

ME5005/ME4002 DESIGN FOR MANUFACTURE/ PRODUCTION ENGINEERING

Dr. Bill Wright
bill.wright@ucc.ie
Room 2.14 Tel: 490 2213

Lecture 1: Course outline

Design for Manufacture: Lecture 1

1

Teaching Period 1

Materials, processing, and design for manufacture

Objectives:

- To review production processes; to select appropriate manufacturing techniques; to design and optimise components for manufacturing processes

Design for Manufacture: Lecture 1

2

Recommended Texts

- **Recommended texts:**
 - M. P. Groover, "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", Q+2, 670.4_GROO
 - J. G. Bralla, "Design For Manufacturability Handbook", Q+2, 670.4_BRAL
 - N. G. McCrum, C. P. Buckley and C. B. Bucknall, "Principles of Polymer Engineering", Q+2, 620.19_MCCR
 - D. R. Askeland, "The Science and Engineering of Materials", Q+2, 620.11_ASKE
 - A. Ghosh and M. K. Malik, "Manufacturing Science", Q+2, 670.4_GHOS

Design for Manufacture: Lecture 1

3

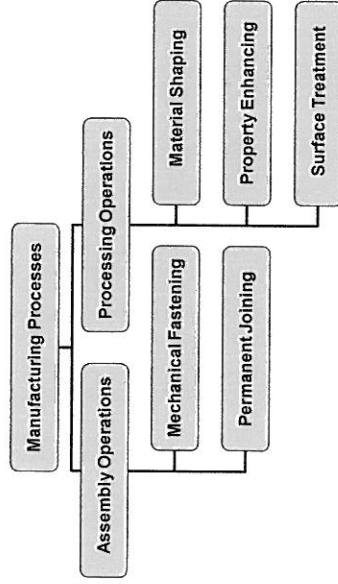
Topics covered

- Brief review of materials and properties
- Metal and polymer processing
- Design for:
 - casting
 - forging
 - rolling
 - extrusion
 - injection moulding
 - sheet metal working
 - heat treatment
 - advanced techniques

Design for Manufacture: Lecture 1

4

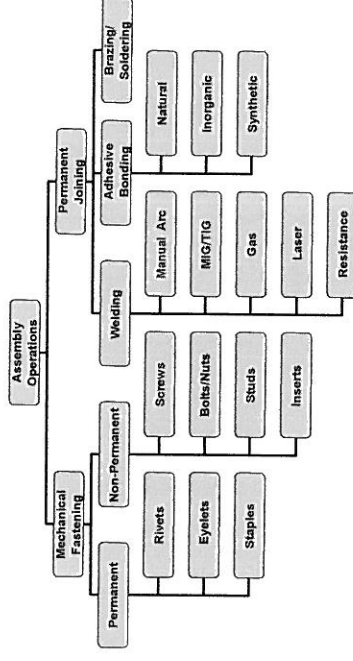
Classification of processes



Design for Manufacture: Lecture 1

5

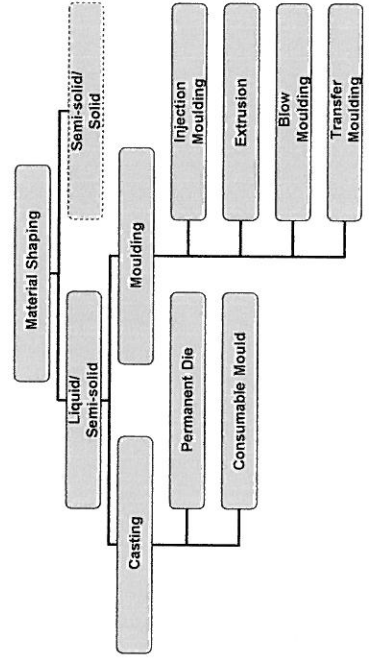
Assembly



Design for Manufacture: Lecture 1

6

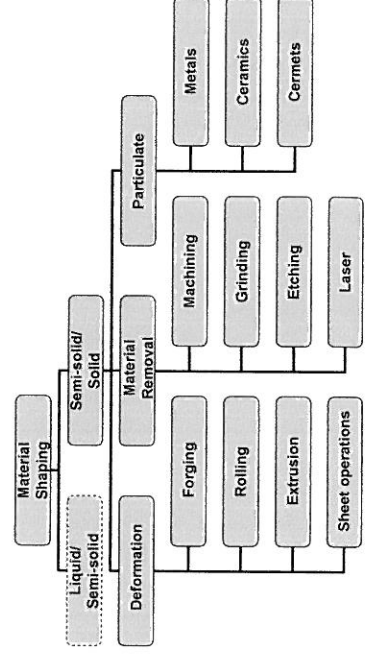
Liquid/Semi-Solid Shaping



Design for Manufacture: Lecture 1

7

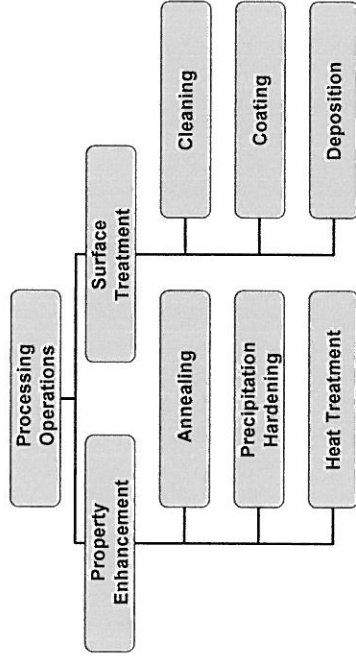
Semi-Solid/Solid Shaping



Design for Manufacture: Lecture 1

8

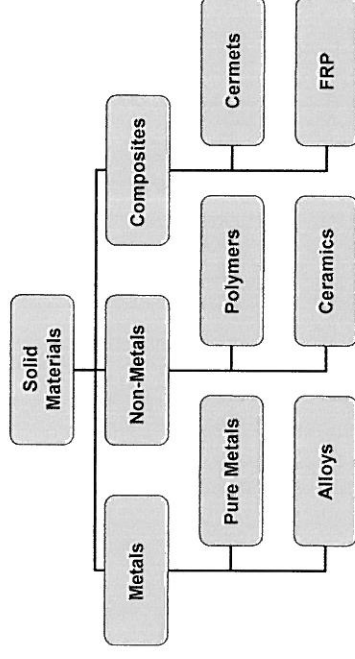
Property Enhancement



Design for Manufacture: Lecture 1

9

Materials Classification



Design for Manufacture: Lecture 1

10

Choice of Process

- The same component may be manufactured by a number of different processes
- Dictated by material, geometry and physical properties of final component
- Production volume (number required) may also determine the process used
- Large scale manufacturing equipment is expensive (M€)
- Capital costs must be recouped in the component's lifetime

Design for Manufacture: Lecture 1

11

Low-Quantity Production

- 1 to 100 units/year
 - Prototypes
 - Specialised/Customized components
 - e.g.: satellites, test aircraft, tunnelling machines
- General purpose/multi-use equipment
- Highly skilled workforce
- Expensive
- Inefficient/wasteful processes

Design for Manufacture: Lecture 1

12

Medium-Quantity Production

- 100 to 10,000 units/year
- Semi-specific equipment, skilled workforce
 - May be adapted to other uses/products
- Batch production
 - Make one batch of a single component
 - Change tooling/modify equipment
- Cellular manufacturing
 - Equipment makes similar component range

Design for Manufacture: Lecture 1

13

High-Quantity production

- 10,000 to >1,000,000 units/year
- Mass production of a single component
 - Components for cars, household appliances, mobile phones, etc.
- Expensive dedicated equipment or tooling
- Semi-skilled workforce
- Product changes require substantial additional investment

Design for Manufacture: Lecture 1

14

Design for Manufacture

- Design/re-design/modify components for a specific manufacturing process
 - 1) Shorter time to bring product to market
 - 2) Smoother transition into production
 - 3) Fewer components in final product
 - 4) Easier assembly
 - 5) Lower production costs
 - 6) Higher product quality
 - 7) Greater customer satisfaction

Design for Manufacture: Lecture 1

15

Some Basic Guidelines

- Minimize the number of components used
- Use standard commercially available components where possible
- Use common parts/sizes where possible
- Design for ease of fabrication
- Design parts that are within the process capabilities
- Design for “foolproof” assembly

Design for Manufacture: Lecture 1

16