

Summary

In this lesson, MES primary functions are shown

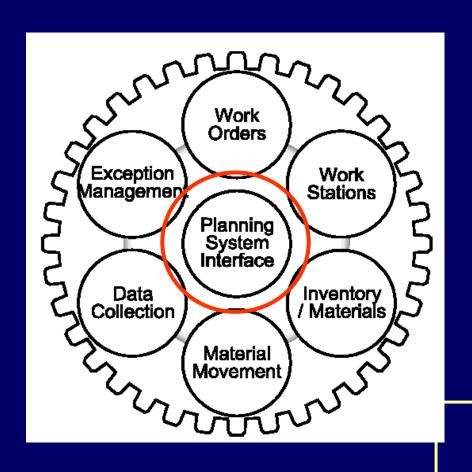
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MES PRIMARY FUNCTIONS

Functions generally present in any MES and directly connected to production

They are also taken into account as MES core functions

PLANNING SYSTEM INTERFACE



PLANNING SYSTEM INTERFACE

- Between MES and the planning level (ERP/MRPII) a bidirectional flow must be supported
- MES must support such function

PLANNING SYSTEM INTERFACE WHY?

Different position of the decision:

- Planning is settled in a management centre
- MES in the shopfloor

Different primary objectives:

- Planning focuses on customer
- MES focuses on the product

PLANNING SYSTEM INTERFACE WHY?

Other motivations:

Different time horizon:

- Planning: off-line, batch, medium term
- Execution: on-line, batch, soft real-time

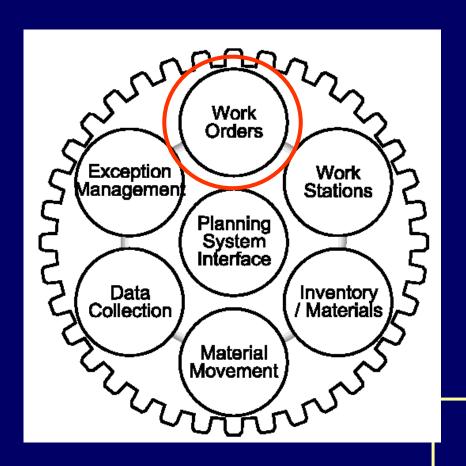
Similar information which is sometimes managed in concurrency

INFORMATION FLOW PLANNING2MES

- ⇒ Production request (MPS, Master Production Schedule)
- Resources
- Orders
- Inventory state
- **----**

INFORMATION FLOW MES2PLANNING

- Current state of order (start, duedate, completion time)
- Current state / use of the machines and of the work power
- Current / state use of the raw material
- **-** ...



MES automatically or manually accepts information related to what, how much, and when producing

This is usually specified in «work orders» containing:

- Identifier of the item to be produced
- The quantity
- Delivery time
- Priority
- ...
- The MES module implementing such function is able to:
 - Modify orders
 - Assign and manage their scheduling
 - Manage a planned sequence of orders with priorities

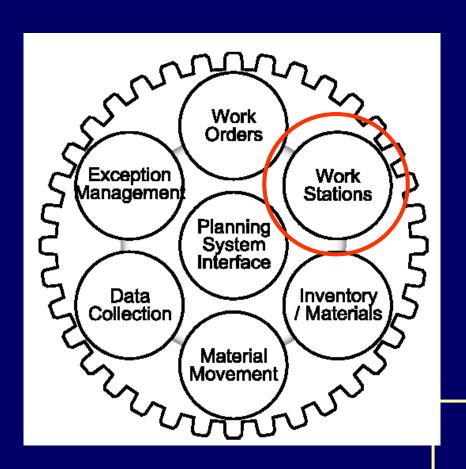
- Assign and/or delete material assignment to product
 - -Although it is already done at planning level it can be redone at MES level.

Examples of frequent operations done in this module are:

- Modify scheduling of orders
- Modify quantity
- Modify "routing" in production
- Split orders in smaller orders
- Join orders in larger orders

- Mark an order as "missing material"
- Assign a state (e.g. waiting) to an order
- Add messages and notes to orders
- Make simulations «what-if» or a query
- Define and assign priorities

→ In conclusion, this function allows to make an on-line view of pending orders and their current state



- **⇒** The MES module implementing this function is able to:
 - Implement order schedule
 - «Program» work stations (plan, schedule, load the program)

- MES are highly customized and they allow the definition of a logic production model
- This model is based on a list of all production units, work stations, and their operations

→ This information is put in relationship allowing to retrieve the information on which work station can do that/those operation

PROD. UNIT	WORK	OPERATION	DESCRIPTION
ABC	0001	112	Punching
ABC	0001	114	Drilling
ABC	0044	119	Welding
DEF	1230	220	Smoothing
MNO	4422	460	Painting
XYZ	2210	999	Packaging

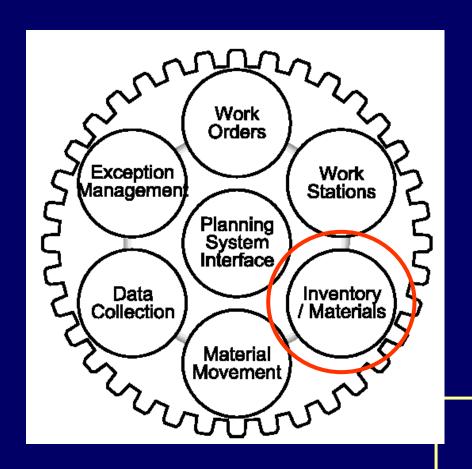
- Once defined the data model, MES puts in relationship the «routing» (i.e. the sequence of operations or bill of processes) necessary to produce the items required, with the work load on the work stations
- ⇒ If an operation can be executed on more work stations, rules and/or algorithms assign the work loads

STEP	OPERATION	DURATI ON	SET-UP DUR.	DESCRIPTION		
1	112	5	15	Hole by punching		
2	119	10	10	Weld brackets		
3	1230	10	10	Smooth welding		
4	4422	5	30	Paint		
5	2210	10	0	Package		
Routing of item number: 10044 Description: angular bracket welded with two 0.2 cm holes						

Some functions implemented in this module are:

- Assignment of operation code to work stations
- Order optimization
- Assign work load to work stations for each operation, using routing data and standard durations

- Load and download programs in to/from work stations
- Store an online map of the work stations and of the available operations



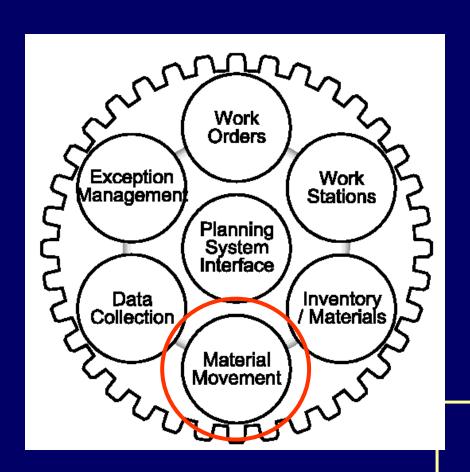
- → This MES function develops, stores, and supports the details of each batch or associated materials and of the inventory, including their current position
- ⇒ Broadly, at MES level, the term «inventory» includes everything required in production including tools, equipment, materials, design... whatever specified in BOM

Such information is generally managed at planning level «grouped» while at MES it is managed as single specific and well identified items

- Some activities implemented in this function are:
 - Management and control of the inventory, of the raw material, and of the «work in process»
 - Access to the detailed information for each item in the warehouse and for each work in progress

- ⇒ Examples of activities for inventory management are the arrival of the raw material and the processes related to its storage
 - Once the material arrives, a label with a bar code is scanned or a purchase number is inserted as input to MES
 - MES can search the purchase order and to show it, jointly to additional information related to the material

- The instruction to treat the storage of this material are executed, so that it can be stored or additionally treated in another physical location
- At each step, MES stores the information and data related to processes executed on the material, keeping the planning level updated



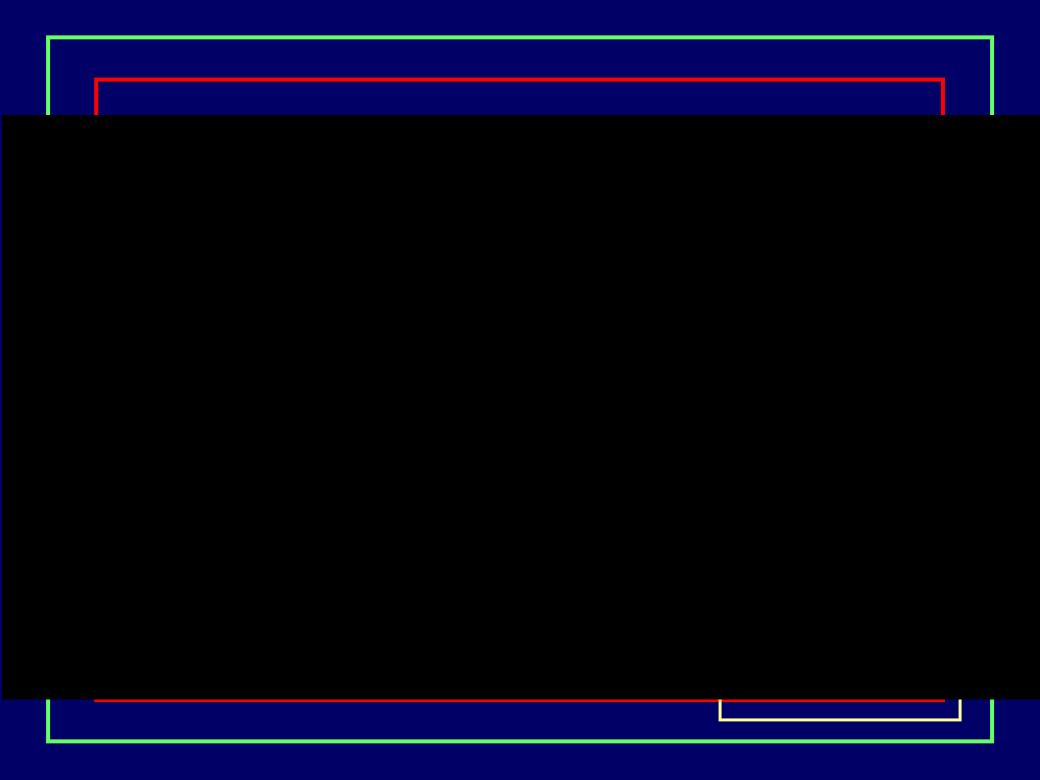
- Once MES has defined:
 - The sequence of orders
 - **⇒**The work station on which the work is executed
 - And the material to be used
- MES can move raw material and work in progress towards a work station

- The fundamental on which such function is based is the knowledge in each instant of the physical position of raw material and work in progress
- This MES function does not add value to the process, but simply allow to move «things»

- It is a simple function, if information is true and exact
- Movement can be done in different ways, e.g.:
 - Manually
 - Using carts
 - Pipelines
 - -Belts
 - -AGV

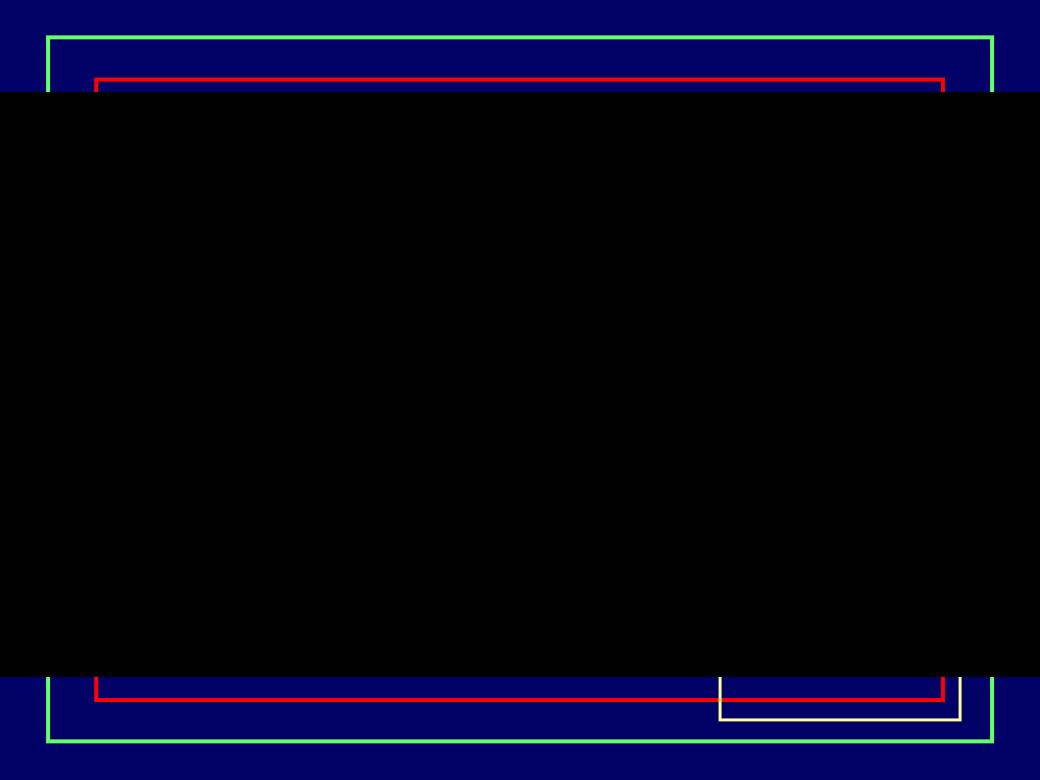
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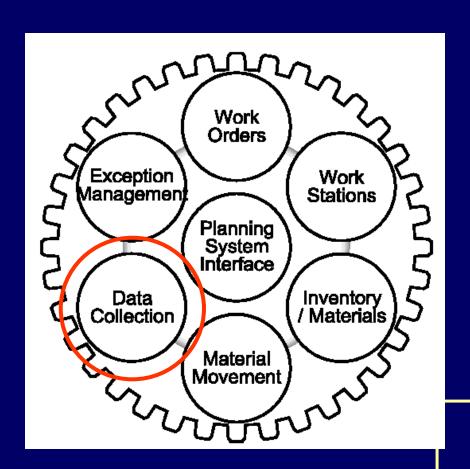
MATERIAL MOVEMENT

- Examples of instructions associated to this function:
 - Print load / unload instructions for the driver of an elevator cart
 - -Inform the control system of the AS/RS (Automatic Storage/Retrieval System) to take a
 - specific raw material to a given position
 - -https://www.youtube.com/watch?
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MATERIAL MOVEMENT

- Inform an AGV to fetch a work in order at a specific work station and to take it to another one
- Open a valve and switch on a pump to feed a work station with a specific liquid



This function might be defined as «the eyes and the ears» of a MES, as, in each instant, it allows to know or to give information on the current state of production

→ Thanks to different sensors and control interfaces, data (both as alarms or process data) coming from production, are collected, grouped, and released as relational real-time database

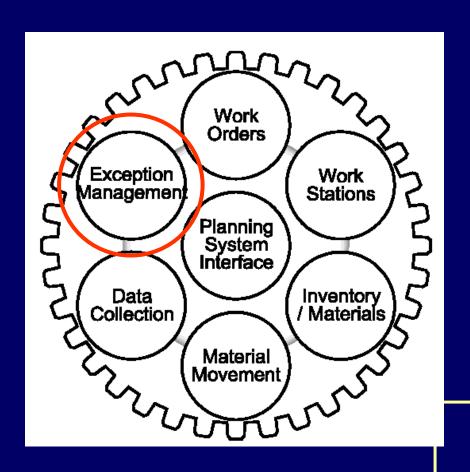
□ In addition, other data is stored, related to movement, status of the orders and of the production process

- The data source technologies include:
 - Barcode scanner
 - speech coding
 - RFID
 - PLC (Programmable logic controller)
 - Magnetic card for personnel presence
 - Machines and processes monitoring
 - Manual data entry

MES data collection represents the core of the communication of a manufacturing information system

This function is so structured and designed to collect and to give electronic (or manual) data between the shopfloor and all the other users.

EXCEPTION MANAGEMENT



EXCEPTION MANAGEMENT

Capability to react to problems (resilience)

- Example:
 - A work station gets broken
 - Raw material is not arrived
 - Modification to the customer order

EXCEPTION MANAGEMENT

- MES can autonomously react to such problems, e.g.:
 - Production rescheduling
 - Alternative routings
 - Monitoring work stations to prevent accidents
 - Informing the planning level that production can not go on

CONCLUSIONS

- MES primary functions focuse on production processes.
- → They allow to know continuously and in real time the state of the system, and to react in an optimal way to unforeseen events.
- **⇒** That is why MES becomes the centre of the part of information system focusing on the state of current production

CONCLUSIONS

Additional support functions of MES, not directly linked to production processes, are shown in next lesson.