

Automation (21-541)

*Advanced Manufacturing Laboratory
Department of Industrial Engineering
Sharif University of Technology*

Session # 12



Session Schedule

- *Computer-Aided Process Planning (CAPP)*
 - *Introduction*
 - *Process planning primitives*
 - *Process planning software solutions*
 - *Architecture considerations of Process planning software solutions*



Computer-Aided Design (CAD)

- *Geometric data exchange*
 - *The heart of any CAD model is the component database.*

This includes

- *The graphics entities like points, lines, arcs, circles etc. and the co-ordinate points, which define the location of these entities.*
- *This geometric data is used in all downstream applications of CAD, which include*
 - *Finite element modeling and analysis,*
 - *Process planning,*
 - *Estimation,*
 - *CNC programming,*
 - *Robot programming,*
 - *Programming of co-ordinate measuring machines,*
 - *ERP system programming and simulation.*

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Computer-Aided Process planning (CAPP)

- *Process planning primitives*
 - *Process planning is concerned with determining the sequence of individual manufacturing operations needed to produce a given part or product.*
 - *The resulting operation sequence is documented on a form typically referred to as operation sheet.*
 - *The operation sheet is a listing of the production operations and associated machine tools for a work part or assembly.*
 - *Process planning is an important stage of product development since production tooling like jigs, fixtures, special tools etc. can be designed only after the process plan is finalized.*

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Computer-Aided Process planning (CAPP)

- *Process planning primitives*
 - *The importance of process planning lies in the fact that process plans have a direct bearing on the cost of the part.*
 - *As new manufacturing processes and machines are introduced, process plans also undergo changes.*
 - *Process planning is a dynamic activity. The continuous emphasis on cost reduction also requires the process plans to be updated to reduce the cost.*

Computer-Aided Process planning (CAPP)

- *Process planning primitives*
 - *Process planning establishes which machining process and process parameters are to be used to convert a work material (blank) from its initial form (raw material) to a final form defined by an engineering drawing.*
 - *All the information determined by the process planning function is recorded on a sheet called process plan.*
 - *The process plan is frequently called an operation sheet, route sheet or operation planning sheet.*
 - *Process plan provides the instructions for the production of the part and contains the operation sequence, processes, process parameters and machine tools used.*

Computer-Aided Process planning (CAPP)

- *Process planning primitives*
 - *The process planning activity can be divided into the following steps:*
 - *Selection of processes and tools*
 - *Selection of machine tools/Manufacturing equipment*
 - *Sequencing the operations*
 - *Grouping of operations*
 - *Selection of work piece holding devices and datum surfaces (set ups)*
 - *Selection of inspection instruments*
 - *Determination of production tolerances*
 - *Determination of the proper cutting conditions*
 - *Determination of the cutting times and non-machining times (setting time, inspection time) for each operation*
 - *Editing the process sheets.*

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Computer-Aided Process planning (CAPP)

- *Process planning primitives*

XYZ GLOBAL MANUFACTURING LTD. VELLORE 632014

PART NUMBER : 610 415 3426

MATERIAL: FG 200

PART NAME : PIN

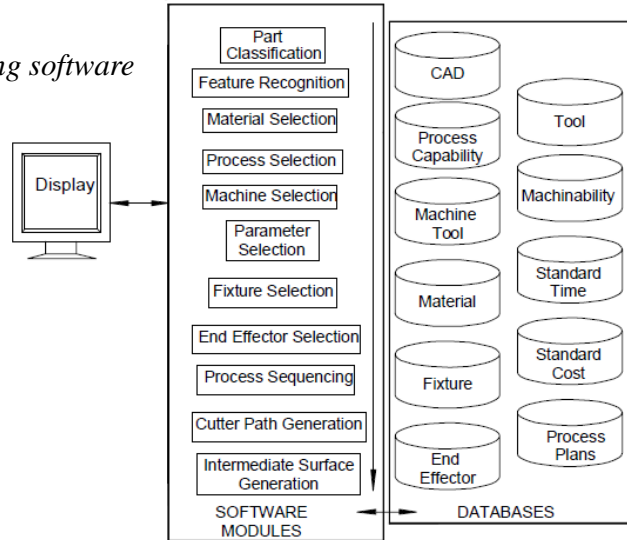
| <i>Process Number</i> | <i>Process Details</i> | <i>Machine</i> | <i>Tool Tip Tool holder</i> | <i>Cutting Speed m/min</i> | <i>Spindle Speed rpm</i> | <i>Feed/ Feed Rate</i> | <i>Set Up Time min</i> | <i>Process Time min</i> |
|-----------------------|------------------------|----------------|---------------------------------|--------------------------------|------------------------------|----------------------------|----------------------------|-----------------------------|
| 01 | HOC CC Drill | CNC LATHE | | | | | | |
| 02 | Drill | CNC LATHE | | | | | | |
| 03 | Face & Turn | CNC LATHE | | | | | | |

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Computer-Aided Process planning (CAPP)

▪ Structure of a process planning software



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Computer-Aided Process planning (CAPP)

▪ Process planning primitives

- The current approaches for computer aided process planning can be classified into two groups:
 - Variant
 - Generative

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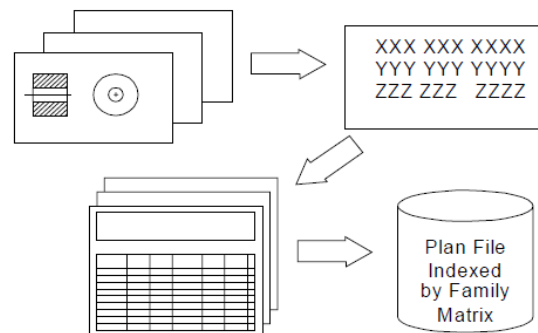
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Computer-Aided Process planning (CAPP)

- **Variant Process planning**
 - A variant process planning system uses the similarity among components to retrieve the existing process plans.
 - A process plan that can be used by a family of components is called a standard plan. A standard plan is stored permanently with a family number as its key
 - A family is represented by a family matrix which includes all possible members.
 - The variant process planning system has two operational stages:
 - A preparatory stage and
 - A production stage.

Computer-Aided Process planning (CAPP)

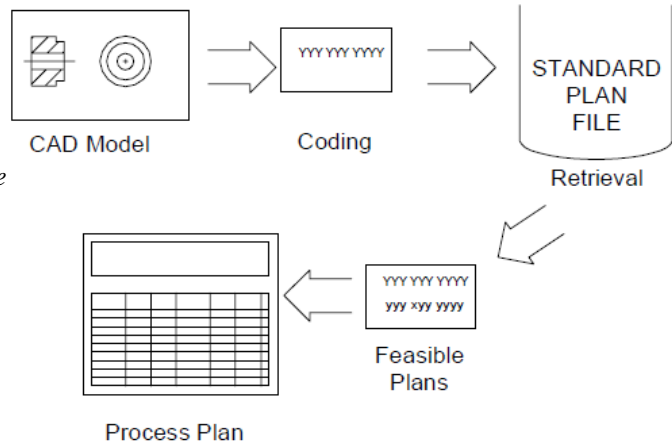
- **Variant Process planning**
 - During the preparatory stage, existing components are coded, classified, and subsequently grouped into families.
 - The process begins by summarizing process plans already prepared for components in the family. Standard plans are then stored in a data base and indexed by family matrices



Computer-Aided Process planning (CAPP)

Variant Process planning

- The operation stage occurs when the system is ready for production.
- An incoming part is first coded. The code is then input to a part family search routine to find the family to which the component belongs.
- The family number is then used to retrieve a standard plan.



Computer-Aided Process planning (CAPP)

Variant Process planning

- The following are the sequences in the design of a variant process planning system:
 - Family formation
 - Data base structure design
 - Search algorithm development and implementation
 - Plan editing
 - Process parameter selection/updating

Computer-Aided Process planning (CAPP)

- *Variant Process planning- Group Technology*
 - *Group technology is an operations management philosophy based on the recognition that similarities occur in the design and manufacture of discrete parts.*
 - *Similar parts can then be arranged into part families*
 - *Part classification and coding is concerned with identifying the similarities and using these similarities to evolve a classification code.*
 - *Similarities are of two types:*
 - *Design attributes (such as geometric shape and size), and*
 - *Manufacturing attributes (the sequence of processing steps required to make the part)*

Computer-Aided Process planning (CAPP)

- *Variant Process planning- Group Technology*
 - *A part family is a collection of parts which are similar either because of geometry and size or because similar processing steps are required in their manufacture.*
 - *The parts within a family are different, but their similarities are close enough to merit their identification as members of the part family.*
 - *There are three general methods for solving this problem.*
 - *Visual inspection*
 - *Production flow analysis*
 - *Parts classification and coding system*