use manufacturing data bases, knowledge bases and suitable part description schemes to generate a process plan for a particular part.

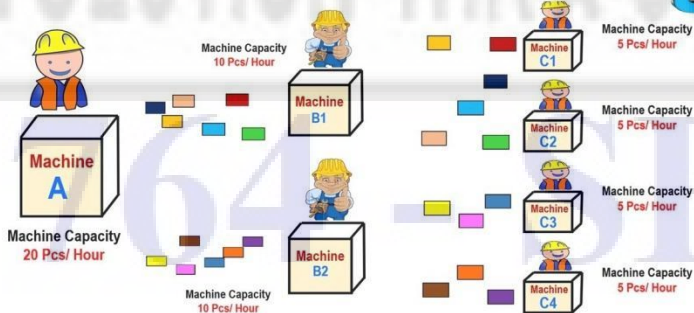
Part Descriptive System



2.4 LINE BALANCING

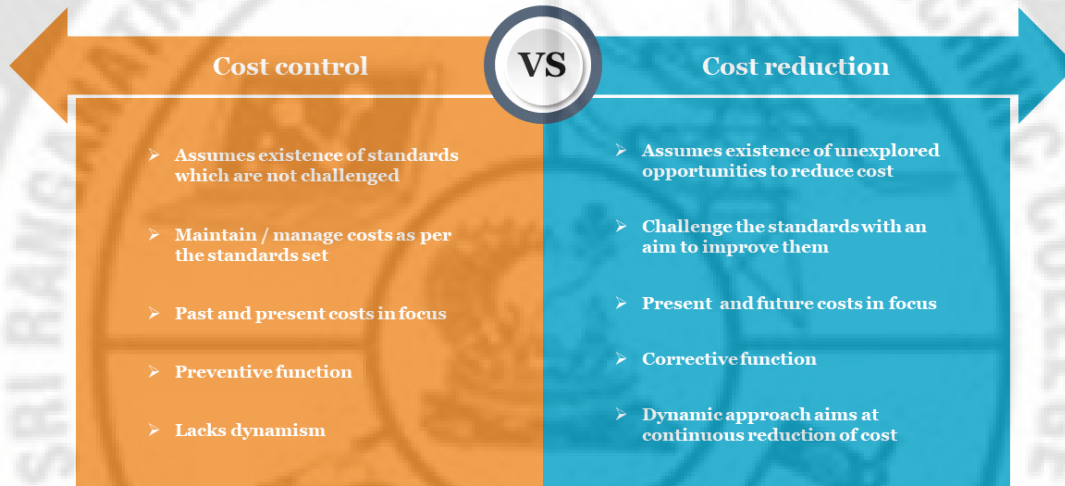
Line balancing is a production strategy that involves balancing operator and machine time to match the production rate to the takt time. Takt time is the rate at which parts or products must be produced in order to meet customer demand.

Line Balancing



2.5 COST CONTROL Vs COST REDUCTION

Cost Control Vs Cost Reduction PPT



3.PROCESS SELECTION

Process selection refers to the tactical choices of choosing the kind of production process to have in a production plant.

3.1 FACTORS AFFECTING PROCESS SELECTION

3.2 MACHINE CAPACITY

It refers to **the production capacity of workers or machines**, and is usually expressed by "hours". The Process Capacity of workers is called human capacity, while that of machines is called machine capacity.

3.3 SELECTION OF MATERIAL, JIGS AND FIXTURES

Materials for Jigs and fixtures

Following points for selection:

- Easily available
- Ability to withstand the stress expected in service
- Ability to retain its shape and size
- Corrosion resistance
- Cast iron is generally used as materials for jig and fixture, light materials like brass, bronze, steels, plastic can also be used.
- The choice of the proper material can also be selected when the operating conditions are known.

3.4 FACTORS INFLUENCING CHOICE OF MACHINERY

Suitability for Job Conditions:

The Equipment must meet the requirement of the work, climate and working conditions.

Size of Equipment:

Size of equipment should be such that it must be able to be used with other matching units.

If the equipment selected is of larger size, that will remain idle for most of the time or shall work on part loads, which means production cost will be more.

On other hand, if equipment is of smaller size than desired, the equipment will not be able to work with the matching equipments and hence other equipments will have to remain idle or to be allowed to work on part loads, which shall again be uneconomic.

Past Performance:

If the equipment being purchased is of new make and models, it is desirable to enquire about its performance from other users, who are using this make and models.

Operating Requirements:

The equipments selected should be easy to operate and maintain, acceptable to the operator and should have lesser fuel consumption.

Reliability of Equipment:

Equipment selected for the project must be reliable one.

Economical Aspects:

While selecting the equipment, it should be considered that cost of unit production should be minimum.

Service Support:

Service Support should be available in the area of project where the equipment shall be used. Service after sales are major criteria for selection of equipment.

Use in Future Projects:

When equipment completes only a part of their useful life in a project, it should be kept in view that the equipment can be used in future project and may not become obsolete.

Availability of Know-How:

The equipment selected should be satisfactorily handled by available operators. Sophisticated equipment may give excellent performance but it may be difficult to handle and maintain.

Multipurpose Equipment (Versatility):

There are certain types of equipments which are not utilized fully. Therefore if possible, they must be capable of performing more than one function for example, excavator with wheel loader bucket arrangement or with rock breaker attachments.

Standardization:

It is better to have same type and size of equipment in project. It means lesser spare parts reserve more interchangeability of parts if required, easy for the operators to understand it , mechanics will be aside to maintain and repair better as they become expert by handling similar type of equipment.

Availability of Spare Parts:

While selecting a particular type or make of equipments,it should be ensured that the spare parts will be available at reasonable price throughout the working life of equipment. It should also be ensured that the downtime of the equipment for want for spare parts may not be more .

Availability of Equipment:

The Equipment which is easily available in the market should be purchased. It should also be ensured that the equipment is of repute and is likely to be continued to be manufactured in future also. This is necessary for future standardization and ensuring spare parts supply. It is easy to dispose off such equipments after completion of project.

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UNIT-II

BASIC CONCEPT OF TOTAL QUALITY MANAGEMENT

QUALITY:

Quality is the totality of features and characteristics of a product or service that bear on its ability to satisfy given needs. (American Society for Quality) Quality, an inherent or distinguishing characteristic, a degree or grade of excellence.

Dimensions of Quality

The quality has a different dimension.

1. Performance □ Primary operating characteristics of a product, such as coverage, audio quality display quality and etc...
2. Features □ Secondary characteristics, added features such as calculator and alarm clock features.
3. Conformance □ Industry standards, workmanship (or) the degree to which a product's design (or) operating characteristics match pre-established standards.
4. Reliability □ The probability of a product's failing within a specified period of time.
5. Durability □ It is a measure of product's life having both economic and technical dimensions.
6. Service □ Resolution of problem and complaints case of repair.
7. Response □ Human to human interface, such as the courtesy of the dealer.
8. Aesthetics □ Sensor Characteristics, such as exterior finish.
9. Reputation □ Past performance and other intangible such as being ranked first.

Brainstorming

Brainstorming is a group creativity technique by which effects are made to find a conclusion for a specific problem by gathering a list of ideas spontaneously contributed by its members. In other words, brain storming is a situation where a group of people meet to generate new ideas and solutions around a specific domain of interest by removing inhibitions, people are able to think

more freely and they suggest as many spontaneous new ideas as possible. All the ideas are noted down without criticism and after the brainstorming session the ideas are evaluated.

Objectives of Brainstroming:

1. The main purpose is to solve a problem creatively (or) innovatively.
2. Brainstoming also emohasizes on improving our ideation process and elevates the creative thinking of individuals.
3. One of the major objective is to withhold eriticism and welcome all sorts of ideas to the table.
4. Idea association is another objective of brainstorming as it encourages us to club ideas (or) work on existing ideas.
5. It belives in getting a brand new perspective towards a problem that can introduce new ideas for it.

Basic Concepts of TQM

A Successful Total quality management need the following 6 basic Concepts:

1. **Top Mangement:**

Top management should participate and completely involve in the total quality programme. They should ensure their complete involvement through company meetings, magazines. Also top management should make sure that everybody within the organization from top to bottom is communicated about TQM programme.

2. **Focus on the customer:**

More than 100% customer satisfaction is the main goal of TQM. Customers include both internal and external customers. The customer is the key for any TQM programme.

3. **Effective involvement and utilization of the entire work force:**

TQM is a team works, Total quality recognizes that each person is responsible for the quality of his work and for the work of the group. All persons must be trained in TQM, statistical process control (SPC) and other appropriate quality improvement skills so that they can effectively participate on quality teams.

4. **Continuous improvement:**

TQM is based on the quest for progress and improvement. There is always a better way of doing things, way to make better use of company's total quality resources, away to be more productive. In this purpose a lot of quality tools and techniques may be used.

5. Treating suppliers as partners:

since the suppliers influence the company quality, therefore a partnering relationship should be developed between the management and suppliers.

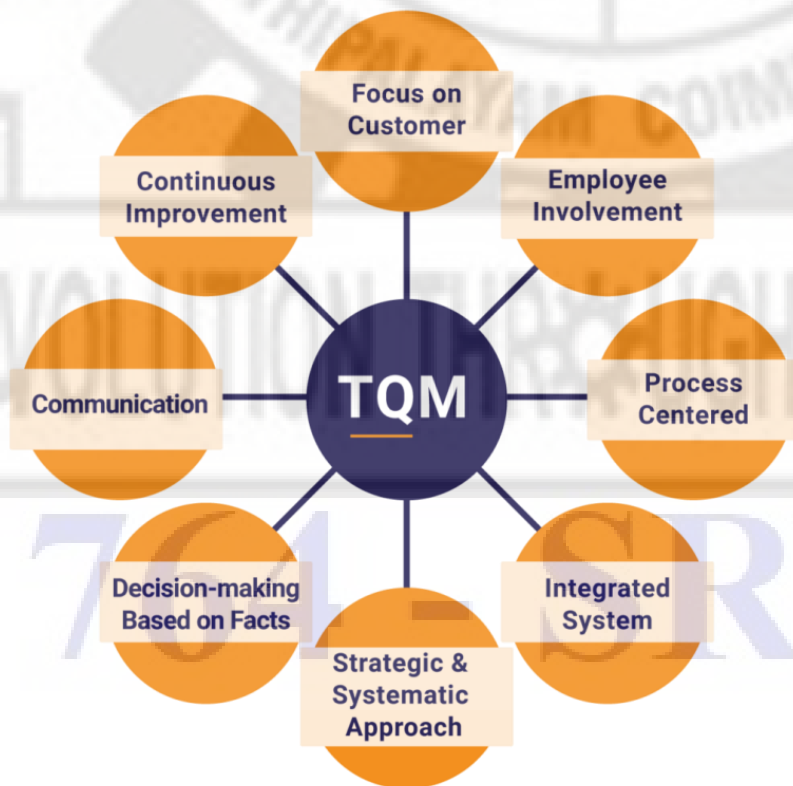
6. Establishing performance measures for the process:

The quantitative data are necessary to measure the continuous quality improvement activity. Therefore performance such as uptime, productivity, sales turnover, absenteeism, percent non-conforming, customer satisfaction and etc., should be determined for each functional area. These results can be used for further improvement activities.

FOUR PILLARS OF TQM:

- 1) Problem solving discipline
- 2) Interpersonal skills
- 3) Teamwork
- 4) Quality improvement process

Principles of TQM:



What is a strategic planning process?

The primary purpose of the planning process is to help companies set goals and have an actionable plan to achieve those goals. Strategic planning can take place at every level of a company. There may be a plan in place that covers the goals of the entire organization, but there may also be plans individual managers design and implement with their teams.

The strategic planning process is integral to a company's long-term success. With a strategic plan in place, a business can more effectively focus its energies and resources on achieving a goal.

Seven steps of a strategic planning process

Consider the following seven steps to help you create effective, actionable plans:

1. Understand the need for a strategic plan.
2. Set goals.
3. Develop assumptions or premises.
4. Research different ways to achieve objectives.
5. Choose your plan of action.
6. Develop a supporting plan.
7. Implement the strategic plan.

1. Understand the need for a strategic plan

The first and perhaps most important step of the planning process is understanding that there is a need for a plan. In terms of management, this means that you need to be aware of the industry environment in which the business operates so that you can identify opportunities for development. You must also be aware of the business's internal operations so that you will know when there is a problem that needs to be solved.

After you have identified opportunities, you can begin looking at actions that would help you take advantage of those opportunities. For example, perhaps

the government is offering contracts for businesses in your industry. If you are aware of this, you can make a plan to help your business compete for a bid.

2. Set goals

Setting goals is the second step of the strategic planning process. Goals can be set for both individual departments and for the business as a whole, depending on their purpose. Continuing the example of using government bids, a company-wide goal could be to secure the bid. Meanwhile, a department goal would be to improve specific performance metrics, such as sales or customer satisfaction.

A goal for an organization can be general, but when you are setting goals for a department, you need to be detailed and specific so that your team members will understand what they need to do. For instance, while increasing profits could be a goal for the business, the individual departments will need more detailed goals related to boosting profits, such as “We will generate an extra \$5,000 in revenue by April 24.”

Goals are vital to the strategic planning process because they allow managers to more effectively direct their teams. They give employees a common purpose to work toward so that their daily activities will be more focused.

3. Develop assumptions or premises

When you make a plan for your business, it should be done with the future in mind. Of course, the future is unpredictable, which means your plan will need to be based on certain assumptions or premises.

A forecast is a common type of premise that involves making certain predictions about the future. If the company’s goal is to increase profits, management would need to forecast whether or not that the industry would be able to support an increase in profits.

During the strategic planning process, you will need to develop both internal and external premises. Internal premises are based on the inner workings of the company and factors. Some examples of internal premises include:

- The resources you expect to have available
- Company policies that you need or will have to implement

- How the levels of management will interact with the plan

External premises are anything outside of the company that may affect the plan and the ability to achieve set objectives. Some examples of external premises include:

- The political and social environment
- Technological advancements
- Competition from other businesses

When trying to achieve an organizational goal, it is important that all managers are operating under the same premises and that they agree with the premises.

4. Research different ways to achieve objectives

There are usually several different ways to achieve a goal. You will need to take the time to research various ways your team could work toward completing a set objective. Researching different solutions for completing a goal is important because it gives managers some flexibility when they are directing their teams. Some managers may prefer innovative solutions for completing goals, while others may wish to use more traditional methods.

When researching different ways to achieve objectives, the goal should be to narrow options down to a few choices. As we mentioned, there are likely countless solutions for achieving the goals that have been set, and if you do not narrow down the options, it will be hard for your managers to choose a solution that works.

Once you have identified a few of the best ways to potentially achieve your goals, it is time to closely examine these solutions to decide which is the best option. You need to carefully consider the strengths and weaknesses of each solution, particularly as they relate to your business's set goals. Imagine that you are developing a financial plan for your company. For every possible plan, you would need to evaluate the risks of the plans as well as the potential returns. You would also need to analyze each option you consider to see if it would help you efficiently achieve your final objective.

5. Choose your plan of action

Once you have set your objectives, developed your premises and identified or evaluated different solutions for completing your goals, you can then decide which course of action to take. Ideally, the strategic plan that you choose is the one that will be the most profitable. Before you choose your plan of action, there are a few things you will need to keep in mind:

- **Avoid a plan that could potentially cost the business money.** This is something to consider whether it's in the short term or the long term.
- **Be sure that you select the plan that has the least amount of potentially negative consequences.** Every plan you can choose will naturally have drawbacks, but some plans will have more disadvantages than others. Compare the different options for completing your goal, and choose the one that has the highest chance of success.
- **Choose a plan of action that is adaptable.** While you are executing your plan, you may encounter obstacles that you did not anticipate. If your plan is flexible, you should be able to overcome these obstacles more easily than with a plan that's fixed. For example, if the business is pursuing a government bid and the government institutes a new policy, you may need to alter your bid so that you can comply with the new policy.

When you form a plan of action, you should largely base your decision on concrete evidence, such as mathematical analysis. That said, your experience as a manager can also help you decide which plan is best for accomplishing your set objectives. Drawing on your personal history, you may realize one of the plans being considered is something you have seen implemented in the past and that you know to be effective.

You can also take elements of various strategic plans and use them together. For example, if you are comparing two financial plans, perhaps one has a better solution for increasing profits and the other contains an effective strategy for shielding the business from unexpected losses. You could combine these two elements to create one strong plan.

6. Develop a supporting plan

Once you know which plan you are going to implement, you may also need to develop a secondary plan to help you institute the primary plan. Secondary plans will vary depending on your objectives, so you should keep your goals in mind while developing this additional plan.

If your objective is for your company to launch a new product your main plan may include steps, such as product research, developing a marketing plan and arranging for manufacturing. The secondary plan will include all the steps that you need to take to support the implementation of the main plan.

For example, you might need to expand your product research team, which means hiring new employees could be a step in your secondary plan. Similarly, you may need to hire a product research team if your firm does not already have one or increase your company's manufacturing capability if your current facilities are not suitable for the new product. Training personnel is a common component of a secondary plan regardless of the goal. Whether you are trying to launch a new product or want to increase sales of a current product, your staff will likely need further training before the company will be able to achieve these objectives.

Read more: [What Are the Different Types of Workplace Training](#)

7. Implement the strategic plan

The final step of the strategic planning process is implementing the plan. In some cases, this can be the most involved step in the planning process depending on the objectives you have set. When it comes time to implement a plan, managers draw on their skill set and experiences to make sure everything runs smoothly.

If the organizational goal is particularly complex, managers will need to take the time necessary to make sure their team members understand their responsibilities and how everyone connects to the larger goal. All team members need to be informed and work together to make the project successful.

The tools you will need to implement the plan depend on the specific circumstances. For instance, if your plan is related to instituting a new company policy, implementation of the plan will require consulting with the

legal department to make sure that the policy is outlined correctly so that it will be effective.

Vision and Mission Statement

Vision Statement

This vision statement describes the long-run objective of your company, usually for a time frame of five to ten years or even longer.

Mission Statement

A mission statement is like a road map of how to achieve the goals set in your vision statement. It defines the purpose of the organization

What Is PDCA?

In the 1950s, management consultant Dr William Edwards Deming developed a method of identifying why some products or processes don't work as hoped. His approach has since become a popular strategy tool, used by many different types of organizations. It allows them to formulate theories about what needs to change, and then test them in a "continuous feedback loop."

Note:

Deming himself used the concept of Plan-Do-**Study**-Act (PDSA). He found that the focus on **Check** is more about the implementation of a change. He preferred to focus instead on studying the results of any innovations, and to keep looking back at the initial plan. He stressed that the search for new knowledge is always guided by a theory – so you should be as sure as you can that your theory is right! [1]

The Four Phases of the PDCA Cycle

With the PDCA cycle you can solve problems and implement solutions in a rigorous, methodical way. Let's look at each of the four stages in turn:

1. Plan

First, identify and understand your problem or opportunity. Perhaps the standard of a finished product isn't high enough, or an aspect of your marketing process should be getting better results.

Explore the information available in full. Generate and screen ideas, and develop a robust implementation plan.

Be sure to state your success criteria and make them as measurable as possible. You'll return to them later in the Check stage.

2. Do

Once you've identified a potential solution, test it safely with a small-scale pilot project. This will show whether your proposed changes achieve the desired outcome – with minimal disruption to the rest of your operation if they don't. For example, you could organize a trial within a department, in a limited geographical area, or with a particular demographic.

As you run the pilot project, gather data to show whether the change has worked or not. You'll use this in the next stage.

3. Check

Next, analyze your pilot project's results against the criteria that you defined in Step 1, to assess whether your idea was a success.

If it wasn't, return to Step 1. If it was, advance to Step 4.

You may decide to try out more changes, and repeat the Do and Check phases. But if your original plan definitely isn't working, you'll need to return to Step 1.

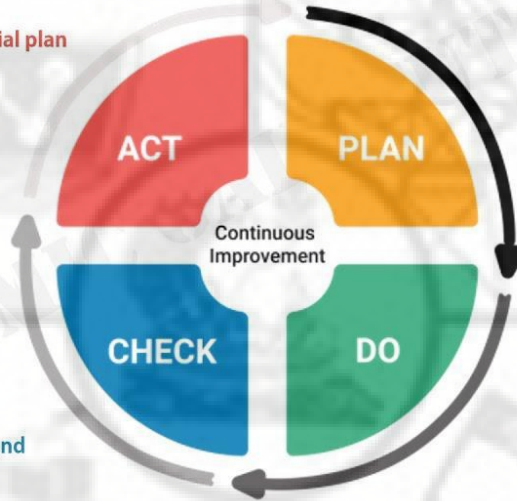
4. Act

This is where you implement your solution. But remember that PDCA/PDSA is a loop, not a process with a beginning and end. Your improved process or product becomes the new baseline, but you continue to look for ways to make it even better.

The four stages of the cycle are illustrated in Figure 1, below:

PDCA Cycle

- Proceed and apply your initial plan
- New standard baseline



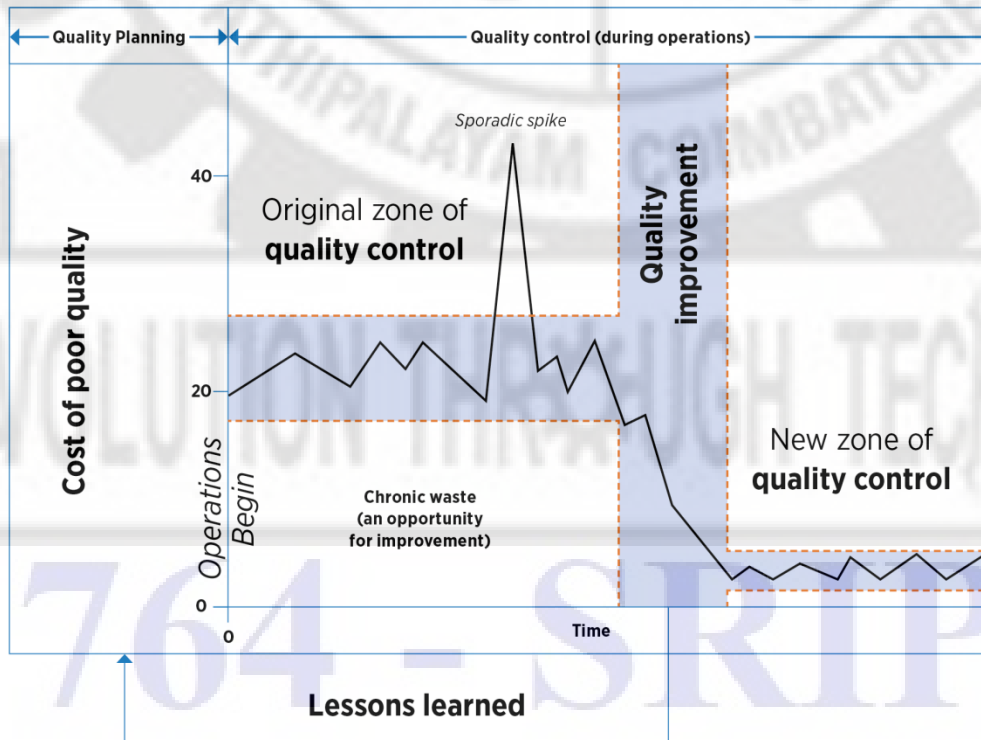
- Core problem?
- Resource needs?
- Existing resources?
- Best solution using available resources?
- Conditions?
- Goals?

- Most important stage
- Avoid recurring mistakes
- Apply continuous improvement
- Audit the results
- Identify problematic parts and eliminate them

- Time to take action
- Apply everything
- Be aware of unpredicted problems
- Standardize

ONLINE FIGURE 1

Juran's Quality Trilogy



What is the Juran Trilogy?

The Juran Trilogy, also called Quality Trilogy, was presented by [Dr. Joseph M. Juran](#) in 1986 as a means to manage for quality. The traditional approach to quality at that time was based on [quality control](#), but today, the Trilogy has become the basis for most quality management best practices around the world.

In essence, the Juran Trilogy is a universal way of thinking about quality—it fits all functions, all levels, and all product and service lines. The underlying concept is that managing for quality consists of three universal processes:

- [Quality Planning \(Quality by Design\)](#)
- [Quality Control \(Process Control & Regulatory\)](#)
- [Quality Improvement \(Lean Six Sigma\)](#)

The Juran Trilogy diagram is often presented as a graph, with time on the horizontal axis and cost of poor quality on the vertical axis.

The initial activity is quality planning, or as we refer to it today, '[quality by design](#)' – the creation of something new. This could be a new product, service, process, etc. As operations proceed, it soon becomes evident that delivery of our products is not 100 percent defect free. Why? Because there are hidden failures or periodic failures (variation) that require rework and redoing.

In the diagram, more than 20 percent of the work must be redone due to failures. This waste is considered chronic—it goes on and on until the organization decides to find its root causes and remove it. We call it the Cost of Poor Quality. The design and development process could not account for all unforeseen obstacles in the design process.

Under conventional responsibility patterns, the operating forces are unable to get rid of the defects or waste. What they can do is to carry out control—to prevent things from getting worse, as shown. The figure shows a sudden sporadic spike that has raised the failure level to more than 40 percent. This spike resulted from some unplanned event such as a power failure, process breakdown, or human error.

As a part of the control process, the operating forces converge on the scene and take action to restore the status quo. This is often called [corrective action](#), troubleshooting, firefighting, and so on. The end result is to restore the error level back to the planned chronic level of about 20 percent.

The chart also shows that in due course the chronic waste was driven down to a level far below the original level. This gain came from the third process in Juran's Trilogy—improvement. In effect, it was seen that the chronic waste was an opportunity for improvement, and steps were taken to make that improvement.

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