

King Saud University

College of Engineering

IE – 462: “Industrial Information Systems”

Fall – 2020 (1<sup>st</sup> Sem. 1442H)

Introduction (Chapter 1)

*part 2 – Introduction to Industrial Information Systems (IIS)*

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# Lesson Overview

Part 2:

- MRP / MRP II
- ERP
- MES
- ERP/MES/Control
- Information flow within the IS
- Network Architecture
- Functions of an Information System

# Why IS in Industry?

- Industrial firm:
  - Set of activities, or processes, that interact with each other (creating and exchanging information)
- Example:
  - When *quality control* gives final approval to use material
  - This is *information* passed on to *production* before production personnel can *process* the material



# Material Requirements Planning as IIS

- Material Requirements Planning (MRP):
  - Represents a typical example of IIS for inventory/production management
  - Input to the MRP is the **Master Production Schedule (MPS)** through *sales order* or *warehouse stock replenishment request*
  - MPS contains *how much* and *when* (i.e. gross requirements) for finished product units (see e.g. below):

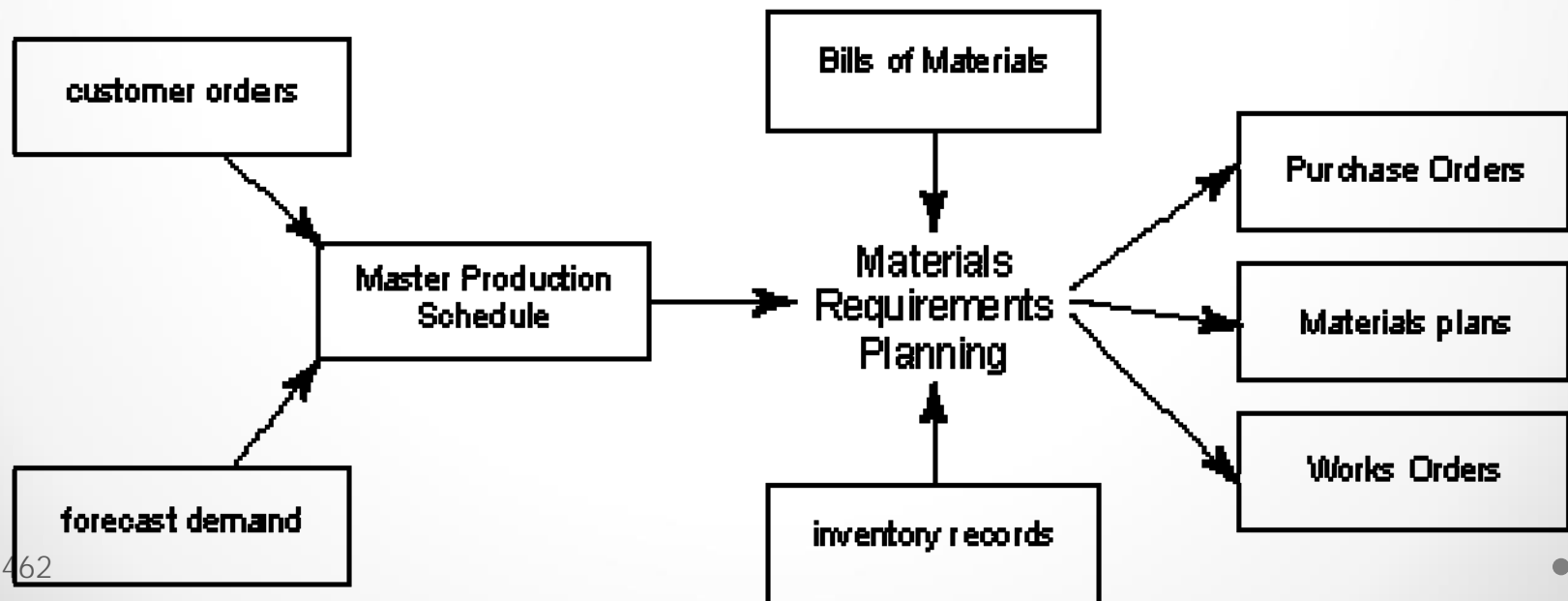


Production Plan for Week 2, December 09

Demand Management	12/7	12/8	12/9	12/10	12/11
Monthly Demand for Product A	4000	4000	4000	4000	4000
Working Days in Month	23	23	23	23	23
MPS Daily Demand for Product A	174	174	174	174	174

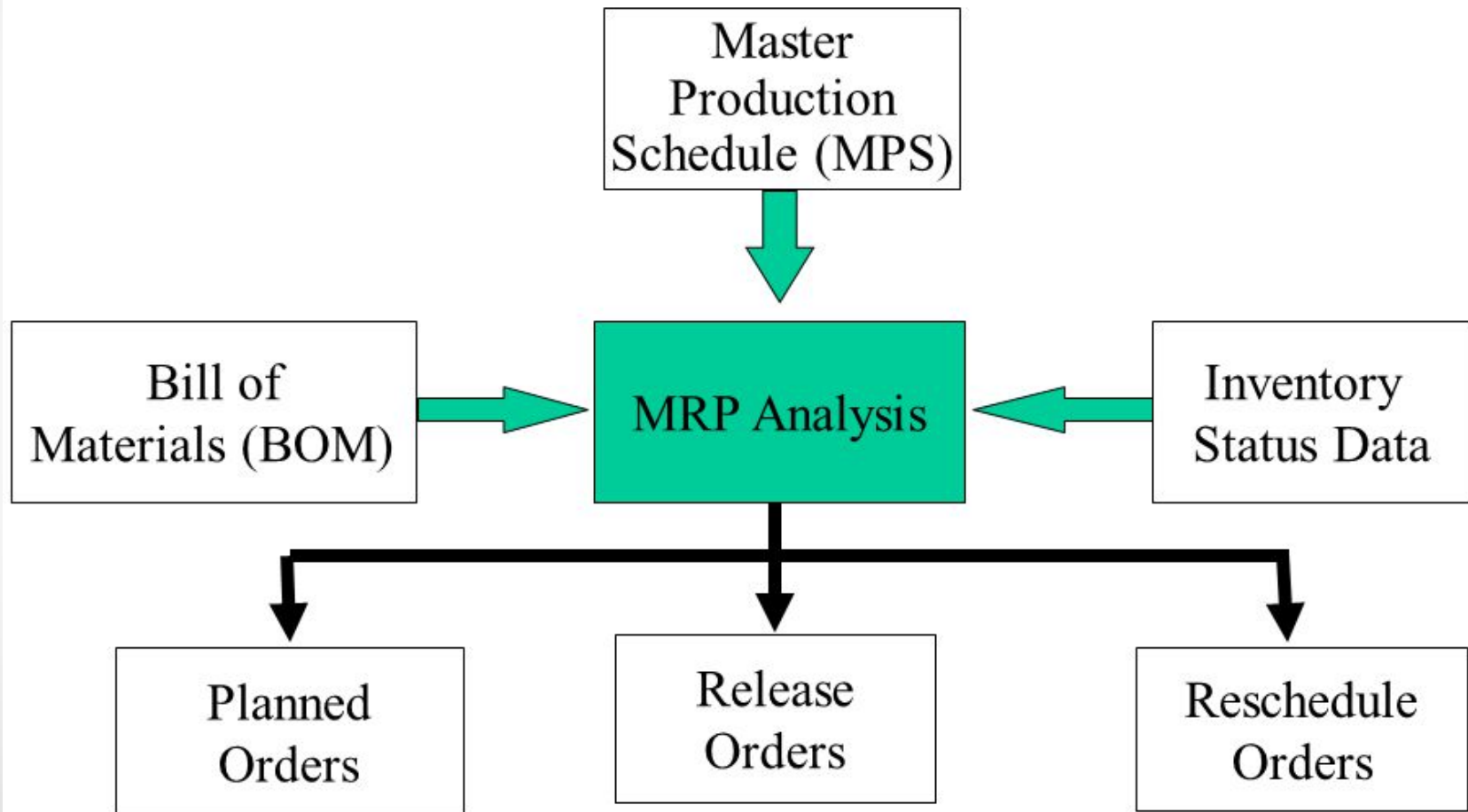
# Material Requirements Planning as IIS (cont.)

- Demands for subassemblies and components:
  - determined through **Bill of Materials** (BOM) explosion
- Demand for raw materials:
  - determined from subassemblies and components demands
  - and fulfilled either from *stock* or through *purchase requisitions*



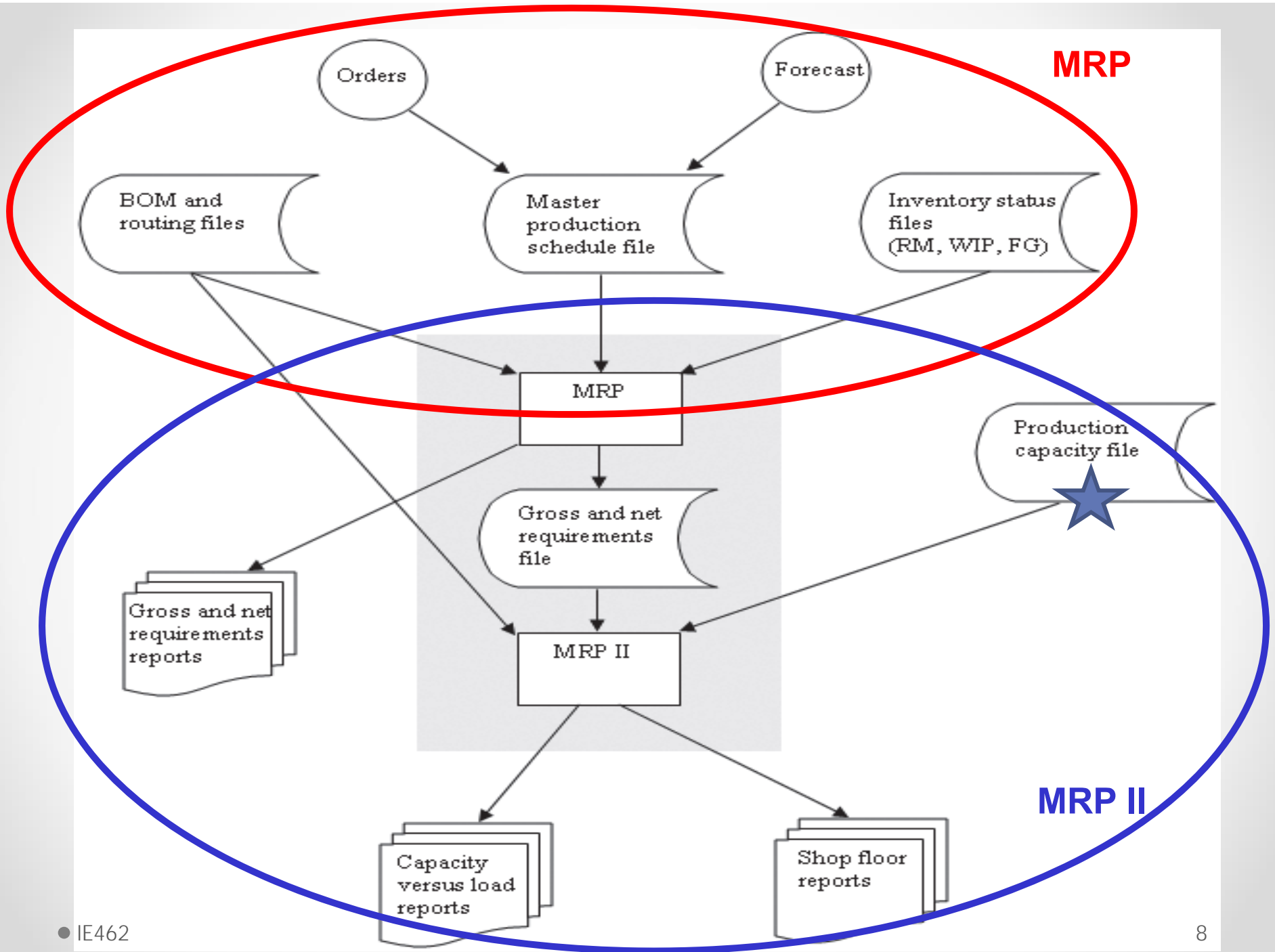
# Material Requirements Planning as IIS (cont.)

## Definition of MRP



# Material Requirements Planning as IIS (cont.)

- **MRP II:**
  - This is an extension of MRP
  - Includes additional **capacity planning** (aka: resources planning: workers, machines, etc.) required to meet the manufacturing activities
  - MRP II answers the question of whether or not a *sufficient* week-by-week plant *capacity* exists to meet the planned production schedule ([see next slide](#))





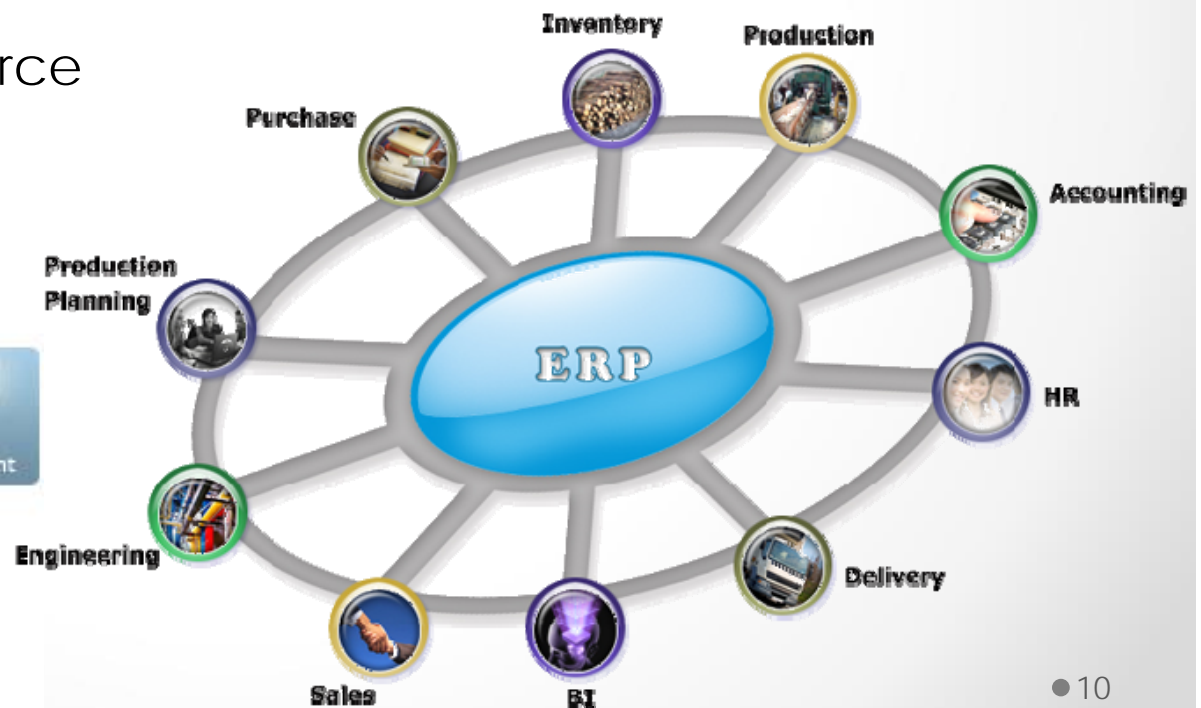
# Enterprise Resource Planning (ERP)

- The standard MRP system has been expanded to include much more functionality within a concept known as **enterprise resource planning (ERP)**
- In addition to the traditional MRP, ERP has added support for some of the following functions:
  - Quality management
  - Sales and distribution
  - Human resource management
  - Project management



# Enterprise Resource Planning (ERP) – cont.

- More recently, ERP was extended *beyond the factory* and the firm to include functions that link the company to its *customers and suppliers*, such as:
  - Logistics supply chain management
  - Inter-company communications
  - Electronic commerce



# Manufacturing Execution System

- MRP / MRP II / ERP:
  - Generally considered as “planning” systems
  - They’re not very well integrated into *execution* of production
- Absence of available software solutions for production execution in the shop floor has led to development of the **manufacturing execution system (MES)**
- MES *manages resources* (materials, machines, and personnel, etc) on a *daily or hourly basis*



# Manufacturing Execution System (cont.)



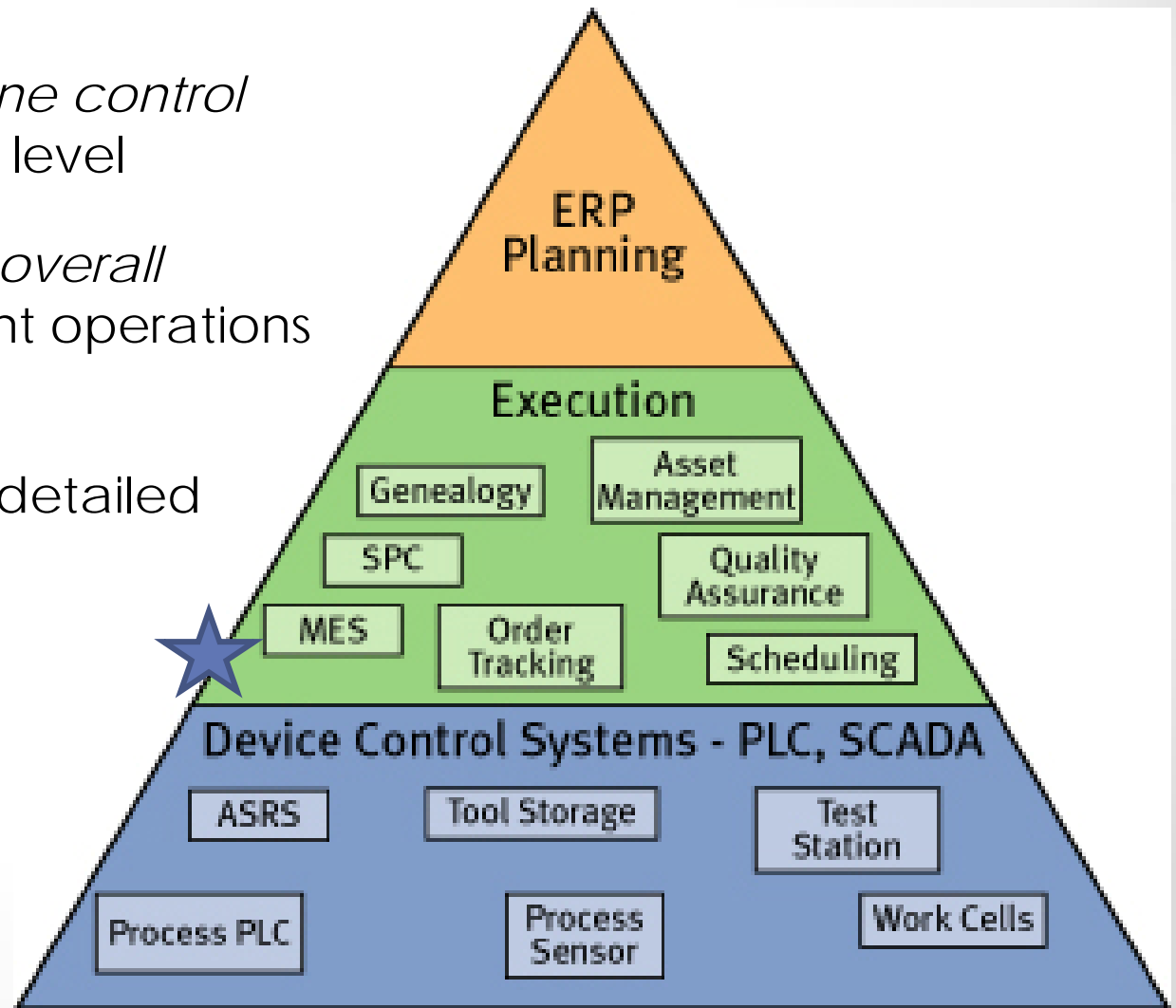
# MES Functions

Typical MES functions include the following:

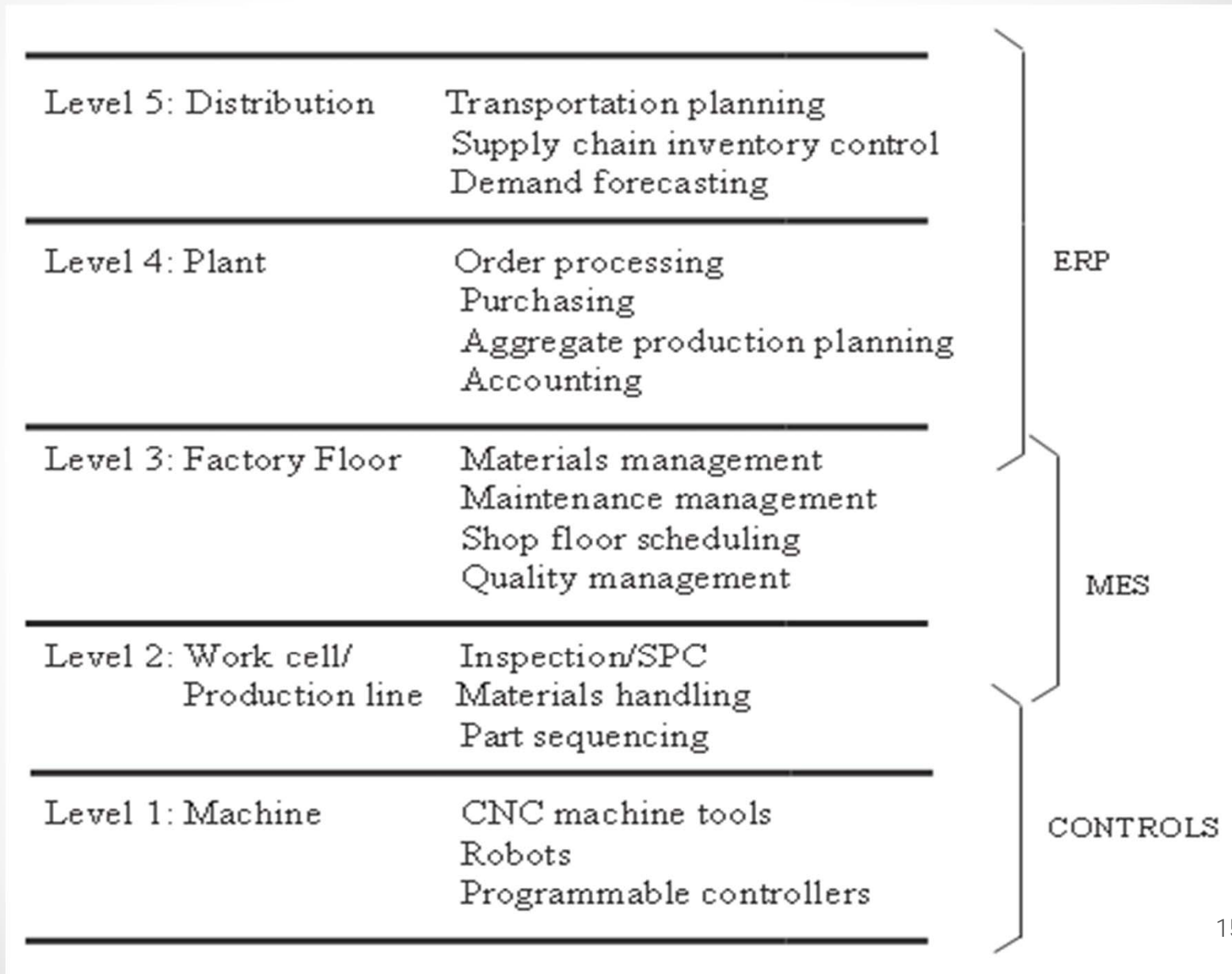
- Dispatching and monitoring production:
  - controlling the release of work orders to the shop floor
  - tracking work-in-process inventory
- Detailed scheduling
- Data collection:
  - from factory floor operation
  - provides a history of factory events
- Quality data analysis:
  - real-time analysis of manufacturing
  - notification of out-of-tolerance values
  - sometimes recommending corrective action

# ERP/MES/Control: I.S. Hierarchy in Plant

- A hierarchy of decisions must be made in manufacturing:
  - from the *machine control* (unit operation) level
  - up through the *overall planning* of plant operations (i.e. ERP)
  - this hierarchy is detailed in the [next slide](#)



# ERP/MES/Control: I.S. Hierarchy in Plant (cont)



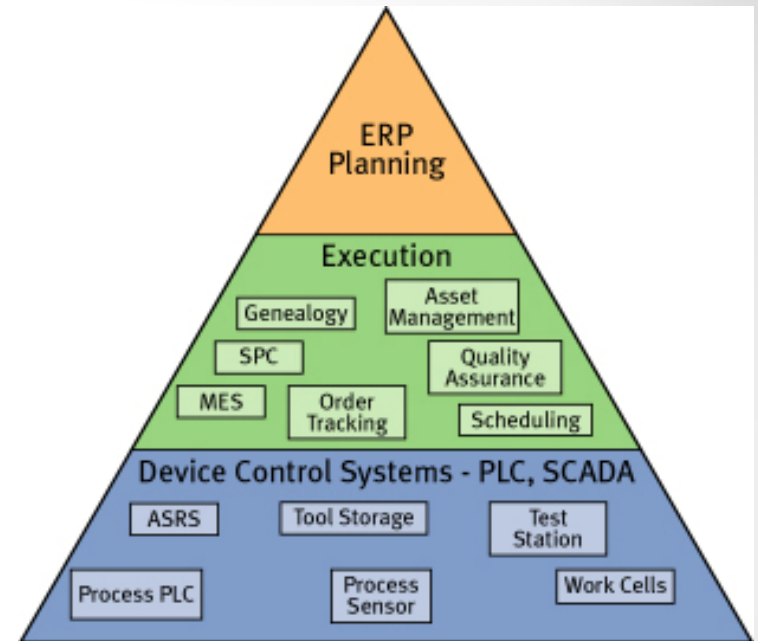
# ERP/MES/Control: I.S. Hierarchy in Plant (cont)

- Production line or work cell level (level 2):
  - Control the interactions between a group of related machines or processes
  - This level of decision making is concerned with the release and delivery of materials at the correct time
  - Considered part of the *MES* level, but there is some overlap with the *controls* level
- Examples of decisions at this level include:
  - Routing of material among machines
  - Decision to extract out-of-specification components while they are being processed



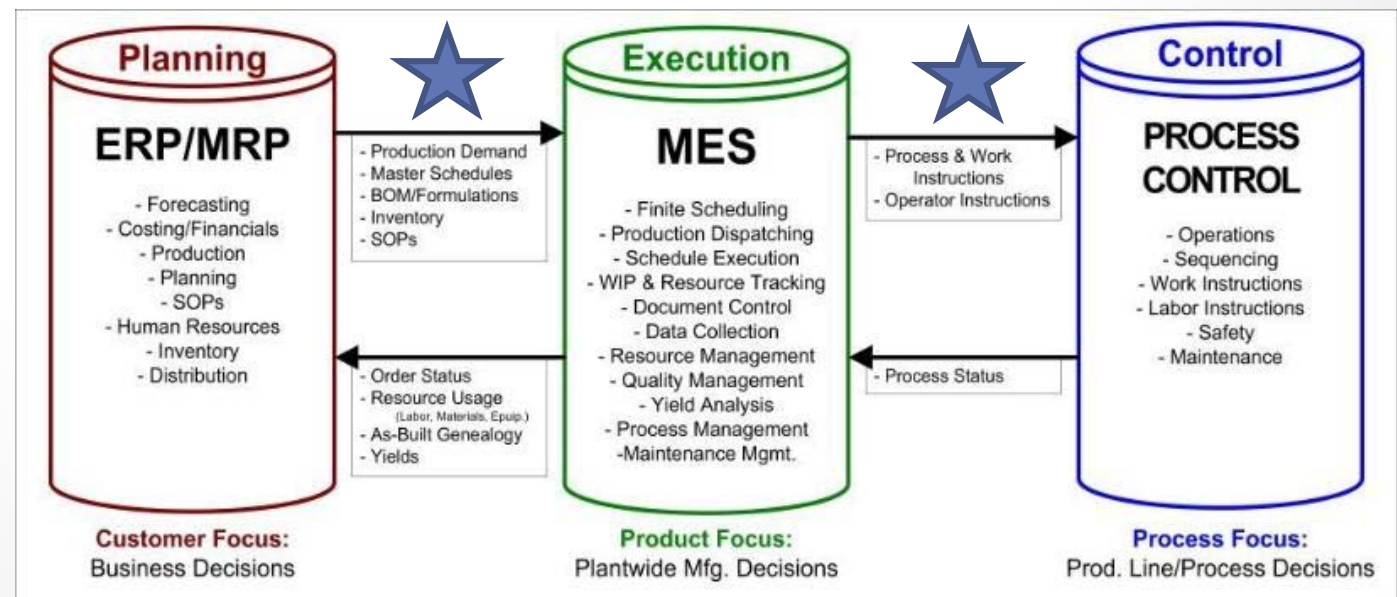
# The Nature and Role of I.I.S.

- Industrial system is modeled as a *hierarchy of decisions*:
  - where the **upper levels** of the hierarchy place *constraints* and ...
  - control *decisions* on each succeeding lower level
- Domain of an IIS:
  - *complete* integration of all levels of decision processes
  - supported by *computer information systems*



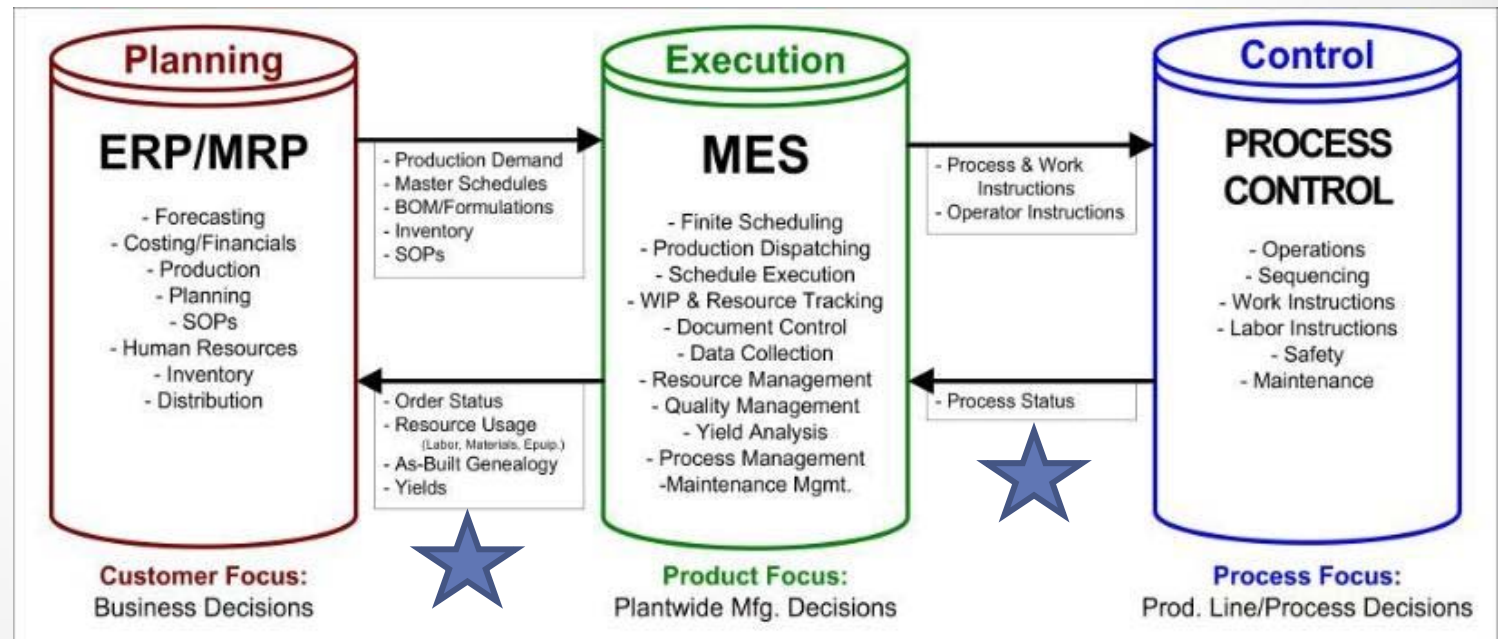
# Information Flow within the I.S.

- ERP, MES, & Control are standard software solutions
  - ERP provides the MES level with an *overall plan* of what is to be produced during the current planning horizon
  - The MES level is then responsible for *detailed production* operations on the factory floor
  - The MES level tells the machine controllers how to produce a particular part by **controller programs**

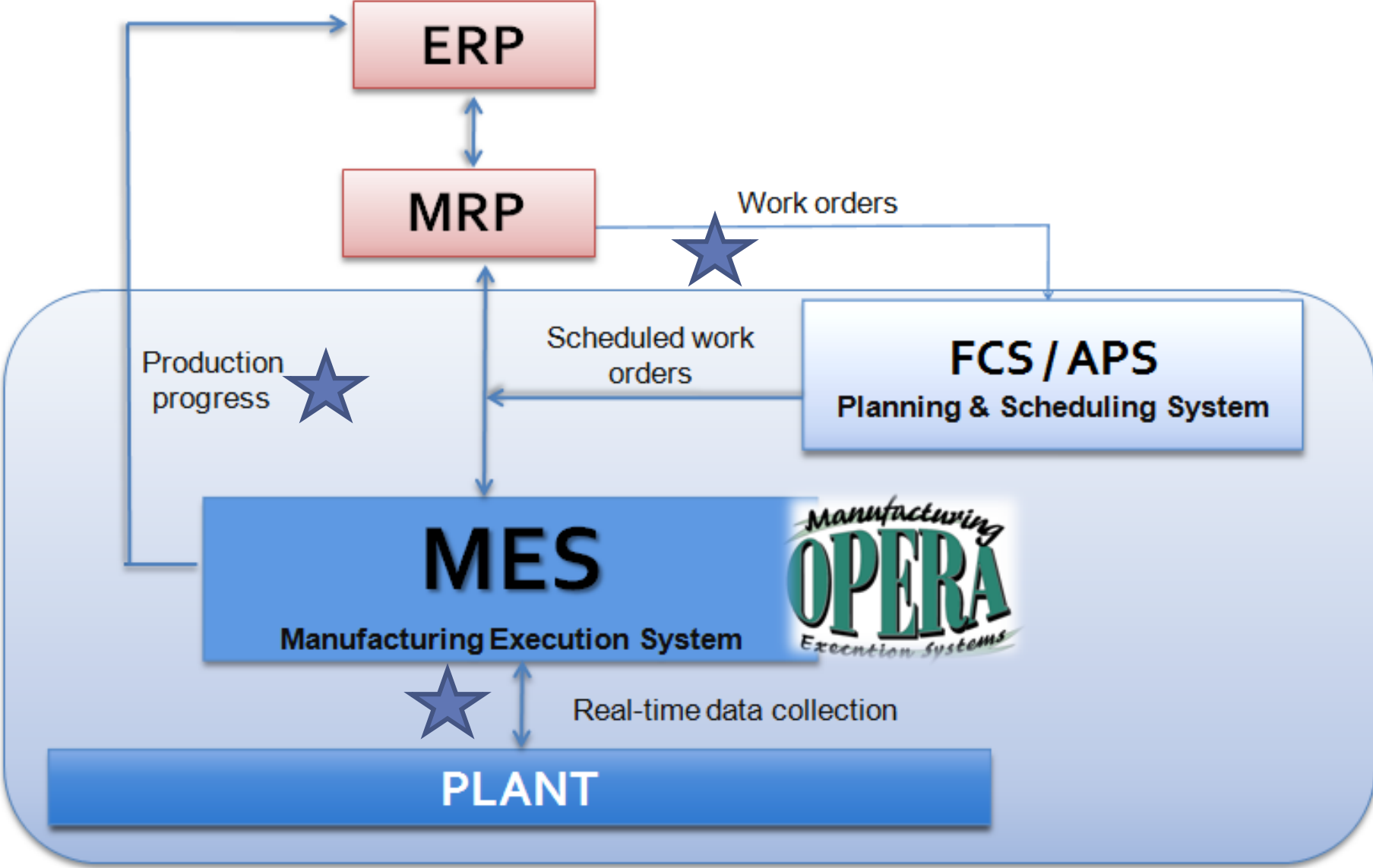


# Information Flow within the I.S. (cont.)

- ERP, MES, & Control software solutions (cont.):
  - As production is executed, actual *results* concerning what was produced are *fed back* to the planning level
  - The MES level monitors *real-time actual results*, and data summaries are logged for storage in factory databases
  - Steps are summarized in schematic shown on [next slide](#)



# Coordinating Layer Interaction in the IIS

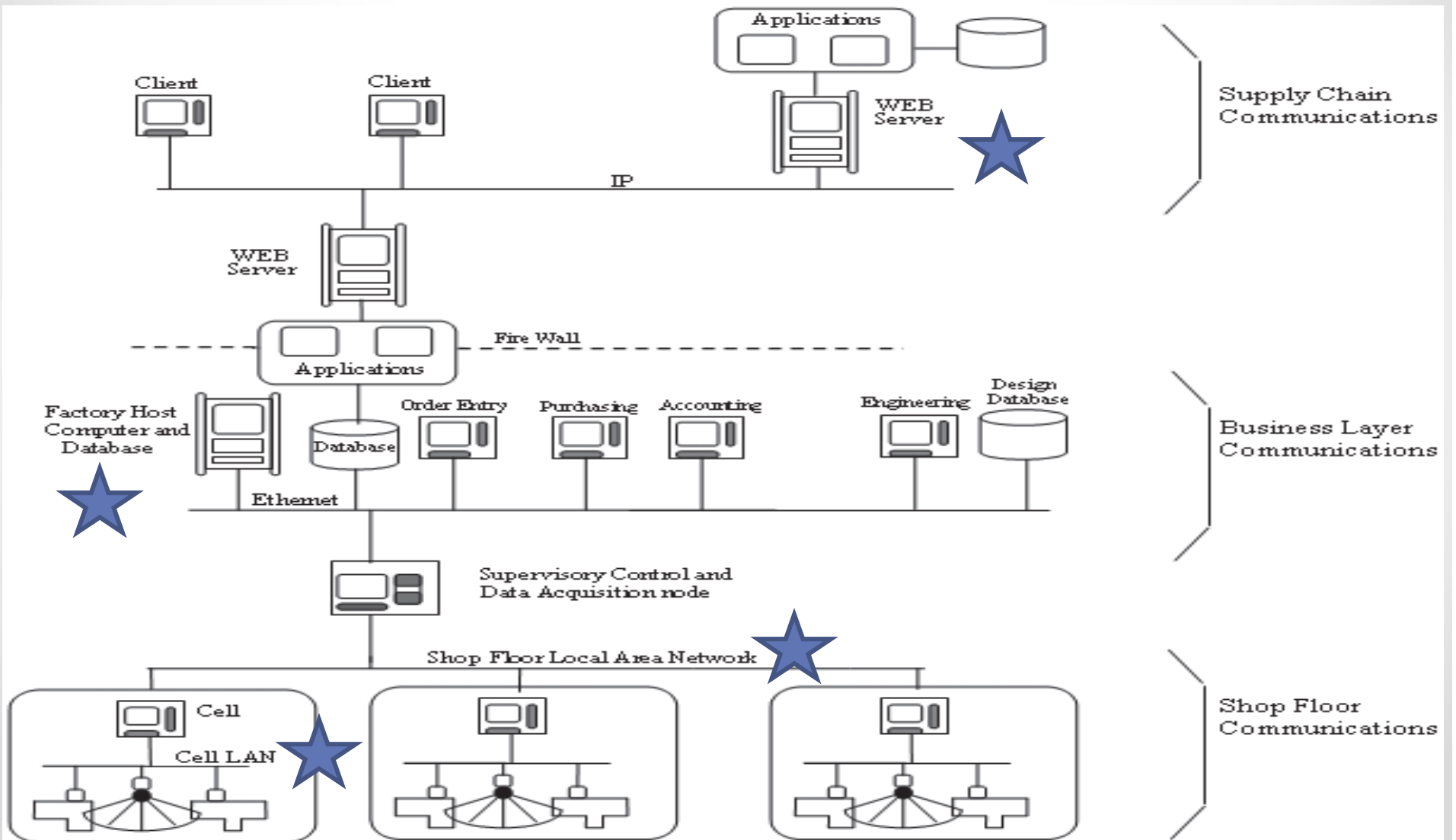


# Network Architecture

- Enterprise integration
  - Involves the *integration* of functional areas through *information sharing*
  - To realize efficient information sharing, it is desirable to *network* the levels of the hierarchy of the manufacturing enterprise
- Network architecture
  - Description of how various *layers* of the decision hierarchy will *communicate* with one another ([see next slide](#))
  - Network architecture is typically implemented with the use of **local area networks** (LAN)

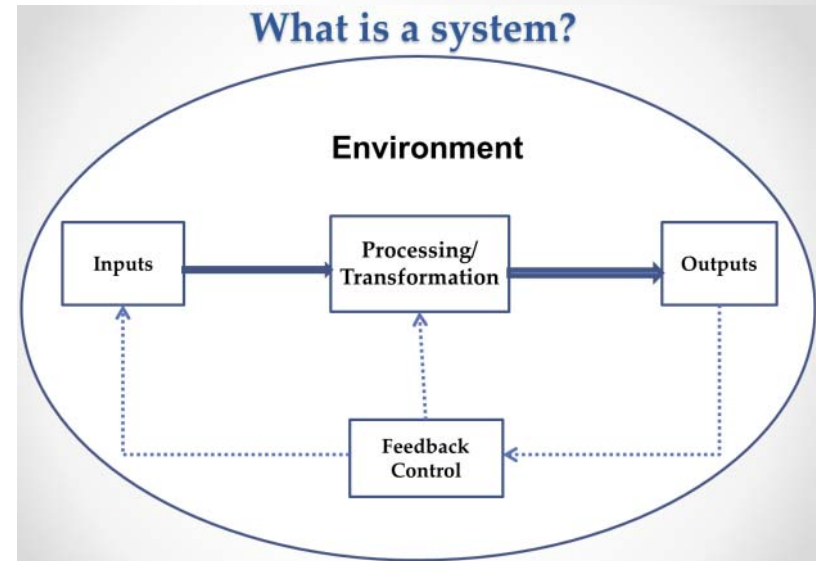


# Typical Network Architecture for Modern Industrial Company



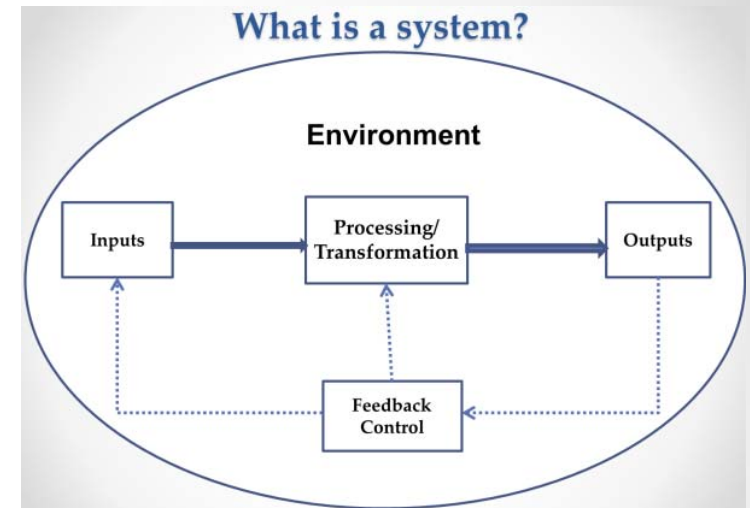
# Functions of an Information System

- Data collection:
  - captures data about events affecting the system and its environment
  - loads data into input devices
  - collected data are classified and indexed in order to make retrieval of desired information easy
- Data storage:
  - storing past data and information into database for future retrieval
- Information retrieval:
  - database management system (DBMS) extracts necessary processed data as information needed for decision making



# Functions of an Information System (*cont.*)

- Data processing:
  - computation or summarization
  - includes all transformation process on input data into information
- Data / information transmission:
  - communication of coded information between geographically separated points
- Data display:
  - presentation of output information in a form suitable for human perception
  - achieved by means of printed form, or temporary display (e.g. on CRT display)





## Videos to Watch (1. ERP)

- ERP Basics - 1  
<https://youtu.be/6qys-562kp4> (*Arcus Universe*)
- ERP Basics - 2 (longer video)  
<https://youtu.be/PVRgIXLWDHs> (*Jonar Systems*)
- ERP Cloud  
[https://youtu.be/c9HfNg4a\\_Og](https://youtu.be/c9HfNg4a_Og) (*Oracle*)
- ERP – Short Case Study  
<https://youtu.be/C7Bp07T5img> (*Oracle*)

## Videos to Watch (2. MES)

- **MES Basics** (Smart Manufacturing 4.0)  
<https://youtu.be/ILyBV5qgAB0> (*Wipro*)
- **MES - Short Case Study 1**  
<https://youtu.be/cKo1foTkE-k> (*Crossroads RMC*)
- **MES - Short Case Study 2**  
<https://youtu.be/tkq56IE0Nb0> (*GE Digital*)

# Sources

- [Design of Industrial Information Systems](#). Thomas Boucher, and Ali Yalcin. Academic Press. First Ed. 2006. Chapter 1.