

MP482

PRODUCT DEVELOPMENT AND
DESIGN

MODULE VI

- Concurrent Engineering
- Rapid prototyping: concepts, processes and advantages.
- Tools for product design – Drafting / Modelling software.
- Patents & IP Acts. Overview, Disclosure preparation

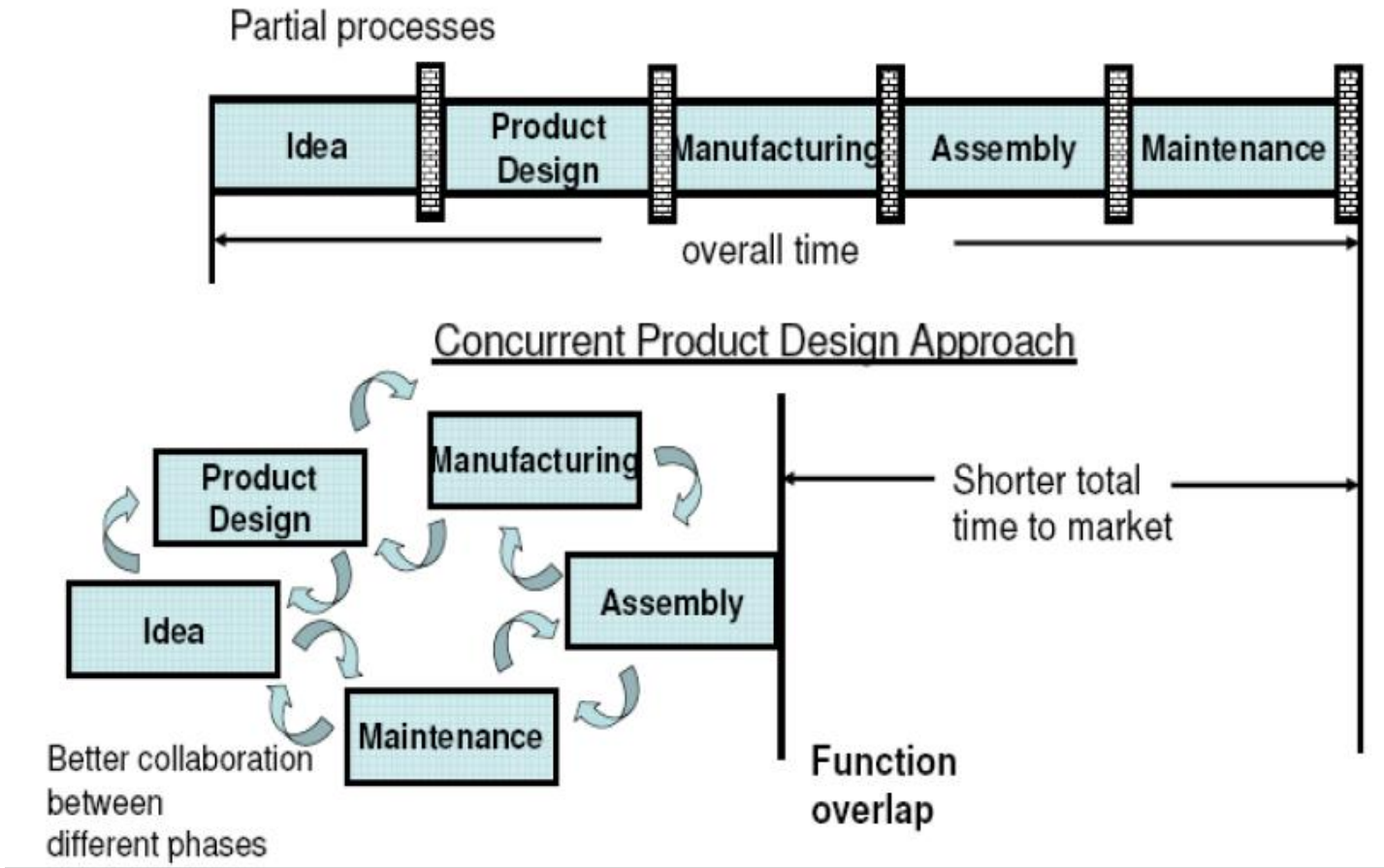
Concurrent Engineering

- Concurrent engineering is a business strategy which replaces the traditional product development process with one in which tasks are done in parallel and there is an early consideration for every aspect of a product's development process.
- This strategy focuses on the optimization and distribution of a firm's resources in the design and development process to ensure effective and efficient product development process.

Concurrent Engineering

- “The simultaneous performance of product design and process design.
- Typically, concurrent engineering involves the formation of cross-functional teams.
- This allows engineers and managers of different disciplines to work together simultaneously in developing product and process design.

Concurrent Engineering



Concurrent Engineering

- Concurrent engineering methodologies permit the separate tasks of the product development process to be carried out simultaneously rather than sequentially.
- Potential problems in fabrication, assembly, support and quality are identified and resolved early in the design process.

Concurrent Engineering

- Concurrent Engineering is a strategy where all the tasks involved in product development are done in parallel.
- Collaboration between all individuals, groups and departments within a company.
 - Customer research
 - Designers
 - Marketing
 - Accounting
 - Engineering

Need of Concurrent Engineering

- React to the changing market needs rapidly, effectively, and responsively.
- To reduce their time to market and adapt to the changing environments.
- Decisions must be made quickly and they must be done right the first time out.
- Concurrent engineering is a process that must be reviewed and adjusted for continuous improvements of engineering and business operations.

Advantages of Concurrent Engineering

- Decrease in time to market.
- Reduces Capital investment by 20% or more.
- Continuous improvement of product quality.
- Increases Product Life Cycle Profitability.
- Increased productivity
- Faster product development
- Less work in progress
- Reduces/eliminates repetition of tasks
- Reduces waste and reworking of design
- Company operates more efficiently
- Reduced Design and Development Times

Disadvantages of concurrent engineering

- Since the designer would no longer be king. There would be lot of ideas (for product) floating around from manufacturing, quality, service causing ego issues.
- There is always a tendency of the respective teams to protect their areas. For eg. Manufacturing engineers might not easily accept a change in design which increases performance but reduces manufacturability.
- The quality of ideas generated can go down.

Rapid Prototyping

- Rapid Prototyping technology employs various engineering e.g. computer control and software techniques including laser, optical scanning, photosensitive polymers, material extrusion and deposition, powder metallurgy etc. to directly produce a physical model layer by layer (Layer Manufacturing) in accordance with the geometrical data delivered from a 3D CAD model.

Differences between conventional machining and rapid prototyping

Rapid Prototyping	Non-Conventional machining processes
<ul style="list-style-type: none">• Produce a model by adding material layer by layer.• Addition process.• Unlimited complexity.• No tooling is required.• Parts assembled in a one stage.• Error or flaws can be detected at an early stage.	<ul style="list-style-type: none">• Produce a model by removing material bit by bit.• Subtraction process• Limited complexity.• Tooling is necessary.• Parts assembled different stages• Error cannot check earlier stage

Need of RPT/Advantages

- Prototyping can improve the quality of requirements and specifications provided to developers.
- Reduced time
- Reduced cost
- Complex designs which are difficult in conventional methods is possible
- Users are actively involved in the development.
- Quicker user feedback is available leading to better solutions.
- Errors can be detected much earlier.
- Missing functionality can be identified easily

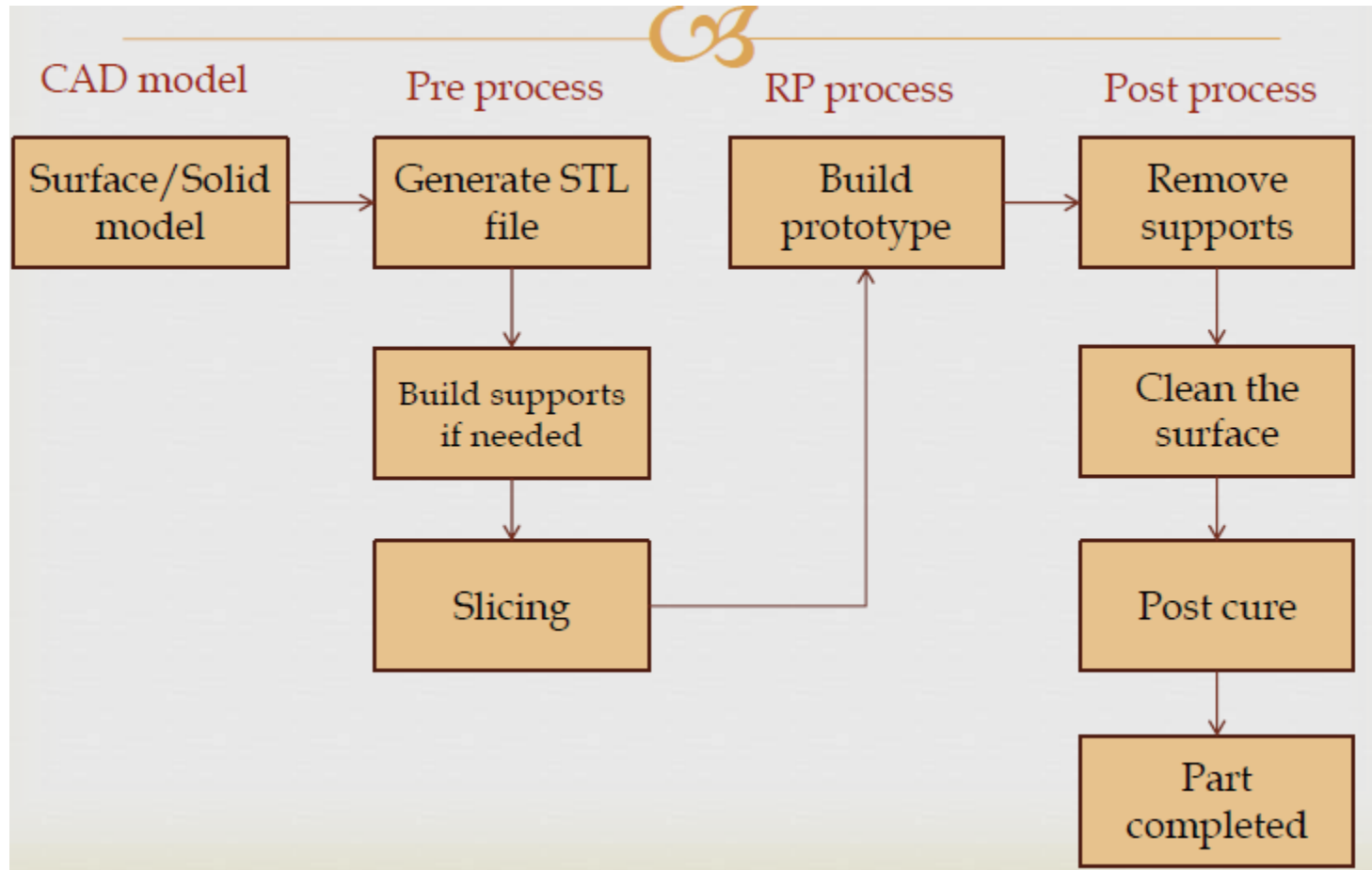
Disadvantages of RPT

- High precision RP machines are still expensive.
- RP systems are difficult to build parts with accuracy under $\pm 0.02\text{mm}$ and wall thickness under 0.5mm .
- The physical properties of the RP parts are normally inferior to those samples that made in proper materials and by the traditional tooling.
- The RP parts are not comparable to (CNC) prototype parts in the surface finishing, strength, elasticity, reflective index and other material physical properties

Workflow of RP processes

- All RP techniques employ the basic five-steps processes:
 - Create a CAD model of the design.
 - Convert the CAD model to STL format.
 - Slice the STL file into thin cross-sectional layers.
 - Construct the model one layer atop another.
 - Clean and finish the model.

Workflow of RP processes



1. CAD Model Creation

- First, the object to be built is modeled using a Computer-Aided Design (CAD) software package.
- Solid modelers, such as Pro/ENGINEER, tend to represent 3-D objects more accurately than wire-frame modelers such as AutoCAD, and will therefore yield better results.

2. Conversion to STL Format

- To establish consistency, the STL format has been adopted as the standard of the rapid prototyping industry.
- The second step, therefore, is to convert the CAD file into STL format. This format represents a three-dimensional surface as an assembly of planar triangles
- STL files use planar elements, they cannot represent curved surfaces exactly.
- Increasing the number of triangles improves the approximation

3. Slice the STL File

- In the third step, a pre-processing program prepares the STL(Standard Triangulated Language) file to be built.
- The pre-processing software slices the STL model into a number of layers from 0.01 mm to 0.7 mm thick, depending on the build technique(G Code Generation using software like Maker ware,Slicr)
- The program may also generate an auxiliary structure to support the model during the build.
- Supports are useful for delicate features such as overhangs, internal cavities, and thin-walled sections.

4. Layer by Layer Construction

- The fourth step is the actual construction of the part.
- RP machines build one layer at a time from polymers, paper, or powdered metal.
- Most machines are fairly autonomous, needing little human intervention.

5. Clean and Finish

- The final step is post-processing. This involves removing the prototype from the machine and detaching any supports.
- Some photosensitive materials need to be fully cured before use
- Prototypes may also require minor cleaning and surface treatment.
- Sanding, sealing, and/or painting the model will improve its appearance and durability.

Types of RPT

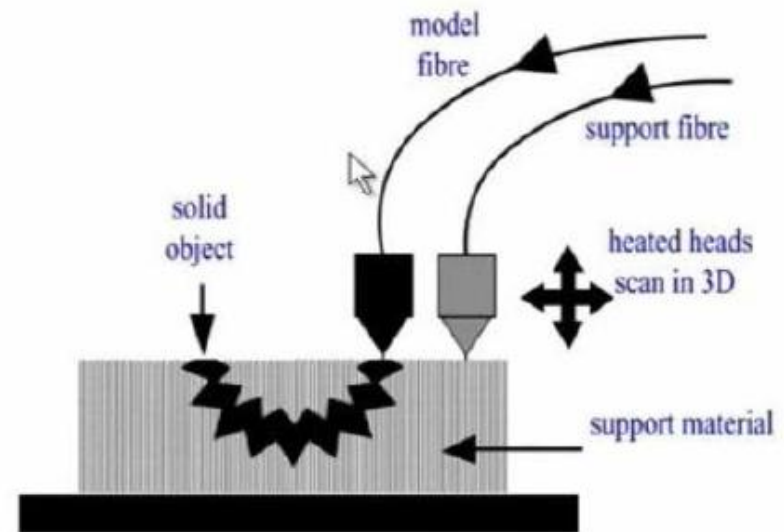
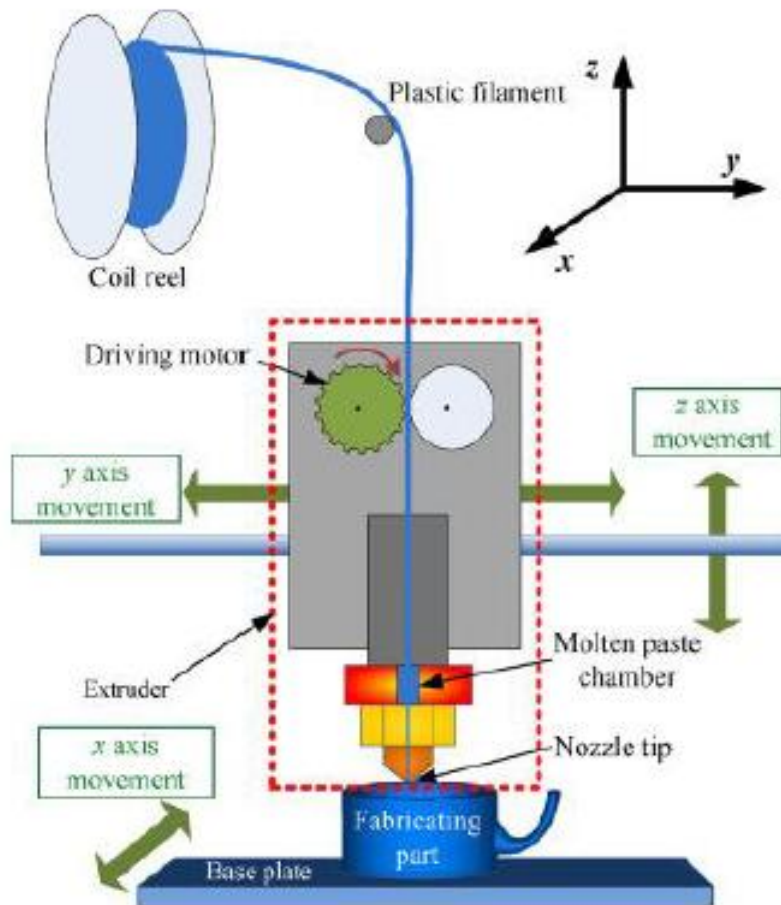
- Liquid Based
 - Liquid-based RP systems have the initial form of its material in liquid state.
 - Through a process commonly known as curing ,the liquid is converted into the solid state.
 - Eg:Stereolithography
- Solid Based
 - Except for powder, solid-based RP systems are meant to encompass all forms of material in the solid state.
 - Eg: Fused Deposition Modeling, Laminated Object Manufacturing
- Powder Based
 - However, it is intentionally created as a category outside the solid-based RP systems to mean powder in grain-like form.
 - Eg: Selective Laser Sintering, Laser Engineered Net Shaping

Fused Deposition Modelling

- Fused deposition modeling (FDM):- FDM works on an "additive" principle by laying down material in layers; a plastic filament or metal wire is unwound from a coil and supplies material to produce a part

Fused Deposition Modelling

- The FDM technique relies on melting and selectively depositing a thin filament of thermoplastic polymer (ABS - engineering and medical grade - plastic, Polycarbonate and investment casting wax) in a cross-hatching fashion to form each layer of the part.
- The material is in the form of a wire supplied in sealed spools which is mounted on the machine and the wire is threaded through the FDM head.
- The head is moved in the horizontal X and Y directions for producing each layer through zigzag movements.
- The supporting table moves in the vertical direction and is lowered after the completion of each layer.



Fused Deposition Modelling

- Here, a spool of thermoplastic filament is fed into a heated extrusion head with a narrow nozzle.
- The x and y movements of the nozzle are controlled by a computer, so that the exact outline of each layer is obtained.
- The filament is unwound from a coil and gets melted and extruded as a continuous thread of polymer to produce a layer.
- Each layer is formed by depositing the molten thermoplastic material as per the outline of the layer.
- The subsequent layers are bonded to the earlier ones by heating.
- The method is also known as Fused Filament Fabrication (FFF). A wide range of durable thermoplastics like PLA, ABS, PVA, polycarbonate etc. are used as the material in this process.

Fused Deposition Modelling

- For certain shapes, a support structure may be needed and this is provided by a second nozzle squeezing out a similar thread of molten material.
- The material extruded by the second nozzle is usually given a different color.
- By using different colors, the actual object and the support material can be easily distinguished.
- At the end of the build process, the support structure is broken away and discarded to take out the object.

Fused Deposition Modelling(FDM)

Advantages

- No post curing.
- Variety of materials.
- Easy material changeover.
- Office environment friendly.
- Low end, economical machines.

Disadvantages

- Not good for small features, details and thin walls.
- Surface finish.
- Supports required on some materials / geometries.
- Support design / integration / removal is difficult.
- Weak Z-axis.
- Slow on large / dense parts

Intellectual Property

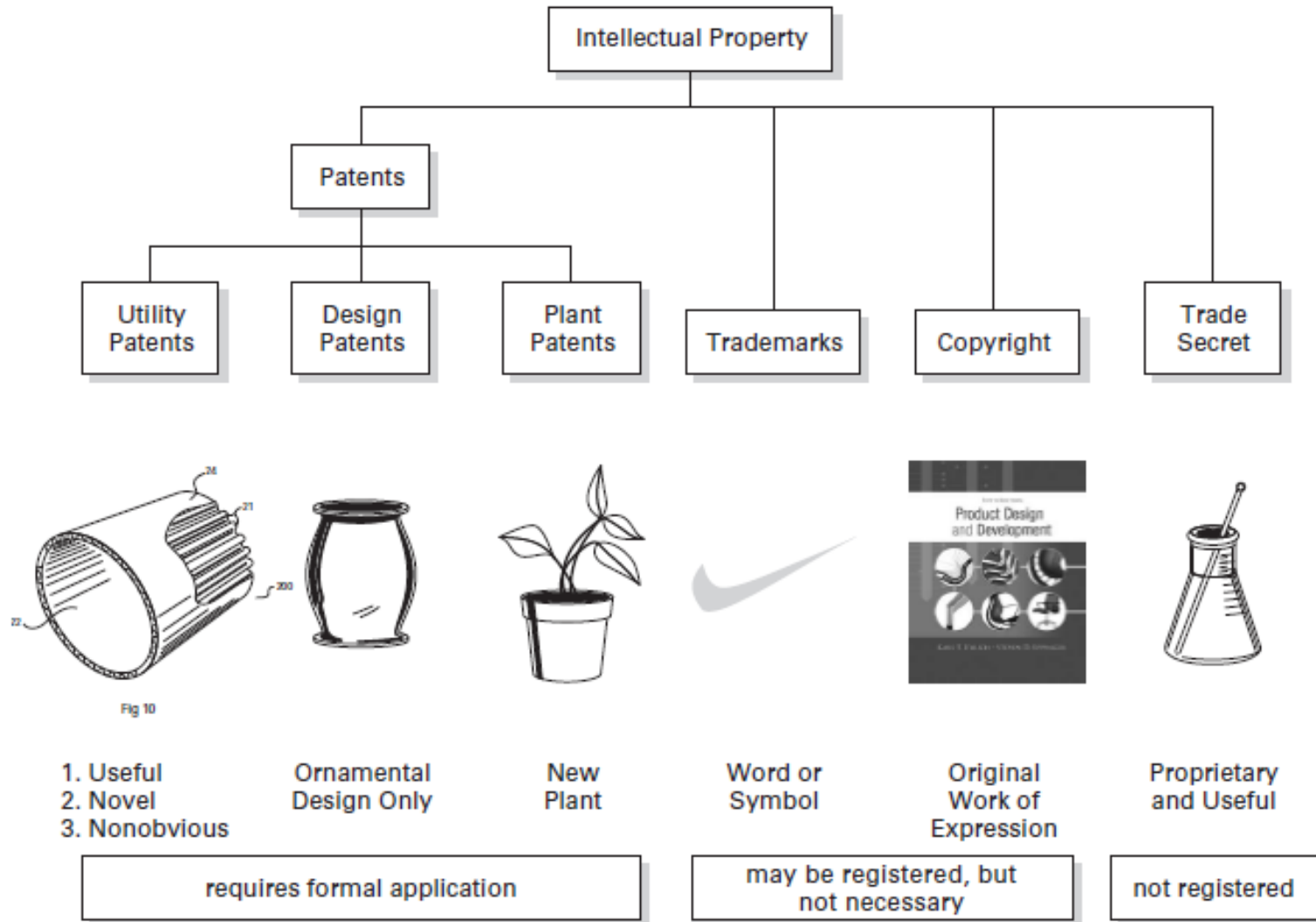
- Intellectual property is the product or creation of the mind.
- It is different from other properties in term that it is “intangible”. Hence it needs some different way for its protection.
- IPR (Intellectual Property Right) is the body of law developed to protect the creative people who have disclosed their invention for the benefit of mankind.
- This protects their invention from being copied or imitated without their consent.

Intellectual Property

- *Intellectual property* refers to the legally protectable ideas, concepts, names, designs, and processes associated with a new product.
- Intellectual property can be one of the most valuable assets of firms.
- Unlike physical property, intellectual property cannot be secured with lock and key to prevent its unwanted transfer.
- Therefore, legal mechanisms have been developed to protect the rights of intellectual property owners.

Types of intellectual property

- Patent
- Trademark
- Trade secret
- Copyright



Types of intellectual property

- **Patent:**

- A patent is a grant from the government which confers on the guarantee for a limited period of time the exclusive privilege of making, selling and using the invention for which a patent has been granted.

- **Trademark:**

- Exclusive right given by government to the trademark owner to use a specific name or symbol in association with a class of product or process.
- Normally trademarks are typically brands or product names

Types of intellectual property

- **Trade Secret:**

- A trade secret is a information used in a trade or business that offers its owner a competitive advantage and that can be kept as secret.
- A symbol, logo, word, sound, color, design, or other device that is used to identify a business or a product in commerce.

- Different Symbols are :

- TM Intent to use application filed for product
- _{SM} Intent to use application filed for services

- **Copyright:**

- Exclusive right granted by the government to copy and distribute an original work of expression, whether literature, graphics, music, art, entertainment, or software.
- Registration of a copyright is possible but not necessary.
- Can Lasts up to 95years

Types of Patent

- Two basic types
 - Design patents
 - Utility patents
- Design type:
 - Design patent provides legal right to exclude someone from producing and selling of a product.
- Utility type:
 - Patenting of an invention that relates to a new process machine, article of manufacture, composition of matter, or a new and useful improvements.

THE INDIAN PATENT ACT

- In India the grant of patents is governed by the patent Act 1970 and Rules 1972.
- The patents granted under the act are operative in the whole of India.
- **HISTORY**
 - The Patent Law of 1856
 - The Patent and Designs Act, 1911.
 - The Patents Act, 1970 and Rules 1972
 - The Patent amendment act 2005

Major Types of IP

Functional & Technical
Inventions

Patents Act, 1970
Amended
in 1999 & 2005

Purely
Artistic works

Copyright Act,
1957
Amended in 1982,
1984, 1992,
1994 & 1999

A symbol, logo, word, sound,
color, design, etc.

Trademark
Act, 1999
Amended in 1994,
1996 & 2000

What can be patented?

- The invention must fall into one of the five “statutory classes’: Processes, Machines , Manufactures, Compositions of matter, and New uses of any of the above
- The invention must be “useful”
- The invention must be “novel”
- The invention must be “non-obvious’

What can be patented?

Useful:

- The patented invention must be useful to someone in some context.

Novel:

- Novel inventions are those that are not known publicly
- Invention must not be published in India or elsewhere
- Invention must not be in prior public knowledge or prior public use with in India

• Nonobvious:

- Patent law defines obvious inventions as those that would be clearly evident to those with “ordinary skill in the art” who faced the same problem as the inventor.
- Ex: cloth hanger

Rights of a patentee

Right to exploit the patent.

- The patentee has a right to prevent 3rd parties, from exploiting the patented invention.

Right to grant license.

- The patentee has a power to assign rights or grant license.

Right to surrender.

- The patentee is given the right to surrender the patent by giving notice in prescribed manner to the controller.

Right to sue for infringement.

- A patentee is given the right to institute proceeding for infringement of the patent in a district court .

Drafting or Modeling Software

- CATIA
- ProE
- Autocad
- Solidworks
- Creo

Features of Modeling Software

- 2D Drawings(To manufacturing section)
- Part by Part Modeling
- Assembly of Parts
- Animation
- Analysis(Load/Stress ,Thermal ,etc.)

Patent Disclosure Preparation

- The disclosure will be in the form of a patent application, which can serve as a provisional patent application and with relatively little additional work could be a regular patent application.
- We can approach patent attorney for filing the disclosure, however it is recommend that inventor draft the disclosure and revise by attorney.

Steps Involved in Patent Disclosure

- Step1: Formulate a strategy and plan
- Step2: Study prior inventions
- Step3: Outline claims
- Step4: Write the specification (description) of the invention
- Step5: Refine claims
- Step6: Pursue application
- Step7: Reflect on the results and the process

Step1: Formulate a strategy and plan

- While formulating a patent, the team should decide on three important factors
 - **Timing** of the filing of a patent application
 - **Type** of application to be filed
 - **Scope** of the application
- **Timing of the filing of a patent application:**
 - Legally, patent application must be filed within one year of the first disclosure of an invention.
 - Although it is recommend that filing precede disclosure, the inventor usually benefits by delaying the application until just before such disclosure.

Step1: Formulate a strategy and plan

- **Type of application:**
 - First, the team must decide whether to file a *regular patent application* or a *provisional patent application*.
 - Secondly team should decide whether to file domestic and/or foreign patent.
- A provisional patent application needs only to fully describe the invention, it does not need to contain claims or comply with the formal structure.
- The principal advantage of a provisional patent application is that it requires less cost and effort to prepare and file than a regular patent application
- Disadvantages are
 - Delays the eventual issuance by one year,
 - Cannot add details in later(regular patent application) .

Step1: Formulate a strategy and plan

- **Scope of Application**
- The team should evaluate the overall product design and decide which embody inventions that are likely to be patentable.
- Complex products often embody several inventions, As a results team may need to file multiple applications.
- While defining the scope of the patent, the team should also consider who the inventors are.

Step 2: Study prior inventions

- What is Prior art?
 - Firstly by studying prior patent literature, design teams can learn whether an invention may infringe on existing unexpired patents.
 - Secondly by studying the prior art, the inventors get a sense how similar their invention to the prior invention and how likely they are to be granted a patent.
 - Third the team will develop background knowledge enabling the members to craft a novel claims.
- Some of the sources information on prior inventions include:
 - Existing and historical product literature.
 - Patent searches
 - Technical and trade publications

Step3: Outline claims

- Issuance of a patent gives the owner a legal right to exclude others from infringing on the invention specifically described in the patent's claims.
- Claims describe certain characteristics of the invention.
- They are written in formal legal language and must adhere to some rules of composition.
- At this point , team benefits from thinking carefully about what it believes is unique about the invention.

Step 4: Write the Description of the Invention

- It is the body of the patent application as it describes the invention.
- Description must present the invention in enough detail that someone with “ordinary skill in the art” could implement the invention.
- The description should be a marketing document in promoting the value of the invention and the weakness in existing solution.

Step 4: Write the Description of the Invention

A typical description includes the following elements:

- Title
- List of inventors
- Field of the invention
- Background of the invention
- Summary of the invention
- Brief description of the drawings
- Detailed description of the invention

Further discussion of detailed description includes

- Figures
- Writing the detailed description
- Defensive disclosure

Step 4: Write the Description of the Invention

- ***Title:***
 - Provide a short descriptive label for the invention, for example, “Recyclable Corrugated Beverage Container and Holder.”
- ***List of inventors:***
 - All inventors must be listed.
 - A person should be listed as an inventor if he or she originated any of the inventions claimed in the application.
 - There are no legal limits to the number of inventors and no requirements about the order in which inventors are listed.
 - A failure to list an inventor could result in a patent eventually being declared not valid.
- ***Field of the invention:***
 - Explain what type of device, product, machine, or method this invention relates to. For example, the Coffin patent reads, “This invention relates to insulating containers, and especially to those which are recyclable and made of cellulosic materials.”

Step 4: Write the Description of the Invention

- ***Background of the invention:***
 - State the problem that the invention solves.
 - Explain the context for the problem, what is wrong with existing solutions, why a new solution is needed, and what advantages are offered by the invention.
- ***Summary of the invention:***
 - This section should present the substance of the invention in summarized form.
 - The summary may point out the advantages of the invention and how it solves the problems described in the background.
- ***Brief description of the drawings:***
 - List the figures in the description along with a brief description of each drawing.
- ***Detailed description of the invention:***
 - This section of the description is usually the most comprehensive and contains detailed descriptions of embodiments of the invention along with an explanation of how these embodiments work.

Step5: Refine claims

- The claims are a set of numbered phrases that precisely define the elements of the invention.
- These claims are basis for all offensive rights.
- **Writing the claims:**
- Although claims must be expressed verbally, they adhere to a strict mathematical logic.
- $X=A+B+C\dots\dots$, where $A=u+v+w\dots$, $B=\dots$,
- Multiple claims are arranged in hierarchically into independent claims and dependent claims.
- Independent claims stand alone and forms root nodes of hierarchy claims.
- Dependent claims always add restriction to an independent claim.

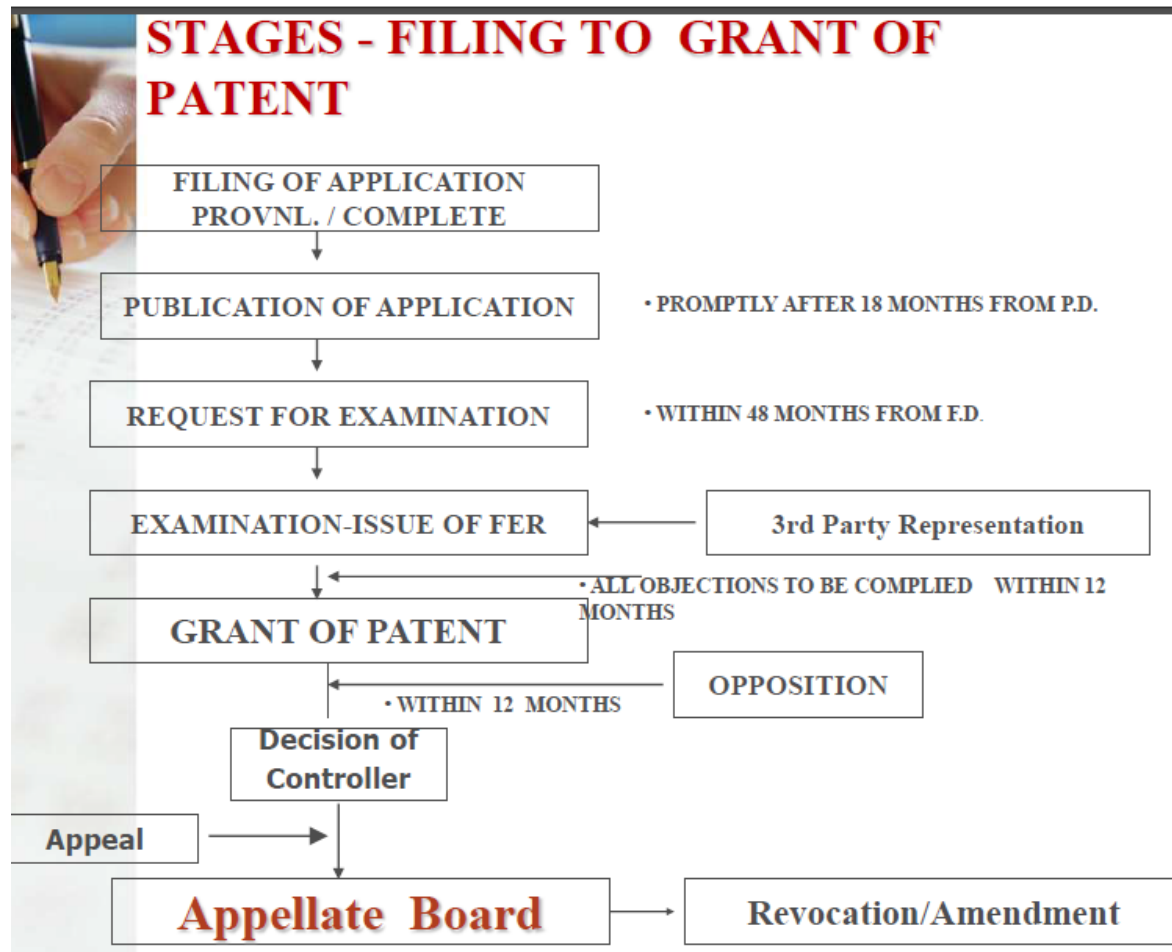
Step6: Pursue application

- Once an invention disclosure is prepared, the team can proceed in four different ways
 - The team can file a provisional patent application
 - The team may file a regular patent application
 - The team may file a Patent Cooperation Treaty(PCT)
 - The team can defer application indefinitely

Step7: Reflect on the results and the process

- What are the essential and distinctive features of the product concept?
- Are these features reflected in the description of the invention and in claims?
- Timing of the future required actions
- What did the team learn about the prior art that may inform future product development
- Did the team begin the process too early or too late? What is the ideal timing for next effort?

STAGES FROM FILING TO GRANT OF A PATENT



Obtaining A Patent

- File an application for patent
 - With one of the patent offices based on territorial jurisdiction of the place of office or residence of the applicant /agent
 - Pay the required fee
- Information concerning application form and details of fee available at www.ipindia.nic.in
- Guidelines for applicants also available on this website

Formality Check

- An Examiner checks the formal requirements before accepting the application and the fee — this is done immediately
- Issue of application number and the cash receipt — this is done the same day
- In case of receipt of application by post, cash receipt, application number is sent by post within 2- 3 days

Publication

- Application is kept secret for a period of 18 months from the date of filing
- In 19th month, the application is published in the official journal – this journal is made available on the website weekly
- Applicant has an option to get his application published before 18 months also
- In that case, application is published within one month of the request

Request for Examination

- Application is examined on request
- Request for examination can be made either by the applicant or by a third party
- A period of 48 months, from the date of filing, is available for making request for examination

Examination

- Application is sent to an Examiner within 1 month from the date of request for examination
- Examiner undertakes examination w.r.t
 - whether the claimed invention is not prohibited for grant of patent
 - whether the invention meets the criteria of patentability

Issue of FER

- A period of 1 to 3 months is available to Examiner to submit the report to the Controller
- 1 month's time available to Controller to verify the Examiner's report
- First Examination Report (FER) containing list of the objections is issued within 6 months from the date of filing of request

Response from the Applicant

- 12 months' time, from the date of issue of FER, is available to the applicant to meet the objections
- If objections are met, grant of patent is approved by the Controller – within a period of 1 month

Pre-grant Opposition

- After publication, an opposition can be filed within a period of 6 months
- Opportunity of hearing the opponent is also available

Examination of Pre-grant Opposition

- Opposition (documents) is sent to the applicant
- A period of 3 months is allowed for receipt of response

Consideration of Pre-grant Opposition

- After examining the opposition and the submissions made during the hearing, Controller may
 - Either reject the opposition and grant the patent
 - Or accept the opposition and modify/reject the patent application
- This is to be done within a period of 1 month from the date of completion of opposition proceedings

Grant of a Patent

- A certificate of patent is issued within 7 days
- Grant of patent is published in the official journal