Lecture One

MSE 257: INDIGENOUS METHODS OF MATERIALS PROCESSING

Course Code: MSE 257

Dr. Emmanuel Kwesi Arthur

Department of Materials Engineering,
Kwame Nkrumah University of Science and Technology,
Kumasi, Ghana

Email: ekarthur2005@yahoo.com
Phone #: +233541710532

Course Description:

- The course spans the full range of indigenous materials working processes: and manufacturing. It also allow students to have practical experience by visiting local manufacturers who use such indigenous materials working processes.

Course Content

- Indigenous materials working processes: Blacksmithing, Goldsmithing/ silversmithing – materials required, equipment and tools,
- Process technology which involves casting, investment casting, forging, wire drawing, soldering/brazing.
- Copperware– materials required, sources, preparation of raw materials, coldworking, design of ware, joining of pieces (brazing).
- Beads making – materials required, production (preparation of organic/clay moulds, communition of raw materials, filling of mould with glass powder, colouring oxide, sintering), factors affecting rearrangement of particles, effect of temperature, problems and health hazards. etc.

Aim/purpose

- This course aims to introduce students to local materials manufacturing processes such as beads, casting and forging techniques used in blacksmithing and metalworking and how they can be applied in practice.

* Research and development to find solutions to problems that may be identified.

The learning objectives are:

- To understand indigenous methods of processing materials into useful products
- To introduce the integrated concepts of manufacturing processes
- Explain basic properties of materials and apply it to manufacturing process.
- Compare and contrast the production advantages of traditional manufacturing processes (casting, forming, machining, and joining).
- Evaluate material-process-geometry relationships in manufacturing processes.

Resources:

- Groover M.P. (2006). Fundamentals of Modern Manufacturing (3rd ed.). New York NY: John Wiley & Sons. 1040 pp. ISBN 0-471-74485-9.
- Manufacturing Science by Amitabh Ghosh and Ashok Kumar Mallik
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Delivery

- Delivery of this course will involve practical assessments, written assessment, visits to suitable local materials manufacturers.

- Lectures:
  - time: 10:00 – 11:20 AM
- Field work:
  - Time: TBD

- Course Website:
  - TEACH website – http://classes.engr.oregonstate.edu/

Course Instructor

Time: Tuesday 8:00-9:00 am

Lecture Room:

Instructor: Dr. Emmanuel Kwesi Arthur
Dept. of Materials Engineering

Teaching Assistant: Anita Yetumi

Office: PB325

Office Hour: Tuesday, Wednesday: 10-10:55 AM,

Email: ekarthur2005@yahoo.com
Phone: 0541710532

Grading

- Homework: 5%
- Field Trip Report: 10%
- Mid-Sem Exam: 15%
- Final Exam: 70%

Course Outline

- Manufacturing process decisions
- Deformation processes
  - Forging and blacksmiting
- Casting processes
  - Investment casting
  - Glass beads making
- Sheet metalworking
- Machining
- Finishing
- Assembly
  - Soldering and brazing
- Material compatibilities / Process capabilities
- Material costs, Tooling costs, Processing costs

Why do you need to take this course?

A knowledge of the basic manufacturing processes is essential for a successful materials manufacturing processes in today's global marketplace.

Background

- Categorization of Nations
  - Advanced
  - Rich
  - Developing/Poor

- REASONS
  - These are due to the level of technological
  - Scientific achievement

Technology

- Broadly speaking, two forms of technology could be available to a country and they are
  - The Borrowed Technology (BT) and
  - Indigenous Technology (IT).

- Borrowed Technology is a type of technology which is accessed from another country
- Indigenous Technology (IT) is developed in the home country.

Borrowed Technology or the Indigenously Developed Technology?

- The question then is, do African countries stick to the Borrowed Technology or the Indigenously Developed Technology, or use both of them simultaneously?
- Definitely, we cannot move away from developing our Indigenous Technology, because we need that to be able to process many of our raw materials that we consume and export.
- That is to say, the Indigenous Technology, when well-developed has several advantages
  - including development of skills of the labor force, availability of jobs and reduced prices of consumer products.

Borrow Technology From Developed Countries

- However, IT alone may not be enough to keep up with the technological demands of our growing economies
- And so in addition to the IT, African countries can borrow technology from scientifically and technologically developed countries, adapt and possibly improve such technology to suit their environment(s).
- For instance, one area of importance to many African countries is renewable energy, and currently we are aware that solar energy and among others has the power of accomplishing that task. So if such a technology is available we can establish an R&D to adopt and adapt it to our benefit – saving us the trouble of researching from the scratch.

- In other words, it will be a good idea if African countries formulate policies, which make use of both Indigenous Technology and Borrowed Technology simultaneously, which in turn is expected to guide planning and investments in R&D related to S&T development.

Ghana's Industrial Situation

- Most engineering items are imported
- Informal sector is mostly made up of artisans without necessary scientific and technological background.
- Some are illiterates with abilities based on several years of apprenticeship and job experience.

Need to develop indigenous technology

- Technology is very critical to the development of any nation
- Also "technology is the dividing line between developed and under-developed countries".
- if under-developed countries do not "cross the bridge of being marginalized in technology and productivity, it will make very little progress as a nation."

Development of indigenous Technology

- there must be a well formulated policy/plan which seeks to guide the field.
- The necessary adjustments to the policy/plan are then made with advancing knowledge in the field

  - Capital
  - Knowledge, Skills and Expertise
  - Technology
  - Educated workforce
  - Legal and institutional/Regulatory framework
  - Governance structures
  - Enabling Environment

Introduction to Materials & Processes

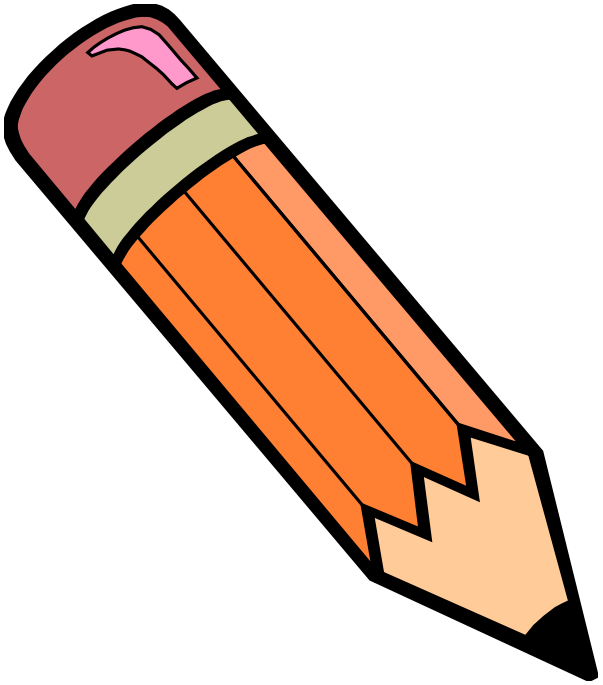
- Material-Geometry-Process Relationships
- Manufacturing Materials
- Manufacturing Processes
- How do we characterize processes?

Math/Manufacturing

- In calculus there is usually only one correct answer to a problem.

- In manufacturing there are usually many ways to make a part, some ways are better than others

Example

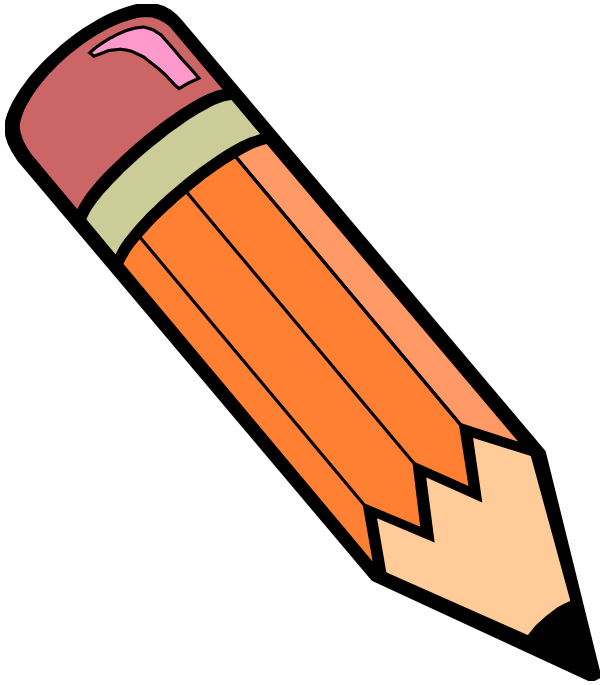


How can you sharpen a wooden pencil?

Example

- How can you sharpen a wooden pencil?

- Knife or other sharp object
- Sand or abrasion
- Toy pencil sharpener
- Hand pencil sharpener
- Electric pencil sharpener
- Automated pencil sharpener



Example

- How can you sharpen a wooden pencil?

Situation

You are taking a timed test

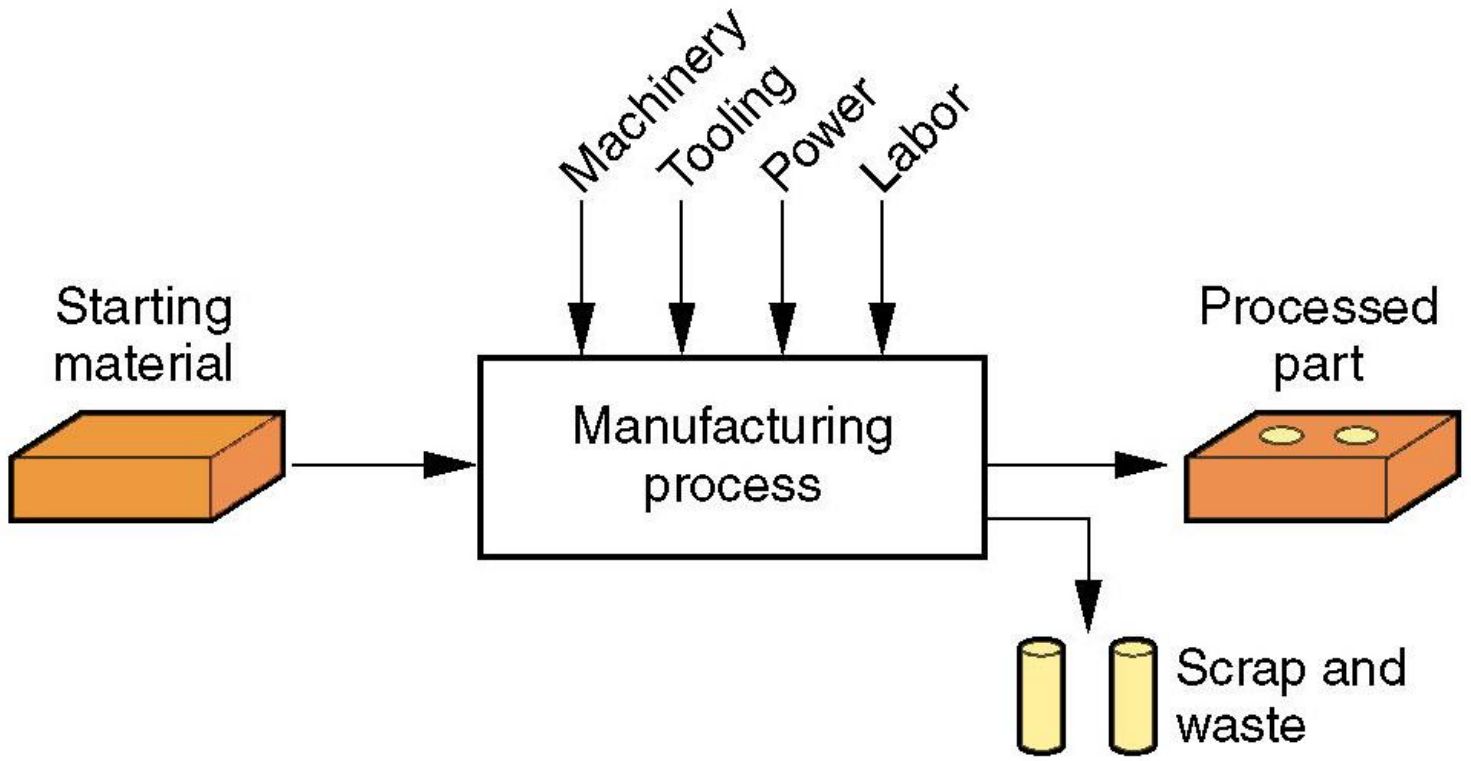
You are in your dorm room

You are designing for a department office

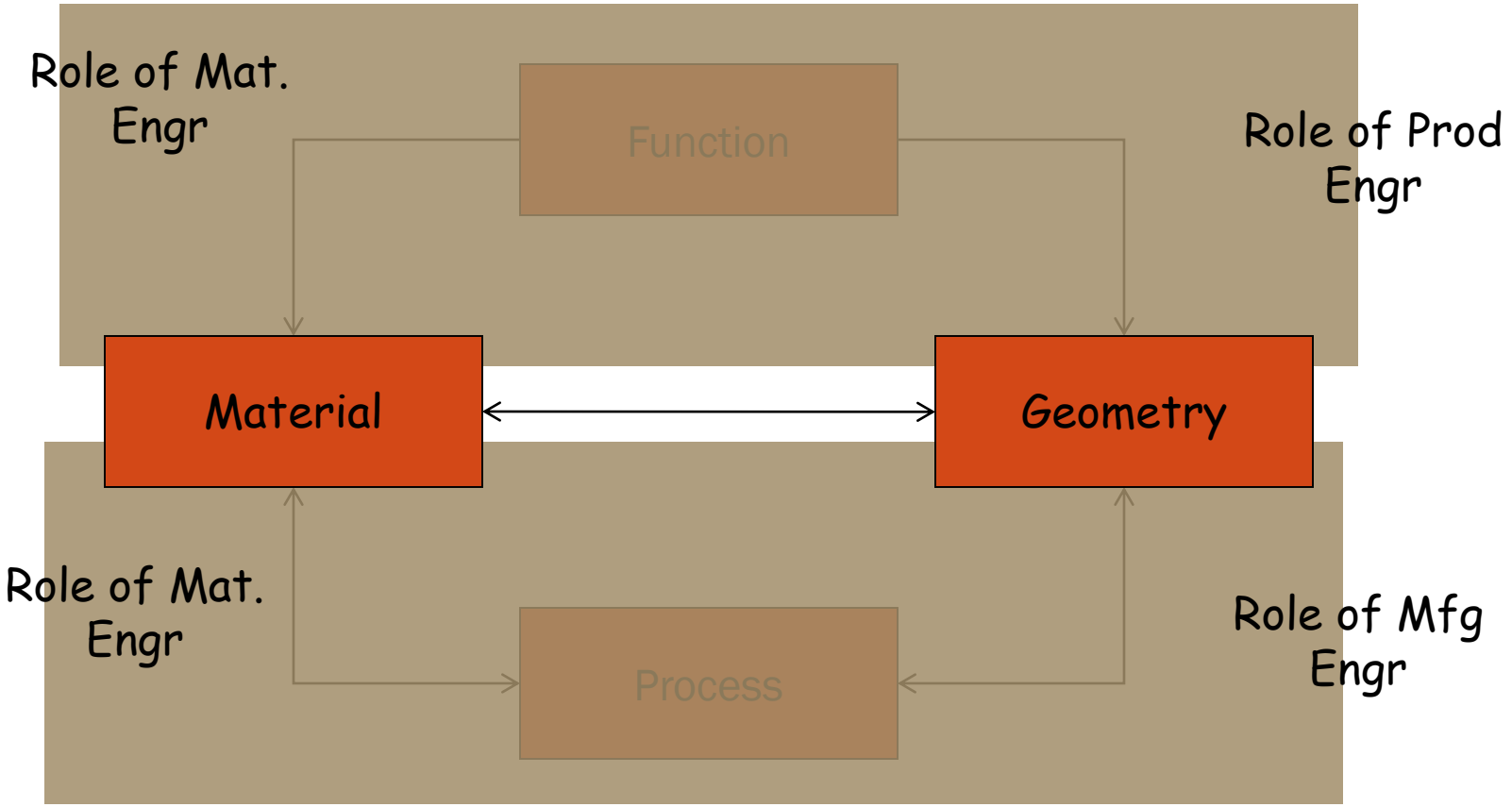
You have 500,000 pencils that are to be packaged with a crossword puzzle

What is Manufacturing?

- *Manufacturing* is the application of physical and chemical processes to alter the geometry, properties, and appearance of a starting material to make parts or products for a given application



Material-Process-Geometry Relationships



Developing a Manufacturing Process

1. **Understand Function/Geometry** ⟶

   Properties: mechanical, electrical, thermal, magnetic, optical, deteriorative.

2. **Properties** ⟶ **Identify candidate Material(s)**

   Material: structure, composition.

3. **Material** ⟶ **Identify required Processing**

   - Processing: changes *structure* and overall *shape*
   - Material and Geometry compatibility
   - Other considerations

Complexity in Manufacturing

Materials: 10^6

metals, ceramics, polymers, composites

Processes: 10^5

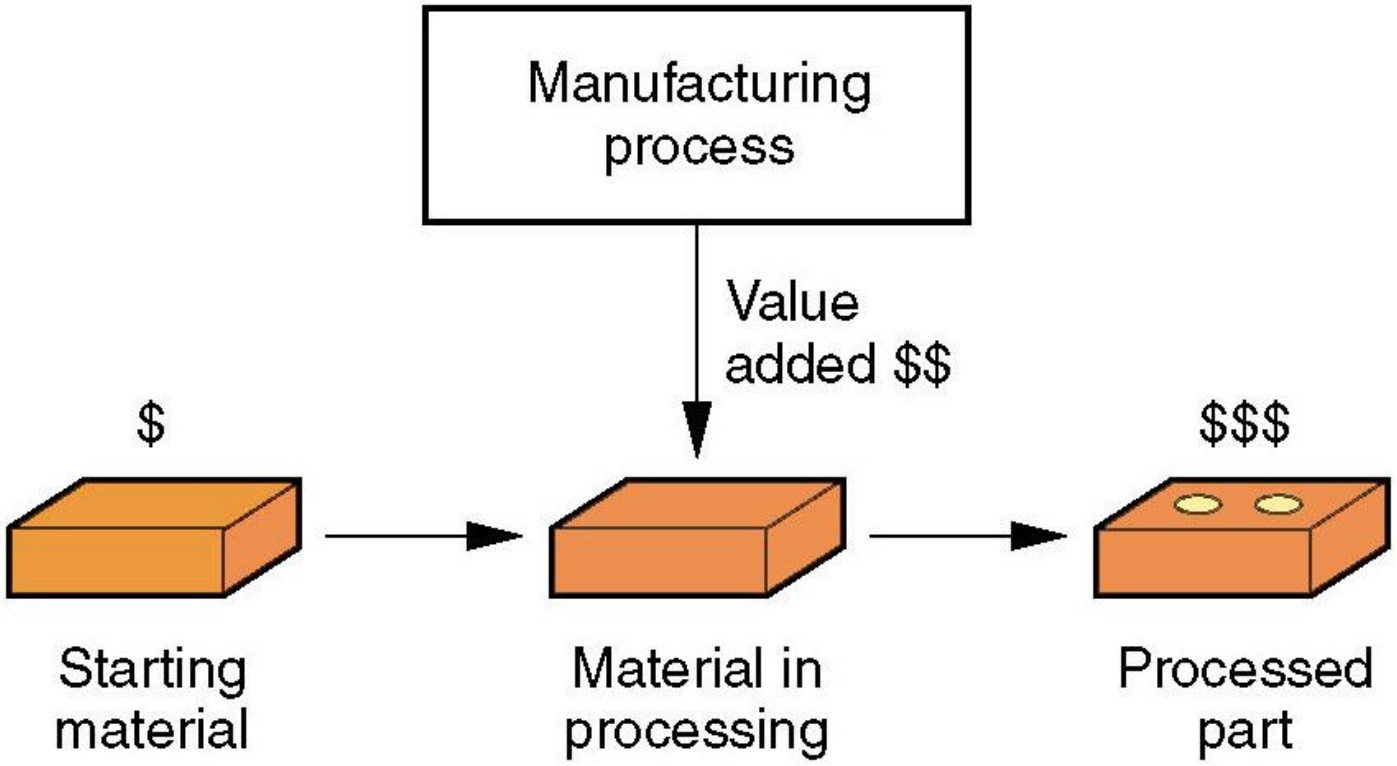
process conditions are ~ ∞

Properties: 10^2

applications are ~ ∞

Purpose of Manufacturing

- *Manufacturing* is the transformation of materials into items of greater value by means of one or more processing and/or assembly operations



Materials in Manufacturing

- Most engineering materials can be classified into one of four basic categories:
  1. Metals
  2. Ceramics
  3. Polymers
  4. Composites