

Plan for the following lectures

- Lecture 1: Course outline and project
- Lecture 2: Product, process and schedule design I.
- Lecture 3: Product, process and schedule design II.
- Lecture 4: Product, process and schedule design III.
- Lecture 5: Flow, space and activity relationships I.

Project proposals! → September 20

- Lecture 6: **Quiz #1 → September 26**

Plan of the lecture

- Introduction (Chapter 1)
 - Facilities planning defined
 - Objectives of facilities planning
 - Continuous facilities planning
 - Significance of facilities planning
- Product, process and schedule design (Chapter 2)

Facilities planning defined

- Facilities planning determines how an activity's tangible assets best support the activity's objective.
- Facilities planning:
 - Facilities location
 - Facilities design
 - Facilities systems design
 - Layout design
 - Handling systems design
- Facilities planning combines the efforts to determine location of a facility and design of it

Facilities location

- The placement of the facility
- Factors:
 - *Closeness* (to the market, to the raw materials, to the suppliers, to other facilities, to the competitors)
 - *Geographical area* (zoning, transportation access, labor, demographics, climate, environmental considerations)
- *Fixed and recurring costs*

Facilities design

- Facility systems design
- Layout design
- Handling system design

Facility systems design

- Structural systems, enclosure systems, atmospheric systems, electrical and lighting systems, communication system, life safety systems, sanitation system, etc.
- What systems are required
- Where they are required
- Integrating the systems into the overall facility

Layout design

- Layout for production areas and production-related and support areas
- Consists of all equipment, machinery and furnishing within the building envelope
- Determination of:
 - Block layout - relative locations and sizes of the planning departments
 - Detailed layout - exact location of all equipment and storage areas

Handling system design

- The mechanisms needed to satisfy the required facility interactions
- It consists of materials, personnel, information and equipment-handling systems required to support production
- Receiving, storing, retrieval, transporting, packaging and shipping, postal system, personnel transit system

- **Which comes first, the material handling system or the facility layout?**

BOTH!

- The layout and the handling system should be designed simultaneously

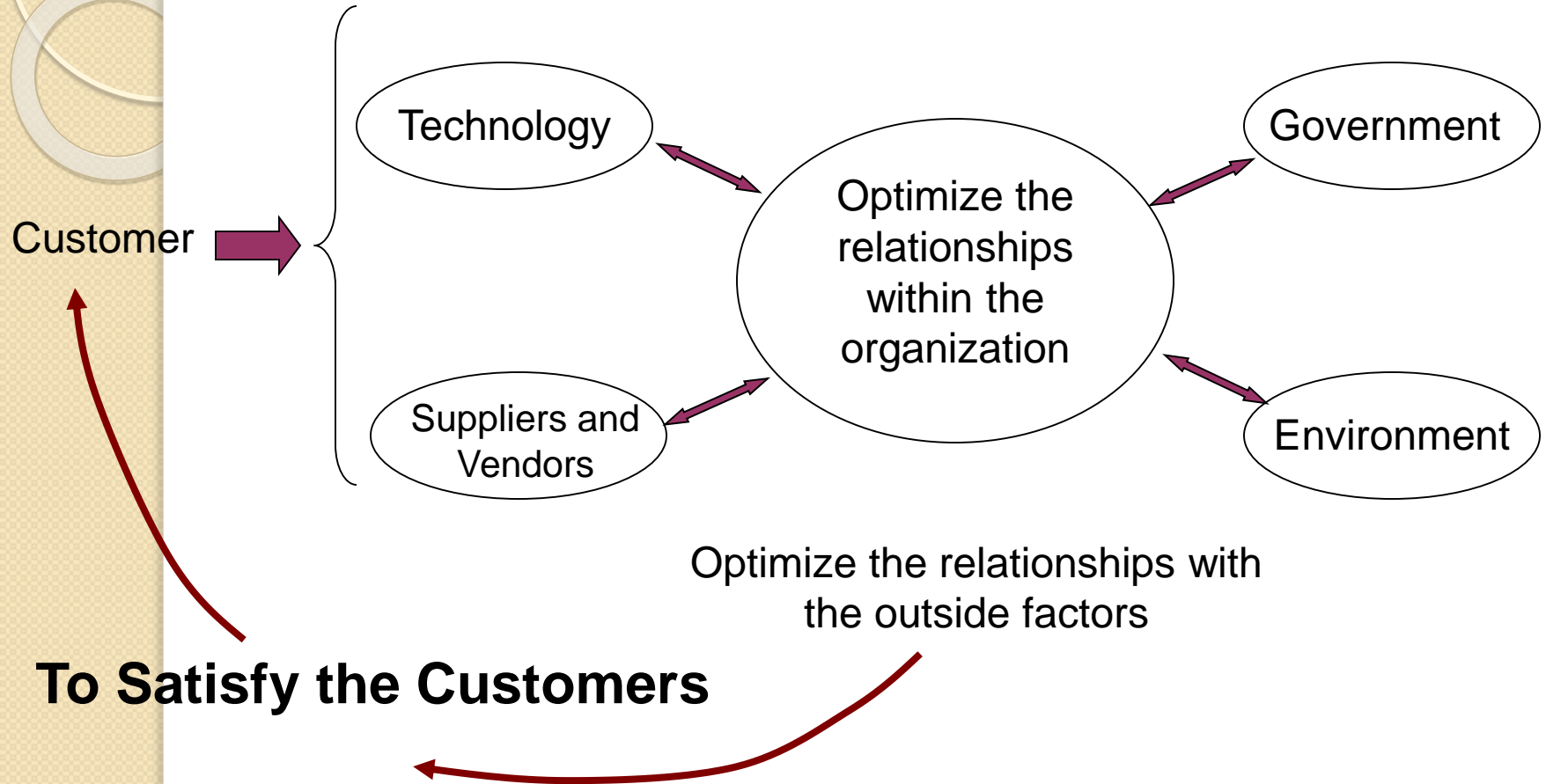
Objectives of Facilities Planning

- **Improve customer satisfaction**
- Maximize speed
- Reduce costs
- Integrate the supply chain
- Support the organization's vision
- Effectively utilize resources
- Maximize return on investment (ROI)
- Maximize return on assets (ROA)
- Be easy to adapt and to maintain
- Provide safety for employees

Objectives of Facilities Planning

- Four main issues when designing a facility:
 - Customers
 - Internal efficiency
 - Work environment
 - Integration into the supply chain

Objectives of Facilities Planning



Main features of facilities

- **Flexibility**
 - Flexible facilities are able to handle a variety of requirements without being altered
- **Modularity**
 - Modular facilities include systems that cooperate efficiently over a wide range of operating rates
- **Upgradeability**
 - Upgraded facilities easily incorporate advances in equipment systems and technology
- **Adaptability**
 - Considering the
 - Calendar
 - Cycles
 - Peaks
- **Selective operability**
 - Understanding how each facility segment operates
 - Allows contingency plans to be put in place

Facilities planning as continuous activity

- Constant reevaluation and replanning of facilities, and continuous improvement
- Why replanning facilities?
 - Economic considerations
 - Employee health and safety
 - Energy conservation
 - Community considerations
 - Disabilities considerations
 - Fire protection
 - Pilferage

Significance of facilities planning

- Facilities planning is one of the core areas in industrial engineering field
- Can learning facilities planning contribute to the economy?
 - In 1999, \$320.8 billion was spent on structures in the US
 - 93% for new structures
 - In average 8% of GNP is spent for new facilities each year (US)

Industry	GNP Percentage
Manufacturing	3.2
Mining	0.2
Railroad	0.2
Air and other transportation	0.3
Public utilities	1.6
Communication	1.0
Commercial and other	1.5
All industries	8.0

Source: U.S. Bureau of Census.

Significance of facilities planning

- The size of the investment in new facilities each year makes the field important
- **Adequate facilities planning is not being performed**
 - Existing facilities cannot adapt to changes easier
 - 20% to 50% of operating expenses are material handling cost
 - Facilities planning can reduce these costs by at least 10-30%.
 - If effective facilities planning were applied the annual manufacturing productivity in the US would increase 3 times!
- ***There exists a significant opportunity for improvement of facilities planning process!***

Product, process and schedule design I.

- Chapter 2 of the textbook
 - **Product design**
 - Process design
 - Schedule design

Product, process and schedule design

- Before we start developing alternative facility plans, we should have answers for the following questions

1. **What** is to be produced?
2. **How** are the products to be produced?
3. **When** are the products to be produced?
4. **How much** of each product will be produced?
5. **For how long** will the product be produced?
6. **Where** will the products be produced?

Answer for the first 5 questions can be obtained from:

- Product design
- Process design
- Schedule design

Answer for the last question might be searched outside of the company -

global sourcing effect

Answers to these questions will help develop the first part of your term projects!

- Market analysis
- Product design
- Suppliers and vendors selection
- Equipment and personnel requirements
- Location selection
- Plant layouts designs (using CAD) and selection of the best
- Materials handling
- Life cycle analysis of both product and facility

Product, process and schedule design

- *Product design:*
 - Product designers determine:
 - Product specifications (dimensions, material, packaging, etc.)
- *Process design:*
 - Process designers determine:
 - How the product will be produced
- *Schedule design:*
 - Production planners determine:
 - Production quantities
 - The schedules for the equipment
- **WHERE DOES THE FACILITY PLANNER COME IN?**

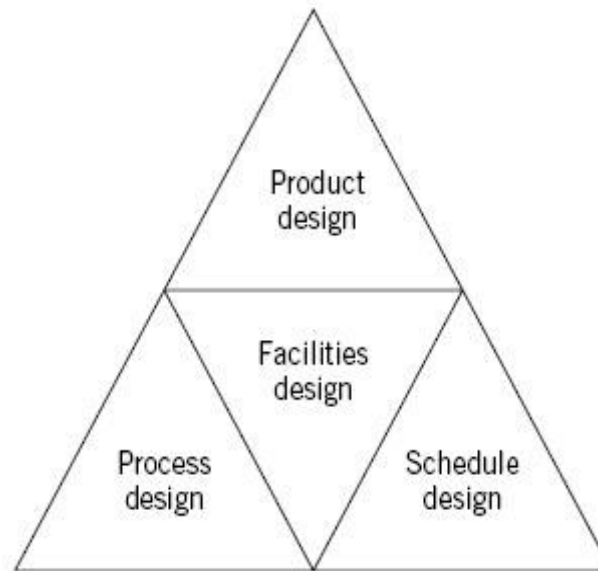


Figure 2.1 Relationship between product, process, and schedule (PP&S) design and facilities planning.

- *Facility planner* is dependent on timely and accurate input from product, process and schedule designers
- The need for close coordination among the four groups

Product Design

- Determination of a product to be produced
- Detailed design of the product

Product Design – Product Determination

- Based on input from:
 - Marketing
 - Manufacturing
 - Finance
 - Etc.
- Most of the time final decisions are made by the top management

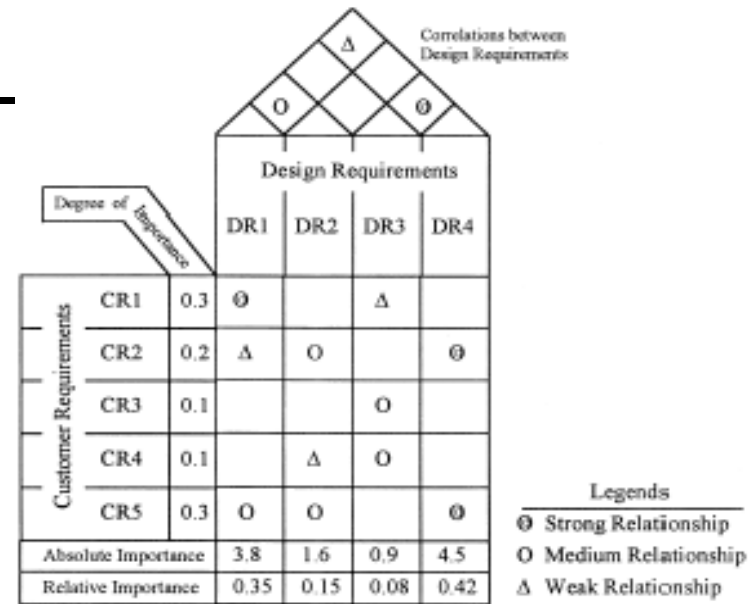
Product Design – Product Determination

- *Uncertainty* regarding the mission of the facility
- The occupants of the facility may change frequently or may never change at all
 - If changes are likely – a high degree of flexibility and a very general space
 - If a high degree of confidence about the products – the facility design should optimize the production of those products

Product Design – Detailed Design

- The detailed design of the product is influenced by aesthetics, function, materials and manufacturing considerations

- Quality Function Deployment* - translation of the customers' desires into product design, and subsequently into parts characteristics, process plans and production requirements.

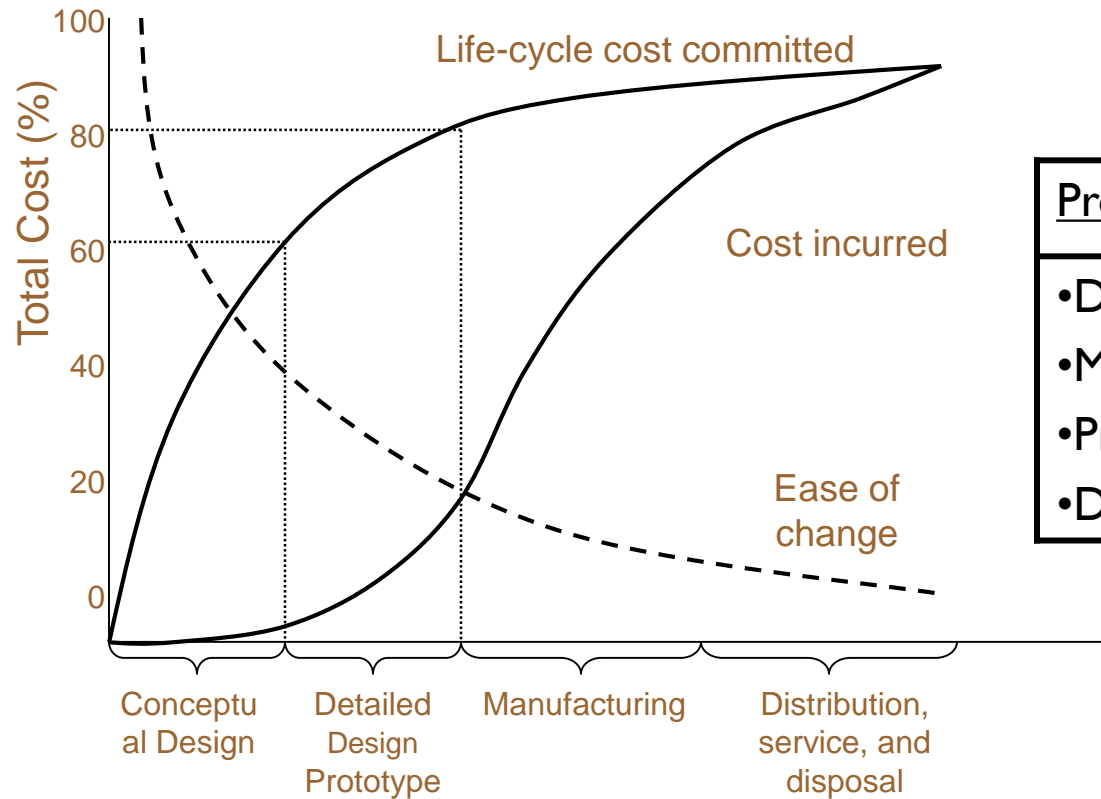


- Benchmarking* – used to identify the approach of the competition

Product Design – Detailed Design

- Finally, detailed designs take place (CAD designs, prototypes, assembly designs, 2D drawings and dimension determinations)
- **Concurrent Engineering** is a systematic way of enabling communication between all the related units during the product development
 - The aim is to minimize the changes in design parameters once the design is finalized
 - 70% of the manufacturing cost is set during the design phase
 - Changing the design later in the process costs significantly more

Cost of design changes

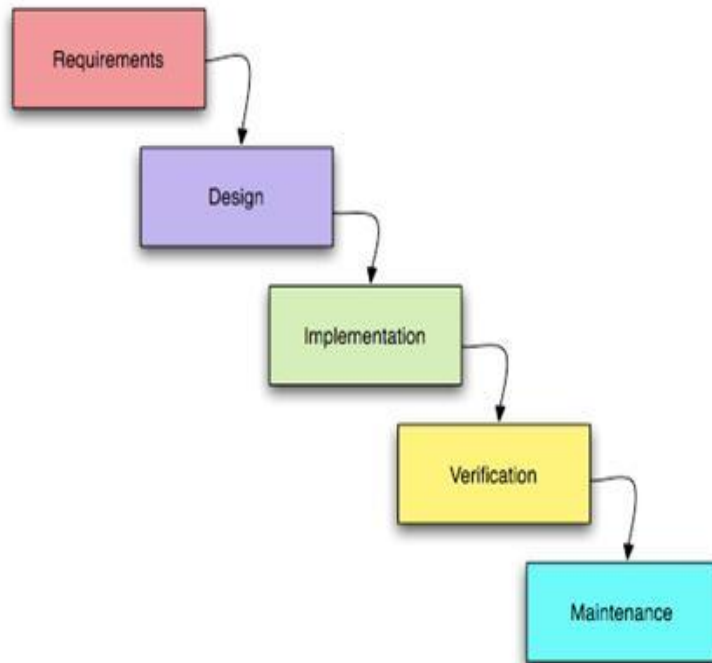


Product Life-Cycle Includes

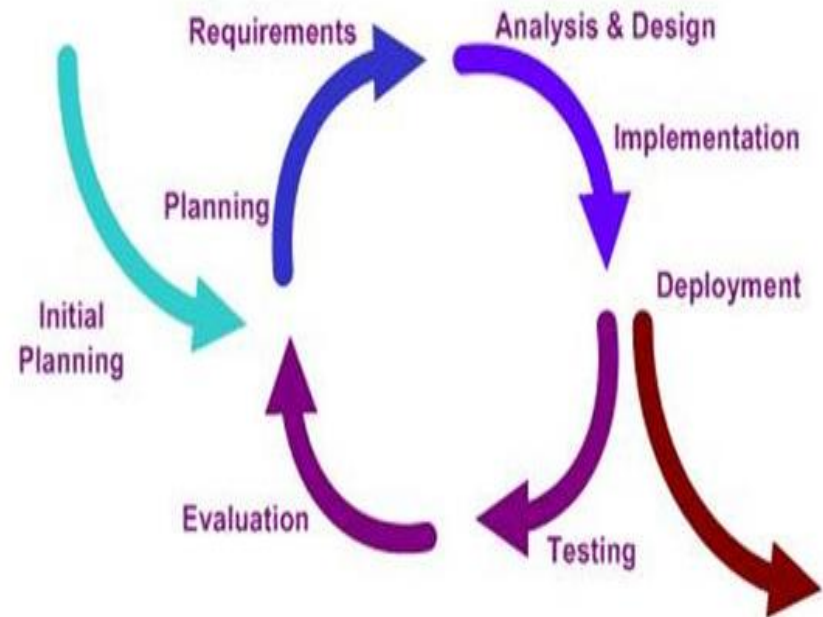
- Design Phase
- Manufacturing Phase
- Product usage phase
- Disposal phase

Design phase determines the most of the costs associated with delivering a product. Typically, 70-80% of the cost of a product is fixed at the design stage.

Sequential development method



Concurrent development method



Product Design - Documentation

- Once the product design is completed, usually following documents are provided for the facilities planning process as inputs
 - *Exploded assembly drawing* – omits specifications and dimensions
 - *Exploded parts photographs*
 - *Component part drawing* - detailed

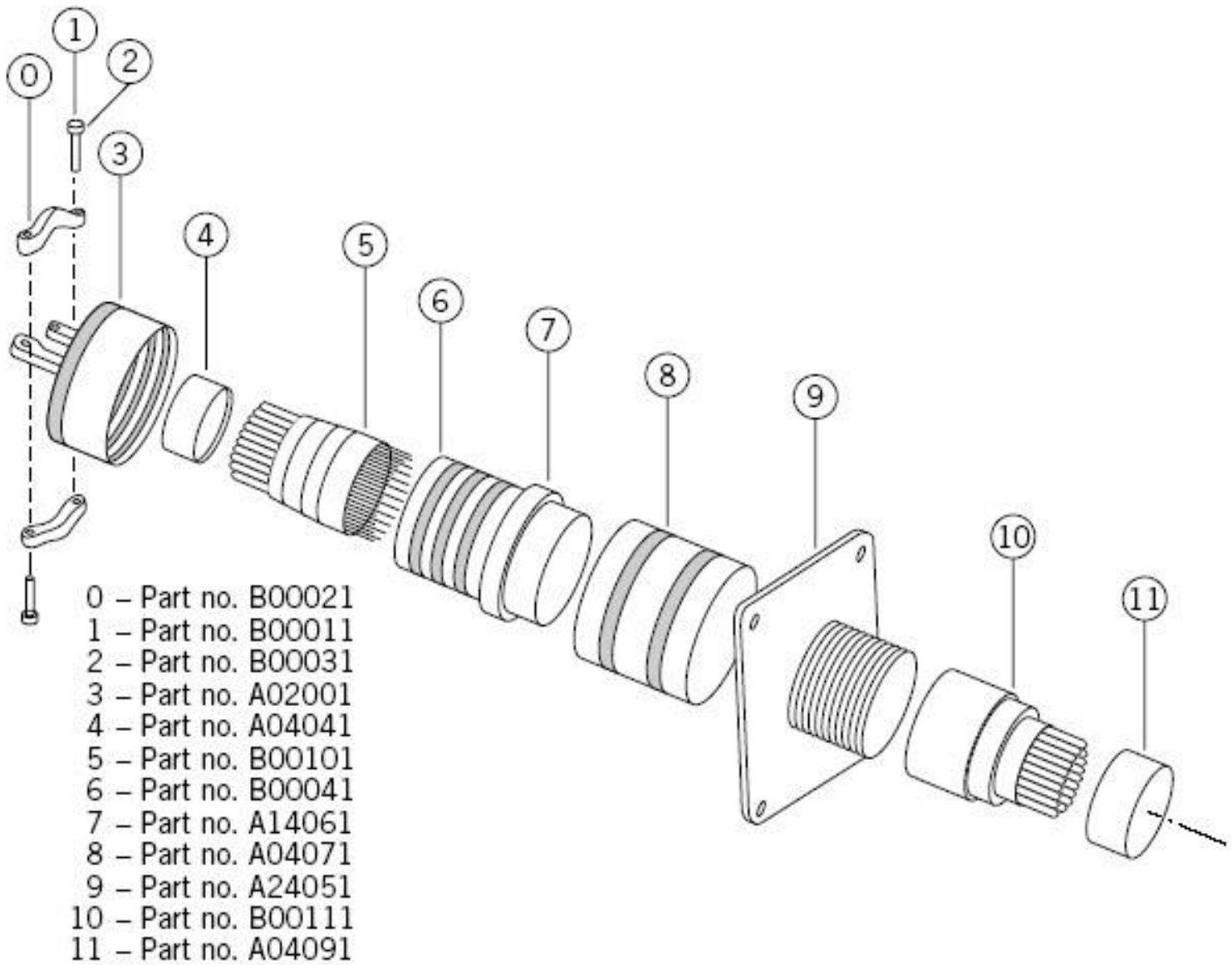
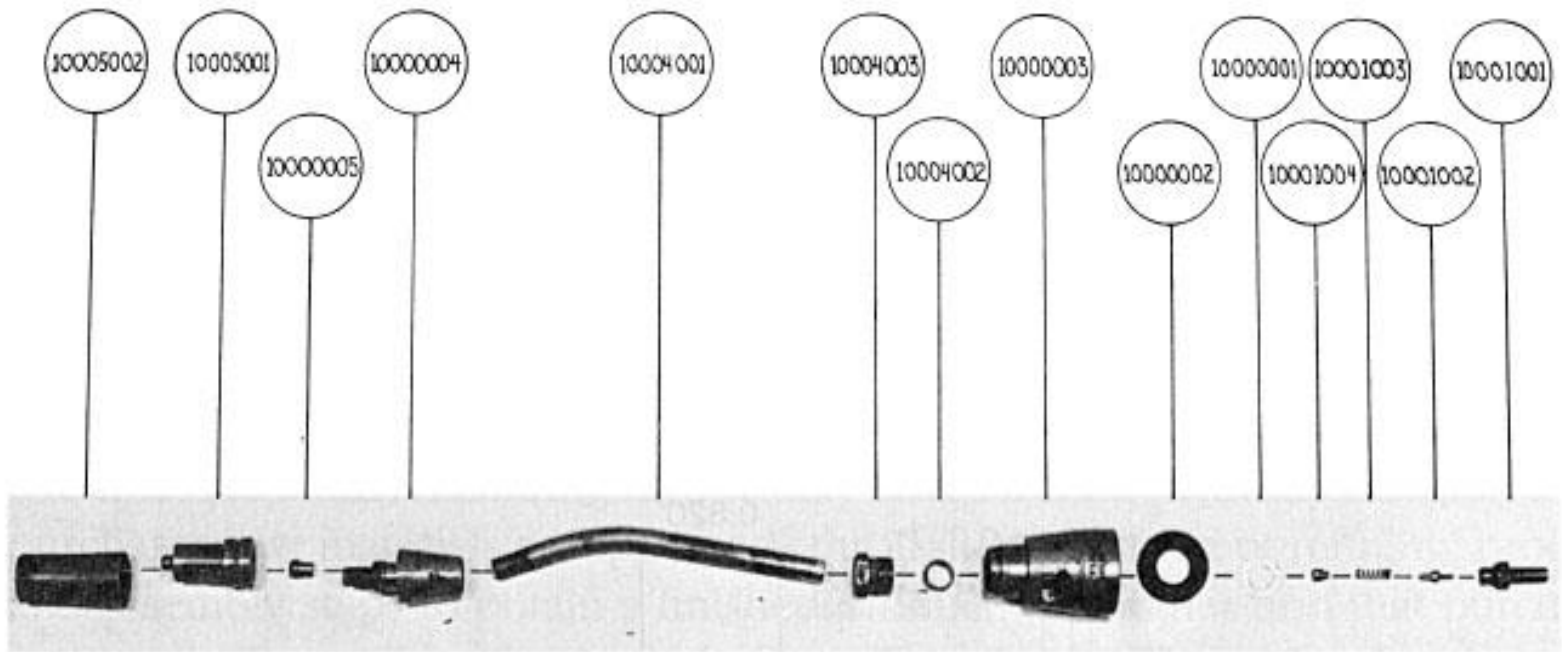


Figure 2.2 Exploded assembly drawing.



DRAWING No.	4482
DRAWING TYPE	EXPLODED ASSEMBLY
PREPARED BY	FRAZELLE
CHECKED BY	DEW
DATE	3-14-81
COMPANY	UNCAN-ARNELL, INC.

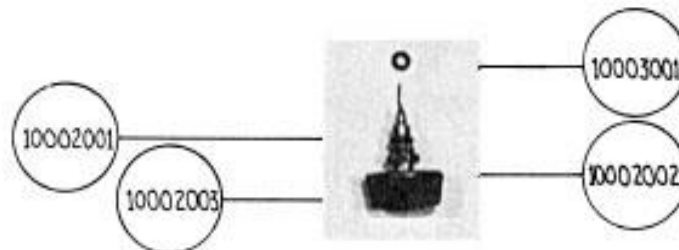


Figure 2.3 Exploded parts photograph.

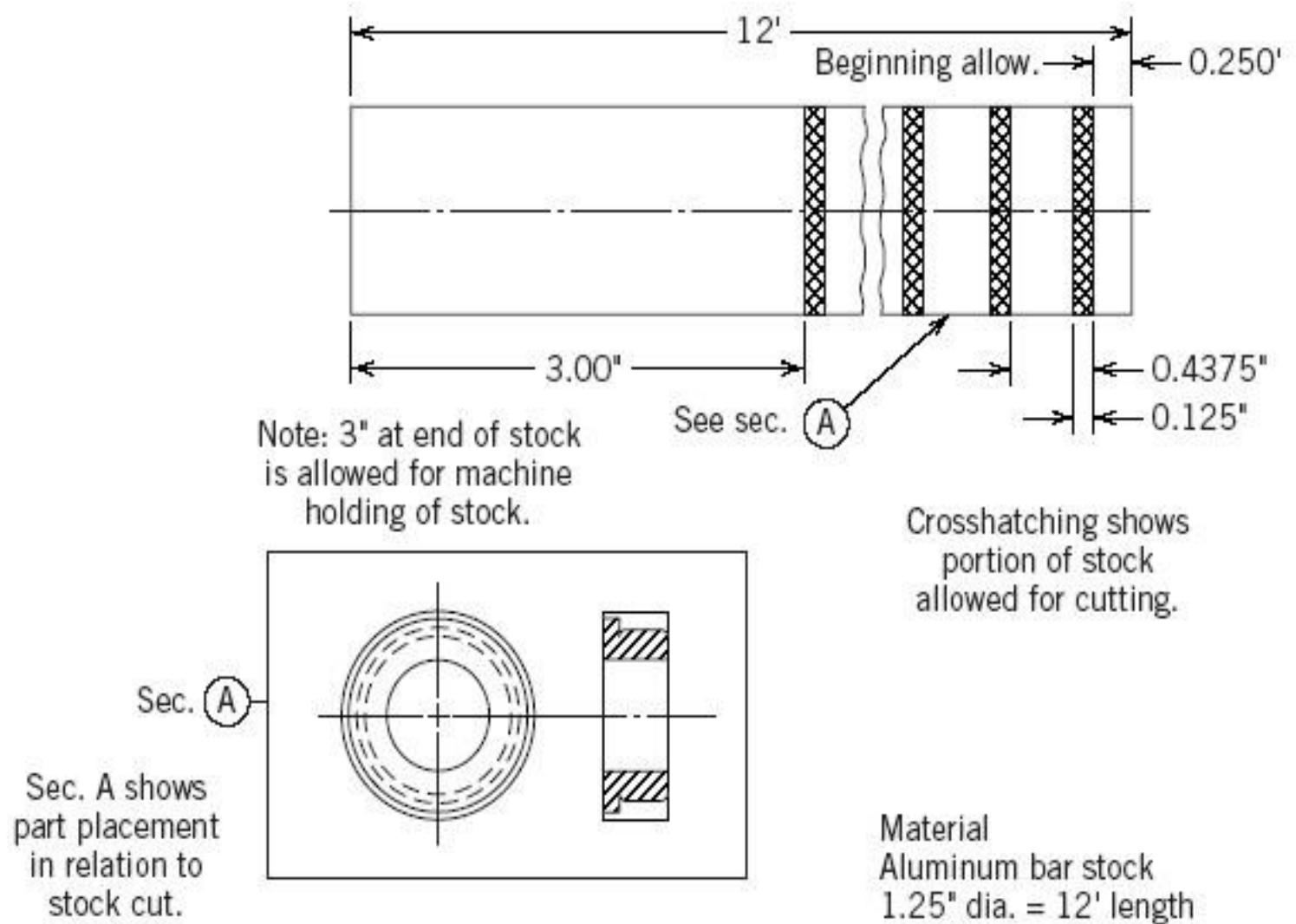


Figure 2.4 Component part drawing of a plunger.

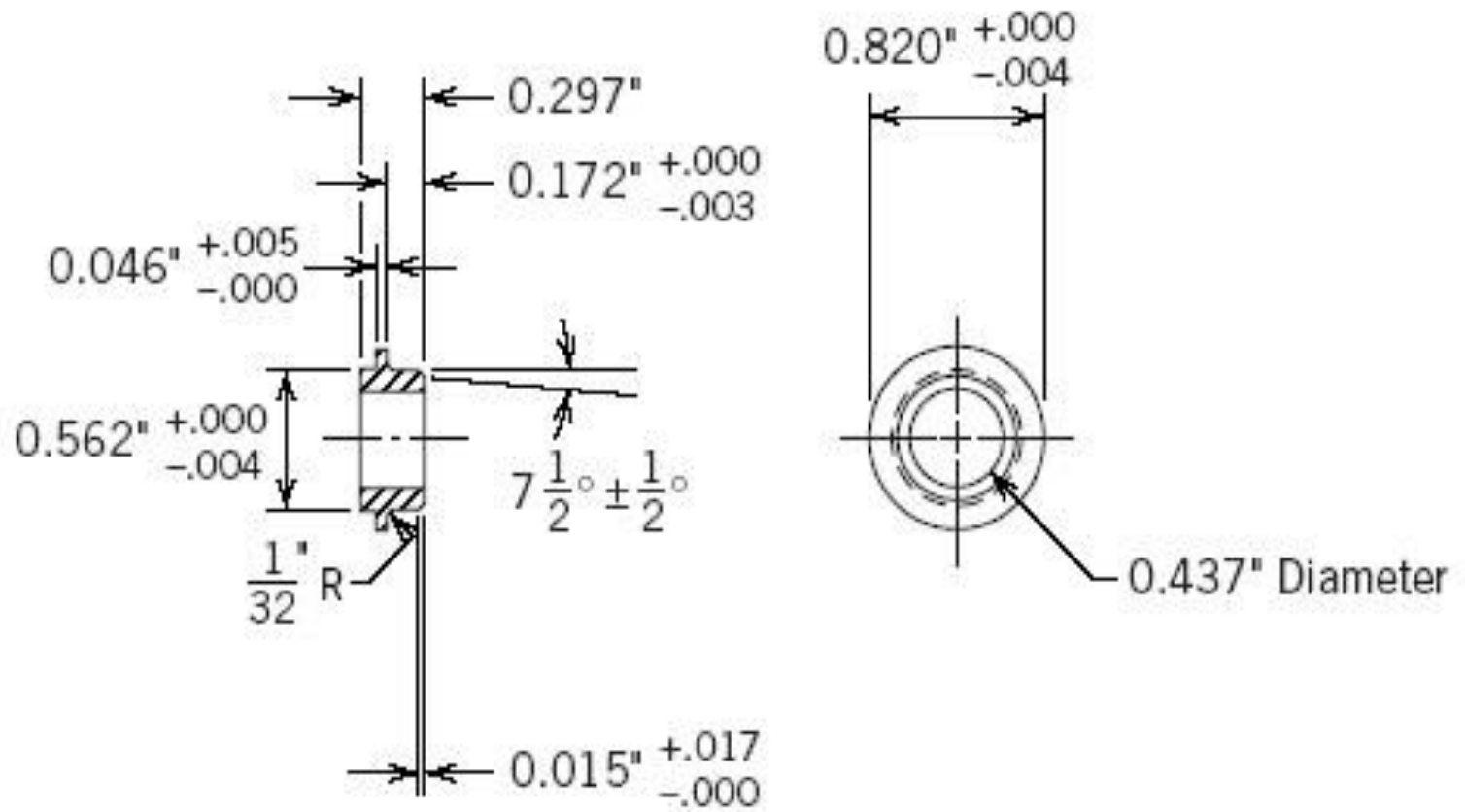


Figure 2.5 Component part drawing of a seat.

Next lecture

- Process design
- Schedule design