# King Saud University

College of Engineering

IE – 462: "Industrial Information Systems"

Fall – 2022 (1st Sem. 1444 H)

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

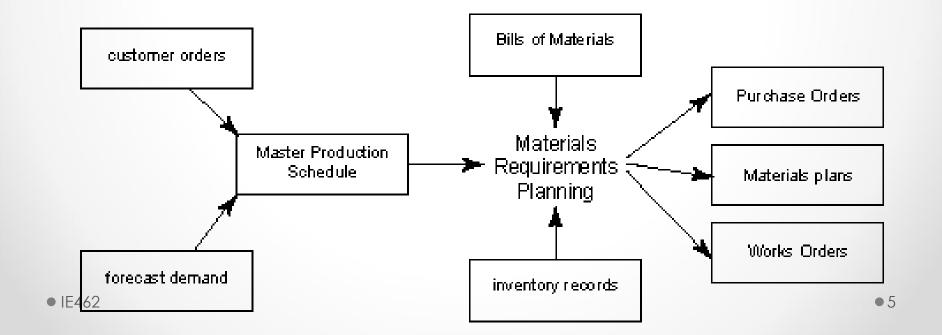


- Input to the MRP is the Master Production Schedule (MPS)
   through sales order or warehouse stock replenishment request
- MPS contains how much and when (i.e. gross requirements) for finished product units (see e.g. below):

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

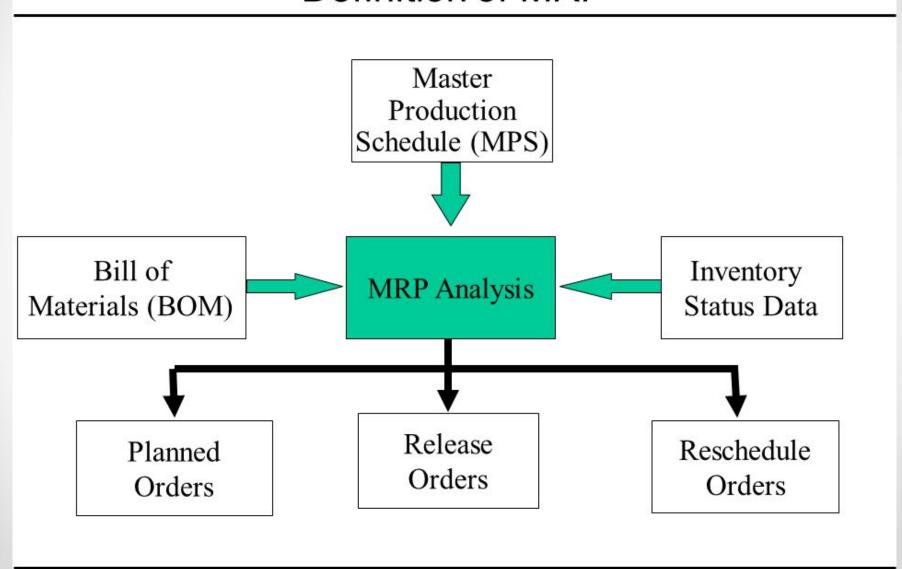
# Material Requirements Planning as IIS (cont.)

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



# Material Requirements Planning as IIS (cont.)

#### Definition of MRP

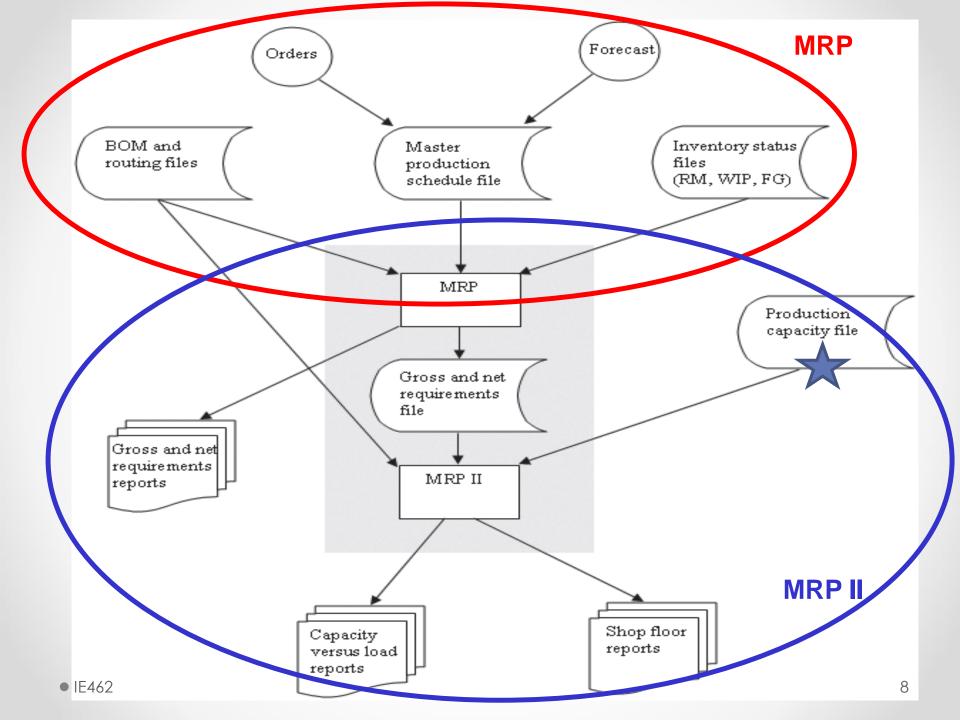


# Material Requirements Planning as IIS (cont.)

#### 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)

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# **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



# **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
  - o provides a history of factory events
- Quality data analysis:
  - real-time analysis of manufacturing
  - notification of out-of-tolerance values
  - o 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 <u>next slide</u>

Device Control Systems - PLC, SCADA

ASRS Tool Storage Test

Order

Tracking

ERP Planning

Execution

Genealogy

SPC

Asset

Management

Quality Assurance

Scheduling

Station

Process PLC

Process Sensor Work Cells

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

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

ERP

MES

CONTROLS

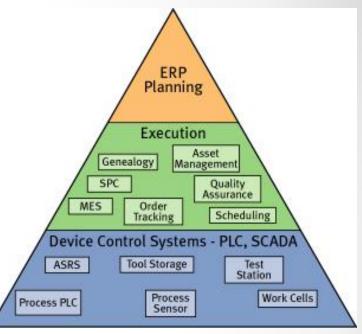
# ERP/MES/Control: I.S. Hierarchy in Plant (cont)

- 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

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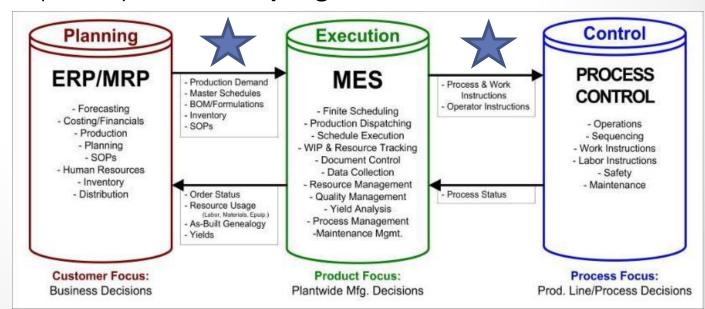
#### The Nature and Role of I.I.S.

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



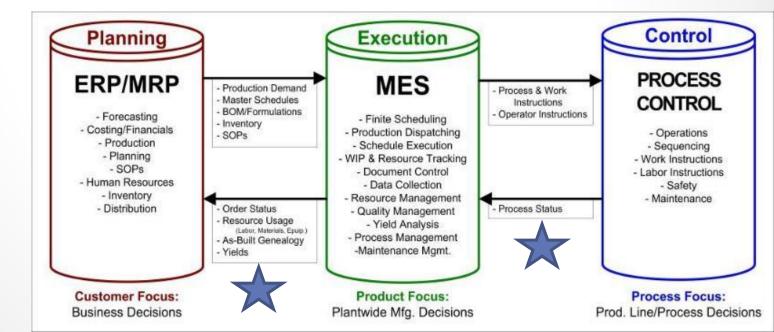
#### Information Flow within the I.S.

- 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

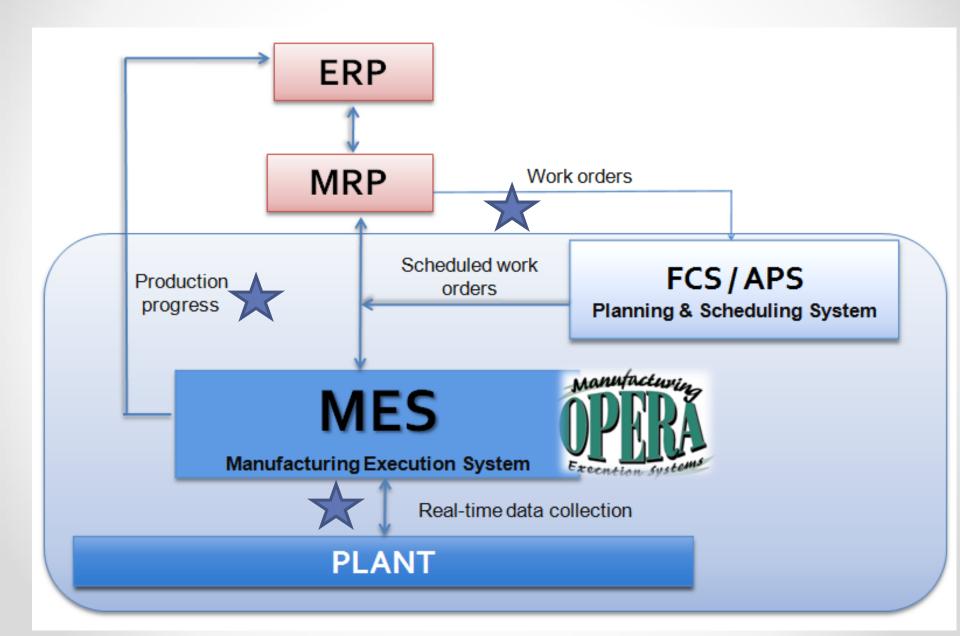


## Information Flow within the I.S. (cont.)

- 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 <u>next slide</u>



# **Coordinating Layer Interaction in the IIS**



### **Network Architecture**

MRP IANUFACTURIN RESOURCE PLANNING

CRM

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

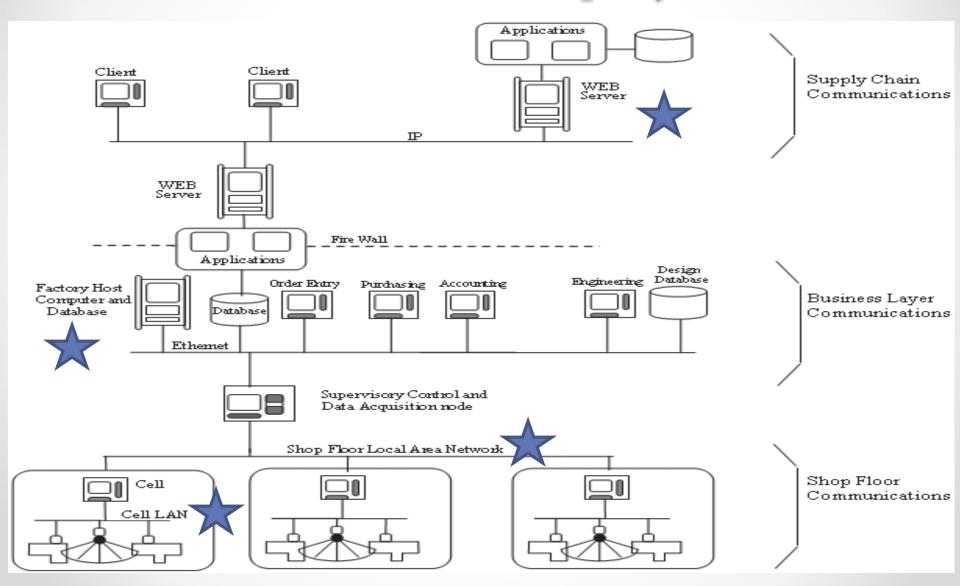
#### Network architecture

- 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)

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HRM

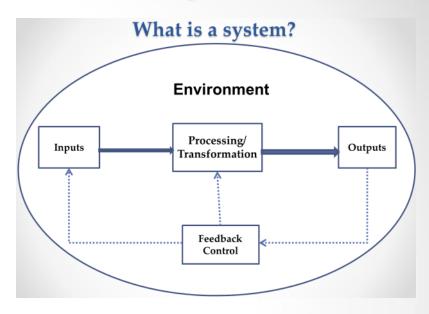
# Typical Network Architecture for Modern Industrial Company



## **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:
  - o database management system (DBMS) extracts necessary
- 1E462 processed data as information needed for decision making 23

# Functions of an Information System (cont.)

- Data processing:
  - computation or summarization
  - includes all transformation process on input data into information
- Environment

  Processing/
  Transformation

  Outputs

  Feedback
  Control
- 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)

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#### Videos to Watch (1. MRP)

MRP Basics - 1
 https://youtu.be/eoLSZh35\_LY (Oracle)

MRP Basics - 2
 https://youtu.be/Dis3UYcEXVw (TechTarget)

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### Videos to Watch (2. ERP)

- ERP Basics 1
   https://youtu.be/6qys-562kp4
   (Arcus Universe)
- ERP Basics 2 (longer video)
   <a href="https://youtu.be/PVRgIXLWDHs">https://youtu.be/PVRgIXLWDHs</a> (Jonar Systems)
- ERP Cloud https://youtu.be/c9HfNg4a\_Og
   (Oracle)
- ERP Short Case Study
   <a href="https://youtu.be/C7Bp07T5img">https://youtu.be/C7Bp07T5img</a> (Oracle)

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### Videos to Watch (3. MES)

- MES Short Case Study 1
   https://youtu.be/cKo1foTkE-k
   (Crossroads RMC)
- MES Short Case Study 2
   <a href="https://youtu.be/tkq56lE0Nb0">https://youtu.be/tkq56lE0Nb0</a> (GE Digital)

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#### **Sources**

 <u>Design of Industrial Information Systems</u>. Thomas Boucher, and Ali Yalcin. Academic Press. First Ed. 2006. Chapter 1.

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