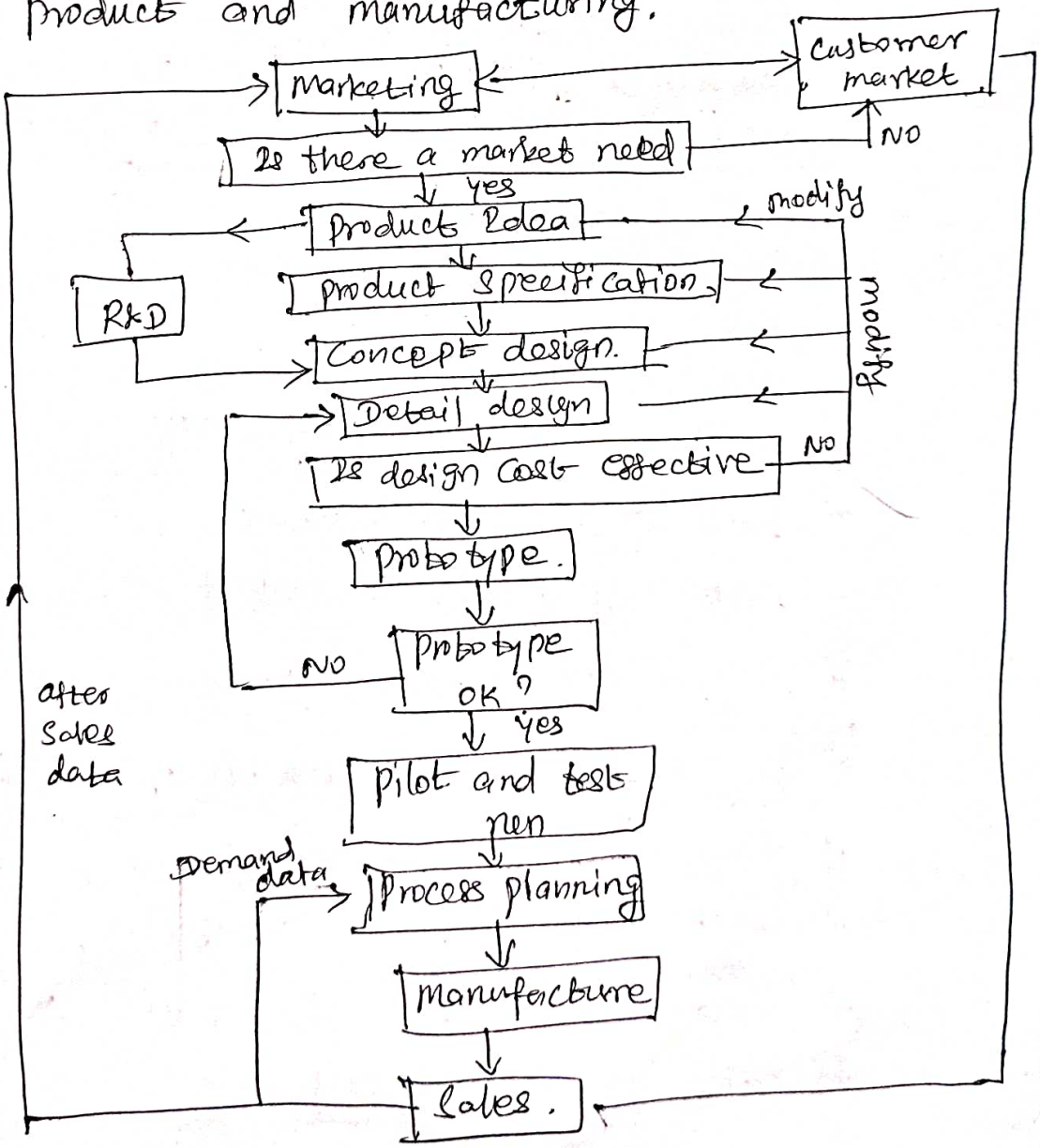
UNIT-I . PROCESS PLANNING (Introduction)

Process planning :

Process planning is the systematic determination of the engineering processes and systems to manufacture a product competitively and economically.

Process planning [Design/manufacture interface]

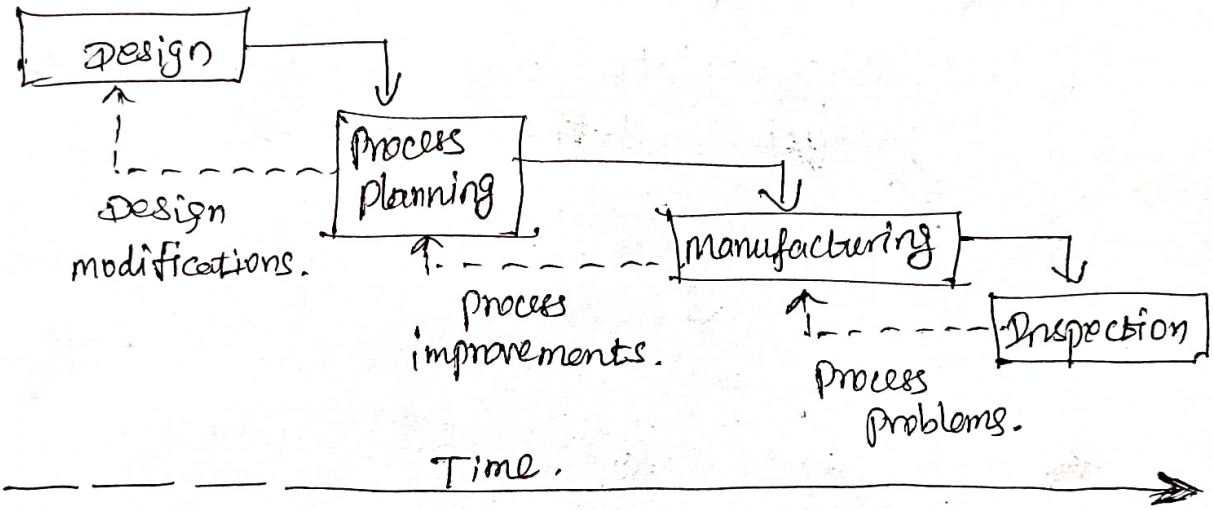
* Intermediate stage between designing the product and manufacturing.



Three main functions (product design) manufacture).

* Marketing and Sales functions.
* Design functions.
* Manufacturing functions.

Process planning (Link b/w Design and Manufacturing).



Process planning Engineer (Responsibilities)

* Part analysis and symbols
* Gathering details of product design..
* Selects the suitable machining process
* Select the suitable machining and tooling.
* Sequencing the operations.
* Meet the desired quantity.
* Determine the product tolerance.
* Calculate the overall times.

Process planning Activities :

Step 1: Drawing interpretation.

Step 2: material evaluation and process selection.

Step 3: Selection of machines, Tooling, work holding devices.

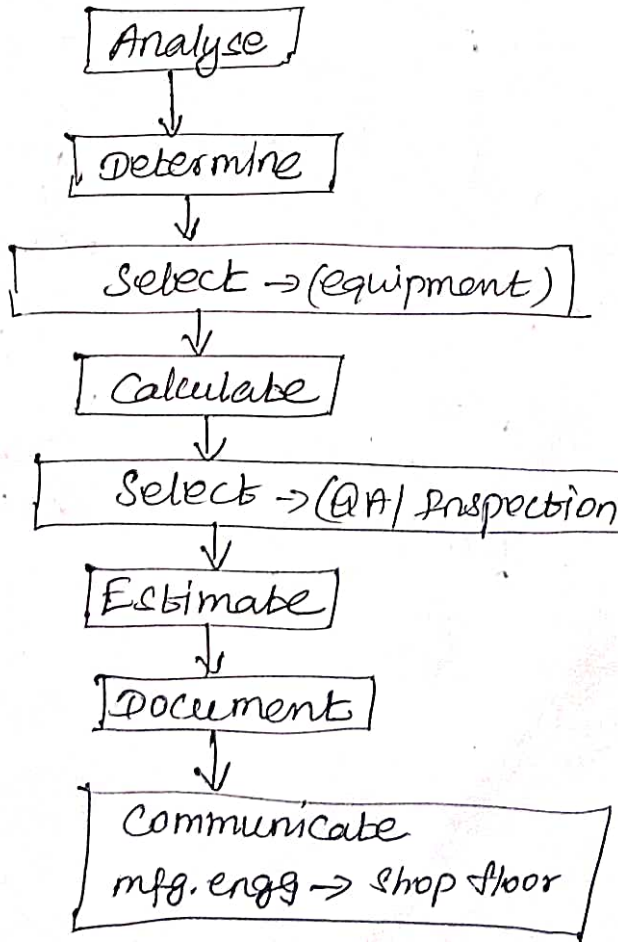
Step 4: Setting process parameters.

Step 5: Selection of quantity assurance methods.

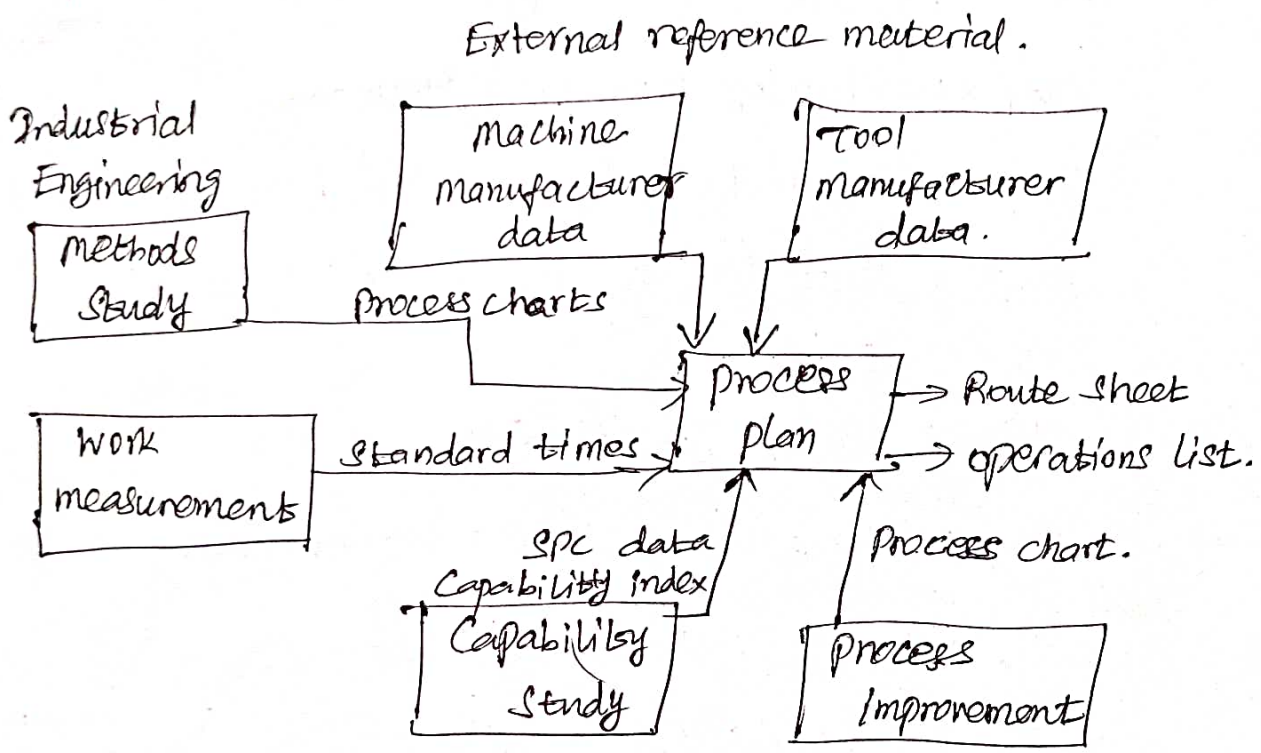
Step 6 : Cost Estimating.

Step 7 : preparing the process planning documentation.

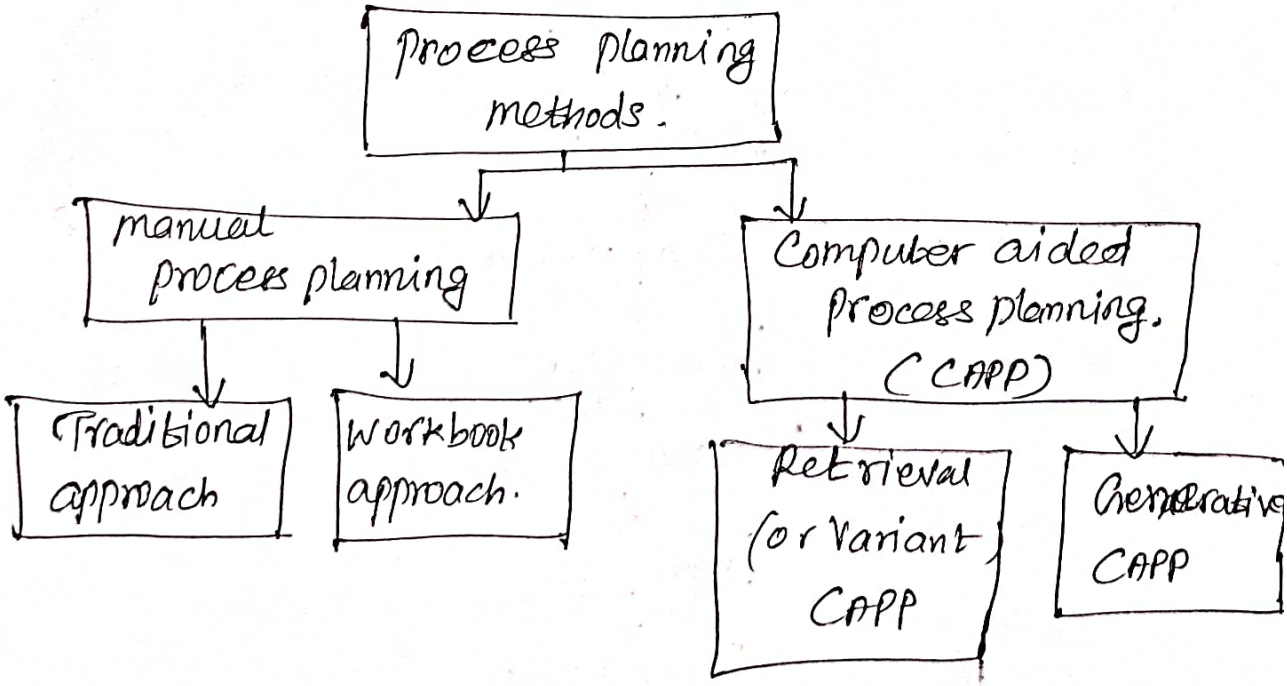
Step 8 : Communicating the manufacturing knowledge to the shop floor.



Input, output of process planning.



Process planning methods:



Manual Process planning : (Traditional Approach)

* process plan prepared manually.

* Task involves,
  - interpreting engineering drawing
  - machining process selection
  - equipment selection.
  - operation sequence.

Stage 1 : process planner interprets the component/product drawing.

Stage 2 : Referes manuals to decide tools, feeds, speeds.

Step 3 : Resulting process documented as routing sheet.

Manual process planning : (Work book approach).

* modified version of traditional approach.

* Developed workbook for preparing route sheet.

* possible works of predetermined sequence developed as work book.

* Suitable predetermined sequence of operations selected from developed workbook.

* details are documented in the route sheet.

COMPUTER AIDED PROCESS PLANNING : (CAPP)

* Drawbacks overcomed in CAPP than Manual PP.

Benifits of CAPP:

1. Process rationalization and Standardization.
2. Productivity improvement.
3. Product cost reduction.
4. Elimination of human error.
5. Reduction time.
6. Reduced clerical work and paper work.
7. Improved legibility.
8. faster response to engineering changes.
9. Incorporation of other application programs.

Approaches of CAPP:

1. Retrieval CAPP System (or) Variant CAPP System.
2. Crenerative CAPP System.

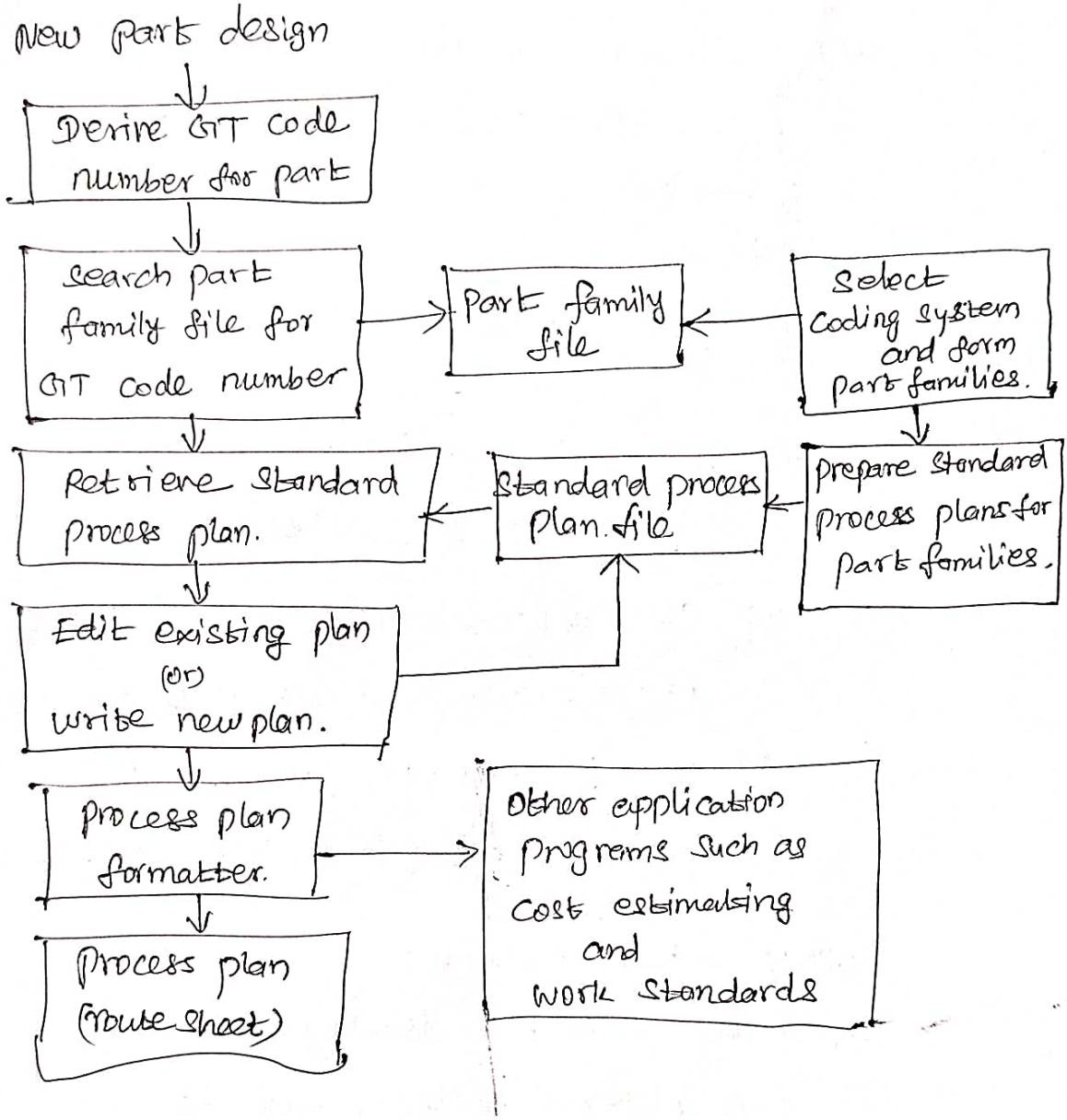
Retrieval CAPP System;

* Widely used in machining applications.

→ Basic concept : Similar parts will have similar plans.

→ process plan retrieving existing plan for similar part.

General procedure for CAPP (Retrieval)



Generative CAPP Systems :

* Generate each individual process plan automatically and without reference to any prior plan. System utilizes the computer.

* process plan based on the decision logics and precoded algorithms.

Components of generative CAPP system:

1) Part description.
2) A subsystem to define the machining parameters.
3) A subsystem to select and sequence individual operations.
4) data base.
5) A report generator.

Selection of process planning system:

major factors to be considered:

(i) General environment
(ii) organisational structure of company.
(iii) Technical expertise available to the company.
(iv) Needs and objects of the company.

Drawing Interpretation:

Information from the drawings:

→ Material of the component.
→ Number of parts to be produced.
→ weight of the component.
→ Dimensions of the parts.
→ tolerances,
→ size and accuracy of parts.

Types of Drawing:

1. Detail Drawings.

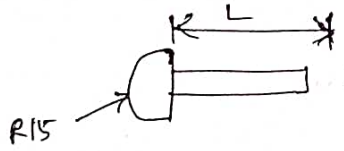
(i) Single part drawing.

* This contains complete detailed information to enable a single component to be manufactured without reference to other sources.

(ii) Collective single part drawings:

* One (or) two dimensions of a component are variable, all others being standard.

Ex: 20 rivets similar in every respect except length.



* length only varied.

2. Assembly Drawings:

* Machines and mechanisms consists of numerous parts.
* Drawing shows the complete product with all its components in their correct physical relationship.

(i) Single part Assembly drawings:

* It consists the information to build a single sub assembly (or) assembly.

(ii) Collective Assembly Drawings:

* Range of products which are similar in appearance but differing in size manufactured and assembled.

Ex: Nut is standard,
but bolt is different length.

3. Combined detail Assembly Drawings:

* It shows the assembly with part list and the details of these parts on one drawing.

Critical processing factors: (Information on the drawing sheet)

→ Geometric and dimensions.
→ Material specifications.
→ Notes on special material Treatments.
→ Dimensional tolerances.
→ Surface finish specifications.
→ Tool references.
→ Gauge references.
→ Quantity to be produced.
→ Part lists.
→ Notes on equivalent parts.
→ Notes on screw thread forms.

Tolerances, Limits and Fits:

→ To ensure that assembly will function properly, it's component must fit together in a predictable manner,

→ practically, no component can be produced to an exact size, so need upper and lower tolerance.

Dimension Tolerances:

In millimeters, as 10 ± 0.02,
the part will be in the size $9.98_{mm} - 10.02$ mm is acceptable.

General Tolerancing:

* apply to all unspecified dimensions on a drawing.

Example: Tolerance except where, otherwise stated ± 0.5

Limits and Fits for Shafts and Holes;

Basic size and shaft/hole tolerancing systems.

* Basic size (or) Nominal size is the size of the shaft/hole that the design specifies before applying the limits to it.

1) Basic hole System:

Starts with Basic hole size and adjust the shaft size to fit.

2) Basic shaft System:

Starts with Basic shaft size and adjust the hole size to fit.

- Basic hole system tends to be preferred and therefore they are commonly used.

bcz,

Holes are usually made with standard tools, such as drills, reamers.

Fit:

* It represents the tightness (or) looseness resulting from the application of tolerances to mating parts. (ie) shaft and holes.

:1)

1. clearance fit: Assemble / diassemble by hand.

- Create running and sliding assemblies

2. Transition fit:

Assembly usually requires press tooling (or) mechanical assistance.

- Creates close accuracy.

3. Interference fit: parts need to be forced (or) shrunk fitted together.

- Creates permanent assemblies.

Geometrical Tolerancing:

(i) Straightness tolerances.
(ii) Flatness tolerances.
(iii) Roundness tolerances.
(iv) cylindricity tolerances.
(v) Parallelism tolerances.
(vi) Squareness tolerances.
(vii) Angularity tolerances.
(viii) Concentricity tolerances.
(ix) Symmetry tolerances.
(x) position tolerances.

Surface finish:

1. Form error
2. Roughness
3. waviness

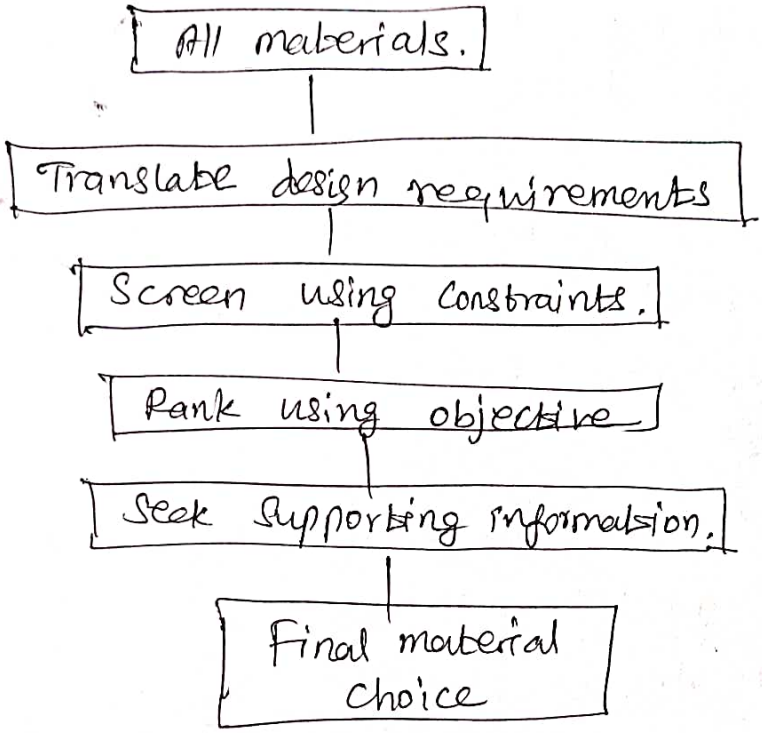
MATERIAL SELECTION AND EVALUTION:

Material selection for a product is the responsibility of design engineers.

Properties of Engineering materials:

1. Physical properties.
2. Chemical properties.
3. Mechanical properties.
4. Electrical properties.
5. Thermal properties ... etc.

MATERIAL SELECTION PROCESS :



Steps Involved in material Selection process :

1. Translation.
2. Screening
3. Ranking.
4. Seeking support information.

Material Selection methods :

1. Selection with computer aided databases.
2. performance indices.
3. Decision matrices.
4. Selection with expert systems.
5. Value analysis.
6. Failure analysis.
7. cost-benefit analysis.

Material Evaluation method:

1. Shape or geometry considerations.
2. material property requirements.
3. Manufacturing considerations.

Shape or Geometry considerations:

* Relative size of the components.
* Complexity of the shape.
* Surface finish requirements.
* Design for assembly.
* Design for manufacturability.
* Dimensional tolerance requirements.

Manufacturing Considerations:

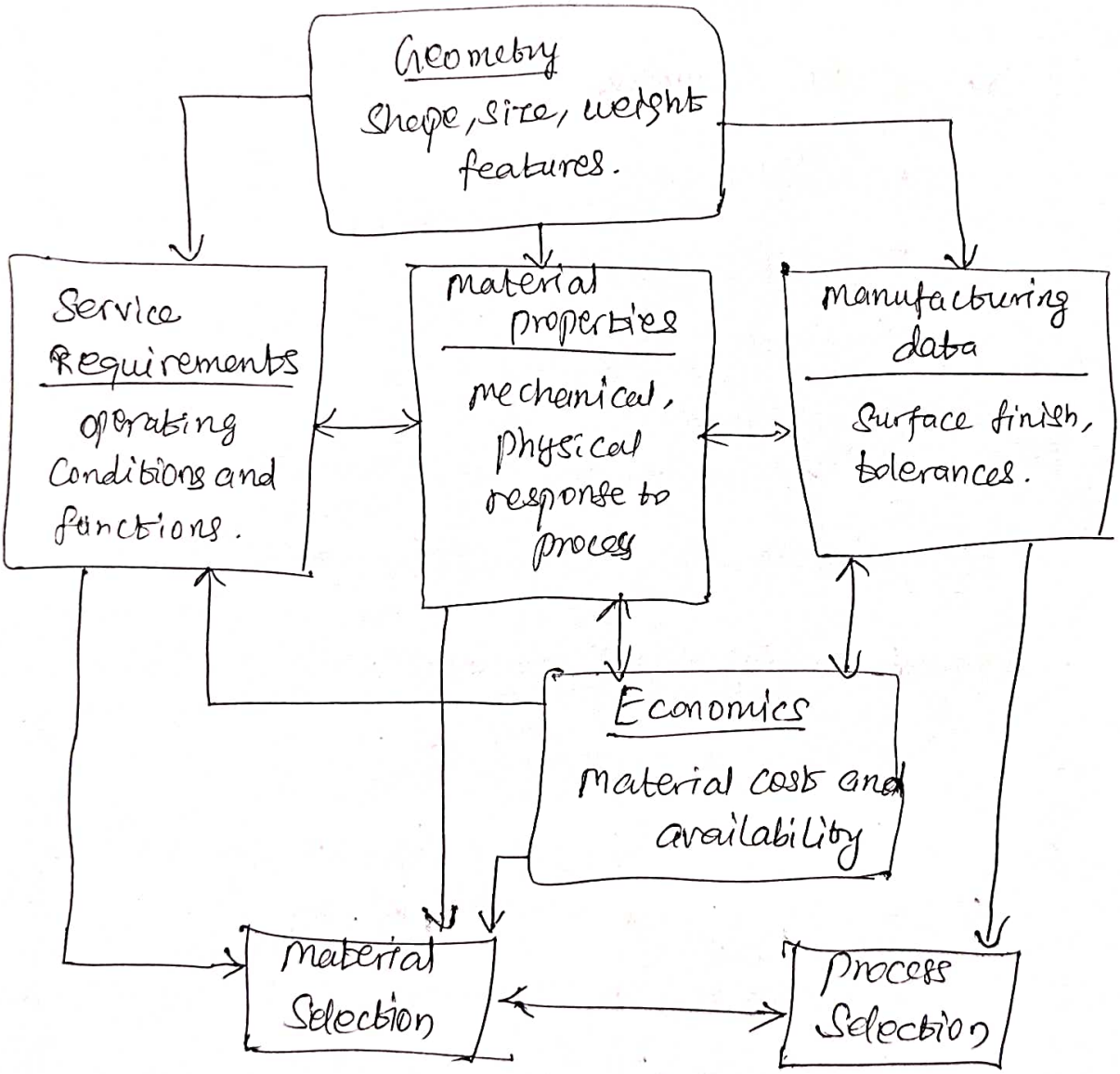
* use of standard components.
* Ease of manufacture of the design.
* Desired level of quality.
* minimum and maximum section thickness.
* Ease of assembly of the design.

PROCESS SELECTION:

Factors in process selection:

* Material form.
* Component size and weight.
* Economic considerations.

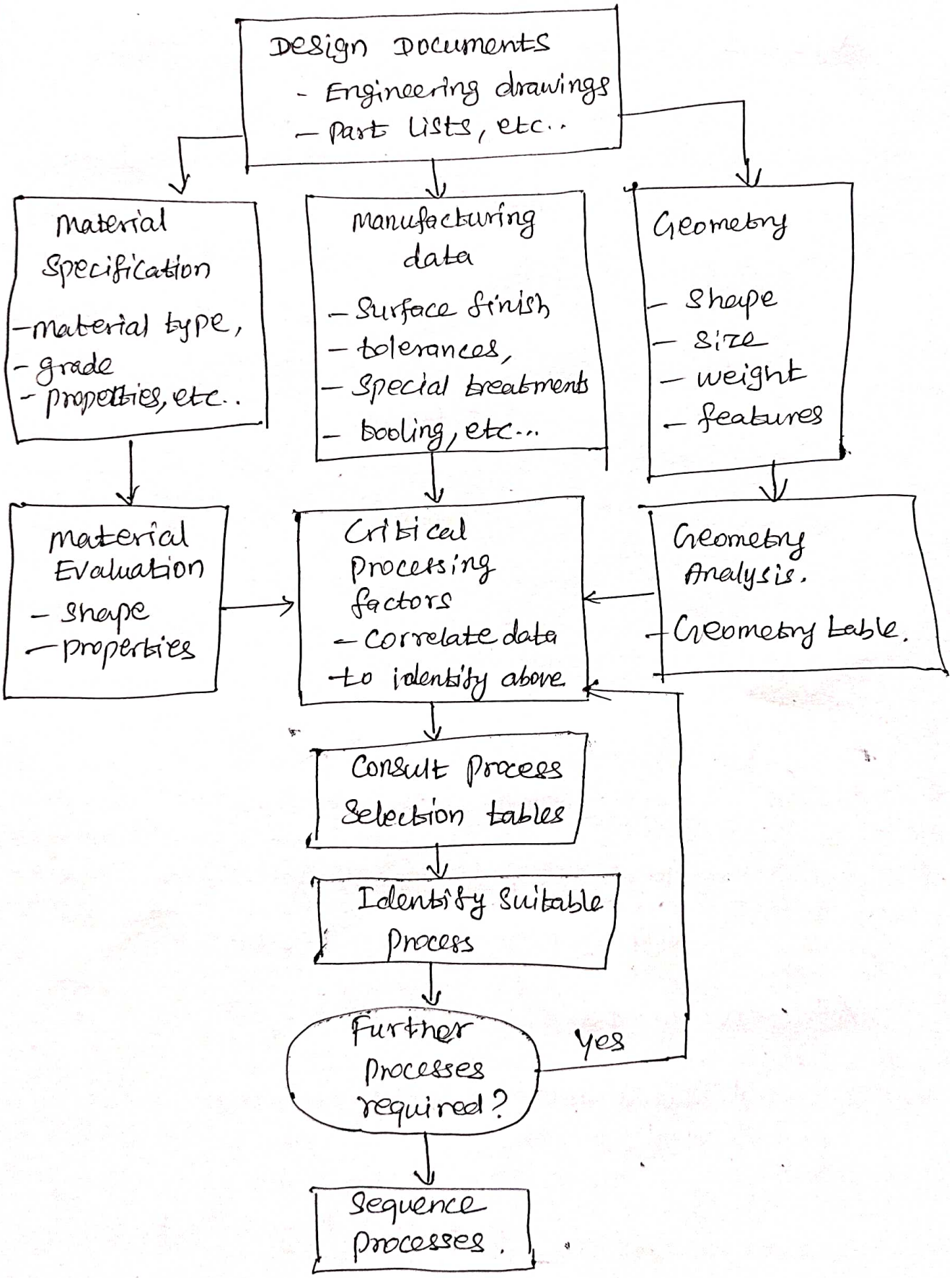
* Dimensional and geometric accuracy.
* Surface finish specification.
* Batch size.
* Production rate.



Stages of process selection:

Stage 1: Drawing Interpretation.
Stage 2: Identification of critical processing factors.
Stage 3: Comparison of potential manufacturing process.
Stage 4: Identification of suitable processes.

Process Selection method (flow chart).



PRODUCT EQUIPMENT AND TOOLING SELECTION:

⊛ Factors Consider for Equipment Selection:

1. Technical factors.
   - (a) physical size of the workpiece.
   - (b) Machine accuracy.
   - (c) Surface finish.
   - (d) Cutting forces.
   - (e) power of the machine.
2. operational factors.
   - (a) Batch size.
   - (b) Capacity
   - (c) Availability.

Stages of Machine Selection:

Step 1 : First cut selection.

Step 2 : power / force analysis.

Step 3 : Capability analysis.

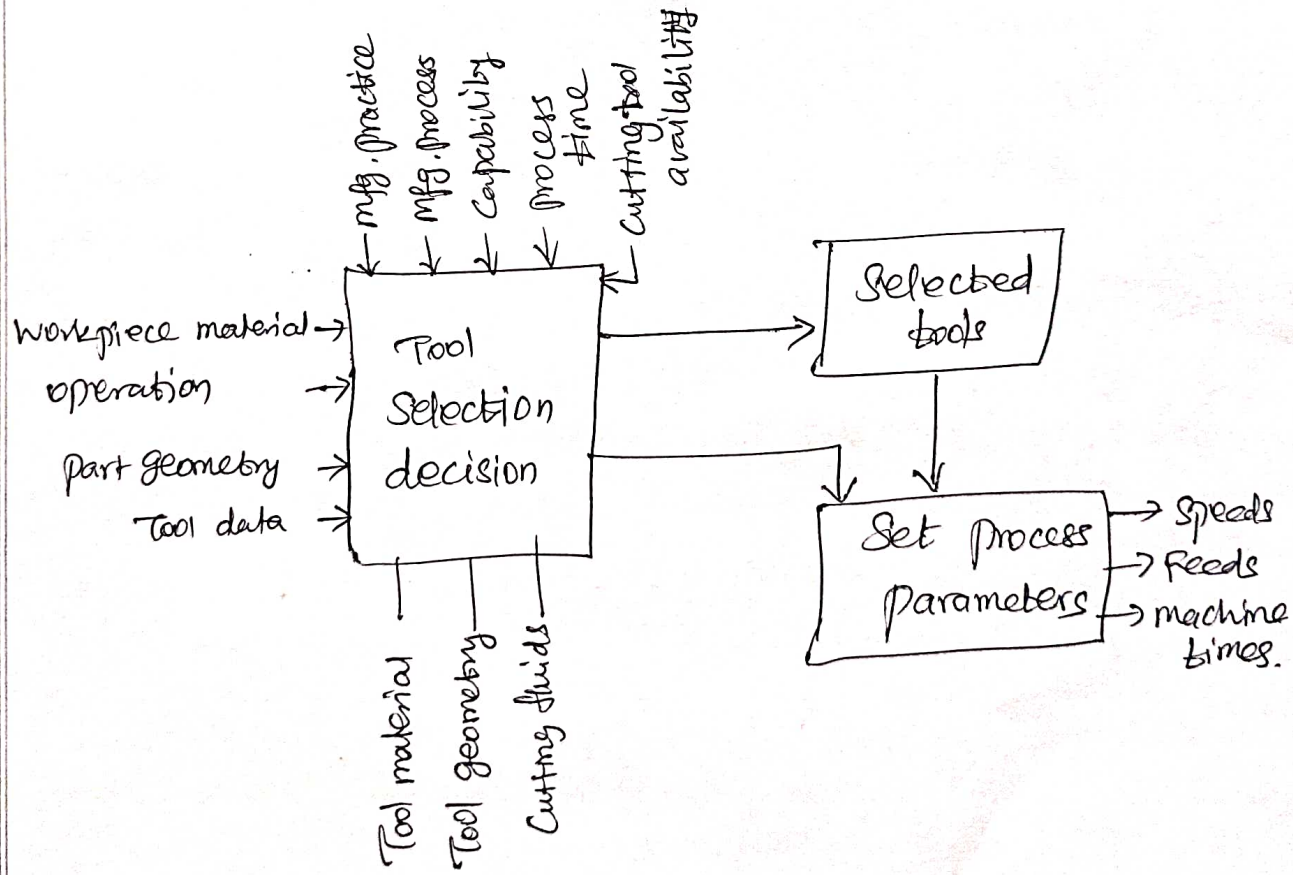
Step 4: operational analysis.

⊛ Factors In tooling Selection:

1. Constraints on tooling selection;
   - (a) Manufacturing practice.
   - (b) Manufacturing process.
   - (c) Machine tool characteristics
   - (d) Capability.
   - (e) processing time.
   - (f) Cutting tool availability.

2. operating requirements for tool selection
   (a) Work piece material.
   (b) operation.
   (c) Part geometry.
   (d) Tooling data.

3. Factors affecting tooling performance,
   (a) Cutting tool material.
   (b) Cutting tool geometry.
   (c) Cutting fluids.



(Factors in tooling selection)

Factors affecting Tooling Performance:

1. Cutting tool materials.
2. Cutting tool geometry.
3. use of cutting fluids.

Stages of Tool Selection Process;

Stage 1: Evaluation of process and machine selections.

Stage 2: Analysis of machine operations.

Stage 3: Analysis of workpiece characteristics.

Stage 4: Tooling Analysis.

Stage 5: Selection of tooling.