

King Saud University

College of Engineering

IE – 462: “Industrial Information Systems”

Spring – 2024 (2nd Sem. 1445H)

Introduction (Chapter 1)

part 2 – Introduction to Industrial Information Systems (IIS)

Prepared by: Ahmed M. El-Sherbeeney, PhD

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

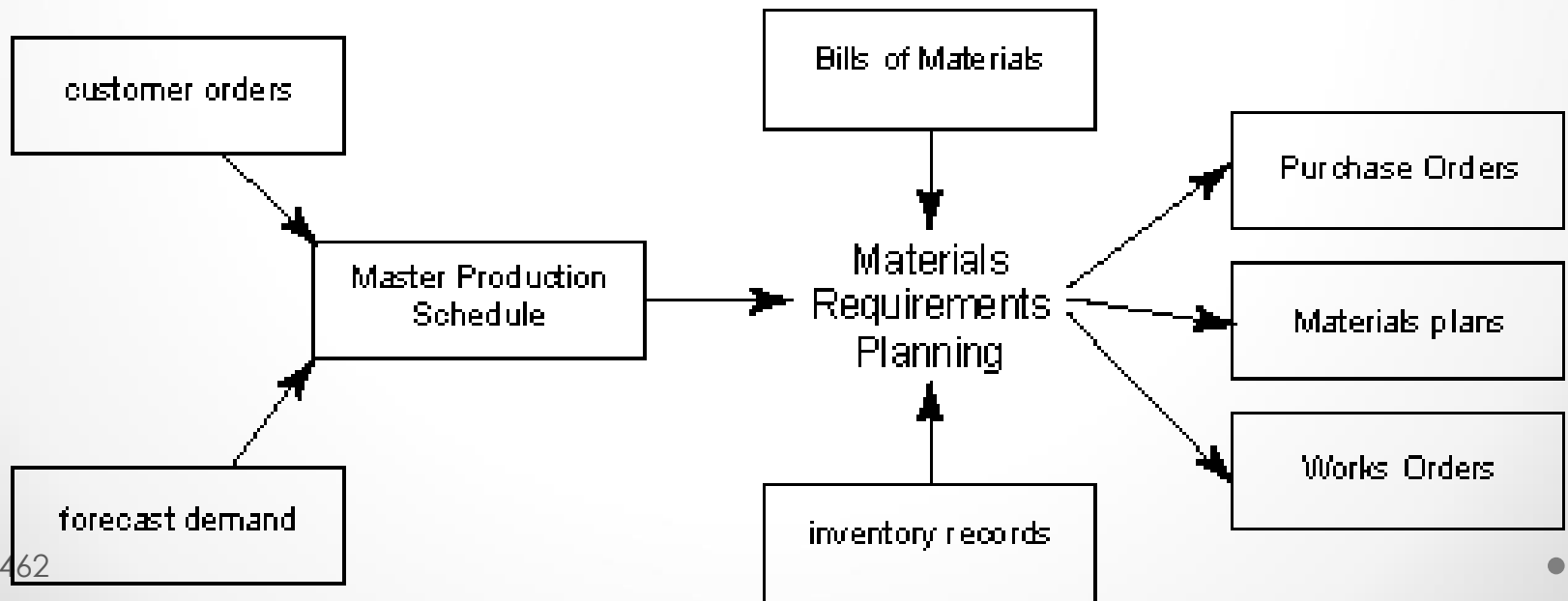
- Material Requirements Planning (MRP):
 - Represents a typical example of IIS for inventory/production management
 - Input to the MRP is the **Master Production Schedule (MPS)** through *sales order* or *warehouse stock replenishment request*
 - MPS contains *how much* and *when* (i.e. gross requirements)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



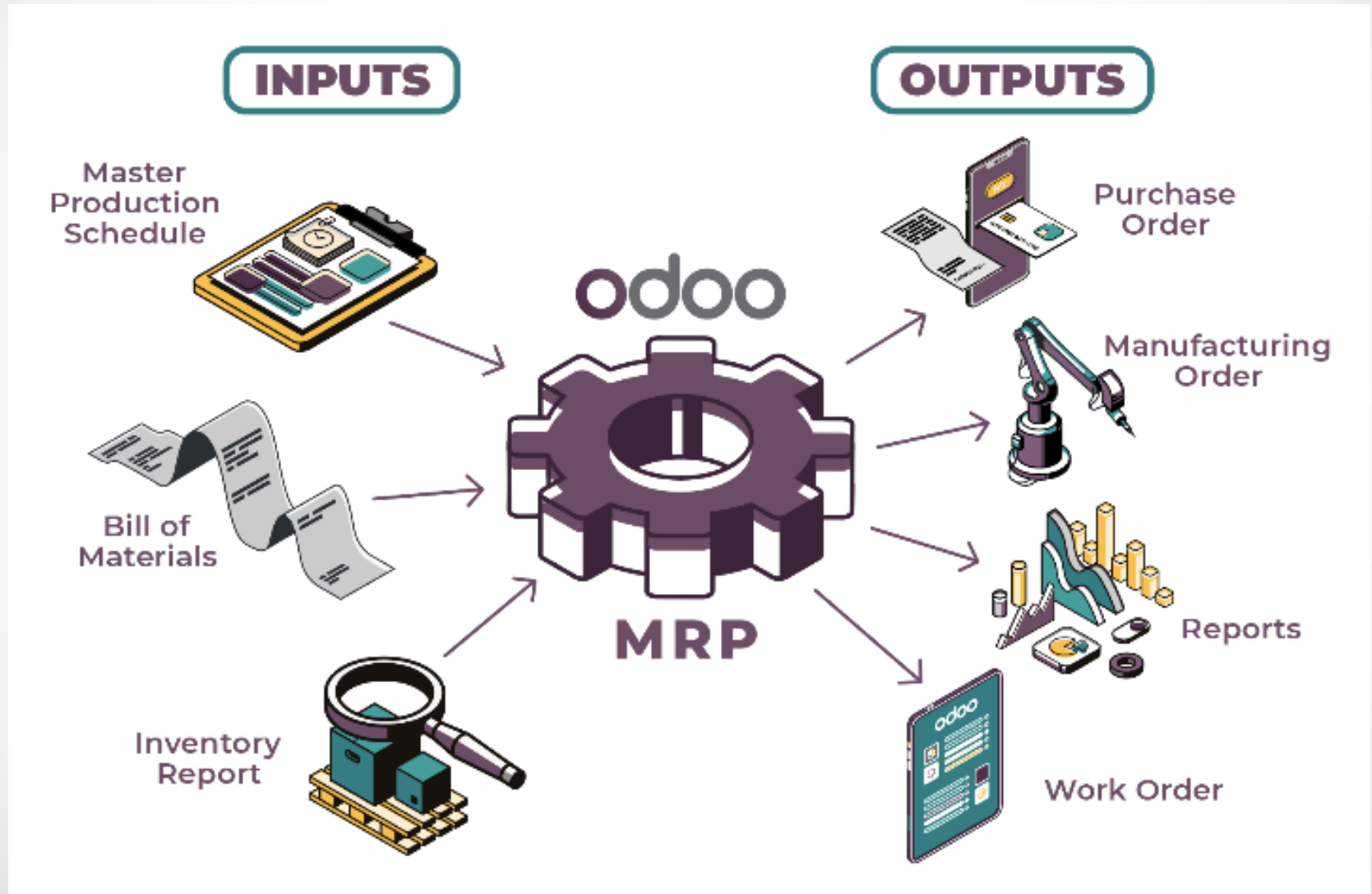
Production Plan for Week 2, December 09					
Demand Management	12/7	12/8	12/9	12/10	12/11
Monthly Demand for Product A	4000	4000	4000	4000	4000
Working Days in Month	23	23	23	23	23
MPS Daily Demand for Product A	174	174	174	174	174

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*

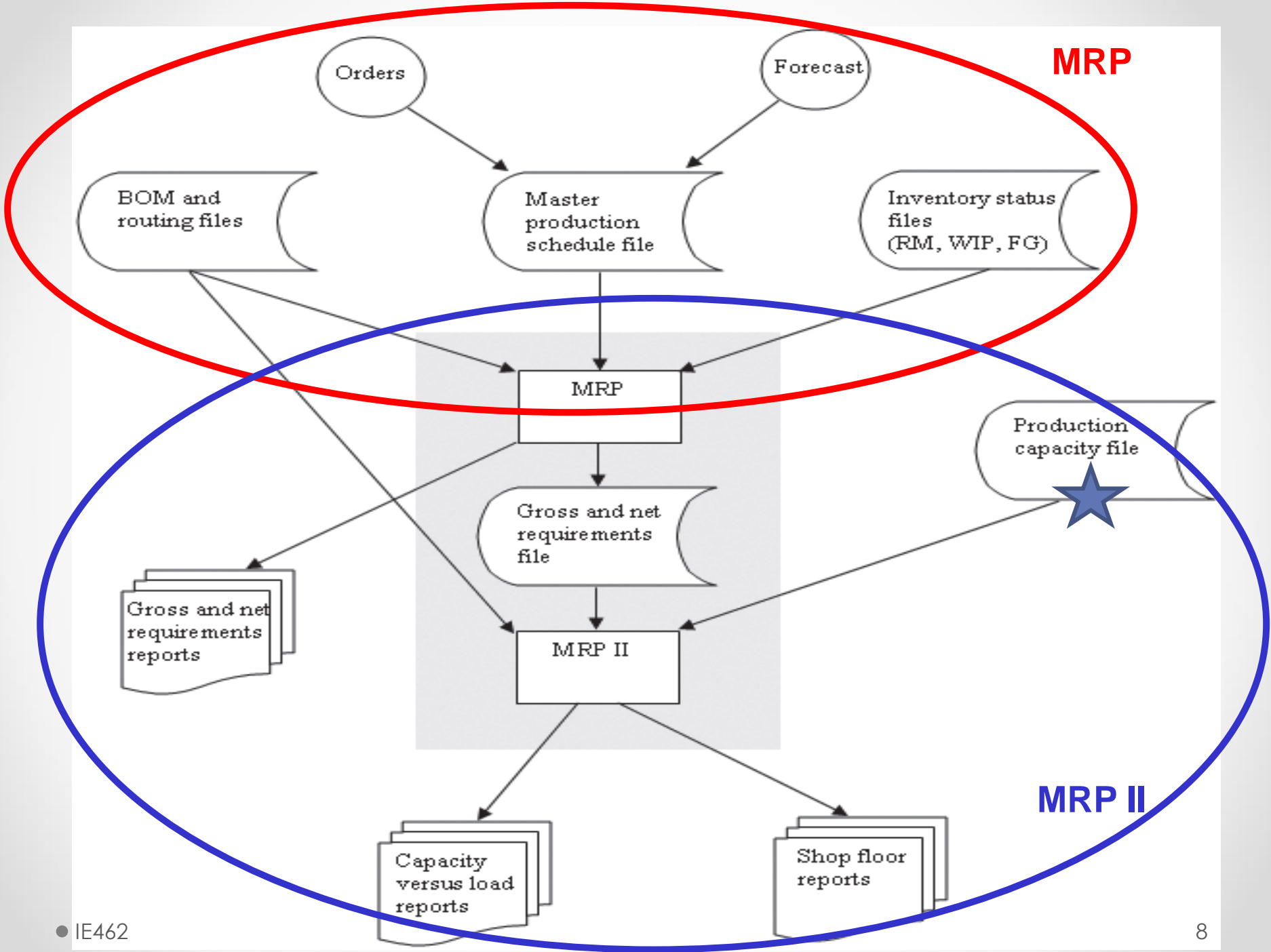


Material Requirements Planning as IIS (cont.)



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](#))



MRP

MRP II

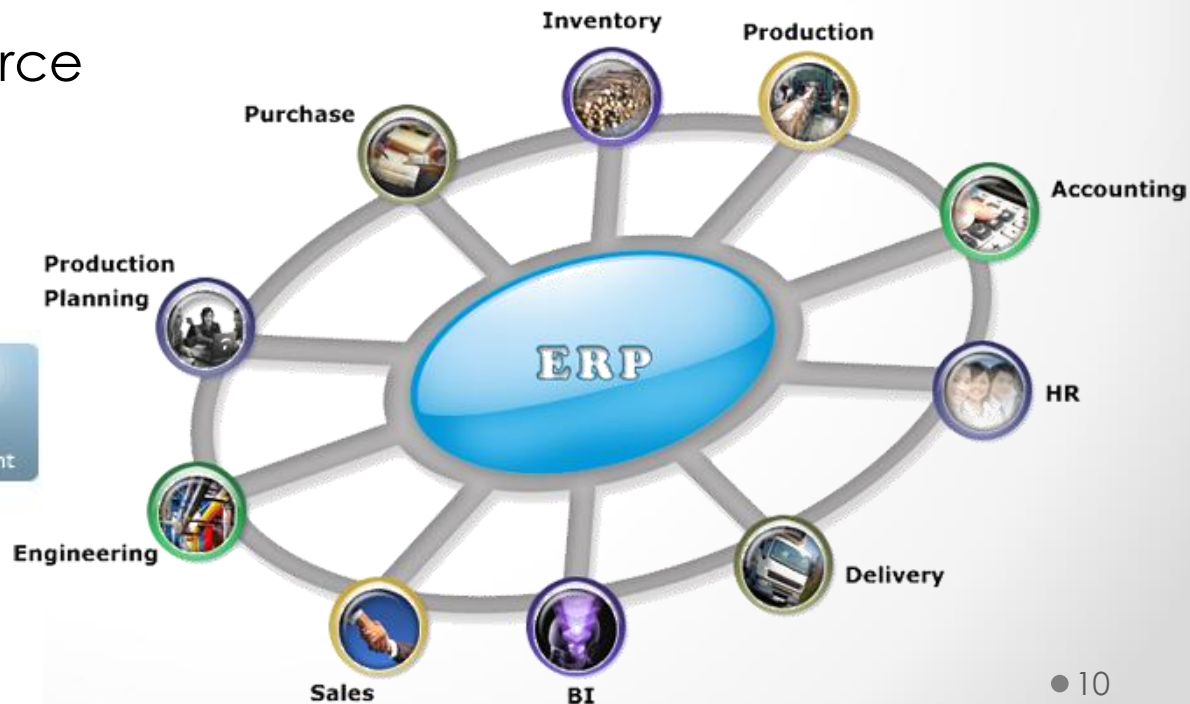
Enterprise Resource Planning (ERP)

- 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.)



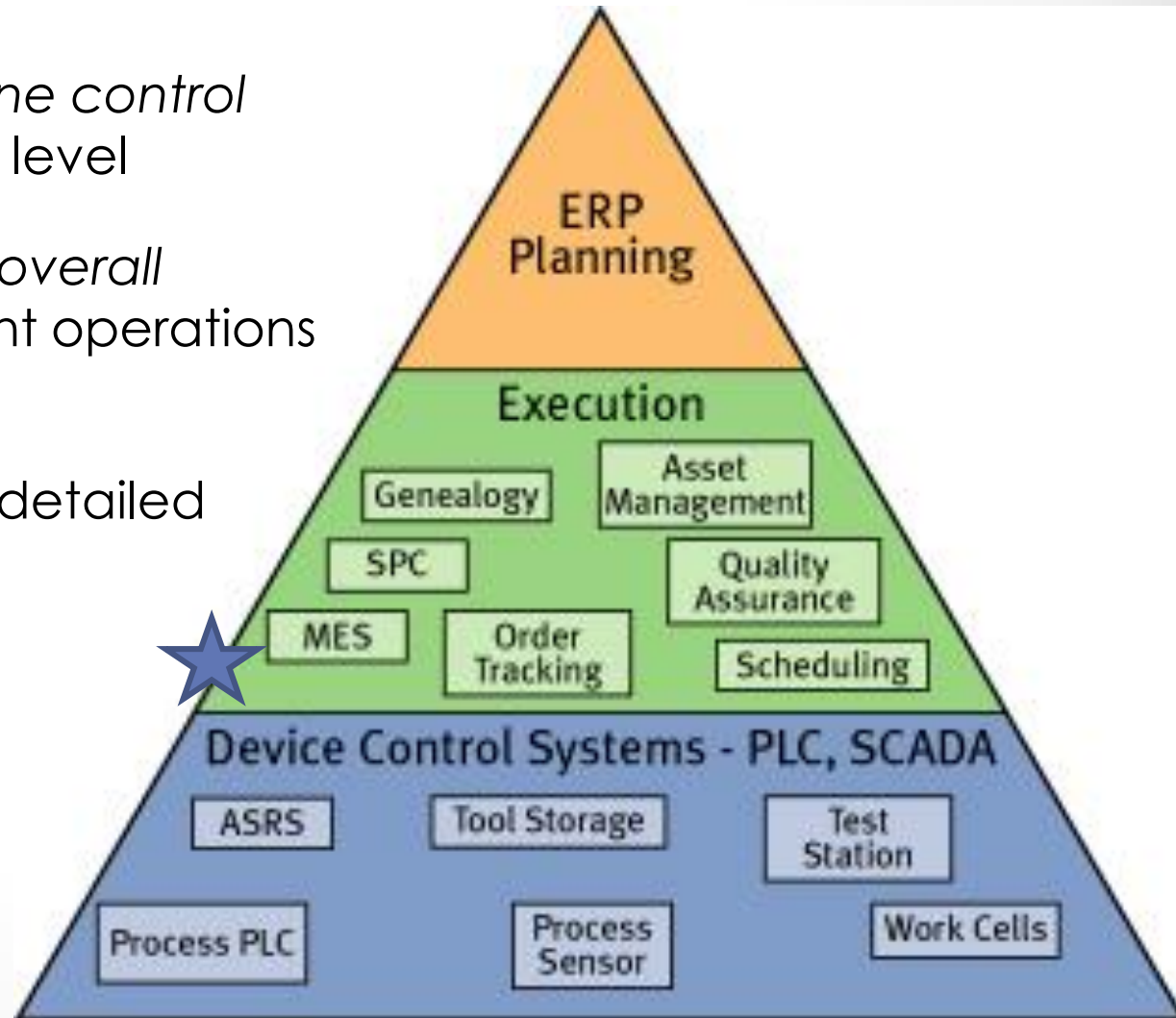
MES Functions

Typical MES functions include the following:

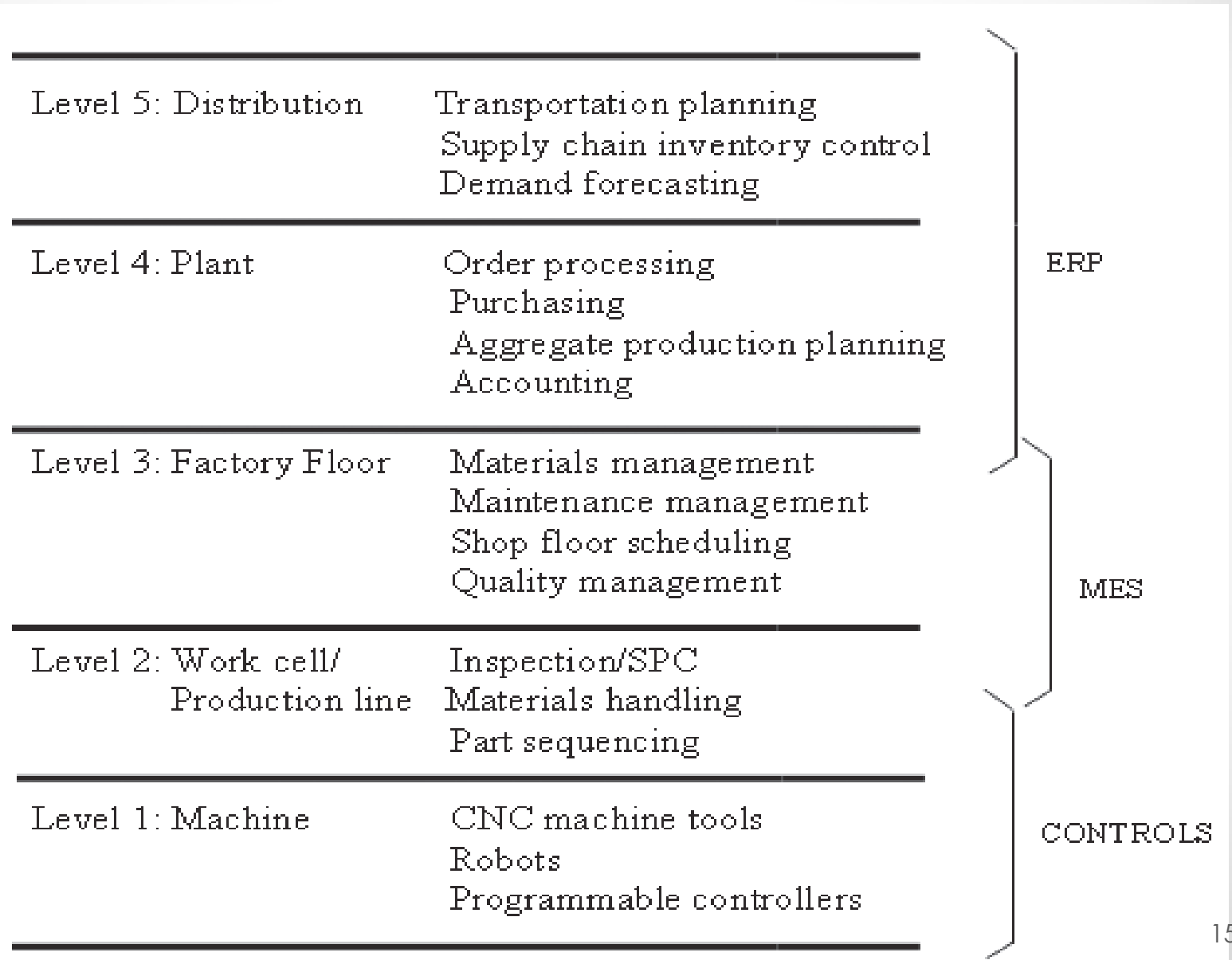
- Dispatching and monitoring production:
 - controlling the release of work orders to the shop floor
 - tracking work-in-process inventory
- Detailed scheduling
- Data collection:
 - from factory floor operation
 - provides a history of factory events
- Quality data analysis:
 - real-time analysis of 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)

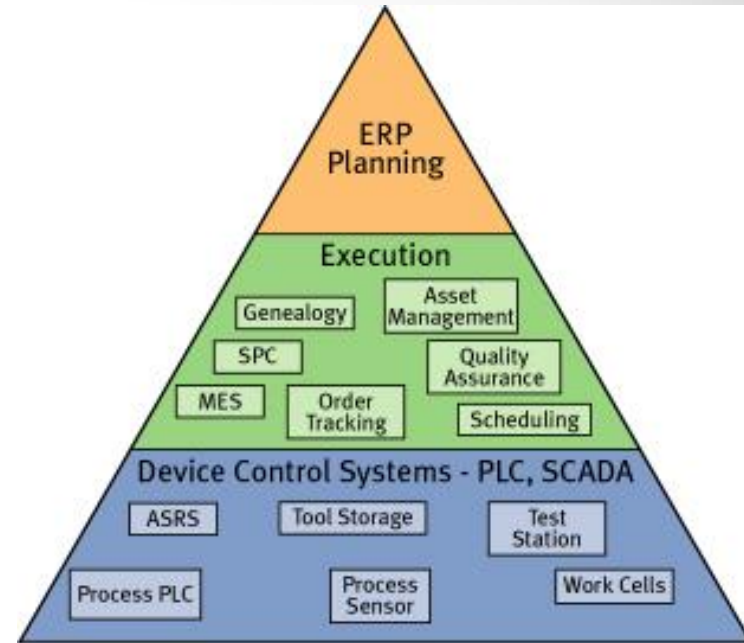


ERP/MES/Control: I.S. Hierarchy in Plant (cont)

- 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

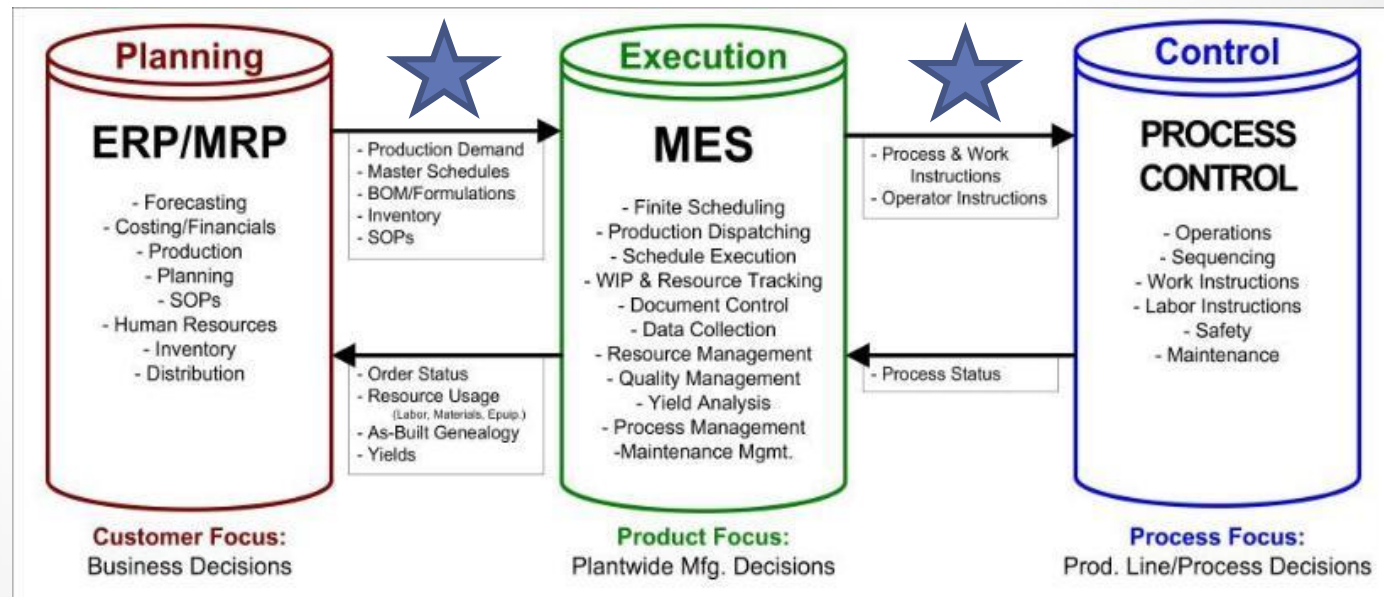
The Nature and Role of I.I.S.

- 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*



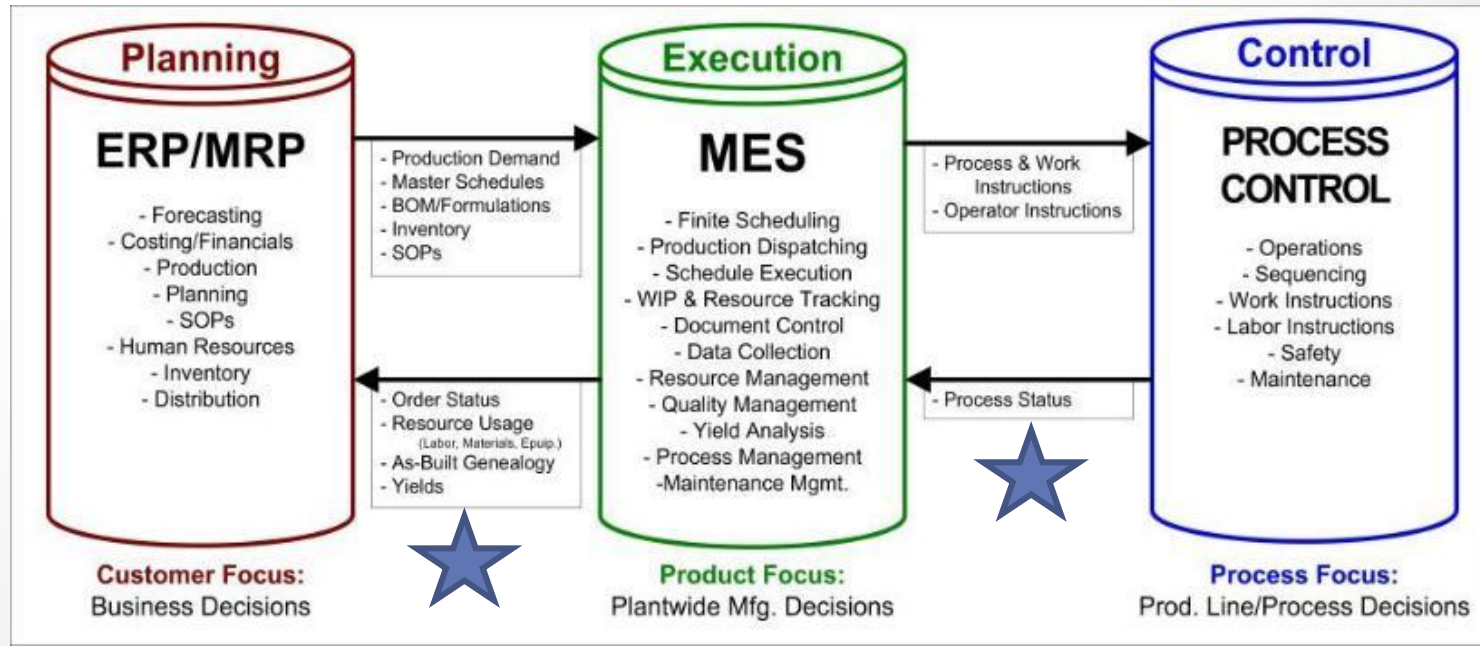
Information Flow within the I.S.

- 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**

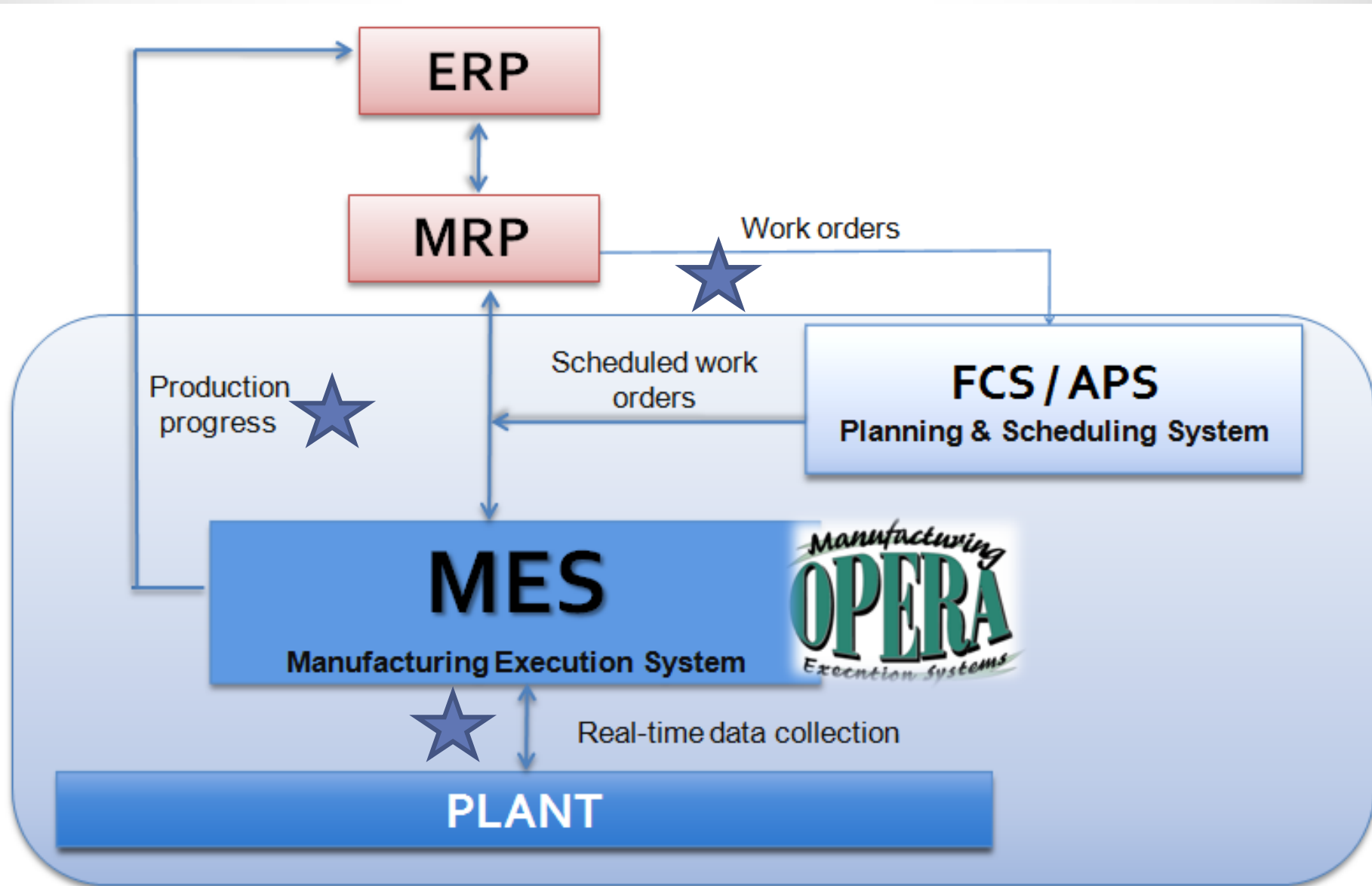


Information Flow within the I.S. (cont.)

- 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

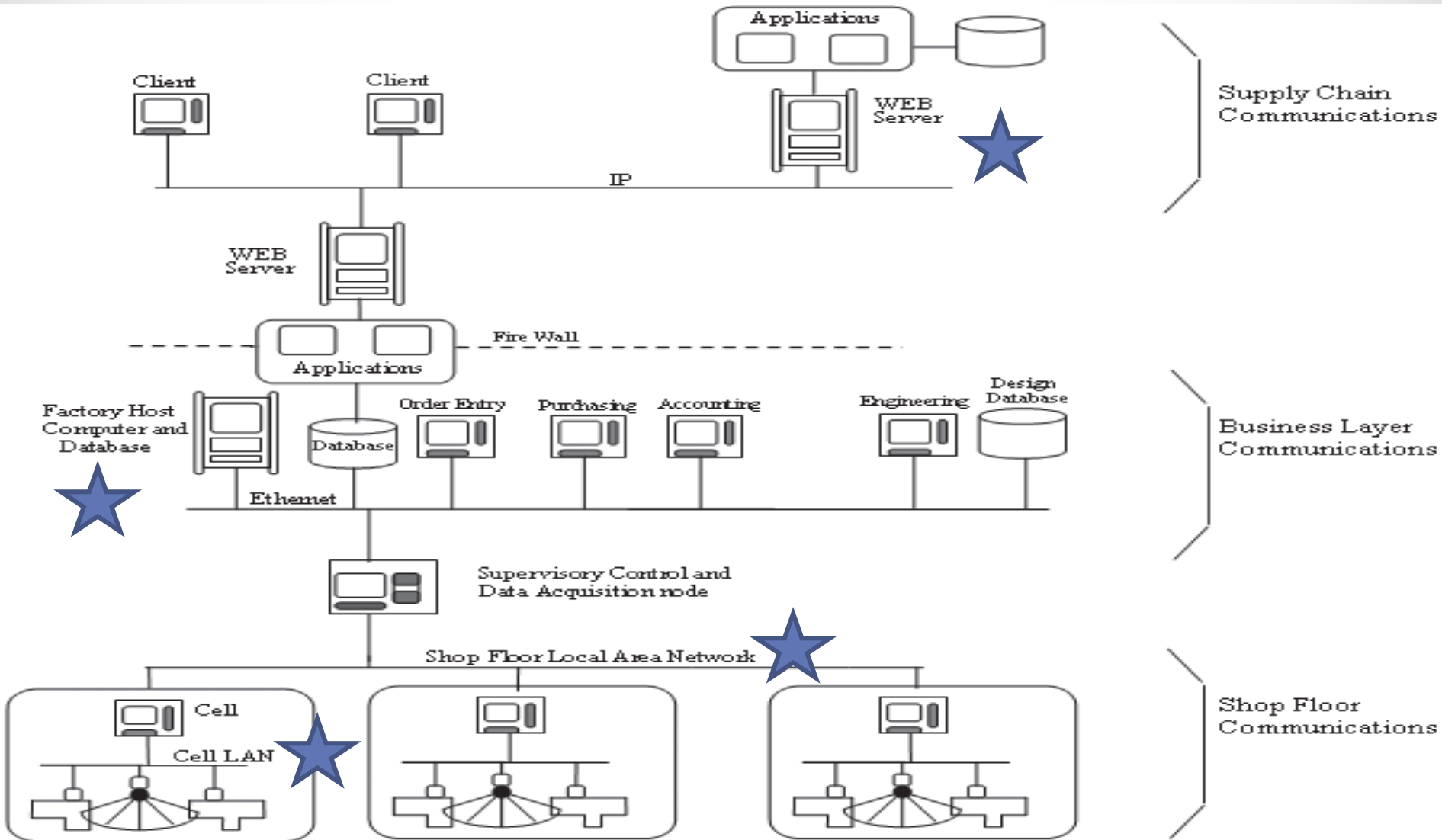


Network Architecture

- 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)

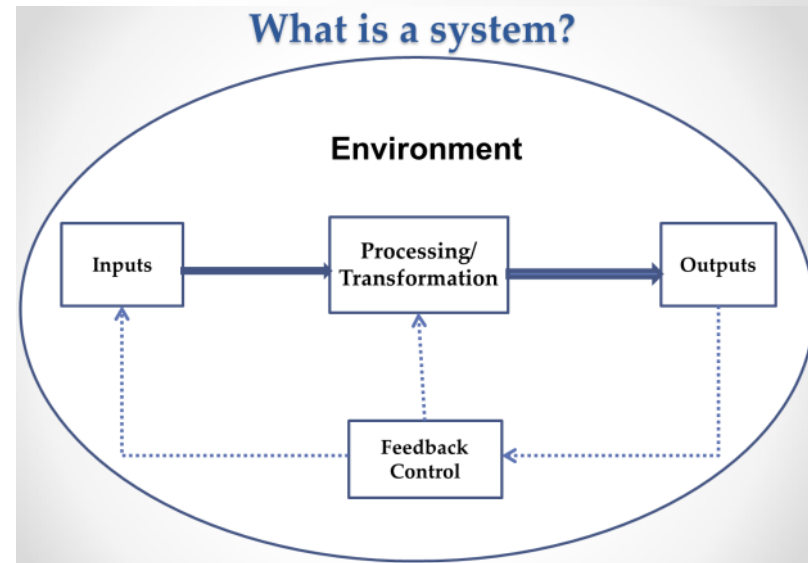


Typical Network Architecture for Modern Industrial Company



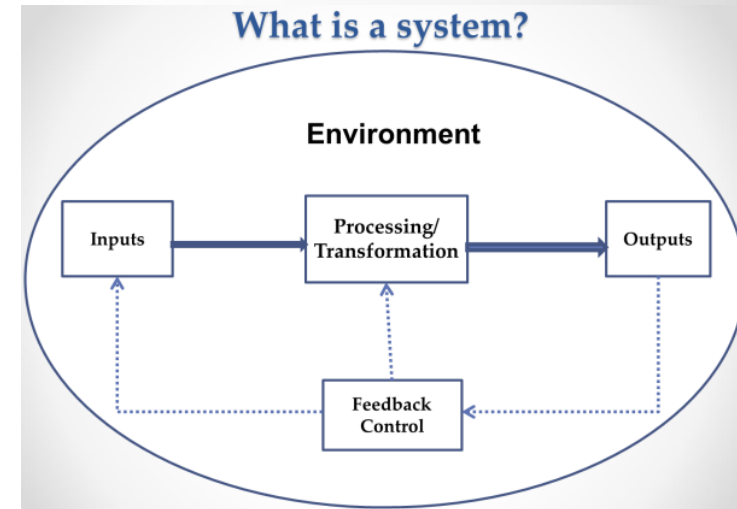
Functions of an Information System

- 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. MRP)

- **MRP Basics - 1**

https://youtu.be/eoLSZh35_LY (*Oracle*)

- **MRP Basics - 2**

<https://youtu.be/Dis3UYcEXVw> (*TechTarget*)

Videos to Watch (2. 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 (*Oracle*)
- **ERP – Short Case Study**
<https://youtu.be/C7Bp07T5img> (*Oracle*)

Videos to Watch (3. MES)

- **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.