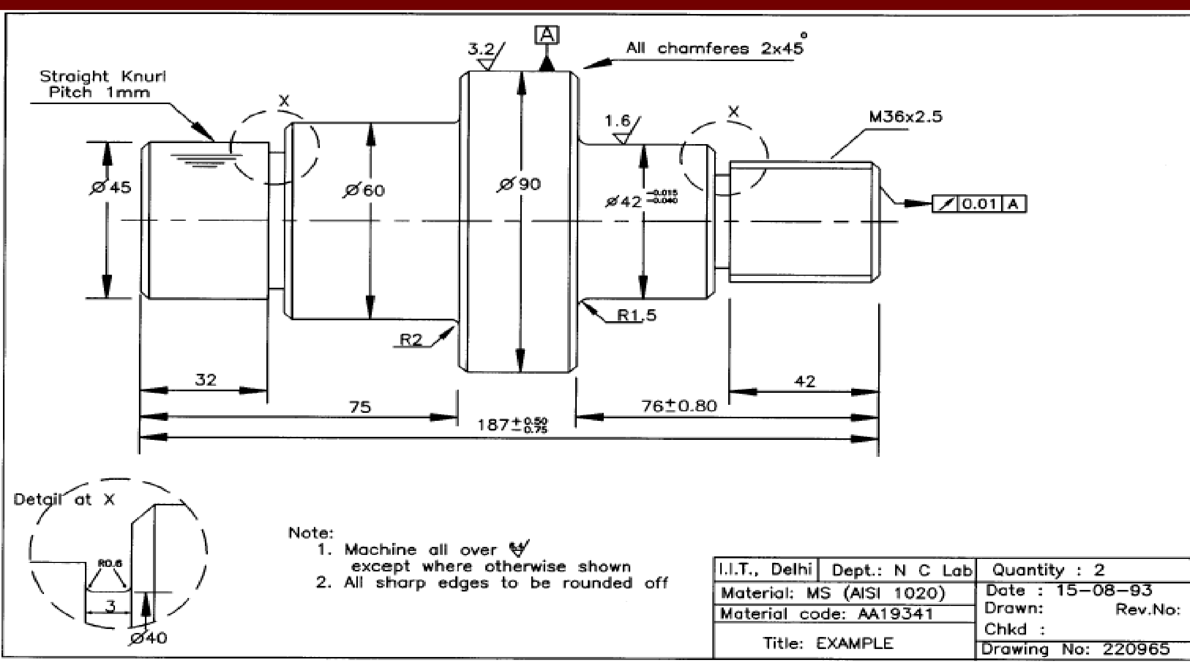
Defining Process planning

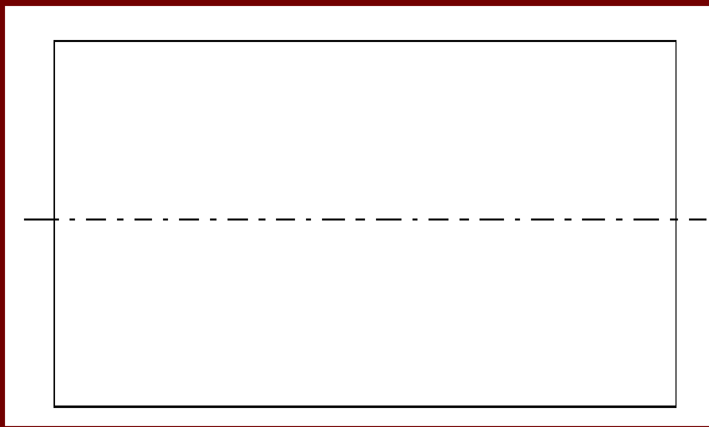
- **Process planning can be defined as the systematic determination of the detailed methods by which workpieces or parts can be manufactured economically and competitively from initial stages (raw material form) to finished stages (desired form).**

- **Geometrical features, dimensional sizes, tolerances, materials, and surface finishes are analyzed and evaluated to determine an appropriate sequence of processing operations.**

Final Form



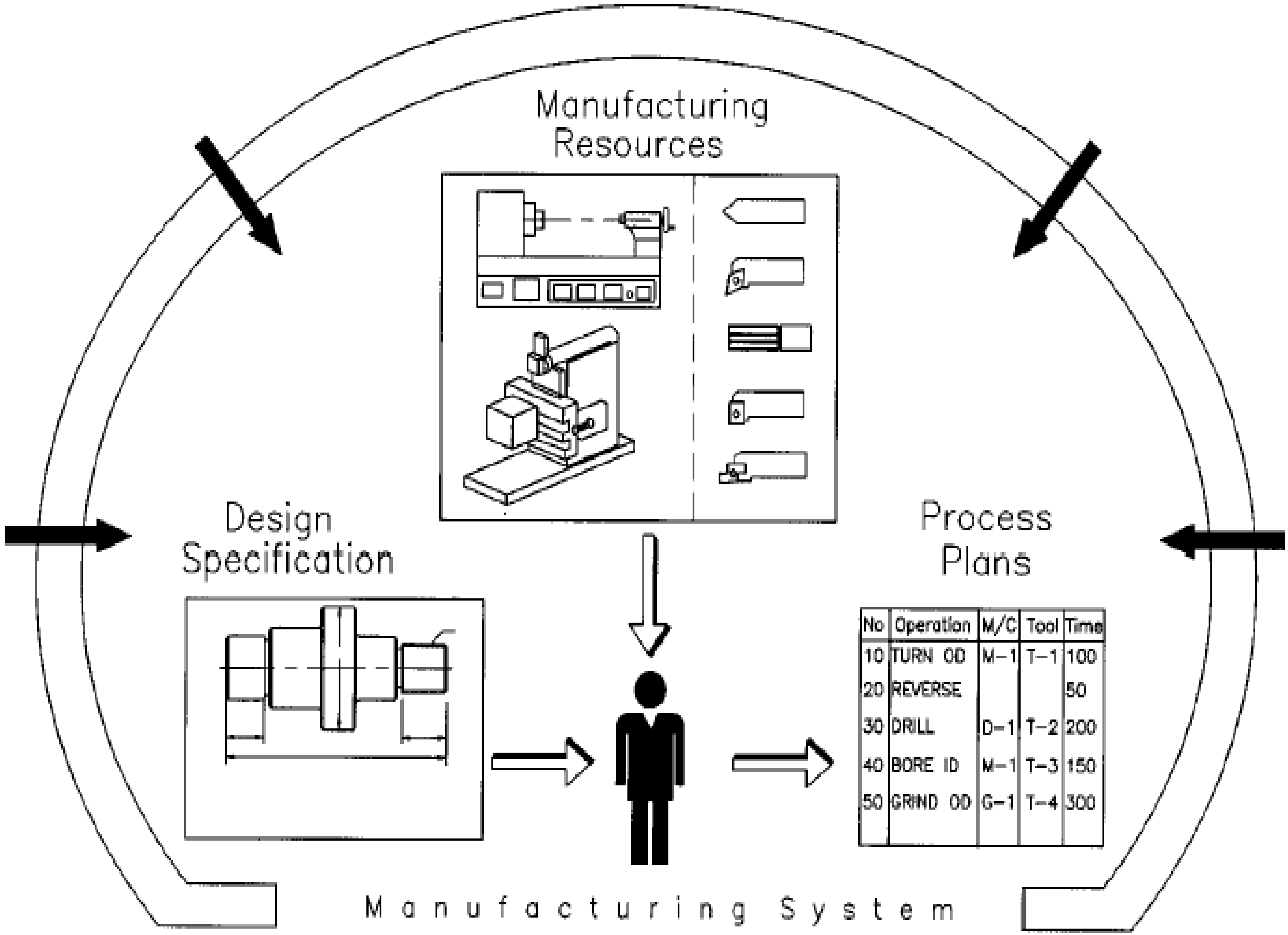
Initial Form



Defining Process planning

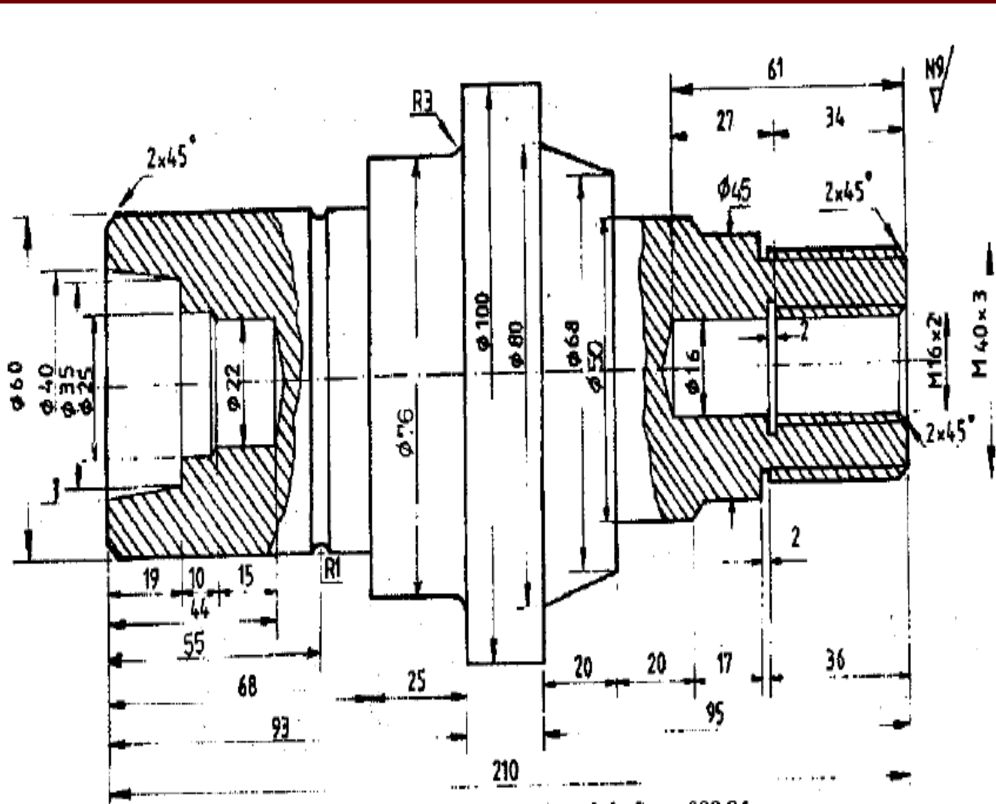
- In general, the inputs to process planning are
  - design data,
  - raw material data,
  - facilities data (machining data, tooling data, fixture data, etc.),
  - quality requirements data, and
  - production type data.

- The output of process planning is the process plan.
  - The process plan is often documented into a specific format and called
    - process plan sheet,
    - process sheet,
    - operation sheet,
    - planning sheet,
    - route sheet,
    - route plan, or
    - part program.


Manufacturing Resources
Design Specification
Process Plans
No
Operation
M/C
Tool
Time
10 TURN OD M-1 T-1 100
20 REVERSE 50
30 DRILL D-1 T-2 200
40 BORE ID M-1 T-3 150
50 GRIND OD G-1 T-4 300
Manufacturing System

Defining Process planning

- **A process plan is an important document for production management. The process plan can be used for**
  - ➢ Management of production,
  - ➢ Assurance of product quality,
  - ➢ Optimization of production sequencing, and
  - ➢ Determination of equipment layout on the shop floor.



PROCESS SHEET

SHEET NAME	:SHEET2	**MATERIAL**	:STEEL 1045
PART NAME	:SHAFT	**PART NO.**	:002.94
BATCH SIZE	:1	**MACHINE**	:MASTER 2500/NO.4
BLANK SIZE	:110x218 mm	**BLANK**	:ROLLED
BHN	:210		

NO.	OPERATION	LENGTH mm	DIAMETER mm	PASSES	DEPTH mm	FEED mm /r	SPEED rpm	TIME min	POWER KW	TOOL
1	Face	55	110	2	2.000	0.32	72	4.86	0.511	16
2	R. Turn	115	100.8	2	2.300	0.32	72	10.60	0.588	1
3	R. Turn	93	76.8	4	3.000	0.32	98	12.56	1.534	2
4	R. Turn	68	60.8	4	2.000	0.32	130	6.94	1.023	1
5	F. Turn	22	100	1	0.400	0.16	98	1.57	0.023	1
6	F. Turn	25	76	1	0.400	0.16	130	1.33	0.023	2
7	F. Turn	68	60	1	0.400	0.16	130	3.45	0.023	1
8	Groove	2	60	1	1.000	0.25	54	0.30	0.035	6
9	Chamfer	2	60	1	2.000	0.25	54	0.30	0.071	9
10	Drill	44	21.5	1	n/a	0.40	320	0.36	n/a	13
11	R. Bore	19	34.2	5	1.270	0.20	175	2.89	0.322	17
12	R. Bore	10	24.2	1	1.350	0.20	235	0.28	0.069	17
13	Taper	19	40 7.5	1	2.900	0.32	235	0.29	0.371	33
14	F. Bore	10	25	1	0.250	0.08	235	0.70	0.005	17
15	F. Bore	15	22	1	0.250	0.08	235	0.97	0.005	17
16	Rechuck	-	-	-	-	-	-	1.00	-	0
17	Face	55	110	2	2.000	0.32	72	4.86	0.511	16
18	R. Turn	95	80.8	4	3.650	0.32	98	12.83	1.866	1
19	R. Turn	75	50.8	4	3.750	0.32	175	5.68	1.918	1
20	R. Turn	55	45.8	1	2.500	0.32	175	1.07	0.320	2
21	R. Turn	38	40.8	1	2.500	0.32	235	0.56	0.320	1
22	Taper	20	68 16.7	2	3.200	0.32	130	1.05	0.818	32
23	F. Turn	20	50	1	0.400	0.16	175	0.80	0.023	1
24	F. Turn	17	45	1	0.400	0.16	175	0.69	0.023	2
25	F. Turn	38	40	1	0.400	0.16	235	1.09	0.023	1
26	Groove	2	40	1	2.000	0.25	72	0.23	0.071	5
27	Thread	36	40	5	0.520	3.00	72	1.26	1.102	13
28	Chamfer	2	40	1	2.000	0.25	72	0.23	0.071	9
29	Drill	61	15.75	1	n/a	0.40	425	0.37	n/a	0
30	F. Bore	61	16	1	0.120	0.08	425	1.91	0.002	17
31	Groove	2	20	1	2.000	0.25	130	0.13	0.071	21
32	Thread	34	16	2	0.870	2.00	175	0.26	0.492	29
33	Chamfer	2	16	1	2.000	0.25	175	0.09	0.071	25

FIRST CLAMPING :clamped diameter =110mm and extended length = 124 mm
SECOND CLAMPING: clamped diameter =100mm and extended length = 104 mm

Total machining time	= 79.18 mim
Total approach time	= 2.36 mim
Total tool changing time	= 42 mim
Non-productive time	= 4 mim
Setup time	= 25 mim
Total production time	= 152.53 mim

ALL OPERATIONS ARE SUPPORTED IN 3-JAW CHUCK

Defining Process planning

- Recent research results have also demonstrated that process planning plays an important role in Computer Integrated Manufacturing – CIM

Process planning is the key link for integrating design and manufacturing

- **the process plan provides necessary information for technical and equipment preparation, such as:**
  - tools,
  - jigs and fixtures,
  - machines,
  - inspection devices,
  - raw material stocks,
  - inventory plans,
  - purchasing plans,
  - personal requirements,
  - etc.

Defining Computer Aided Process planning - CAPP

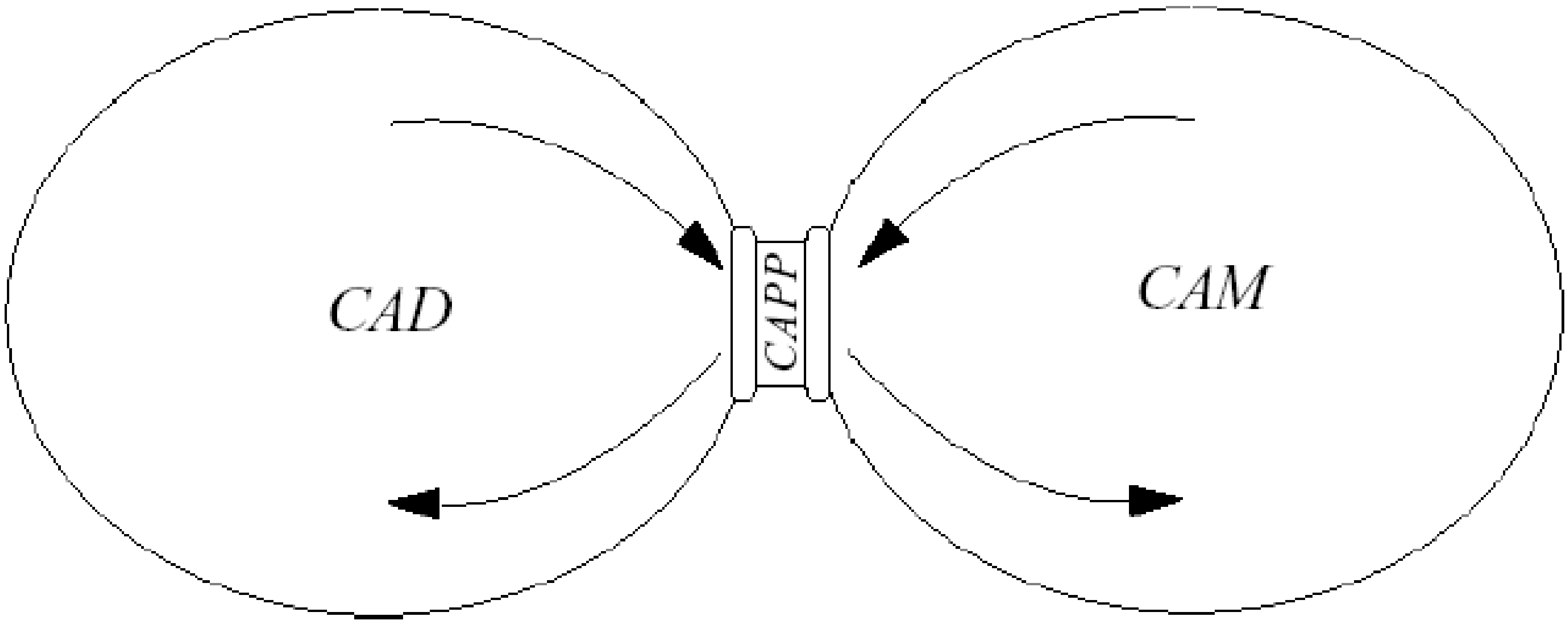
- Computer Aided Process Planning (CAPP) can be defined as the functions which use computers to assist the work of process planners.
- The levels of assistance depend on the different strategies employed to implement the system.

    - **Lower level strategies** only use computers for storage and retrieval of the data for the process plans which will be constructed manually by process planners, as well as for supplying the data which will be used in the planner's new work.

    - **Higher level strategies** use computers to automatically generate process plans for some workpieces of simple geometrical shapes.

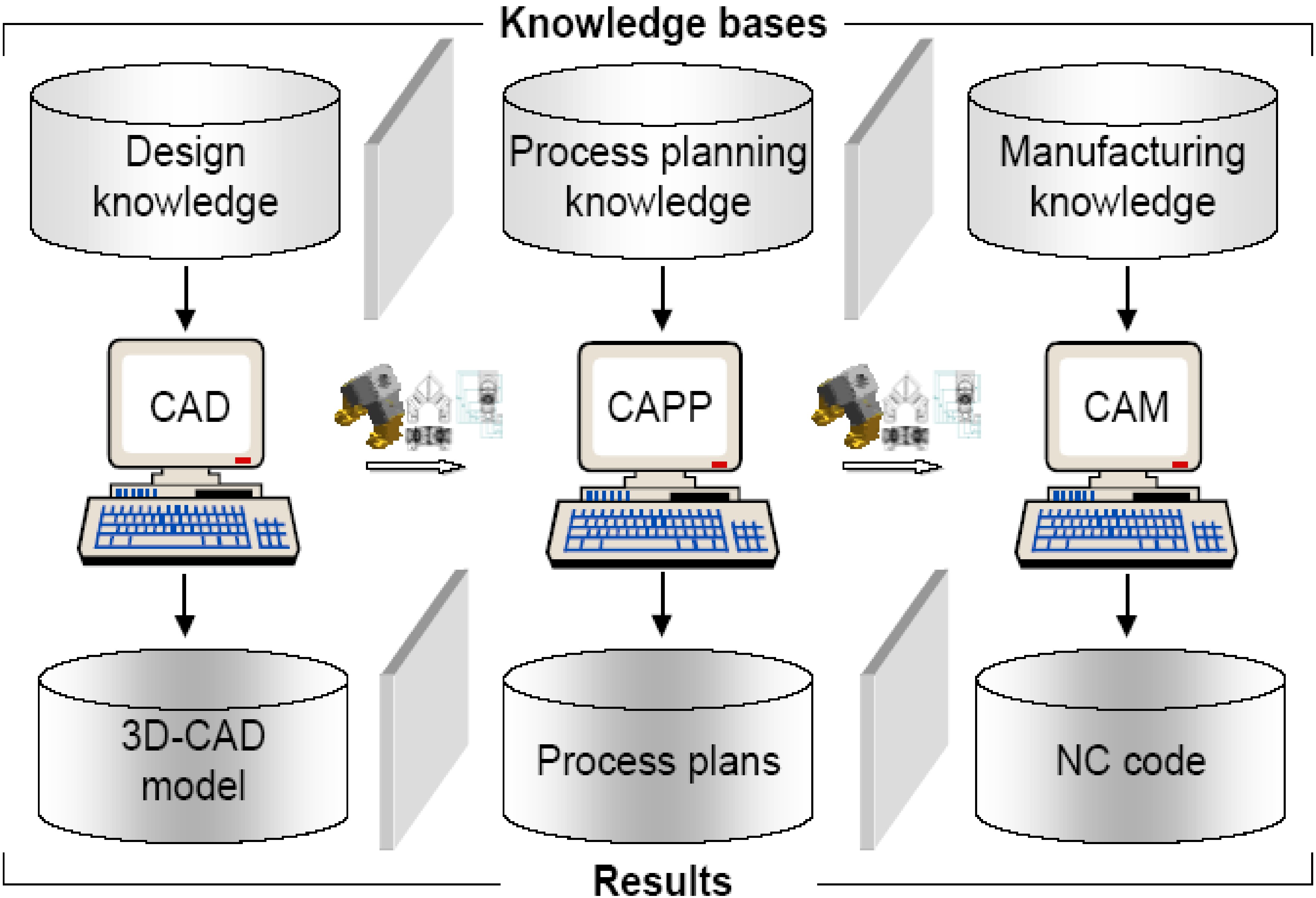
Defining Computer Aided Process planning - CAPP

CAPP a key factor in CAD/CAM integration because it is the link between CAD and CAM.



CAPP bottleneck between CAD and CAM.

Defining Computer Aided Process planning - CAPP



Benefits of CAPP

1. Reduction in process planning time.
2. Reduction in the required skill of the process planner.
3. Reduction in costs due to efficient use of resources.
4. Increased productivity.
5. Production of accurate and consistent plans.

Approaches of CAPP

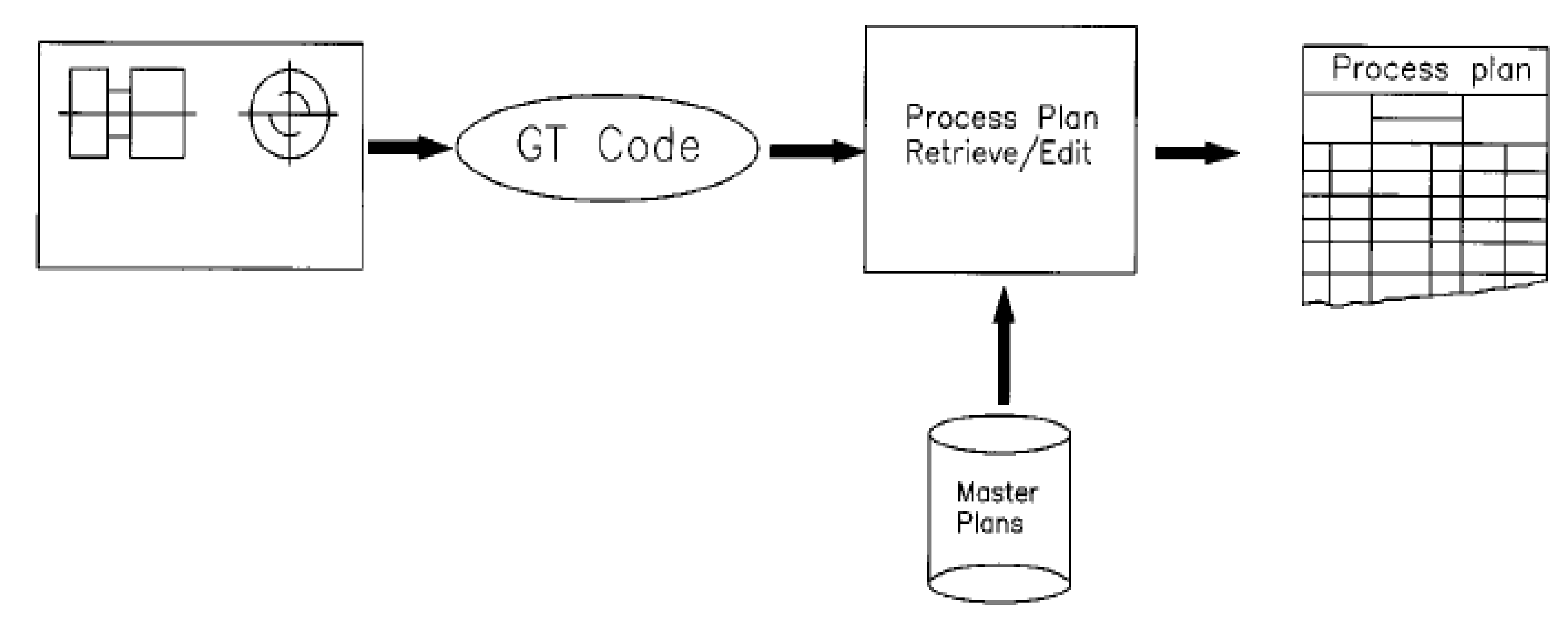
In general, three approaches to CAPP are traditionally recognized:

- the variant approach,
- the generative approach, and
- the hybrid (semi-generative) approach

The Variant approach of CAPP

- The variant approach, which is also called retrieval approach, uses a group technology (GT) code to select a generic process plan from the existing master process plans developed for each part family and then edits to suit the requirement of the part.

- Variant approach is commonly implemented with GT coding system. Here, the parts are segmented into groups based on similarity and each group has a master plan.



Advantages of Variant approach of CAPP

1. Once a standard plan has been written, a variety of components can be planned.
2. Programming and installation are comparatively simple.
3. The system is understandable, and the planner has control of the final plan.
4. It is easy to learn and easy to use.

Disadvantages of Variant approach of CAPP

1. The components to be planned are limited to previously planned similar components.

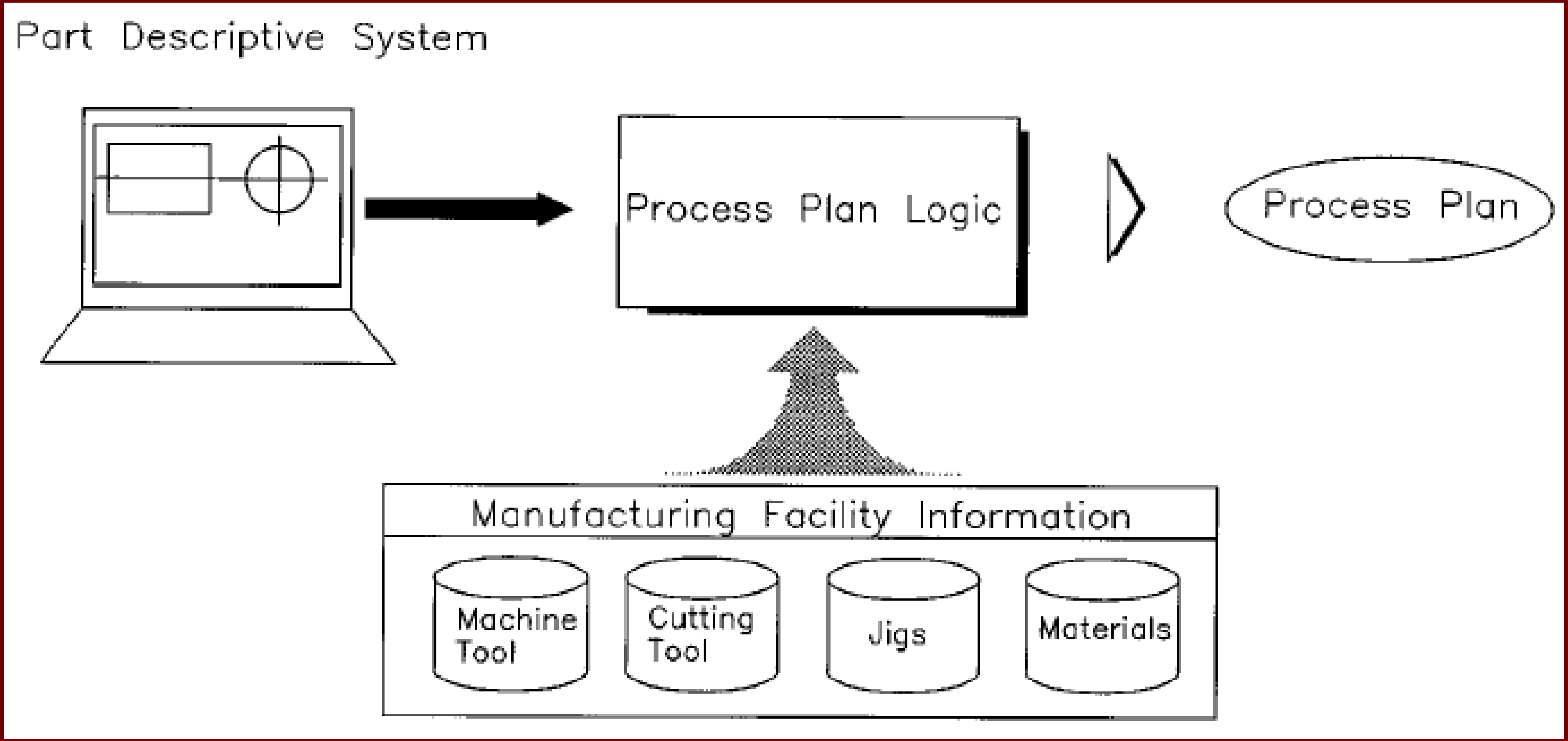
2. Experienced process planners are still required to modify the standard plan for the specific component.

3. Details of the plan cannot be generated.

4. Variant planning cannot be used in an entirely automated manufacturing system, without additional process planning.

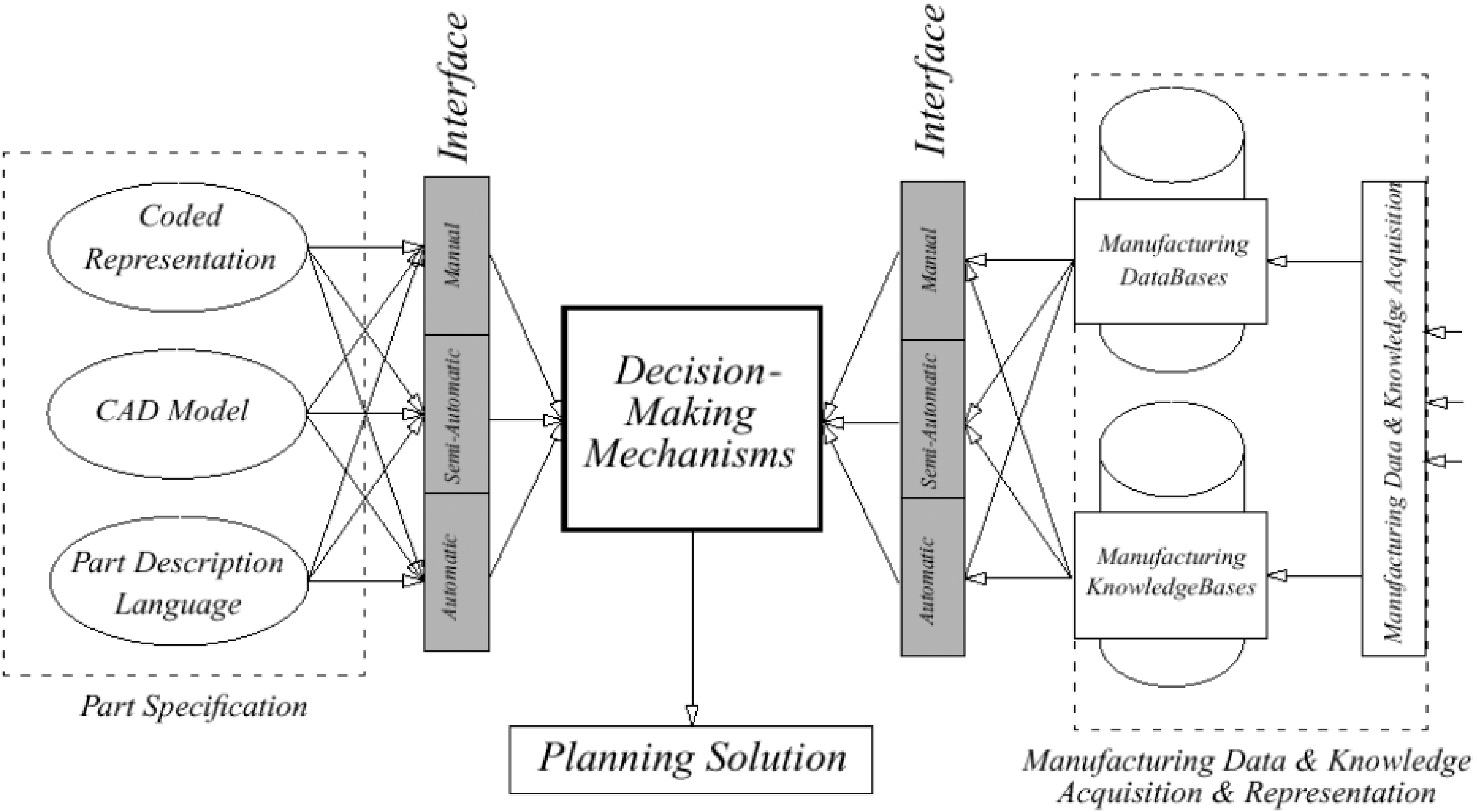
The Generative approach of CAPP

- In a generative approach, a process plan for each component is created from scratch without human intervention. These systems are designed to automatically synthesize process information to develop a process plan for a part



The Generative approach of CAPP

- Generative CAPP systems contain the logic to use *manufacturing data bases*, *knowledge bases* and suitable *part description* schemes to generate a process plan for a particular part.



Advantages of Generative approach of CAPP

1. Consistent process plans can be generated rapidly.
2. New components can be planned as easily as existing components.
3. It has potential for integrating with an automated manufacturing facility to provide detailed control information.

The Hybrid (Semi-Generative) approach of CAPP

- **A hybrid planner, for example, might use a variant, GT-based approach to retrieve an existing process plan, and generative techniques for modifying this plan to suit the new part**

Main Steps of CAPP Systems

- Identification of part specifications.
- Selection of blanks or stock.
- Selection of machining operations.
- Selection of machine tools.
- Selection of cutting tools.
- Calculation of cutting parameters.
- Generation of setup plans.
- Selection of work holding devices (fixtures).
- Calculation of times and costs.
- Generation of process plans