

# **PRODUCT DESIGN AND PRODUCTION TOOLING (PDPT)**

BY

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# **SYLLABUS**

Subject Code: PME6J001

## **Subject: PRODUCT DESIGN AND PRODUCTION TOOLING (PDPT)**

MODULE – I (14 HOURS) **Product Design**-Product design considerations, product planning, product development, value analysis, product specification. Role of computer in product design. **Process Planning** – selection of processes, machines and tools. Design of sequence of operations, Time & cost estimation.

MODULE – II (14 HOURS) **Forging design**- allowances, die design for drop forging, design of flash and gutter, upset forging die design. **Sheet metal working**- Design consideration for shearing, blanking piercing, deep drawing operation, Die design for sheet metal operations, progressive and compound die, strippers, stops, strip layout.

MODULE – III (16 HOURS) **Design of jigs and fixtures**, principle of location and clamping, clamping methods, locating methods, Drill Jig bushing, Indexing type drilling Jig. **Design of single point cutting tool**, **broach and form tool**. Tooling design for **turret lathe and automats**. **Design of limit gauges**.

### **TEXT BOOKS:**

1. *Product Design & Manufacturing*, A K Chitale, R C Gupta, Eastern Economy Edition, PHI.
2. *Product Design & Development*, Karl T Ulrich, Steven D Eppinger, Anita Goyal, Mc Graw Hill.
3. *A Textbook of Production Engineering*, P.C. Sharma, S. Chand & Co

### **REFERENCE BOOKS:**

1. *Fundamentals of Tool Engineering design*, S.K. Basu, S.N. Mukherjee, R. Mishra, Oxford & IBH Publishing co.
2. *Technology of Machine Tools*, Krar, Gill, Smid, Tata Mc Graw Hill
3. *Jigs & Fixture Design*, Edwrd G Hoffman, Cengae Learning.

# PDPT

## MODULE-I

Product Design

Process Planning

## MODULE-II

Forging design

Sheet metal working

## MODULE-III

Design of jigs and fixtures

Design of single point cutting tool

broach and form tool

turret lathe and automats

Design of limit gauges

# **MODULE - I**

## **Product Design**

### Definition of Product Design

Product design deals with conversion of ideas into reality which aims at fulfilling human needs.

### Design

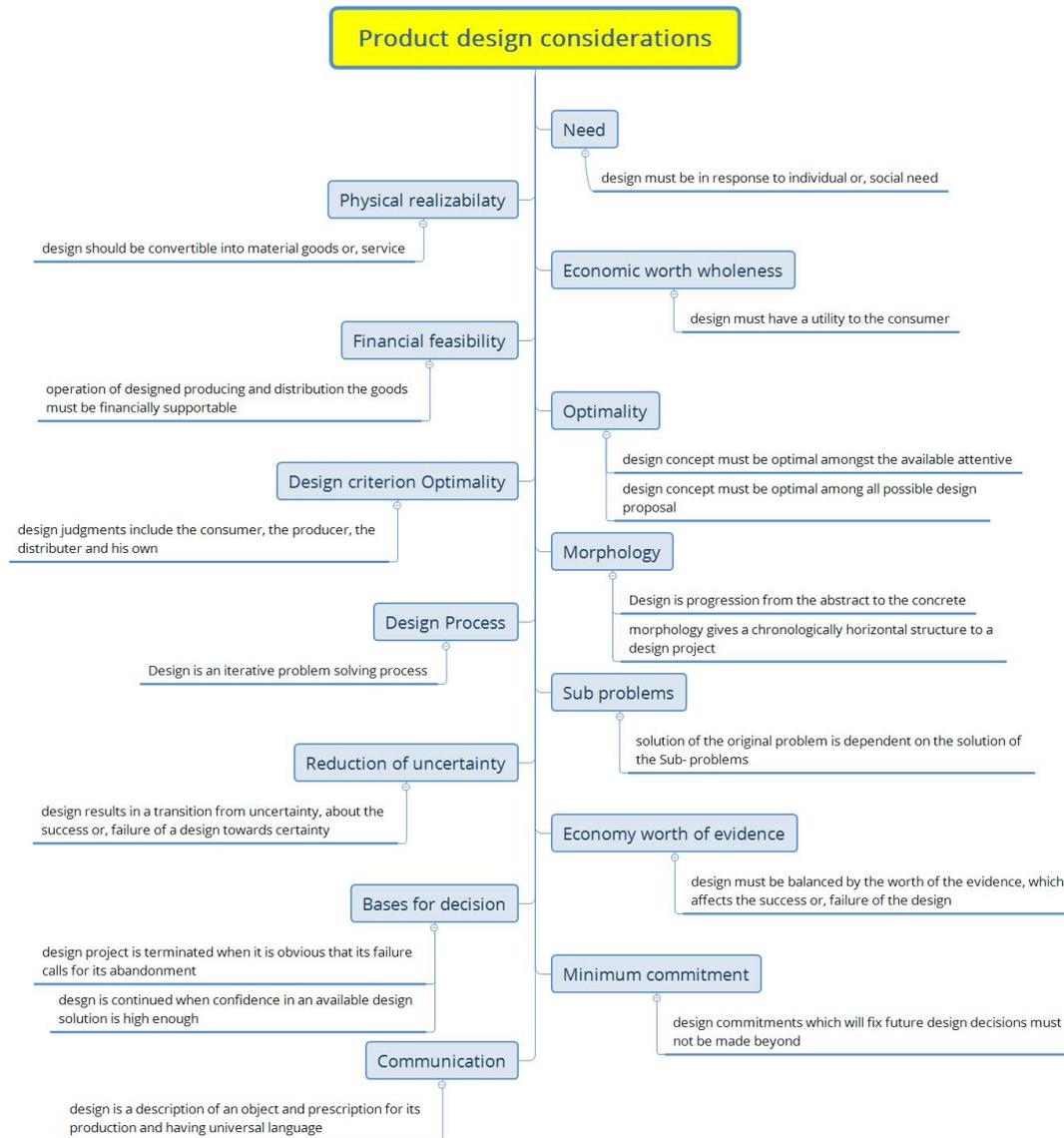
By evolution

for example: Swiss Army Knife

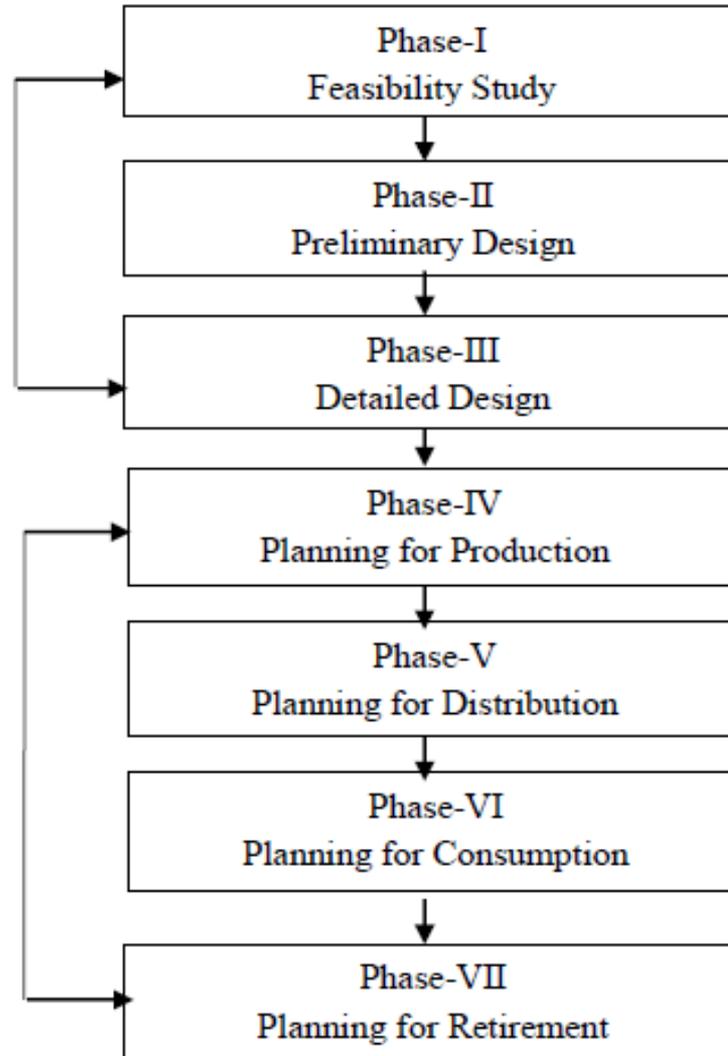
By Innovation

for example: Implementation of laser beam

# Product Design Considerations



*Primitive need*



## Product Planning

### product planning process

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graph TD; A[product planning process] --- B[is an activity that considers the components (portfolio) of projects that and organization might pursue and determines what subset of these projects will be pursued over what time period]; A --- C[takes place before a product development project is formally approved, before substantial resources are applied and before the large development team is formed]; A --- D[actuate ensures that product development projects support the broader business strategy of the company]
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## kept in MIND

1. What product development projects will be undertaken?

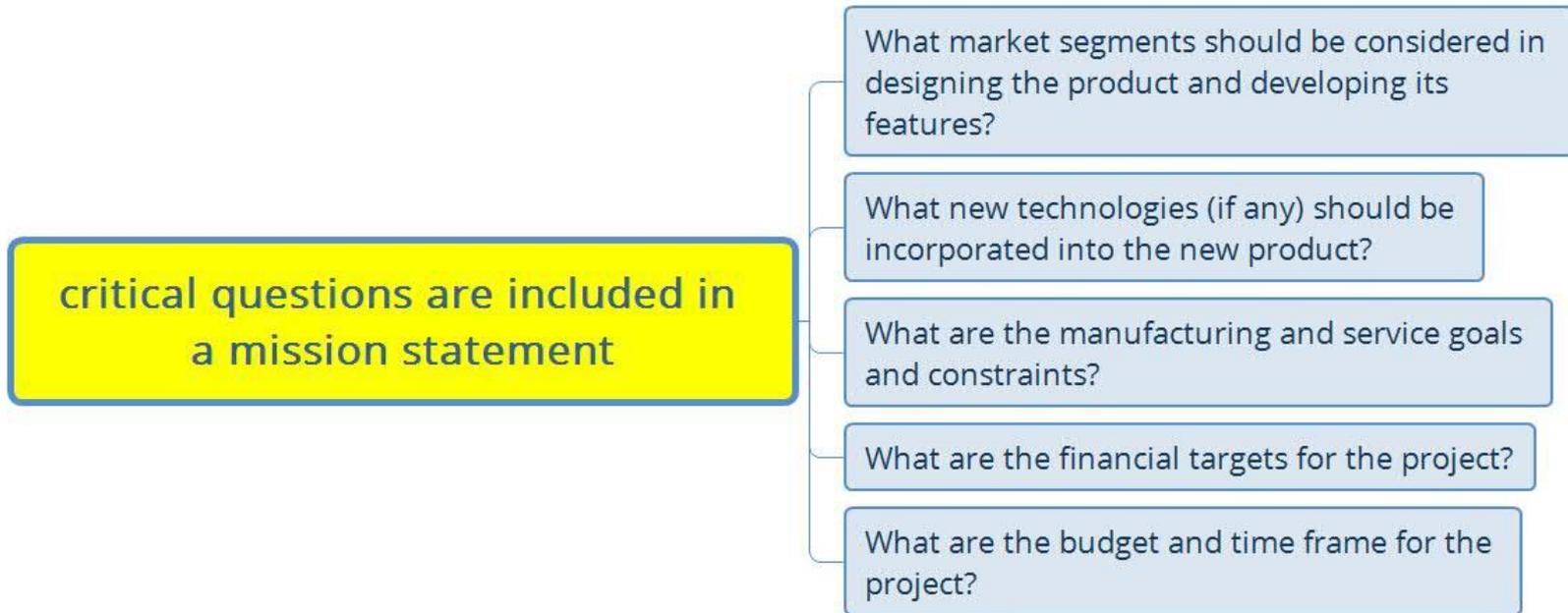
2. What mix of fundamentally new products, platforms, and derivative products should be pursued?

3. How do the various projects relate to each other as a portfolio?

4. What will be the timing and sequence of the projects?

## Product Development

Each of the selected projects is then completed by a product development team. The team needs to know its mission before beginning development.



# Type of product Development Projects

## New product platforms

This type of project involves a major development effort to create a new family of products based on a new, common platform. The new product family would address familiar markets and product categories.

## Derivatives of existing product platforms

These projects extend an existing product platform to better address familiar markets with one or , more new products.

## Incremental improvements to existing products

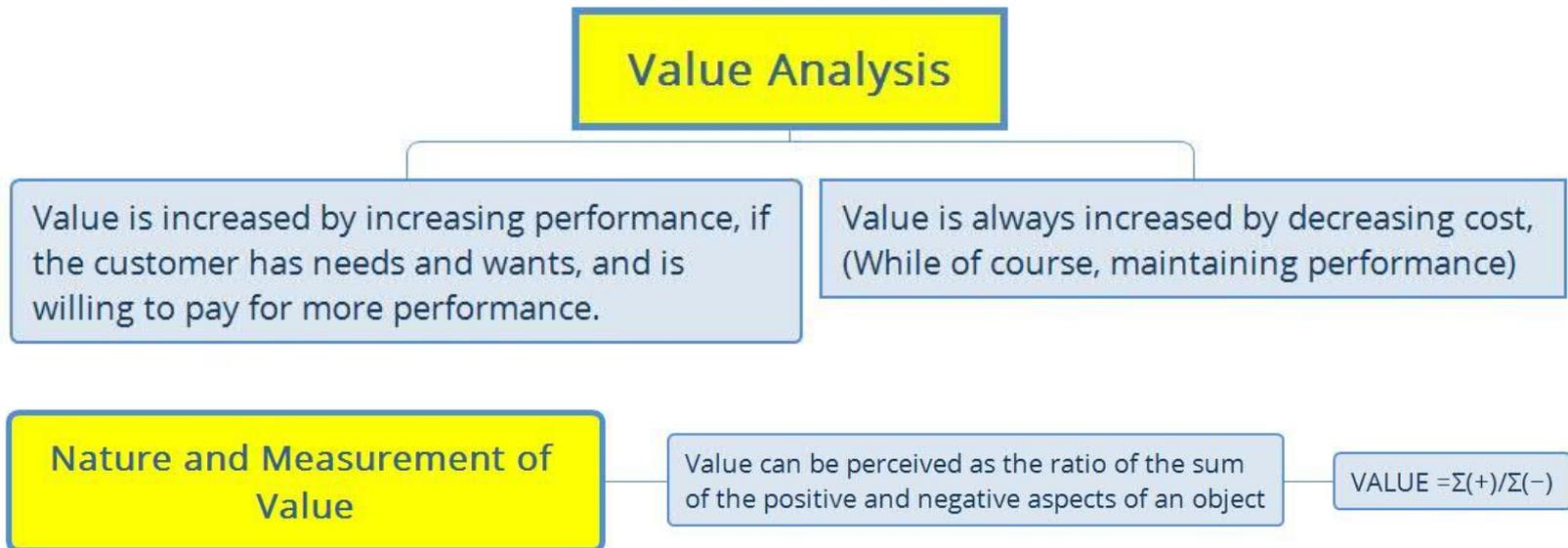
These projects may only involve adding or modifying some features of existing products in order to keep the product line current and competitive. Product life cycle (PLC) is one conceptual tool which helps to analyze the requirement, growth, maturity and decline.

## Fundamentally new products

These projects involve radically different product or, production technologies and may help to address new and infamiliar markets. Such projects inherently involve more risk

## Value Analysis

- Value analysis is defined as an **organized creative approach**, which has for its purpose the efficient identification of unnecessary cost i.e, cost which provides neither nether quality nor use, life, appearance or, customer features”.
- A Product or, service is generally considered to have **good value** if that product or, service has appropriate performance and cost.



# Steps in Value Analysis of Job Plan

## (i) Information step

Record of all the relevant information pertaining to the problem is done by individuals or by groups of any number of persons.

## (ii) Analysis step

In the analysis step, extensive essential "function" thinking is developed. Functions are "evaluated" and problem setting is made precise; functions are separated for single study and then they are grouped as needed for best solutions.

## (iii) Creativity step

When there is a problem to be solved: "Creativity is more important than knowledge". Having acquired understanding and information, we have laid the foundation for the application of various techniques, to generate every possible solution to the overall problem involved, to the part of problem, and to the individual problems.

1. provide logic
2. communicate emotionally in credible terms
3. Identify new types of knowledge needs
4. Provide research techniques that will find that knowledge efficiently
5. Cause creativity that will usefully combine the knowledge from diverse sources

## (iv) Use preliminary judgment

Select the approaches that show so much promise that it is believed. They should be thoroughly studied, extended and judged.

## (v) Evaluation

This phase is a feasibility and cost analysis phase.

## Value Analysis Tests

1. Does its use contribute value?

2. Is its cost, proportionate to its usefulness?

3. Does it need all its features?

4. Is there anything better for the intended use?

5. Can a usable part be made by a lower cost method?

6. Can a standard product be found, which will be usable?

7. Is it made on proper tooling, considering the quantities used?

8. Do material reasonable labour, overhead and profit total its cost?

9. Will another dependable supplier provide it for less?

10. Is anyone buying it for less?

# Product Specifications

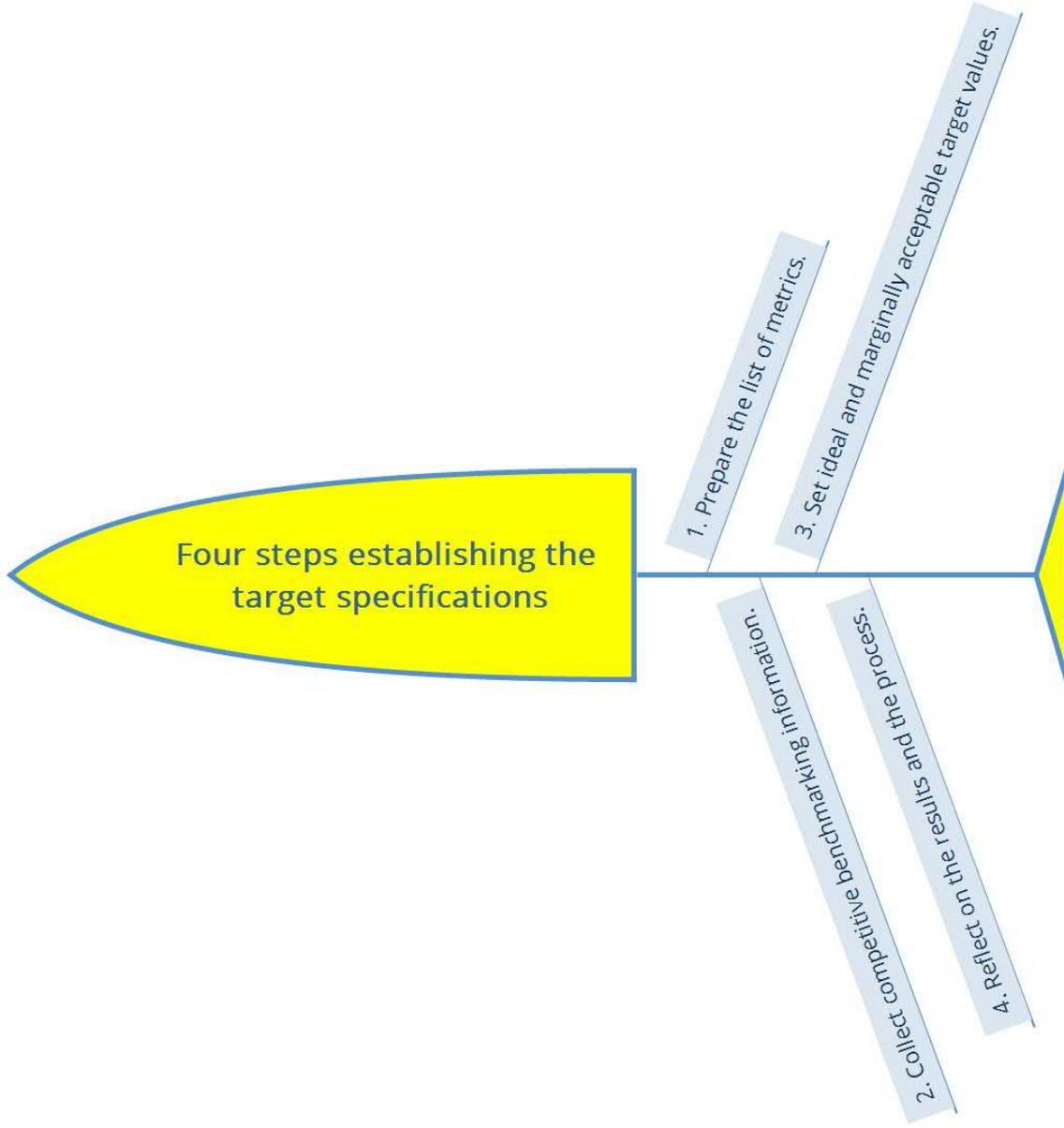
The term product specifications mean the precise description of what the product has to do.

metric

average time to assemble

value

Less than 75 seconds



Five steps refining the target specifications

1. Develop technical models of the product.

3. Refine the specifications, making trade - offs

5. Reflect on the results and the process.

2. Develop a cost model of the product.

4. Flow down the specifications as appropriate.

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## Role of Computer in Product Design



### 1. Geometric modeling.

In CAD, geometric modeling involves computer compatible mathematical description of the geometry of an object.

In geometric modeling, the designer constructs the image of the object on the CRT screen of the interactive computer graphics system, by inputting three types of command to the computer.

1. The first type of command generates basic geometric elements such as points, lines and circles.
2. The second type of command is meant to accomplish translation scaling (size change), rotation or, other transformations of the elements,
3. The third type of command joins the various elements to give the desired object.

During the above process, the computer converts the commands into a mathematical model, stores it in the computer data files and displays it as an image on the CRT screen.

### 2. Engineering Analysis

In the formulation of any design project, some sort of analysis is required. The analysis may be stress-strain calculations, heat transfer computations or, the use of differential equations to describe the dynamic behavior of the

system being designed. The computer can be used to assist in this work. CAD/CAM systems can be interfaced to engineering analysis software to test a given product design.

Probably the most powerful analysis feature of a CAD system is the finite element Method (FEM).

### **3. Design Review and Evaluation –**

Checking the accuracy of design can be accomplished conveniently on the graphics terminal. Semi- Automatic dimensioning and tolerancing routines which, assign size specifications to surfaces indicated by the user help in reducing the possibility of dimensioning errors. The designer can zoom in on any details and closely scrutinize the magnified image. Animation helps in checking kinematic performance of like mechanisms without resorting to pinboard experiments. Gear simulations can be carried out and tooth contact analysis can be done. Interference checking of shaft hole assemblies and the link can be done.

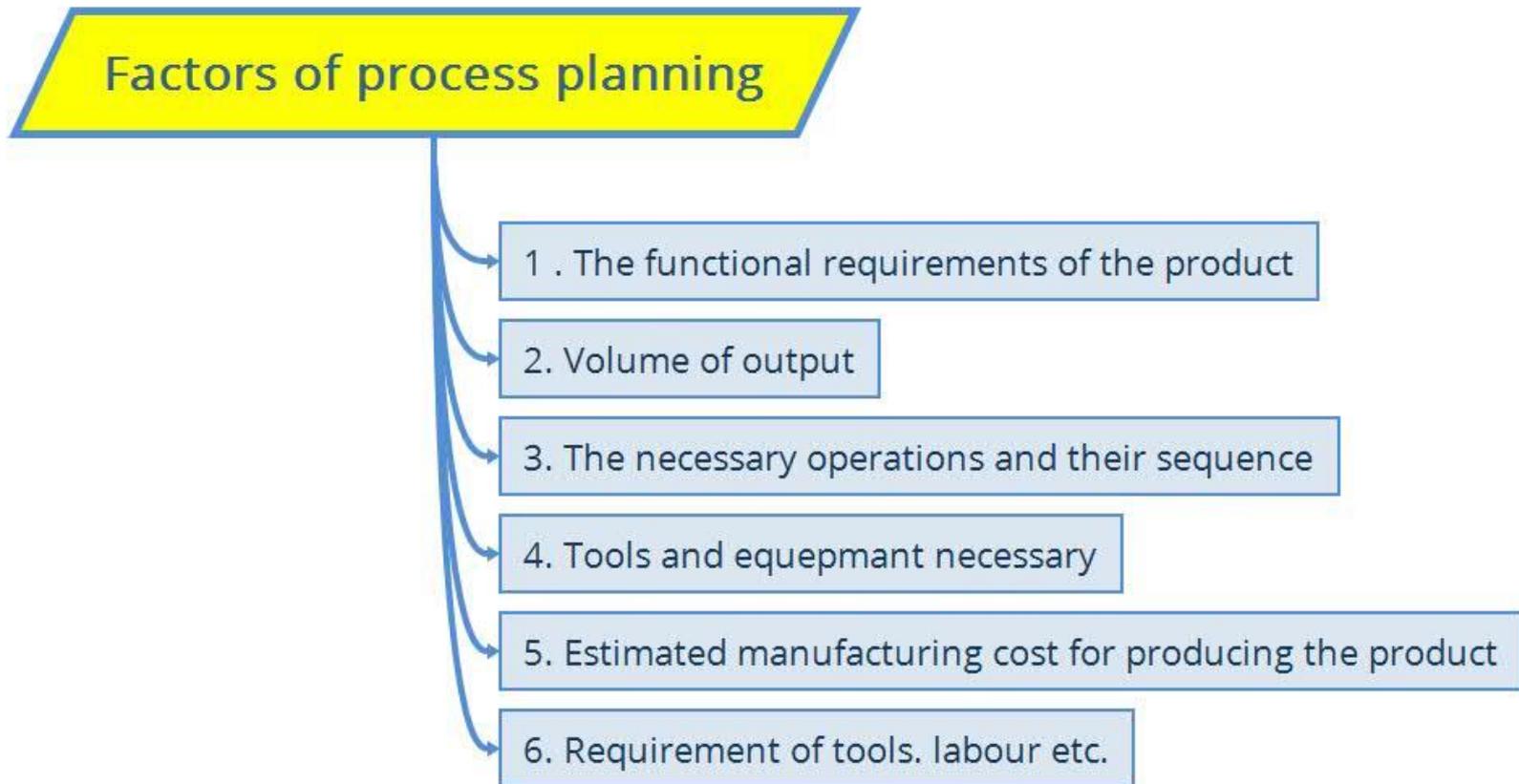
### **4. Automated Drafting –**

This procedure results in saving a lot of time and labor. Computer aided drafting is known as the design workstation. The CAD work station is the system interface with the outside world. A good CAD workstation must accomplish five functions. It must have–

1. Interface with the central processing unit of the computer.
2. Generate a steady graphic image for the user;
3. Provide digital description of the graphic image.
4. Translate computer commands into operating function; and
5. Be user friendly.

## Process Planning

Process planning is the systematic determination of method or, process by which the product is to be manufactured economically and competitively within the limits of design specification laid down. It consists of devising, selecting and specifying processes, machine tools and other equipment to convert raw materials into finished product. Process planning is an intermediate stage between designing the product and manufacturing it.



## Concerns of process planning

(a) Determination the manufacturing process, sequence of operations, equipments tools and labour required for the production of a component or a product

(b) Coordinating the effort of all factors in manufacturing the product.

(c) To finish a guide to use the existing or the proposed facilities.

## Functions of process planning

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graph TD; A{Functions of process planning} --> B[1. To determine what parts are to be manufactured and what part to be purchased from outside.]; A --> C[2. To determine the most economical manufacturing process to be used.]; A --> D[3. To determine the sequence of operation to be performed on each component.]; A --> E[4. To determine the blank sizes of materials in process.]; A --> F[5. To prepare materials list for all components of product to invade the purchasing of row materials.]; A --> G[6. To determine, select and initiate the order for purchasing the equipments/ machine tools needed to manufacture the product.];
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