King Saud University

College of Engineering

IE – 462: "Industrial Information Systems"

Spring – 2020 (2nd Sem. 1440-41H)

Introduction (Chapter 1)

part 2 – Introduction to Industrial Information Systems (IIS)

Prepared by: Ahmed M. El-Sherbeeny, 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

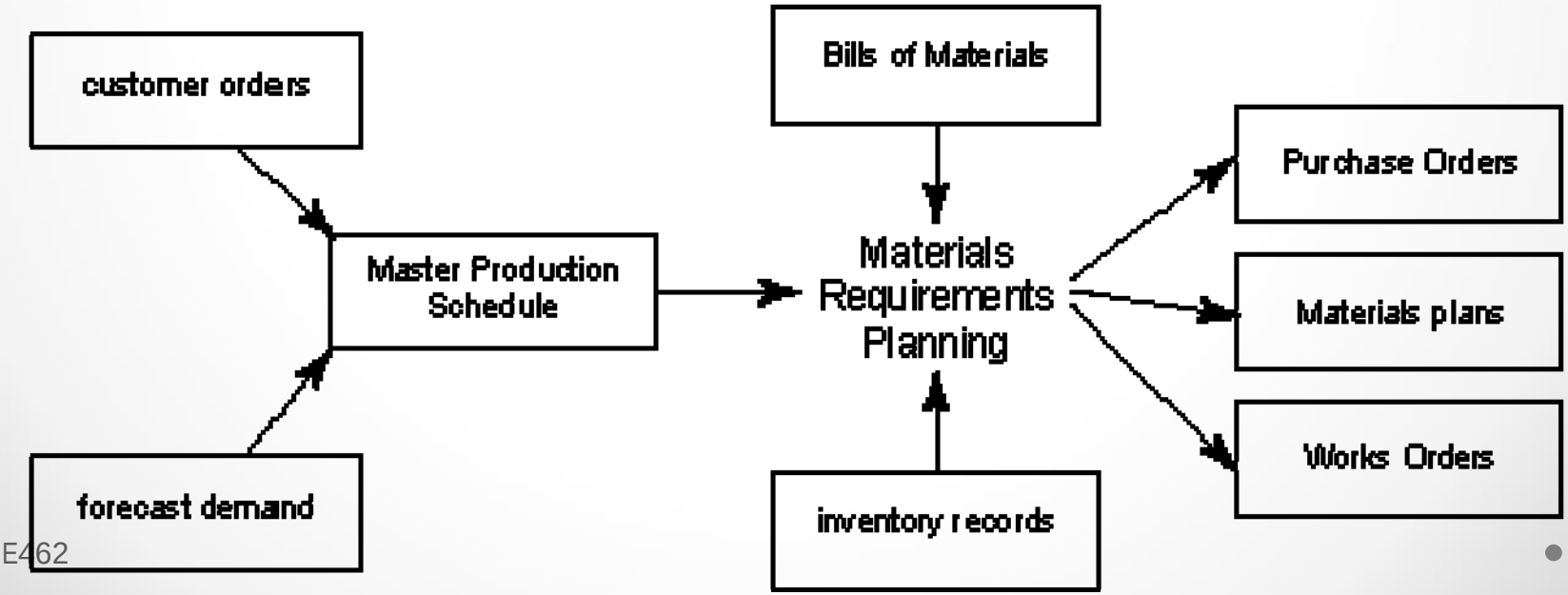
Material Requirements Planning as IIS

- 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):

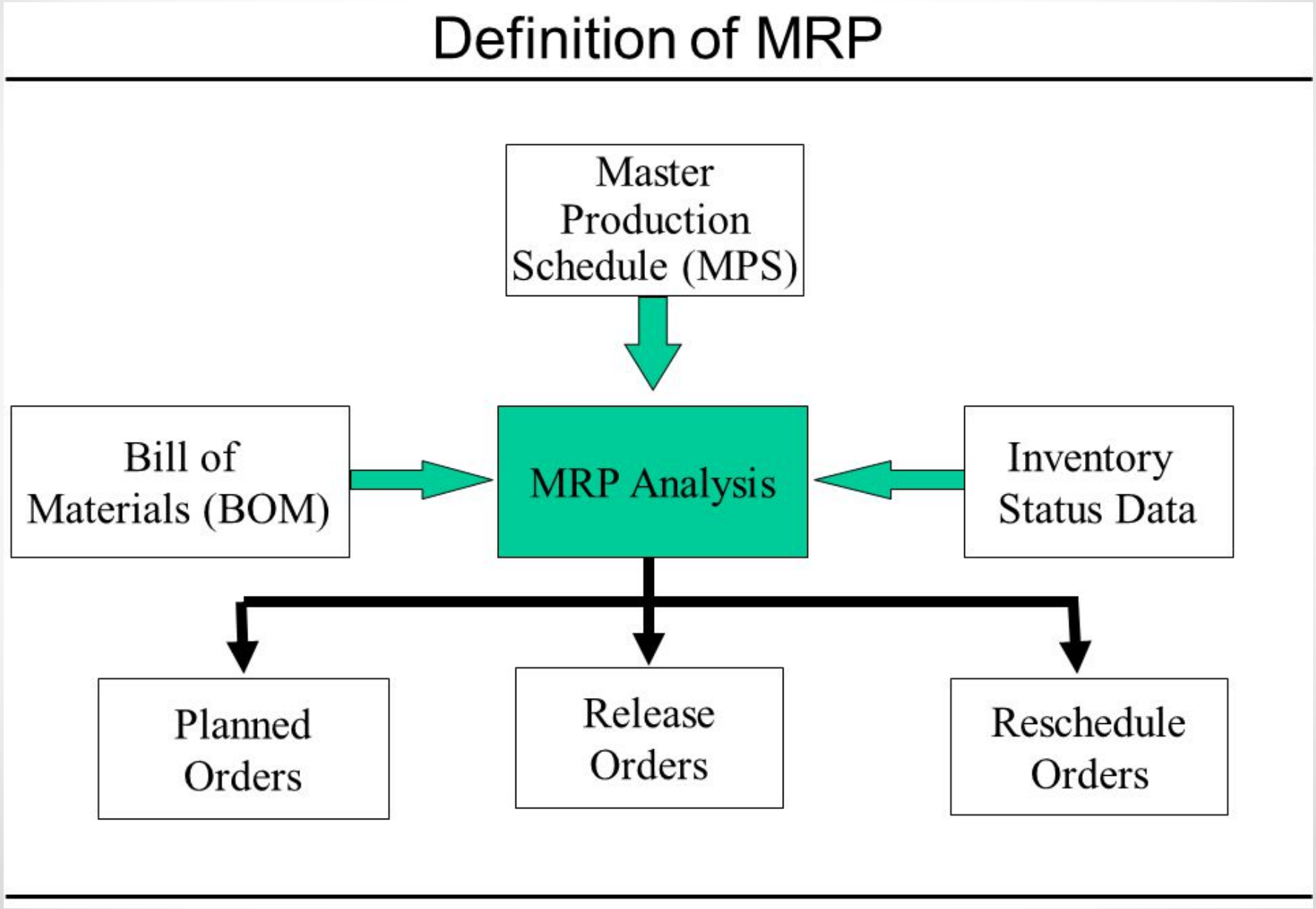
Production Plan for Week 2, December 09					
Demand Management	12/7	12/8	12/9	12/10	12/11
Monthly Demand for Product A	4000	4000	4000	4000	4000
Working Days in Month	23	23	23	23	23
MPS Daily Demand for Product A	174	174	174	174	174

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*

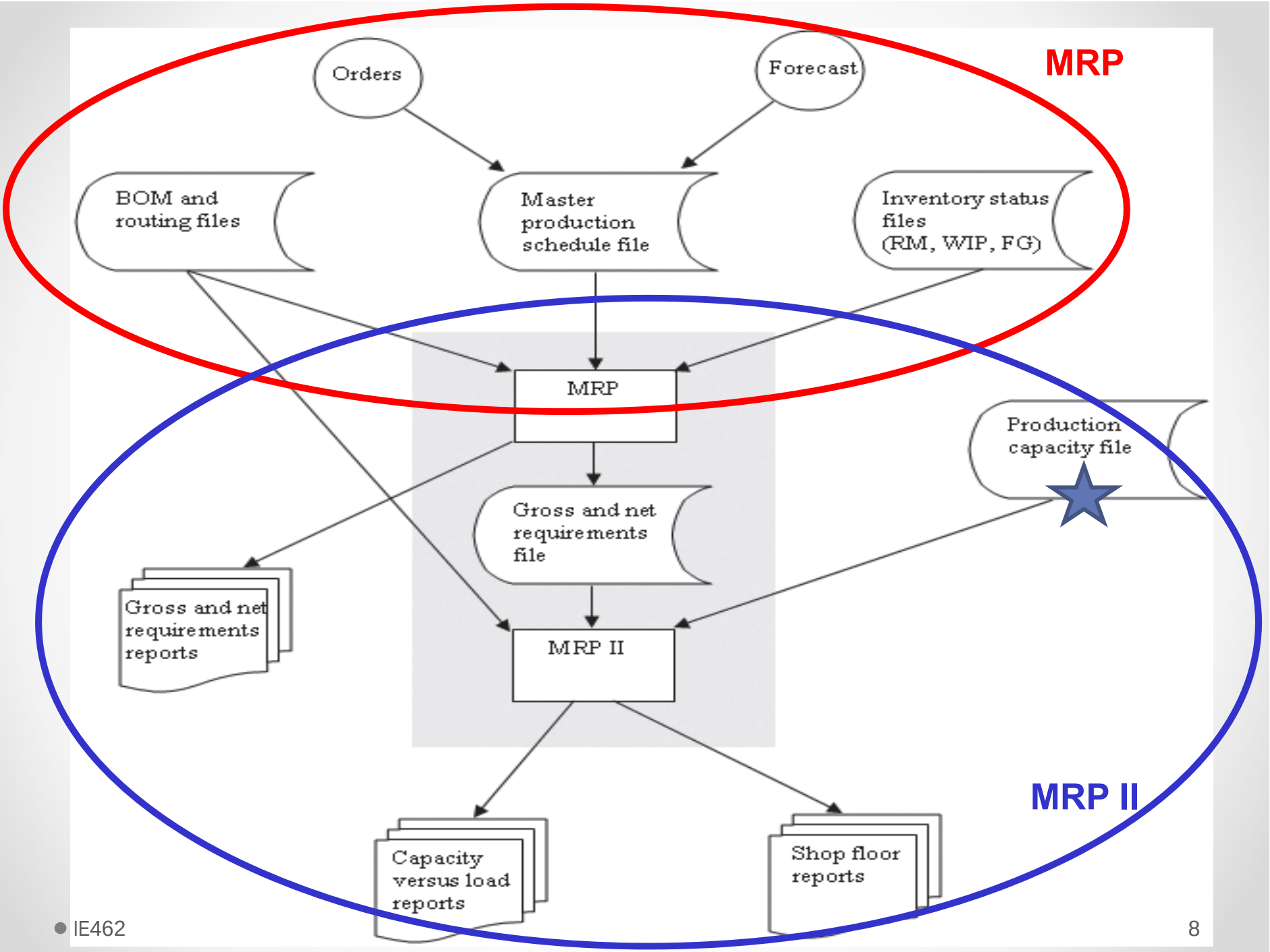


Material Requirements Planning as IIS (cont.)



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
Orders
Forecast
BOM and routing files
Master production schedule file
Inventory status files (RM, WIP, FG)
MRP
Production capacity file
Gross and net requirements file
Gross and net requirements reports
MRP II
MRP II
Capacity versus load reports
Shop floor reports

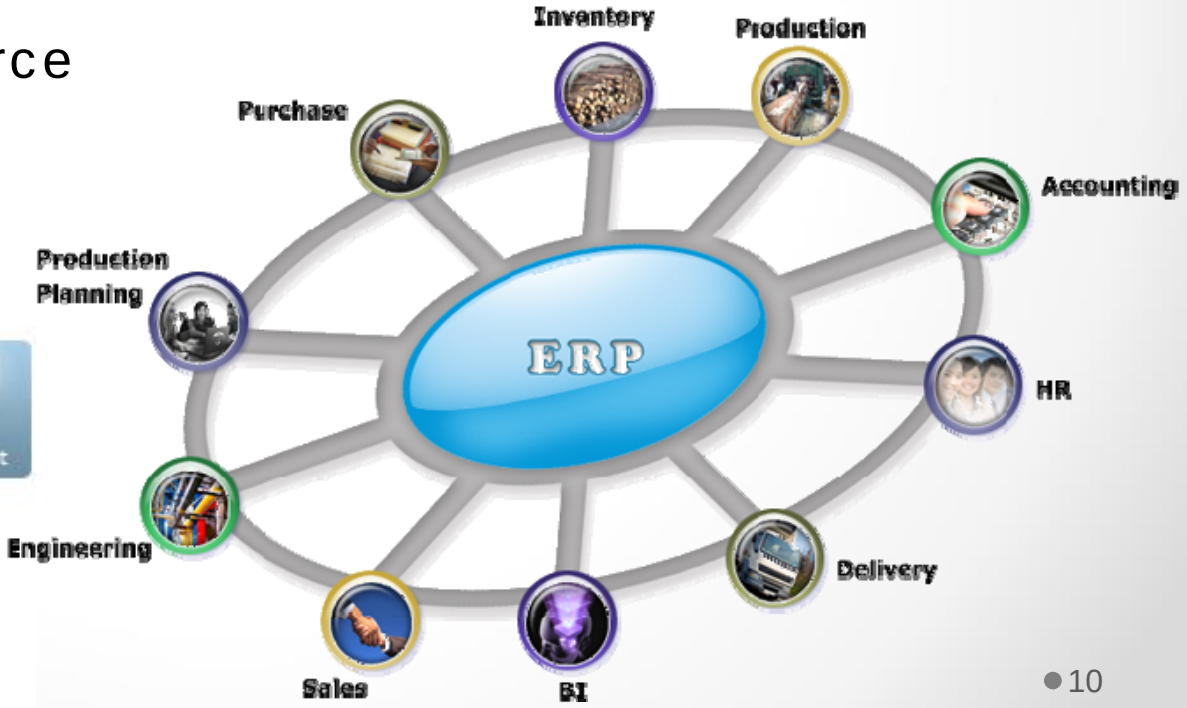
Enterprise Resource Planning (ERP)

- 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.*)

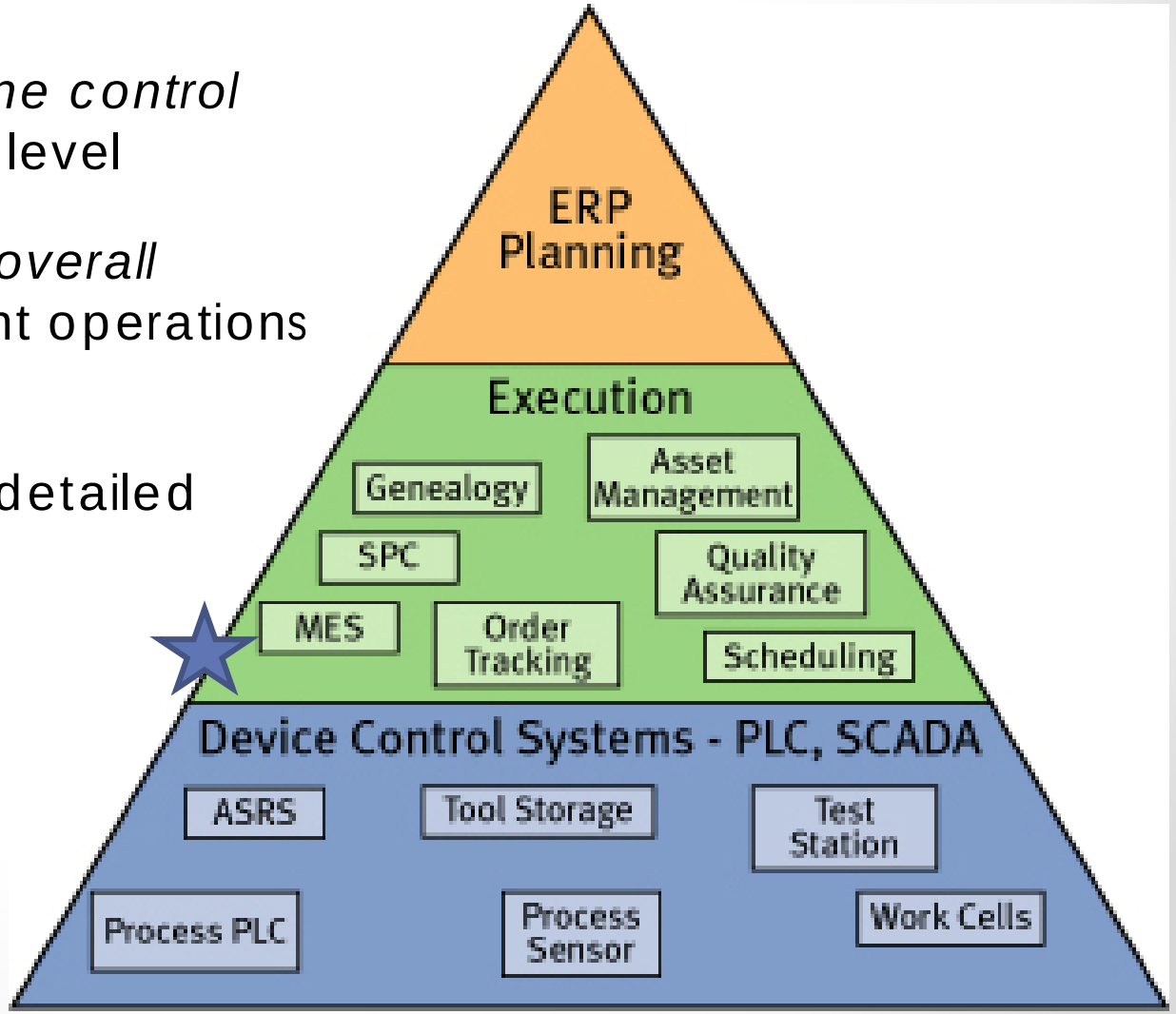
MES Functions

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)

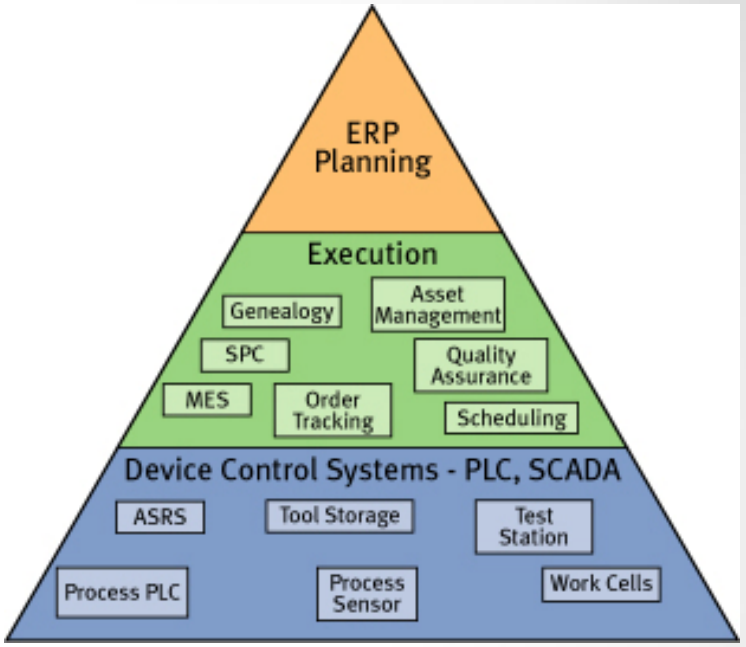
Level 5: Distribution	Transportation planning Supply chain inventory control Demand forecasting	ERP
Level 4: Plant	Order processing Purchasing Aggregate production planning Accounting	
Level 3: Factory Floor	Materials management Maintenance management Shop floor scheduling Quality management	MES
Level 2: Work cell/ Production line	Inspection/SPC Materials handling Part sequencing	
Level 1: Machine	CNC machine tools Robots Programmable controllers	CONTROLS

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.

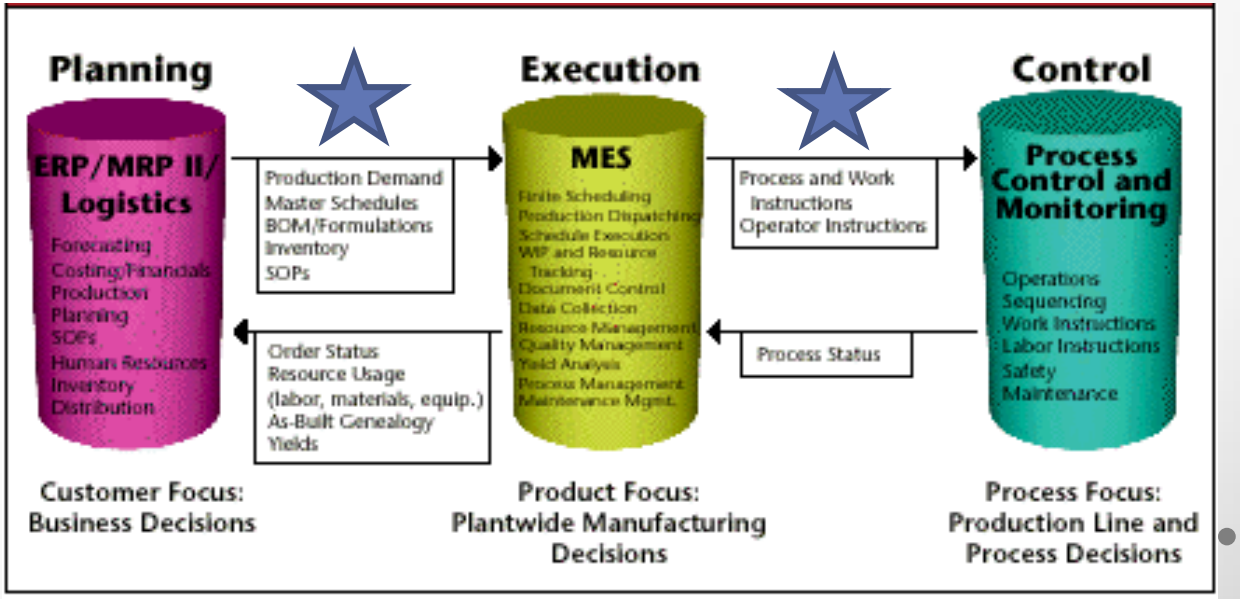
- Industrial system is modeled as a *hierarchy of decisions:*
  - where the ***upper levels*** of the hierarchy place *constraints* and …
  - control *decisions* on each succeeding ***lower level***



- Domain of an IIS:
  - *complete* integration of all levels of decision processes
  - supported by *computer information systems*

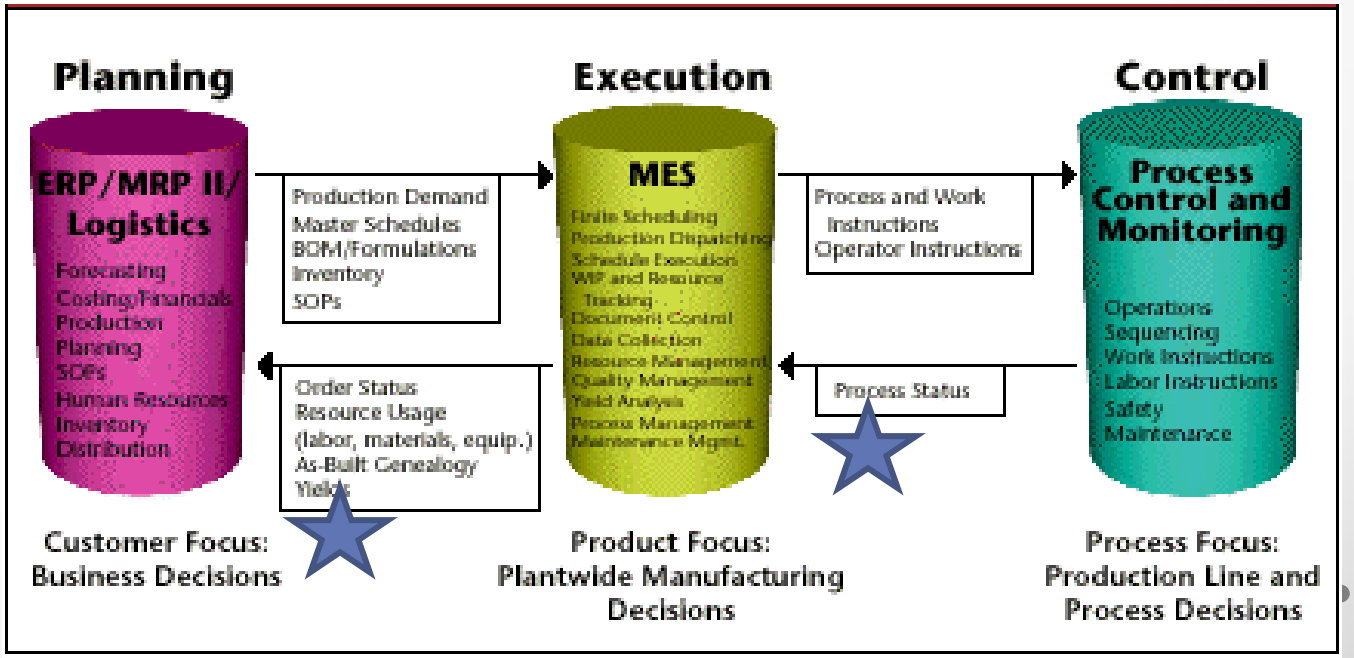
Information Flow within the I.S.

- 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**

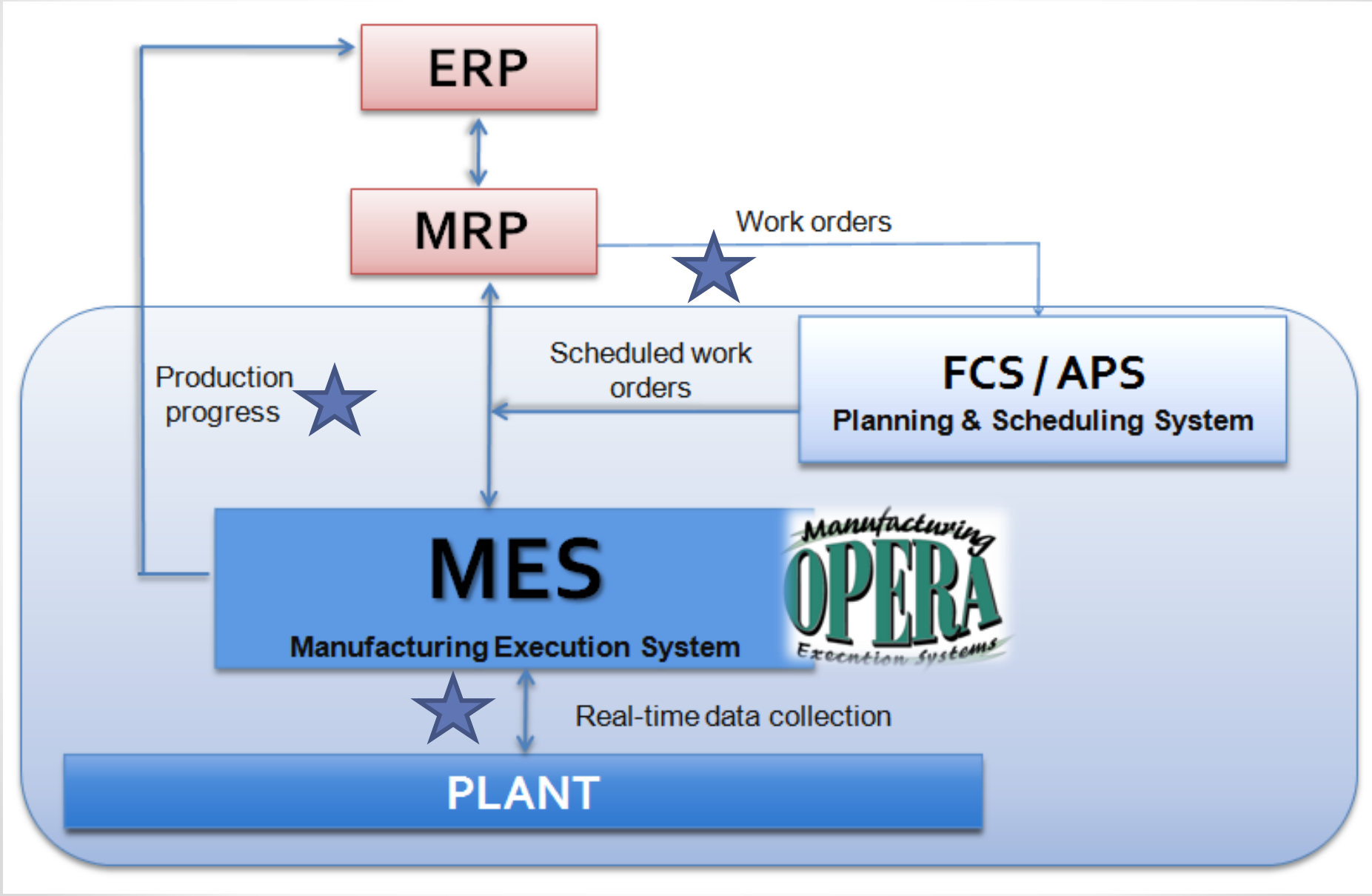


Information Flow within the I.S. (cont.)

- 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



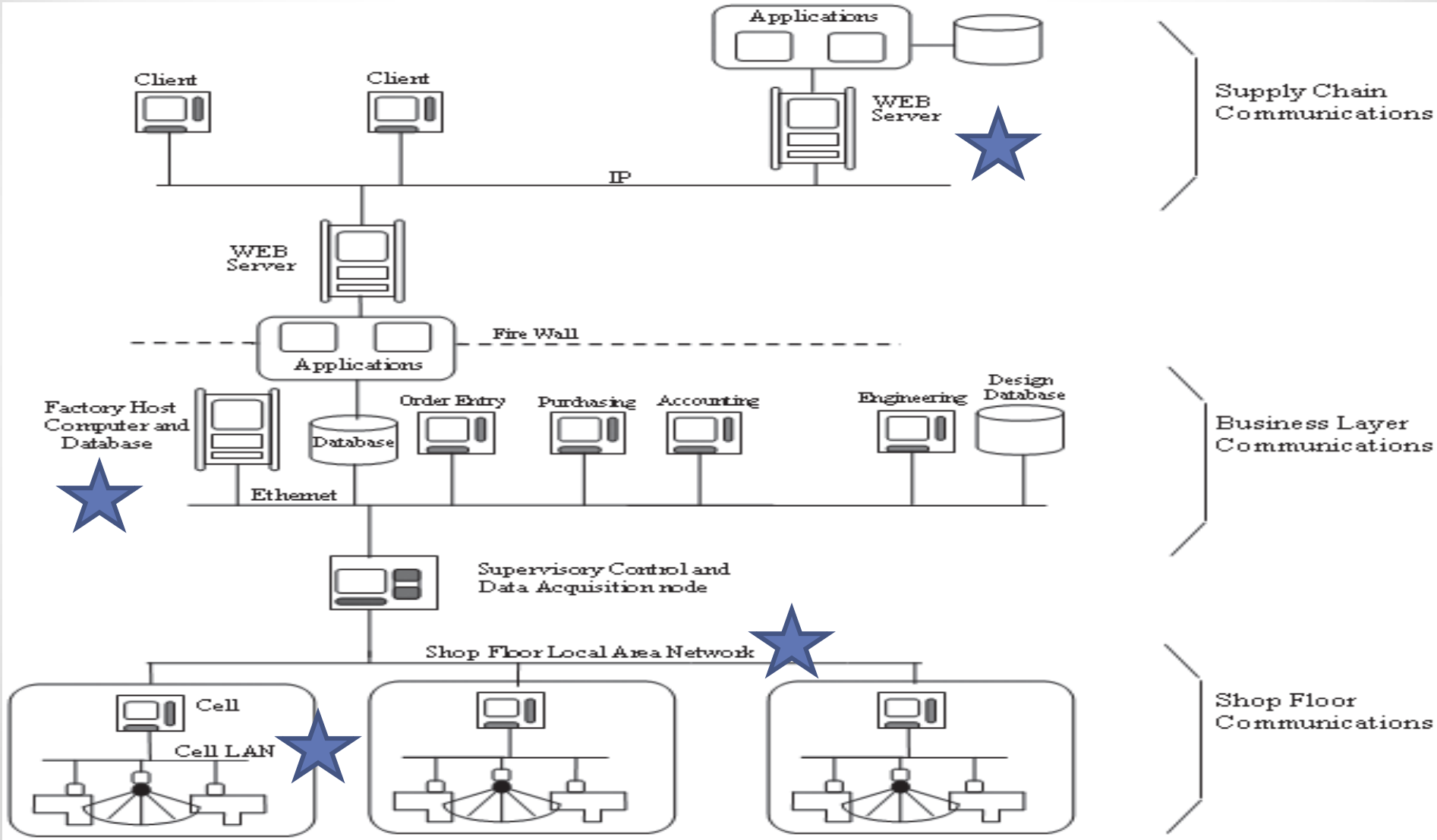
Coordinating Layer Interaction in the IIS



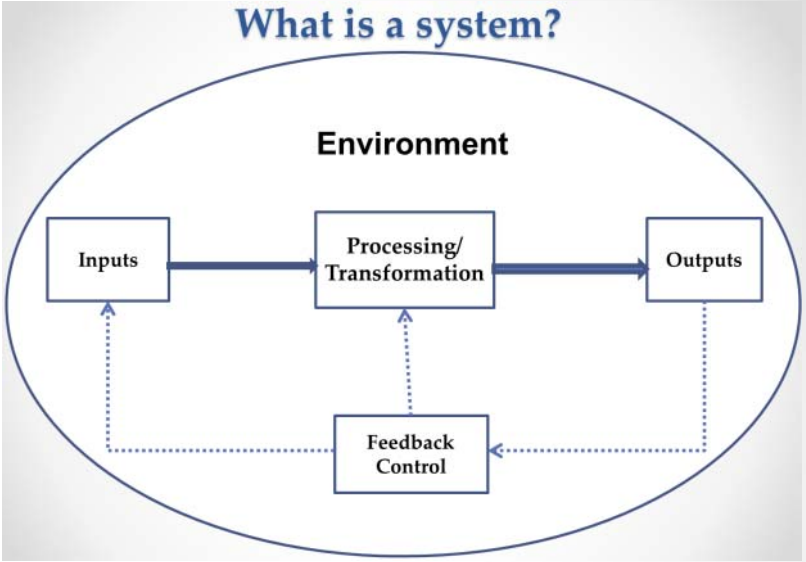
Network Architecture

- 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

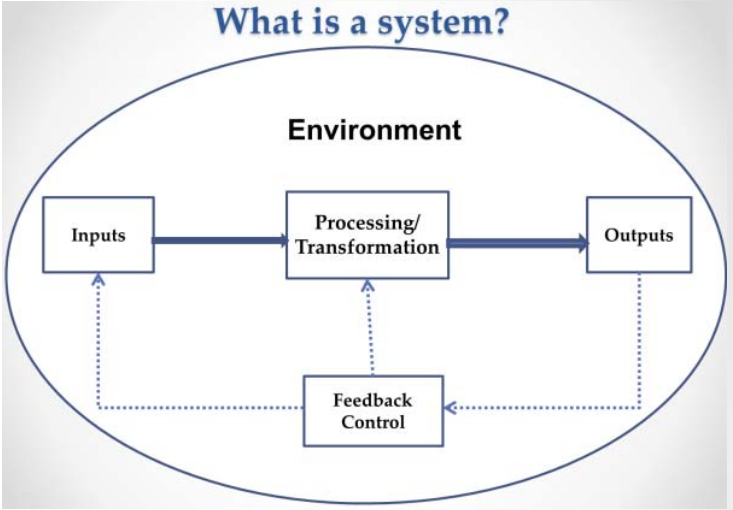


Functions of an Information System



- 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)

Sources

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