

IPE-419 Computer Integrated Manufacturing

Dr. Nafis Ahmad
May 2022

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<https://m2msns.com>
<https://m2msns.com/cim.html>

Objectives

- ✓ To develop an understanding of the **role of computer in manufacturing**
- ✓ To develop an understanding of **hardware and software components used for industrial automation.**
- ✓ To make the students clearly understand about **automatic data capture systems**
- ✓ To provide an in-depth understanding of **control of manufacturing, automated material handling, storage and retrieval systems.**
- ✓ To introduce **group technology and concurrent engineering**, and develop skill in the developing **automated process plans** using variant and generative approaches
- ✓ To introduce **FMS and CIM systems.**
- ✓ To develop understanding of **Industry 4.0**

Outcomes

- ✓ After completion of the course, the students will be able to:
- ✓ Explain **automatic data capture (ADC)** systems in manufacturing to reduce data processing time and facilitate automation.
- ✓ Apply the principles of operation of **automated material handling, storage, and retrieval systems (ASRS)** and how to implement them in production.
- ✓ Use **Programmable Logic Controllers (PLC)** and pneumatics for manufacturing automation.
- ✓ Implement group technology concepts in production to facilitate **cellular and flexible manufacturing**.
- ✓ Develop **automated process plans** using variant and generative approaches
- ✓ Take appropriate strategy to gradually migrate from conventional manufacturing to **FMS and CIM**

Course Outline/Lecture Plan

- ✓ Introduction --1 Lectures
- ✓ Industrial Robotics --4 Lectures
- ✓ Discrete Control Using PLCs and PCs --5 Lectures
- ✓ Class Test-1 --1 Lectures
- ✓ Material Handling
- ✓ Material Transport System (---)
- ✓ Storage System (----)
- ✓ Automatic Data Capture (---)
- ✓ Group Technology and Cellular Manufacturing (---)
- ✓ Flexible Manufacturing System --5 Lectures
- ✓ Product Design and CAD/CAM --5 Lectures
- ✓ Class Test-2 --1 Lectures
- ✓ Process Planning and Concurrent Engg. --5 Lectures
- ✓ Factory of the Future / Industry 4.0 --2 Lectures
- ✓ Review --1 Lectures
- Ref: *Automation, Production Systems, and Computer Integrated Manufacturing*, 2nd Edn, Mikell P. Groover
- Weekly 2 Classes

Computer Aided Process Planning

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Process Planning

- Definition of Process Planning
- Difference between Production Planning and Process Planning
- Decisions taken during process planning
- Route sheet, guidelines for route sheet
- Sequence of processes required for part fabrication
- Typical process sequence
- Computer Aided Process Planning
- Retrieval CAPP systems and Generative CAPP system

Process Planning

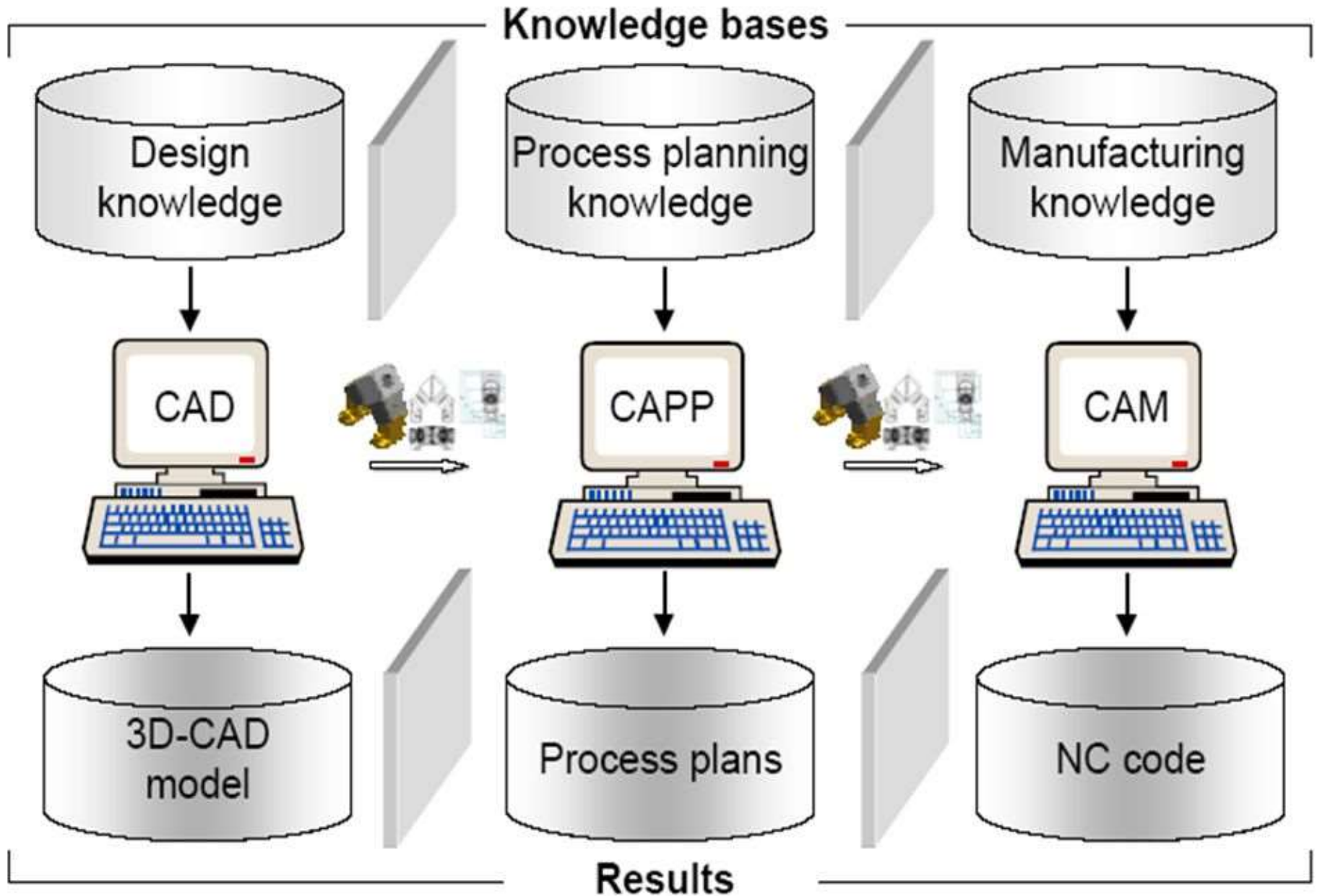
- Process Planning: Determining most appropriate manufacturing and assembly processes and the sequence in which they should be accomplished to produce a given part or product according to specifications set forth in the product design documentation.
- Limited by resources and technological capabilities.
- Experienced process planner is required for the best one.

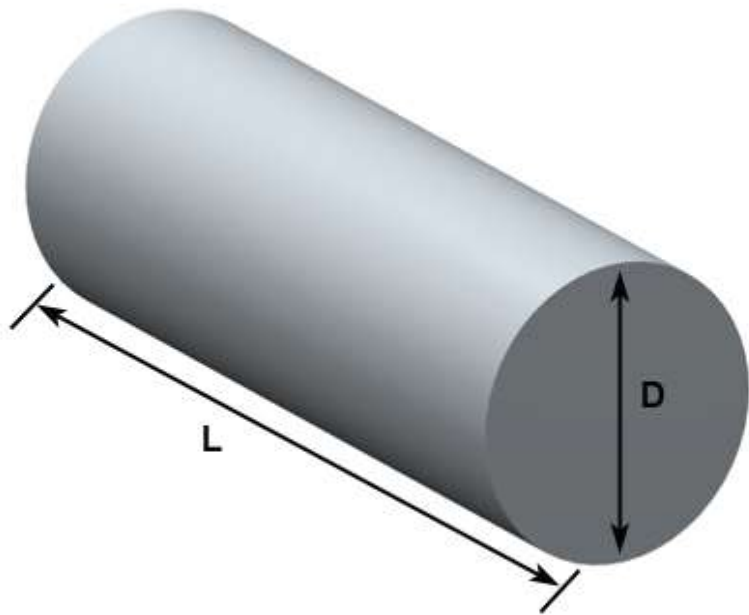
Process Planning

Difference between Production Planning and Process Planning

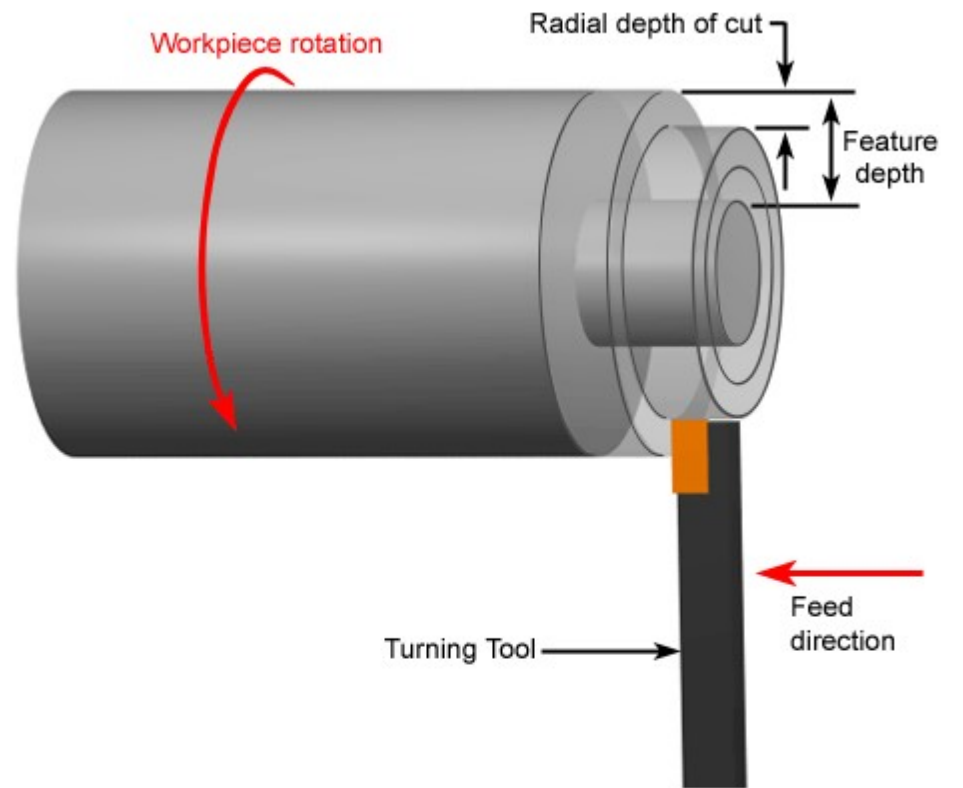
- Process plan- is concerned with engineering and technological issues to manufacture product/part
- Production Planning-is concerned with logistical issues. Managing materials and other resources to meet demand.

Defining Computer Aided Process planning - CAPP





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Process Planning

Decisions taken during process planning:

- Interpretation of design drawing
- Processes and sequence
- Equipment selection
- Tools, dies, molds, fixtures and gages
- Methods analysis
- Work standards
- Cutting tools and cutting conditions

Route Sheet		XYZ Machine Shop, Inc.				
Part no. 081099	Part name Shaft, generator	Planner MPGroover	Checked by: N. Needed	Date 08/12/XX	Page 1/1	
Material 1050 H18 Al	Stock size 60 mm diam., 206 mm length	Comments:				
No.	Operation description	Dept	Machine	Tooling	Setup	Std.
10	Face end (approx. 3 mm). Rough turn to 52.00 mm diam. Finish turn to 50.00 mm diam. Face and turn shoulder to 42.00 mm diam. and 15.00 mm length.	Lathe	L45	G0810	1.0 hr	5.2 min
20	Reverse end. Face end to 200.00 mm length. Rough turn to 52.00 mm diam. Finish turn to 50.00 mm diam.	Lathe	L45	G0810	0.7 hr	3.0 min
30	Drill 4 radial holes 7.50 mm diam.	Drill	D09	J555	0.5 hr	3.2 min
40	Mill 6.5 mm deep x 5.00 mm wide slot.	Mill	M32	F662	0.7 hr	6.2 min
50	Mill 10.00 mm wide flat, opposite side.	Mill	M13	F630	1.5 hr	4.8 min

Figure 24.1 Typical route sheet for specifying the process plan.

TABLE 25.1 Typical Guidelines in Preparing a Route Sheet

- Operation numbers for consecutive processing steps should be listed as 10, 20, 30, etc. This allows new operations to be inserted if necessary.
 - A new operation and number should be specified when a workpart leaves one workstation and is transferred to another station.
 - A new operation and number should be specified if a part is transferred to another workholder (e.g., jig or fixture), even if it is on the same machine tool.
 - A new operation and number should be specified if the workpart is transferred from one worker to another, as on a production line.
-

Process Planning

A typical processing sequence to fabricate an individual part consists of:

- ***Basic process***- determines the starting geometry of the workpart. Metal casting, plastic molding, and rolling of sheet metal etc.
- ***Secondary processes***- transform the starting geometry into the final geometry (or close to the final geometry). The secondary processes that might be used are closely correlated to the basic process that provides the starting geometry. When sand casting is the basic process, machining operations are generally the secondary processes.

Process Planning

A typical processing sequence to fabricate an individual part consists of:

- *Property enhancing process*- Operations to enhance physical properties
- *Finishing operations*- usually provide a coating on the workpart.

Plastic molding and other operations that require no subsequent secondary processing are called *net shape processes*.

What is *near net shape processes*?

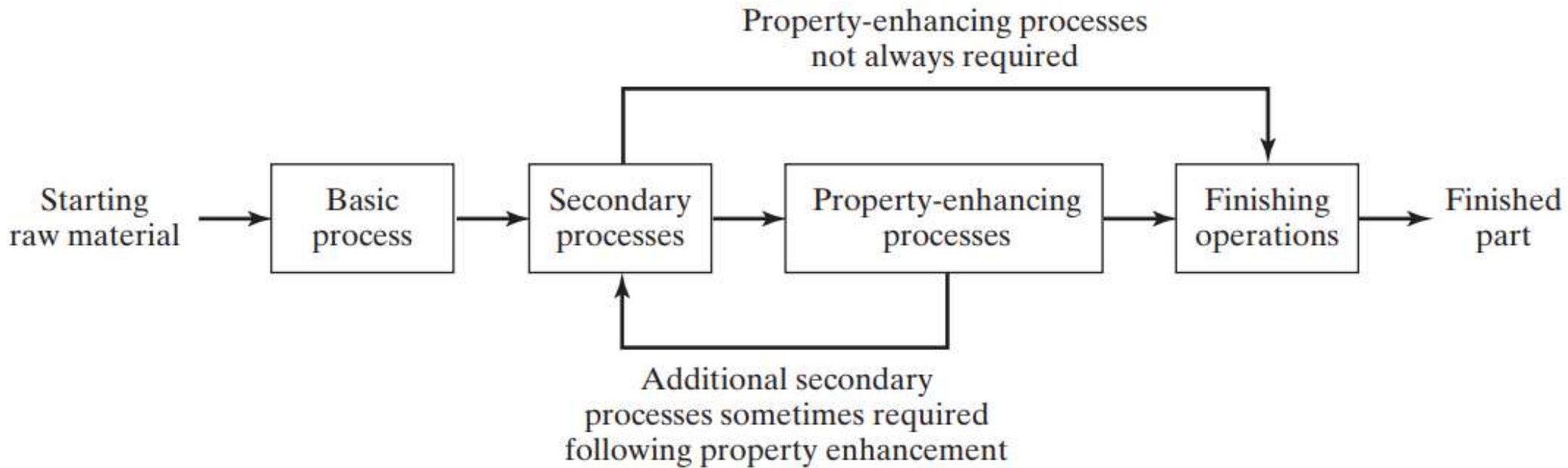


Figure 24.2 Typical sequence of processes required in part fabrication.

Computer Aided Process Planning (CAPP)

Benefits of CAPP:

- Process rationalization and standardization makes process plan more logical and consistent, lowers manufacturing costs and increase product quality.
- Increased productivity of process planners
- Reduced lead time for process planning
- Improved legibility
- Incorporation of other application programs

There are mainly two types of CAPP system:

- Retrieval CAPP system and
- Generative CAPP system

Retrieval CAPP system

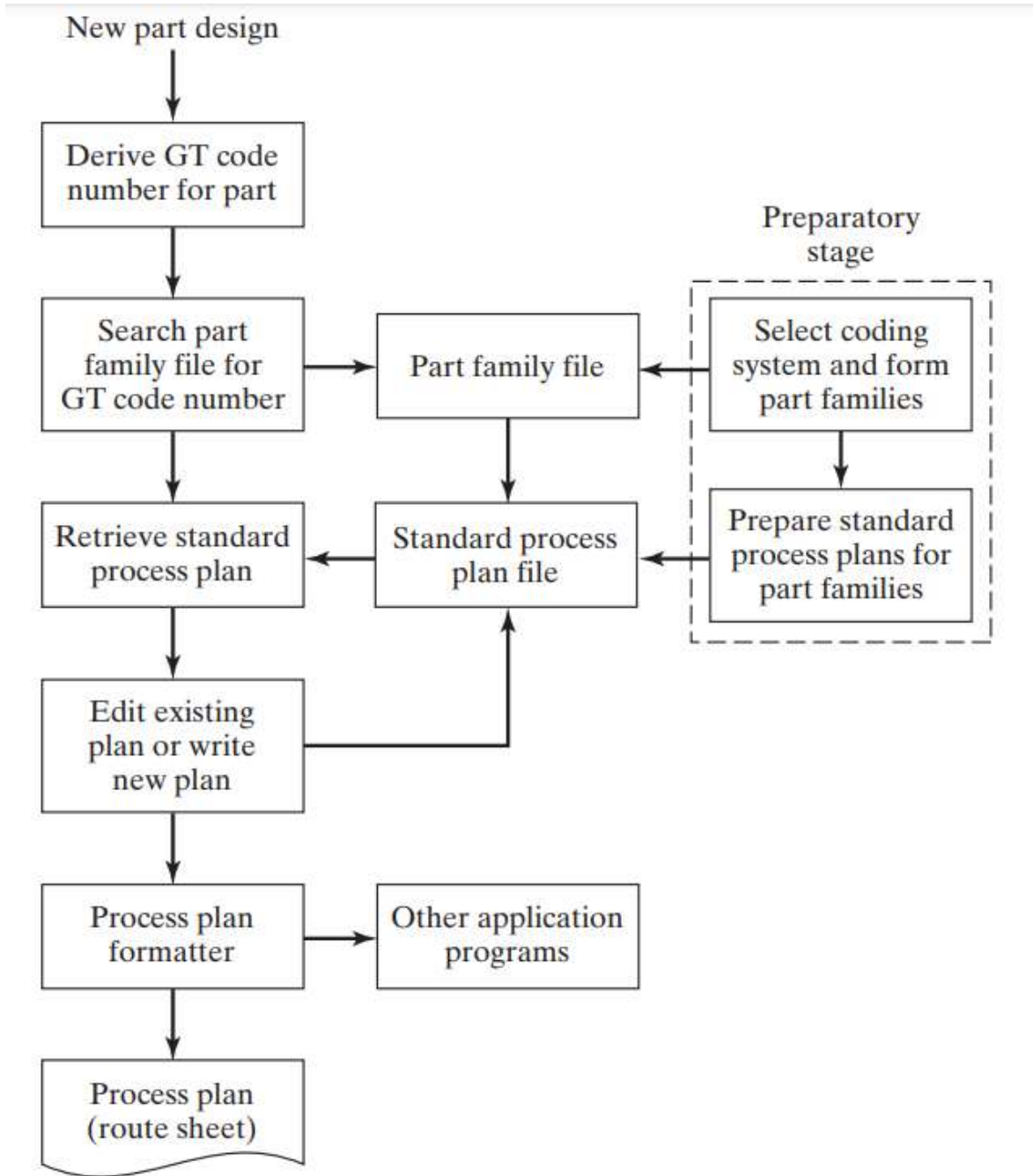


Figure 24.3 General procedure for using one of the retrieval CAPP systems.

Route Sheet		XYZ Machine Shop, Inc.				
Part no. 081099	Part name Shaft, generator	Planner MPGroover	Checked by: N. Needed	Date 08/12/XX	Page 1/1	
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Figure 24.1 Typical route sheet for specifying the process plan.

Generative CAPP system

Instead of retrieving and editing an existing plan contained in a computer data base, a generative system creates the process plan based on logical procedures similar to the procedures a human planner would use.

Key ingredients :

- Technical knowledge and the logic
 - Computer compatible description of parts
 - Using knowledge base
-
- Autonomous car driving

Typical Example

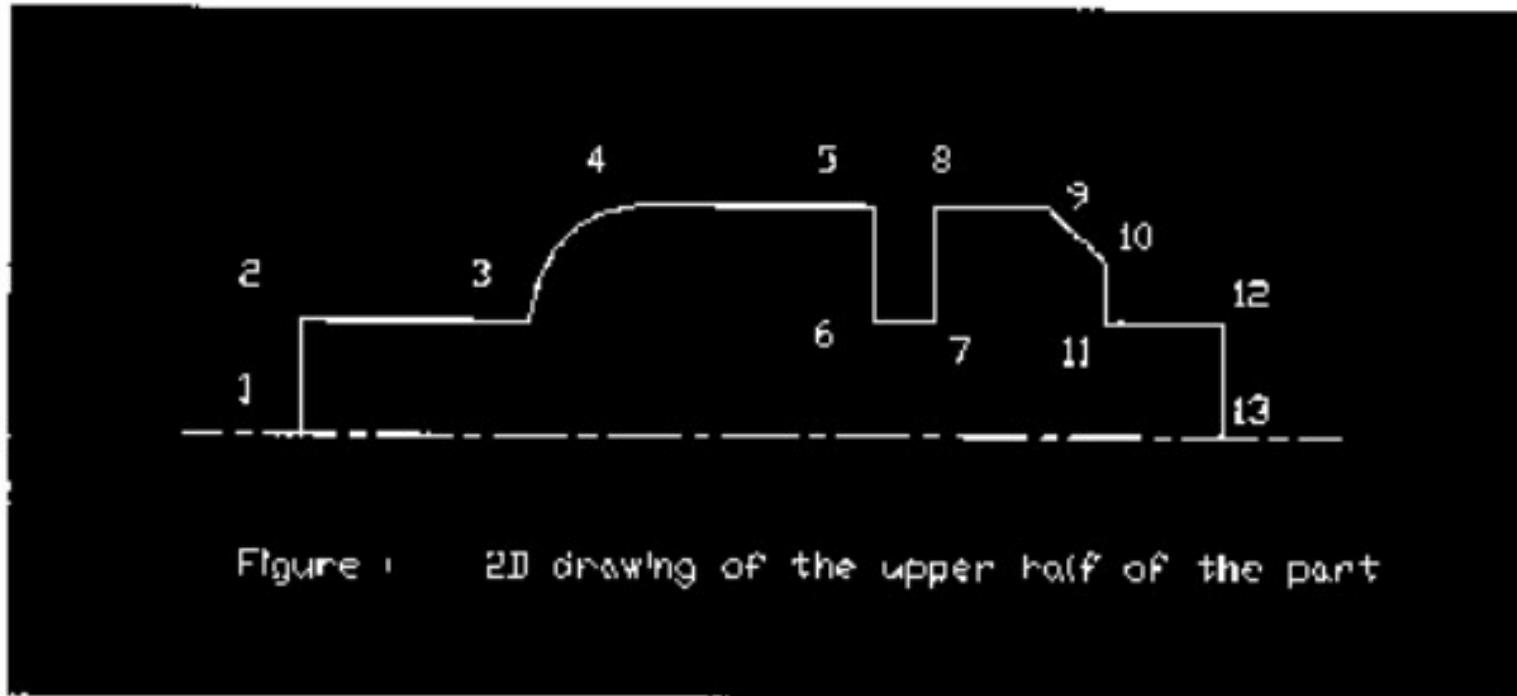


Figure 4.3: 2D profile of upper half of the part

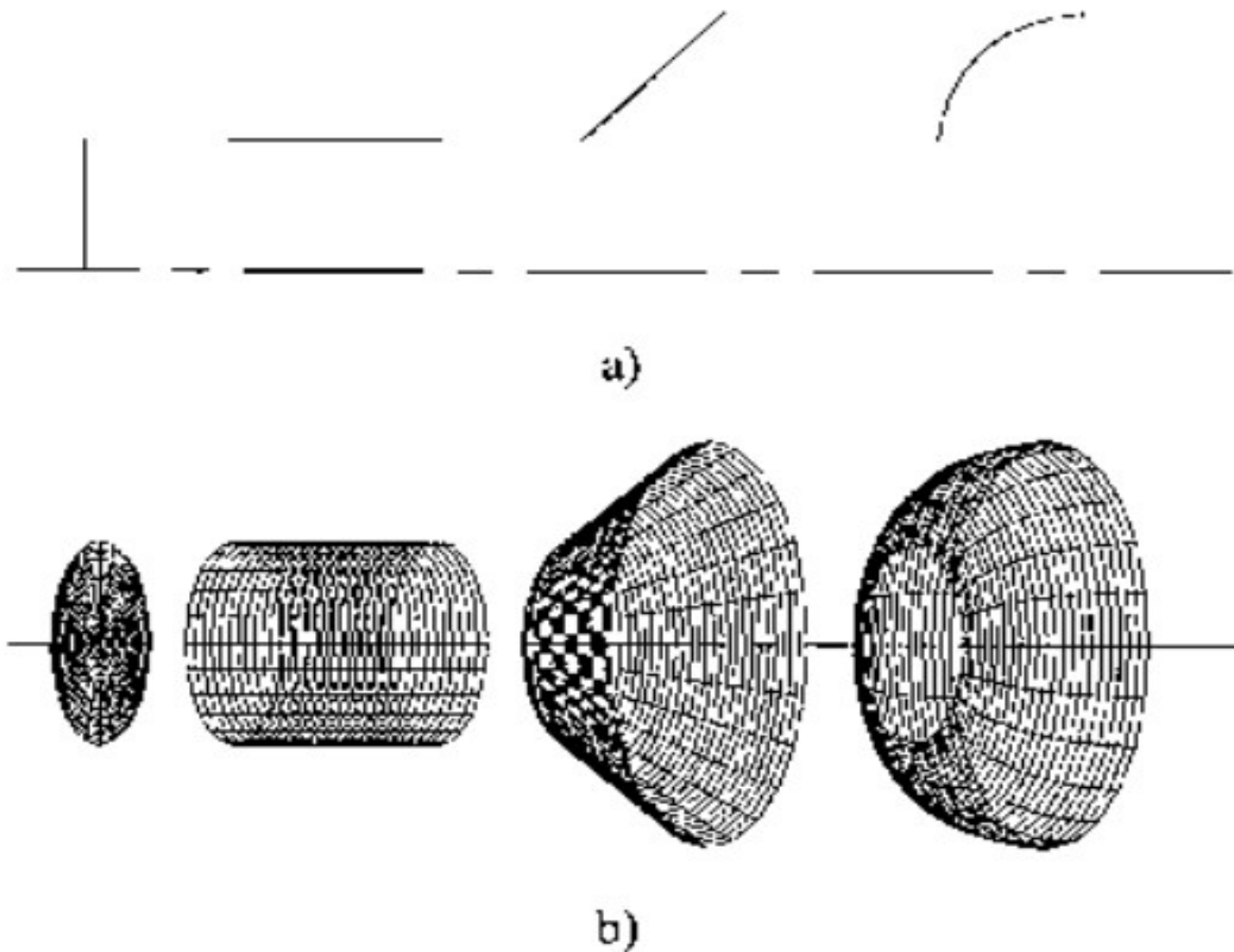


Figure 4.4: a) different types of lines b) Surfaces generated from the lines

Table 4.1: 'ENTITIES' section of the DXF file

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	SECTION	VERTEX	VERTEX	VERTEX	VERTEX	VERTEX	VERTEX	VERTEX	VERTEX	VERTEX	VERTEX	VERTEX	VERTEX	VERTEX	SEQEND
3	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5
4	ENTITIES	C8	C9	CA	CB	CC	CD	CE	CF	D0	D1	D2	D3	D4	D5
5	0	8	8	8	8	8	8	8	8	8	8	8	8	8	8
6	POLYLINE	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	5	10	10	10	10	10	10	10	10	10	10	10	10	10	0
8	BC	0	0	2	3	5	5	5.5	5.5	5.5	7	7	8	8	ENDSEC
9	8	20	20	20	20	20	20	20	20	20	20	20	20	20	0
10	0	0	1	1	2	2	1	1	2	2	1	1	0	0	EDF
11	66	30	30	30	30	30	30	30	30	30	30	30	30	30	
12	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
13	10			42											
14	0			-0.414											
15	20														
16	0														
17	30														
18	0														

X coordinate after DXF code 10
 Y coordinate after DXF code 20
 Z coordinate after DXF code 30
 Value after DXF code 42 indicates the next line is curved

Thanks!

Any questions?

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