

Computer Aided Process Planning(CAPP)

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To understand CAPP, We must briefly discuss about Process Planning

- Products and their components are designed to perform certain specific functions.
- Every product has some design specifications which ensure its functionality aspects.
- The task of manufacturing is to produce components such that they meet design specifications.

- Process planning acts as a bridge between design and manufacturing by translating design specifications into manufacturing process details.
- Process planning answers the questions regarding required information and activities involved in transforming raw materials into a finished product. The process starts with the selection of raw material and ends with the completion of part.

The development of process plans involves mainly a set of following activities:

- Analysis of part requirements
- Selection of raw work piece
- Selection of manufacturing operations and their sequences
- Selection of machine tools
- Selection of tools, tool holding devices, work holding devices and inspection equipments
- Selection of manufacturing conditions i.e. cutting speed, feed and depth of cut
- Determination of manufacturing times

Requirements for process planner

- Must be able to analyze and understand part requirements
- Have extensive knowledge of machine tools, cutting tools and their capabilities
- Understand the interactions between the part, manufacturing, quality and cost

Process Planning In Different Environments

} In tool-room type manufacturing

- “make part as per drawing” is sufficient

} In metal forming type operations

- The process planning requirements are embedded directly into the die.
- Process planning is fairly trivial

} Job shop type manufacturing requires most detailed process planning

- Design of tools, jigs, fixtures and manufacturing sequence are dictated directly by the process plan.

Two Methods of Process Planning are:

- a) The manual experience based planning method
- b) Computer Aided Process Planning

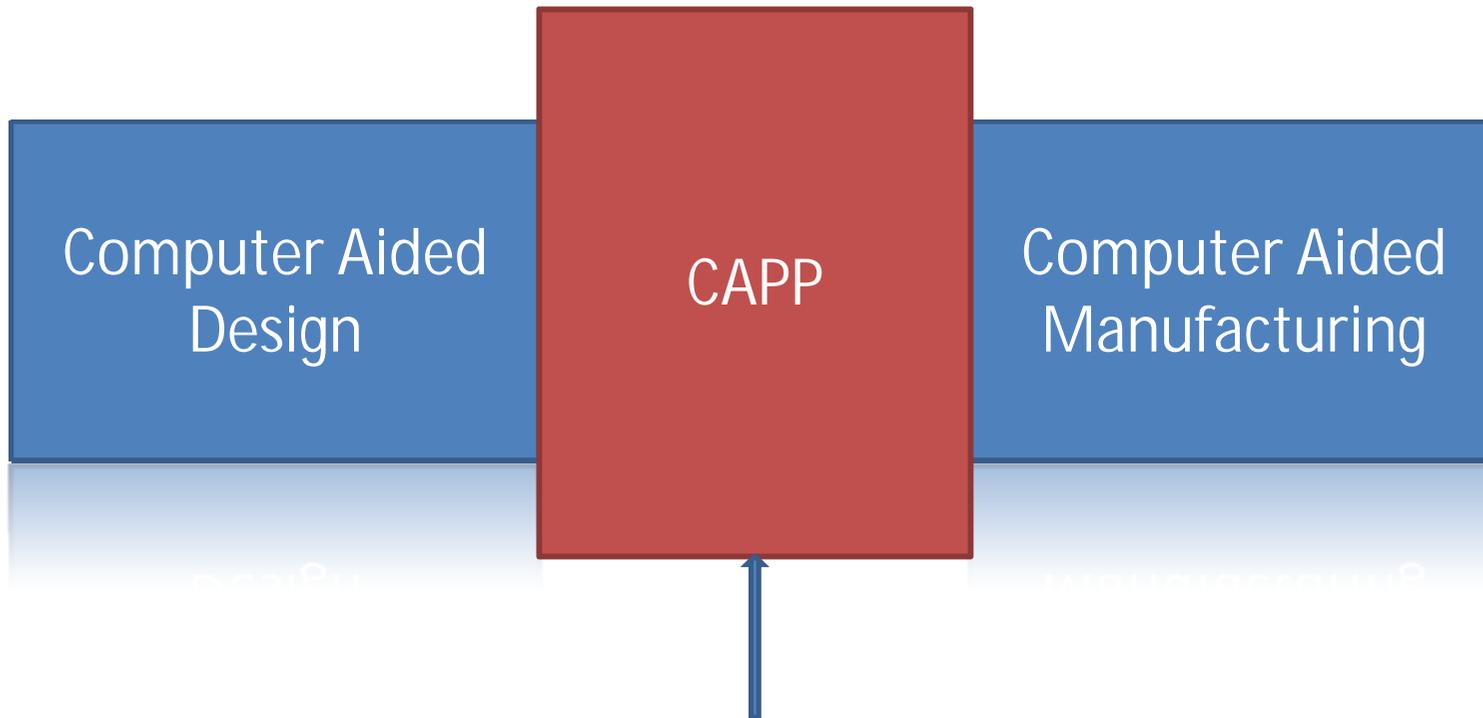
The manual experience based planning method:

- The manual experience based process planning is most widely used.
- It is mainly based on a manufacturing engineer's experience and knowledge of production facilities, equipment, their capabilities, processes and tooling.
- The major problem with this approach is that it is time consuming and developed plans may not be consistent and optimum.

- The feasibility of developed process plan is dependant on many factors such as availability of machine tools, scheduling and machine allocation etc.
- Modern industry is currently lacking skilled labor force to produce machined parts as was done in the past.
- Computer Aided Process Planning is developed to overcome these problems to some extent.

Computer Aided Process Planning

- As we have already discussed, the primary purpose of process planning is to translate the design requirements into manufacturing process details.
- Thus a system was developed in which design information is processed by the process planning system to generate manufacturing process details.
- CAPP is usually considered to be part of CAM, however this results CAM as a stand alone system.
- Synergy of CAM can be achieved by integrating it with CAD system and CAPP acts as a connection between the two.



Synergy results in when CAM is integrated with CAD to form CAD/CAM systems than a stand alone CAD or CAM systems. In such a system CAPP becomes a direct connection between design and manufacturing.

- Readymade CAPP systems are available today to prepare route sheets.
- CAPP integrates and optimizes system performance into the inter organizational flow.
- For example, when one changes the design, it must be able to fall back on CAPP module to generate manufacturing process and cost estimates for these design changes.
- Similarly, in case of machine breakdown on the shop floor, CAPP must generate the alternative actions so that most economical solution can be adopted in the given situation.

When compared with manual experience based process planning, CAPP offers following advantages:

- Systematic development of accurate and consistent process plans.
- Reduction of cost and lead time of process planning.
- Reduced skill requirements and Increased productivity of process planners.
- Higher level application programs such as cost and manufacturing lead time estimation and work standards can be interfaced.

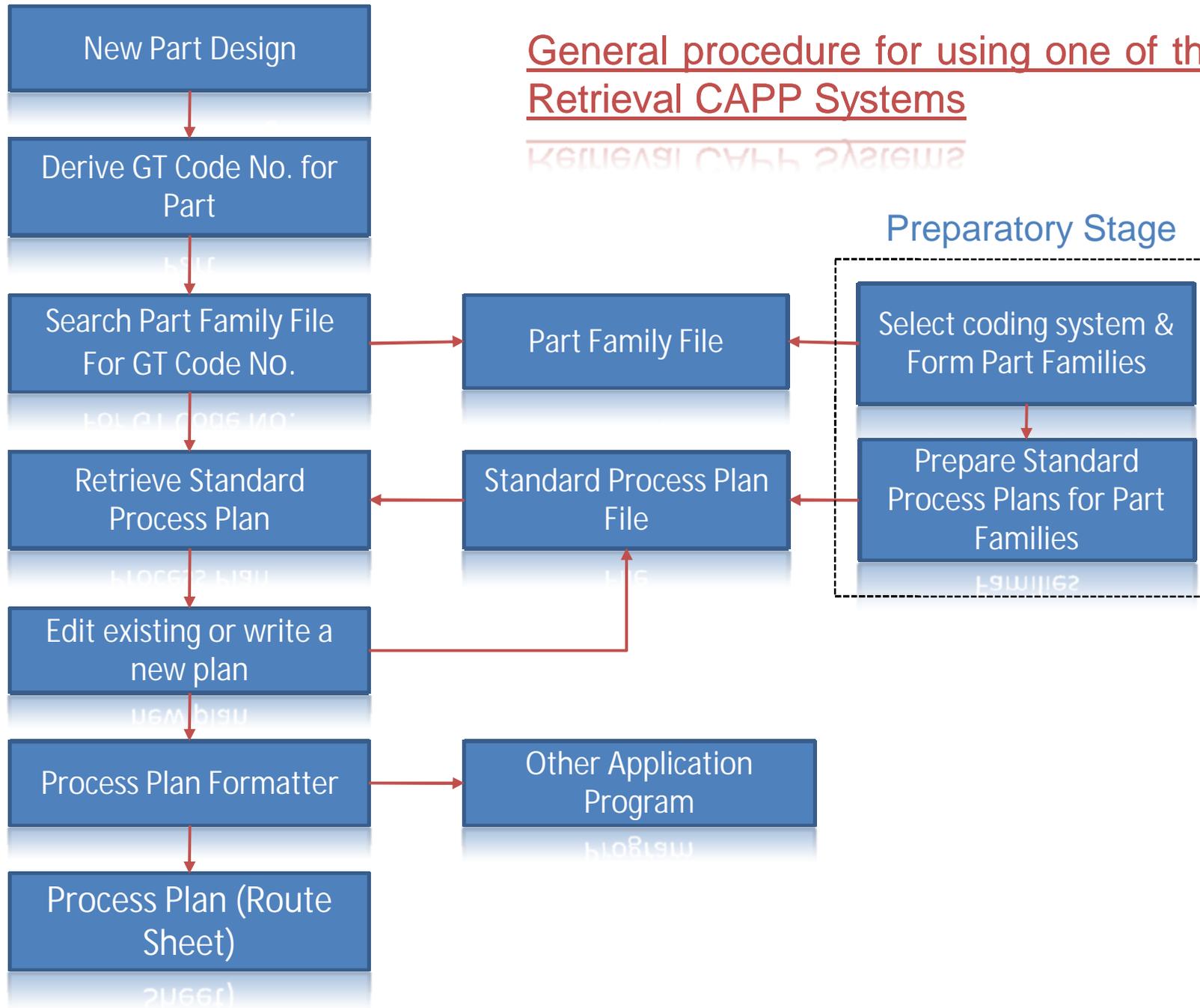
Approaches to CAPP

- Retrieval or Variant CAPP System
- Generative CAPP System

Retrieval or Variant Process Planning

- It is based on the principles of Group Technology (GT) and Parts Classification & Coding.
- In this a standard process plan is stored in the computer files for each part code number.
- These standard route sheets are based on current part routings or on an ideal process plan that has been prepared for each part family.
- Development of the data base of these process plans requires substantial effort.

General procedure for using one of the Retrieval CAPP Systems



- Before the system can be used for process planning a significant amount of information must be compiled and entered into the CAPP data files. This is referred to as the “Preparatory Stage”.
- Preparatory Stage consists of following steps:
 - a) Selecting appropriate classification and coding scheme for company.
 - b) Forming part families for the parts produced by the company.
 - c) Preparing standard process plans for the part families.
- Step ‘b’ & ‘c’ are repeated as new parts are designed and added to the company’s design database.

- After the preparatory phase is completed, the system is ready for use.
- Now assume a new component for which the process plan is to be determined, the first step is to derive the GT Code number for the part.
- With this code no., a search is made in the part family file to determine if a standard route sheet exists for the given part code, if a standard route sheet exists for the part, it is retrieved from the database. Hence the word "Retrieval" for this CAPP System.

- The standard process plan is examined to determine whether any modifications are necessary. Modifications to be made may be minor or major. The user edits the standard plan accordingly.
- This ability to edit the standard plan is what gives the retrieval system its alternative name: Variant CAPP System.
- If the file does not contain a standard process plan for the given code number, the user may search the computer file for a similar or related code number for which a standard route sheet does exist and edit that process plan according to his requirements.

- Even if the user does not find any related file than he may start from scratch, thus the user prepares the route sheet for the new part and this route sheet becomes the standard for the new part code number.
- The process planning session concludes with the Process Plan Formatter, which prints out the sheet in the proper format.
- The formatter may call other application programs into use.
for example: to determine machining conditions for the various machine tool operations in the sequence, to calculate standard times for the operations, etc.

Advantages and limitations of Variant CAPP

- Investment in hardware and software is not much.
- The system offers a shorter development time and lower manpower consumption to develop process plan.
- The system is very reliable and reasonable in real production environments for small and medium size companies.
- Quality of process plan depends on knowledge and background of process planner

Example of Retrieval CAPP system is MultiCAPP, from OIR, the Organization for Industrial Research.

Generative Process Planning

- It is an alternative approach to automated process planning.
- Instead of retrieving and editing an existing plan contained in a computer database, a generative system creates the process plan by means of decision logics, formulas, algorithms and geometry based data that are built or fed as input to the system.

- Format of input may be:
 - a) Text input (interactive)
 - b) Graphical input (from CAD models)

- A fully Generative CAPP System would produce a route sheet without any human assistance and without a set of predefined standard plans.

Ingredients Required In A Fully Generative CAPP System

- First ingredient is technical knowledge of manufacturing.
- This CAPP system requires an expert system which can convert the logic used by successful process planners into a computer program by using certain codes. Such an expert system generates a knowledge base.
- This knowledge base is used by Generative CAPP System to solve process planning problems (i.e.- to create route sheets)

- Second Ingredient is a computer compatible description of the part to be produced. This description contains all of the data and information needed to plan the process sequence.
- Two ways of providing this description are:
 - a) Geometric model of the part that is developed on a CAD system during product design.
 - b) A GT code number of the part that defines the part features in significant detail.

- The third ingredient is the capability to apply the process knowledge and planning logic contained in the knowledge base to a given part description.
- In brief we can say that, Generative CAPP system uses its knowledge base to solve a specific problem, i.e.- planning the process. This system synthesizes a new process plan from scratch for each new part that has been presented to it.

Advantages and limitations of Generative CAPP System

- The generative CAPP has all the advantages of Variant CAPP however it has an additional advantage that it is fully automatic and a up-to-date process plan is generated at each time.
- It requires major revisions if a new equipment or processing capabilities became available.

Some Facts About CAPP Technology:

- Many CAPP systems have so far been developed and commercialized. New systems adopt many advanced techniques and approaches such as feature-based modelling, object oriented programming, utilizes advanced computing methods including expert system and artificial intelligence.
- The implementation of CAPP systems in industry lags behind the rate of development of new systems and introduction of new ideas in the field. Though tremendous effort has been made in developing CAPP systems, the effectiveness of these systems is not fully satisfactory.

- In spite of the benefits promised by the various developed CAPP systems, their adaptation by industry is painfully slow.
- Today, when companies use CAPP systems, it is mostly done in isolation from the product design as well as the production planning and control activities.
- It is also becoming increasingly essential to feedback the information from process planning to assist the designer at an early stage in assigning various design features not only from functional point of view but also regarding manufacturability and economic point of view.

References:

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THANK YOU!!