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Consulting

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The OpenValue Solution

The main OpenValue Applications

- **MRP Availability Check**
- **MRP Planning Engine**
- **MRP Planning Engine Subcontracting**
- **MRP Planning Engine MTO**
- **MRP Planning Engine Capacity Load**
- **MRP Shop Floor Control**
- **MRP SFC External Operation**
- **MRP SFC BoM Substitute Component**
- **MRP Product Costing**
- **MRO Maintenance**
- **MRP MRO Maintenance Integration**

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MRP Availability Check

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The promise delivery date determination

In bidding process, the availability check for determining the promise delivery date in customer quotation phase is one of the biggest issues.

The “MRP Availability Check” tool supports production feasibility check of customer requested quantity based the projected stock availability at all BoM’s levels.

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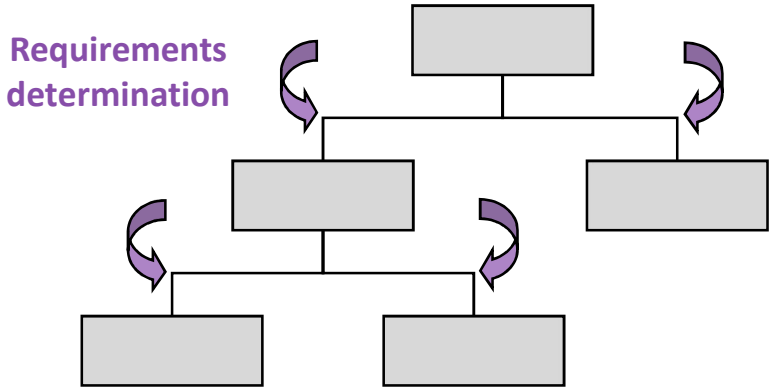
MRP Availability Check outcome

The “MRP Planning Engine Availability Check” tool supports the **customer promise delivery date** determination in Customer Request for Quotation process by taking into account the projected stock quantity compared to customer requested quantity at all BoM’s level.



The tool provides two main sections:

- **BOM explosion**
- **Availability Check Results**

Two printouts are available also:

- BoM Explosion report to provide an overview of all BoM structure with its main procurement attributes
- Availability Check Results report to list all quantities figures related to a component’s replenishment

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MRP Planning Engine

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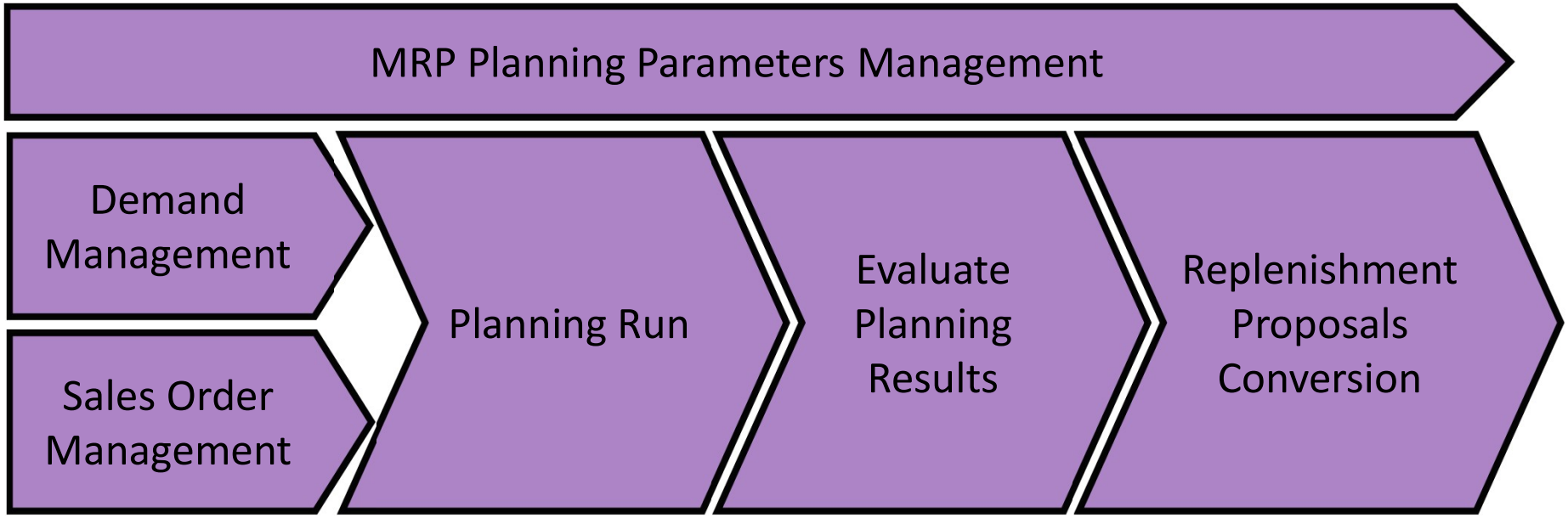
The planning process overview



The OpenValue "MRP Planning Engine" provides a full comprehensive tool for managing the Material Requirements Planning process.

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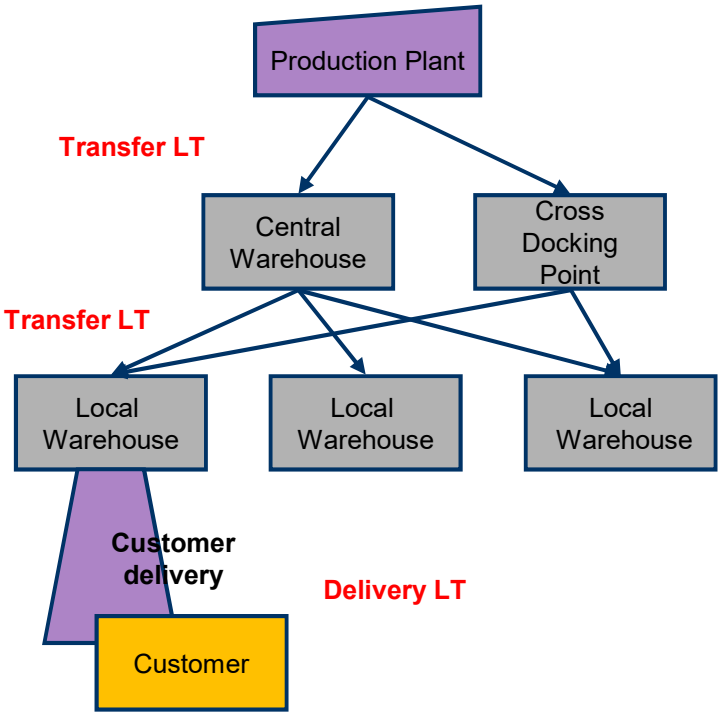
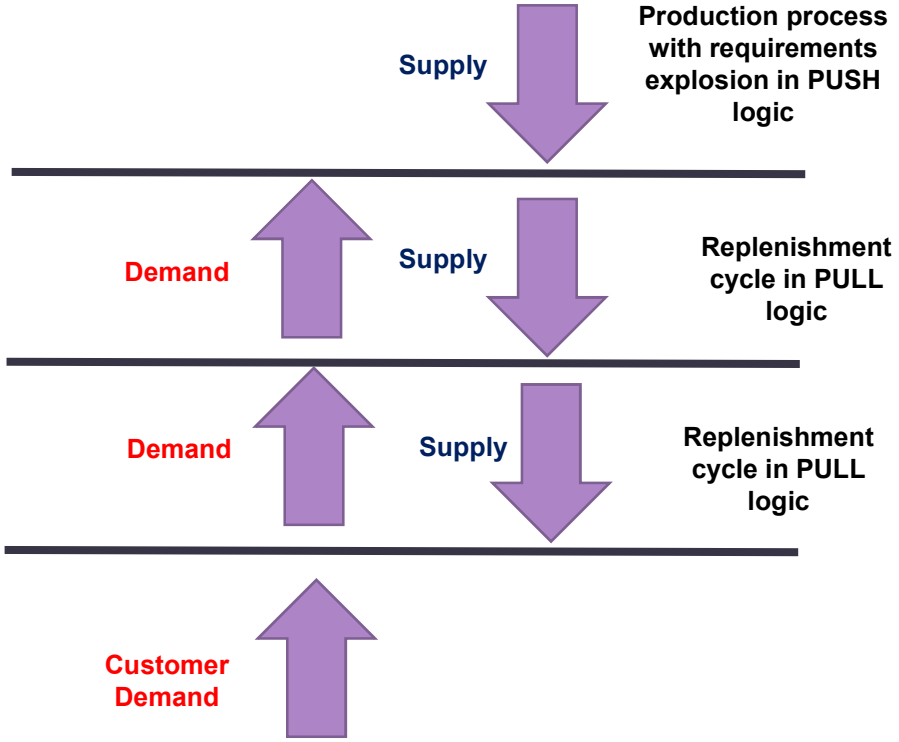
The OpenValue solution in Supply Chain management

Distribution Network





The OpenValue Solution manages planning and execution processes in challenging distribution systems

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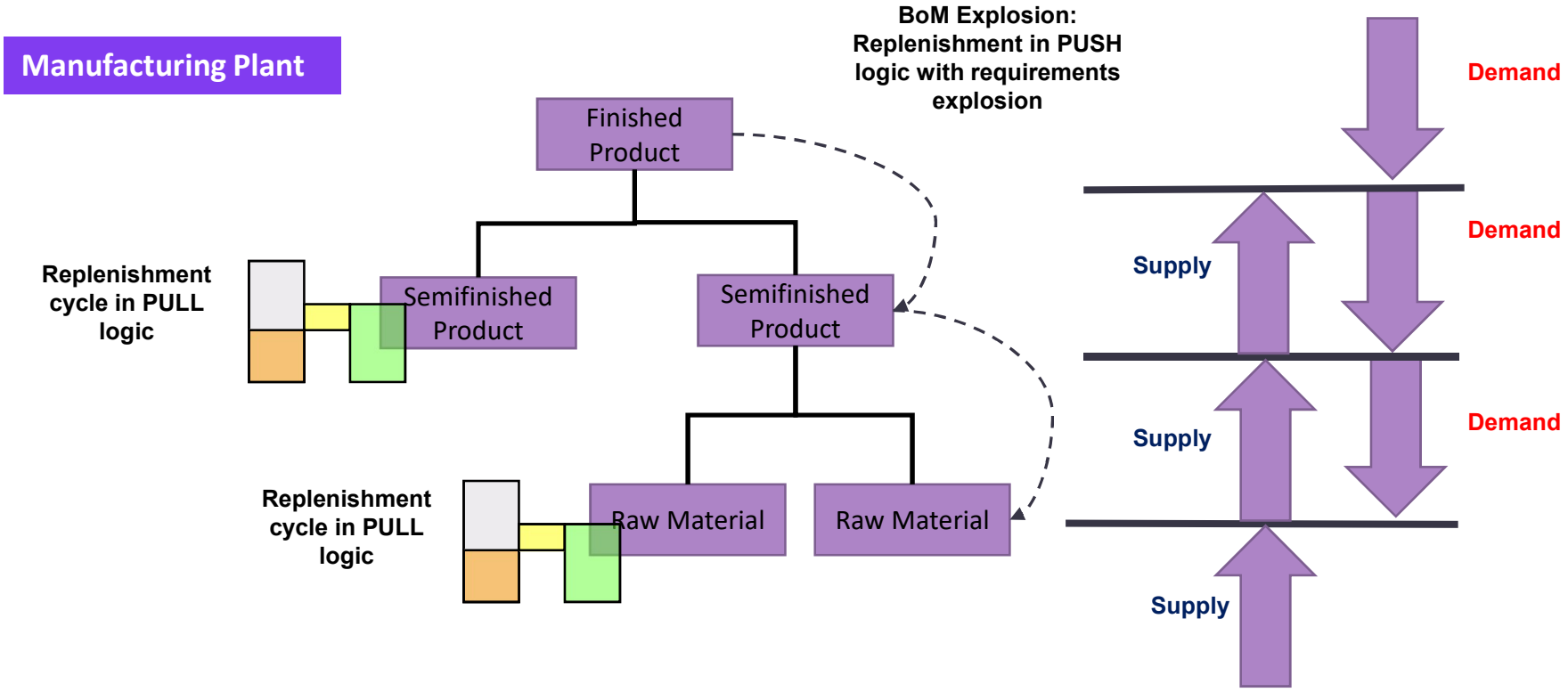
The OpenValue Solution material planning for manufacturing plants



The Material Requirements Planning process inside the production plant is supported by the Planning Engine

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The planning methodologies: PULL vs PUSH

The two basic materials planning methods are:

- **Push logic** with backwards scheduling and requirements explosion (where BoM is defined); that's the classical **MRP** tool provided in the most of ERP packages
- **Pull logic**, that's **Reorder Point** with forward scheduling for automatic stock replenishment

Both of them have been implemented in the same tool and, therefore, are performed at the same time at warehouse level.

The "MRP Planning Engine" implements the two planning methodologies in only one tool

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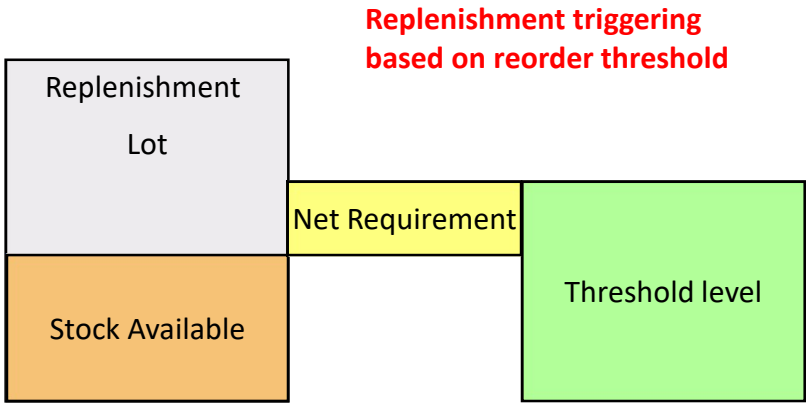
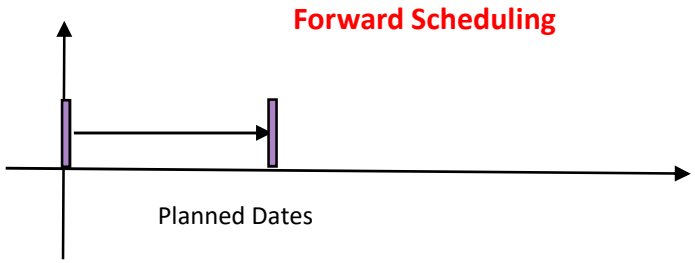
The Reorder Point planning

It’s based on a manually entered reorder point parameters. During the planning run, the system checks only whether stock has fallen below this reorder point or not. It that is the case, the system triggers procurement of the quantity defined by the lot size method.





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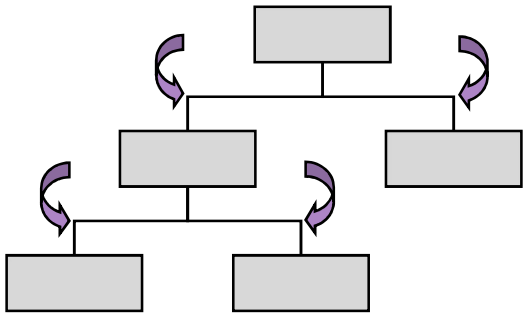
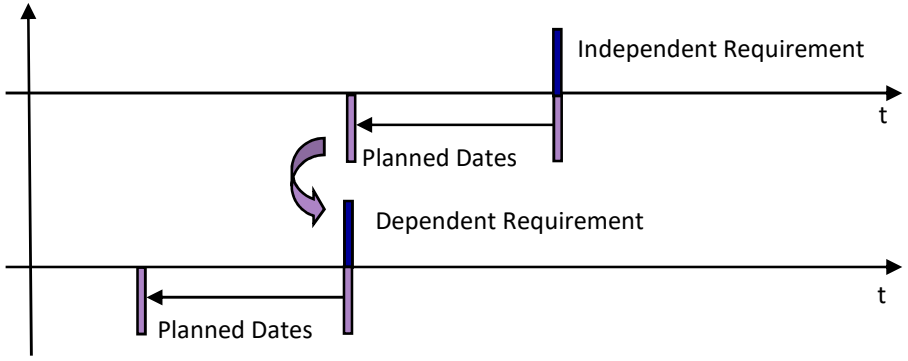
The Material Requirements Planning

MRP takes current and future demand as it's reference point. Depending on the Demand Management strategy, actual and planning sales requirements trigger the MRP calculation. In MRP, the requirements elements include sales orders, planned demand items, material reservations and the dependent requirements created by exploding the BOM.

BoM explosion for requirements determination



Backwards Scheduling



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The replenishment processes

In case the planning run determines shortage quantities, the system creates procurement proposal (planned orders) which can be changed, rescheduled or deleted when and where necessary.

The planned orders are to be converted in their final document:

- For **in-house production**, planned order is converted in a **manufacturing order**
- For **external procurement**, planned order is converted in a **purchase order**
- For **subcontracting**, planned order is converted in a **purchase order for subcontracting**
- For **internal procurement**, a **goods transfer** chain from the source warehouse is achieved by converting planned orders

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The Demand Management

The following **Demand Management Strategies** are supported:

- *Make To Stock Anonymous*
- *Make To Order*
- *Planning production by lots*
- *Planning with final assembly*
- *Planning without final assembly*

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The Planning Strategies: *MTS Anonymous*

- The independent demand is defined without considering any sales order: the Sales orders are not relevant for MRP calculation but they are displayed for information purposes in the MRP list with quantity as zero.

- Sales order are covered by warehouse stock.

- The forecast items consumption is carried out at goods issues (performed sales order delivery) in FIFO logic

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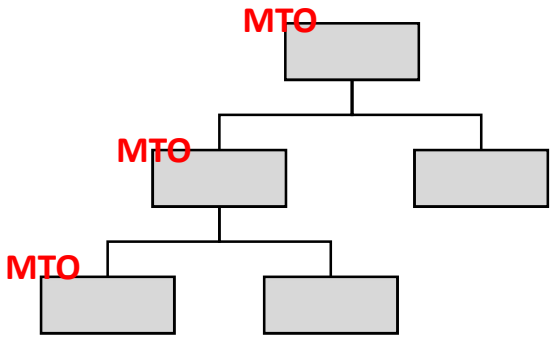
The Planning Strategies: *Make To Order*

- The forecast items cannot be defined for MTO strategy; therefore, only Sales orders are relevant for triggering MRP calculation
- For MTO products, the MRP type “MRP” and the “lot for lot” order quantity method for lot sizing procedure are to be used; therefore the net requirement calculation considers requirements in the same requirement date only
- It’s possible to assign the MTO indicator along the BoM for specifying which subassemblies are to be produced or which components are to be purchased after receiving the customer order



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The Planning Strategies: *Planning production by lots*

- The requirements for finished products are transferred to MRP when sales order is confirmed.
- It is possible to plan additional warehouse requirements with forecast demand items also.
- Independent demand items, i.e. sales orders and forecast items, are grouped according to the lot sizing procedure (procurement lot size).
- Sales orders can be covered from existing stock from the warehouse
- the forecast demand is consumed when performing sales goods issues (sales order delivery) in FIFO logic.

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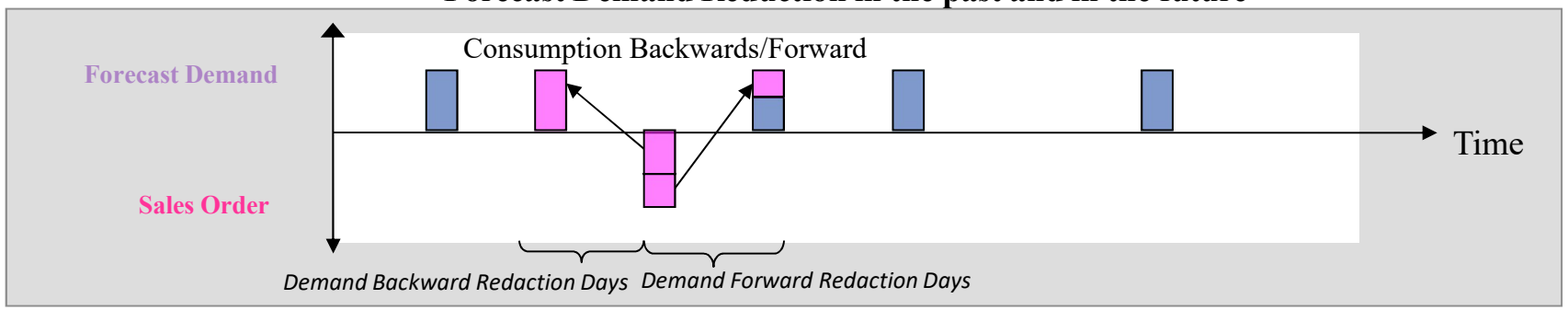
The Planning Strategies: *Planning with final assembly* (1/2)

- The replenishment process, i.e. manufacturing and purchase processes, is triggered by the forecast demand Items before receiving Sales Order.
- the demand reduction occurs when confirming sales orders by searching forecast items from the sales order planned delivery date in the past by the demand backward reduction days and afterwards in the future by the demand forward reduction days.

Forecast Demand Reduction in the past and in the future



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The Planning Strategies: *Planning with final assembly* (2/2)

- Overplanning is taken into account: if the sales order quantities exceed forecast items quantities, the system creates a planned order for the unplanned quantities for a fast reaction to customer demand.

- Demand Items left unconsumed increase the warehouse stock; therefore the “adjust requirements” procedure by forcing as zero the MRP quantity is provided

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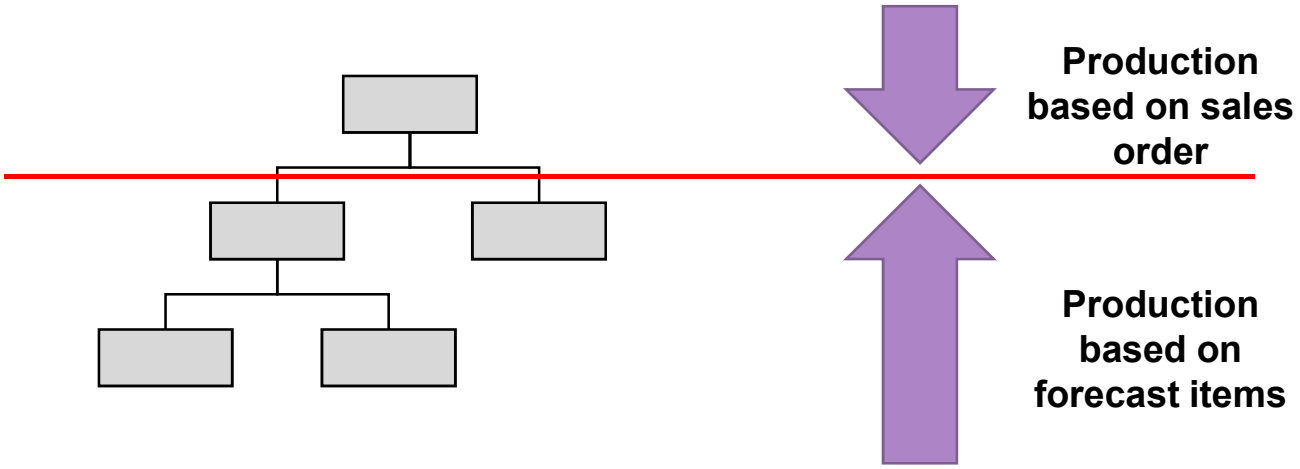
The Planning Strategies: *Planning without final assembly* (1/2)

- As the MTO planning strategy, the “planning without final assembly” enables to manufacture final products specifically for the customer whereas subassemblies are to be produced or procured before the sales orders is received.
- Therefore, planned orders related to forecast Items are created for planning purposes only and cannot be converted; that means the last stage of production process can be performed after receiving the sales order only.



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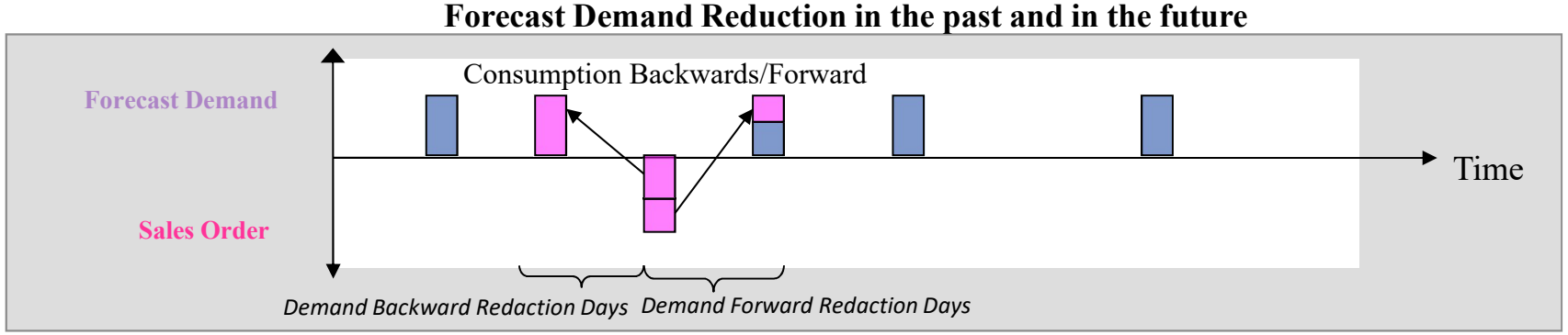
The Planning Strategies: *Planning without final assembly* (2/2)

- As described in the “planning with final assembly”, the demand reduction occurs at sales order confirmation.



- The overplanning (the actual demand has not covered by the forecast items) is transmitted to the lower BoM levels and it is relevant for planning.

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Planning Strategies Overview

Planning Strategy	PIRs – Planned Independent Requirements	Sales Orders
MTS Anonymous	NOT Relevant for planning	Not relevant for planning PIRs consumption at delivery (goods issue)
Make To Order	Not relevant for planning	Relevant for planning
Planning production by lots	Relevant for planning	Relevant for planning PIRs consumption at delivery (goods issue)
Planning with final assembly	Relevant for planning	Relevant for planning: overplanning for quantities not covered by PIRs. PIRs reduction at sales order confirmation
Planning without final assembly	Relevant for planning Not relevant for execution (finished products planned order cannot be converted)	Relevant for planning: semifinished products overplanning for quantities not covered by PIRs. PIRs reduction at sales order confirmation

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MRP Planning Engine Subcontracting

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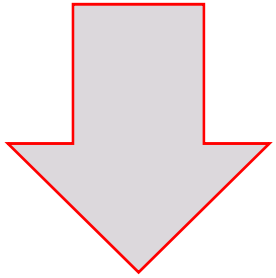
The Subcontracting replenishment fully integrated in MRP Planning Engine process

- The subcontracting replenishment process is supported by a new tool, i.e. "**Planning Engine Subcontracting List**": in case of projected stock quantity shortage in subcontracting location, a replenishment element, the "**Subcontracting Stock Replenishment Order**", is created
- By releasing a Stock Subcontracting Replenishment Order, a delivery stock transfer is created from warehouse stock to subcontracting location



The "MRP Planning Engine Subcontracting" module enhances the OpenValue MRP Planning Engine solution by implementing a subcontracting replenishment process based on the projected stock quantity shortage

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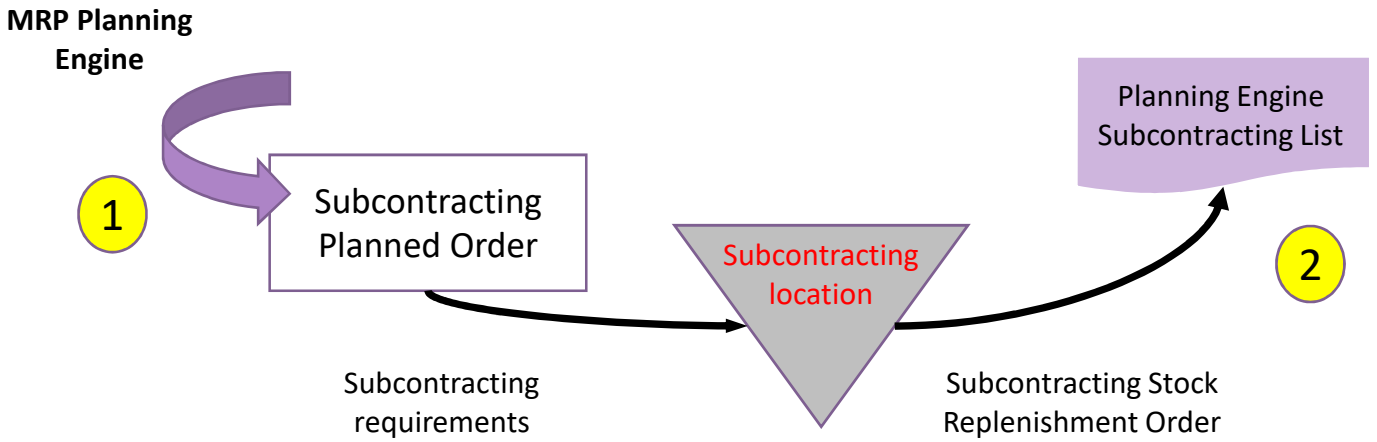
The Subcontracting Replenishment planning phase



1. In case of quantity shortage the MRP Planning Engine run creates a subcontracting planned order; the subcontracting BoM explosion creates subcontracting requirements on subcontracting location
2. the Planning Engine Subcontracting list points out the projected stock shortage and creates a Subcontracting Stock Replenishment Order to fulfill requirements on subcontracting locazion

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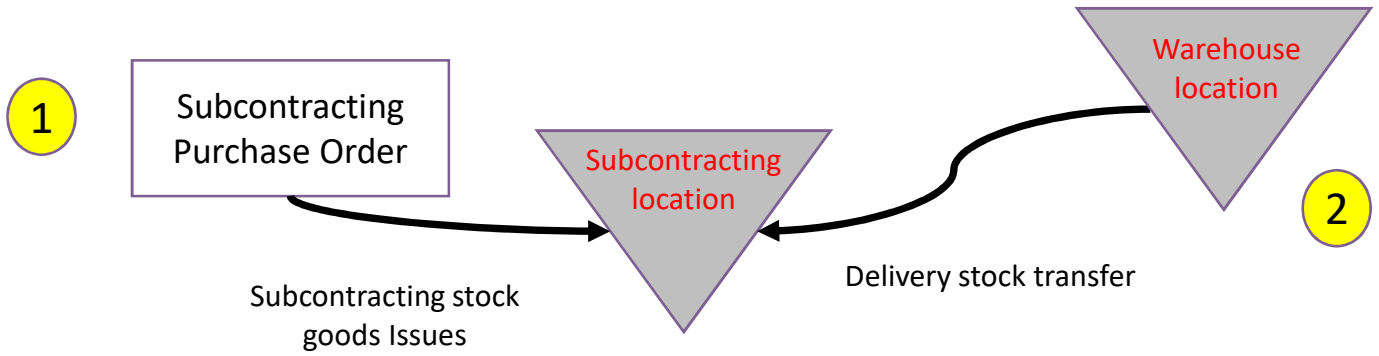
The Subcontracting Replenishment execution phase



1. The planned order is converted in a RfQ and this in a subcontracting PO. Subcontracting goods movements automatically created.
2. When confirming the Subcontracting Stock Replenishment Order, a delivery stock transfer is created to fulfill subcontracting requirements

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MRP Planning Engine MTO (Make to Order)

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MTO Planning Engine Report

- The **MTO Planning Engine Report** purpose is to monitor the MTO supply chain status for checking the expected customer delivery date with alerts for quantity shortages and time delays
- It provides for a MTO sales order an overview of the overall MTO supply chain status by listing of all the MTO replenishment elements, i.e. MTO manufacturing orders and MTO purchase order items, with their status, dates and quantities
- a recap of all necessary figures support in only one report the monitoring of the overall MTO supply chain status

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MRP Planning Engine Capacity Load

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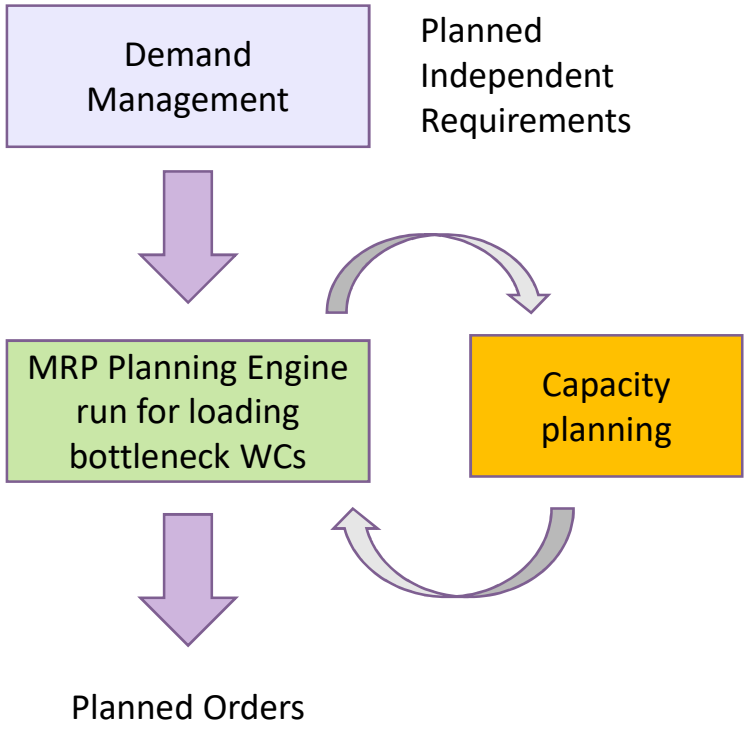
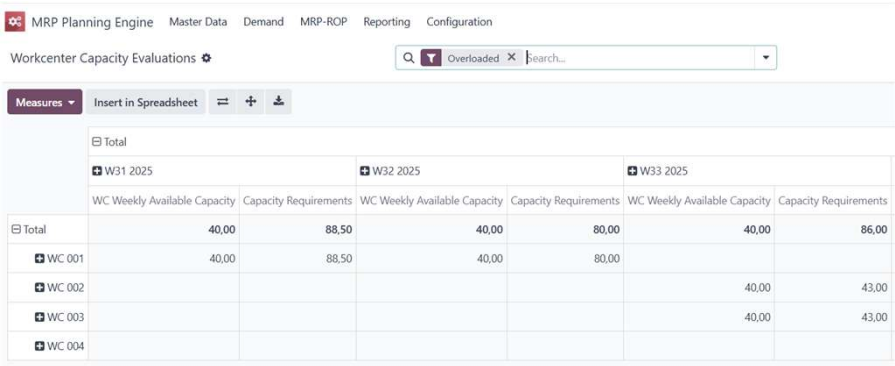
MRP Planning Engine Capacity Load

In an MTS model, it is crucial in mid-term planning to consolidate demand into a feasible plan. With the support of the MRP Planning Engine Capacity Load module, it is possible to determine a capacity-constrained demand plan through work-center capacity loading and recursive capacity-planning cycles.





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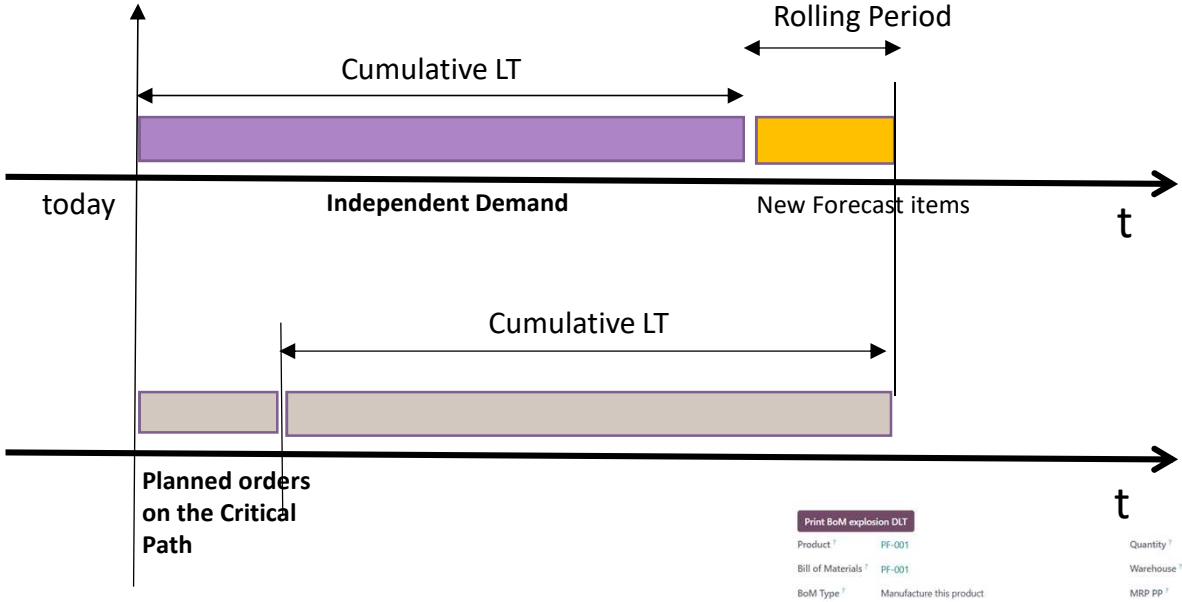
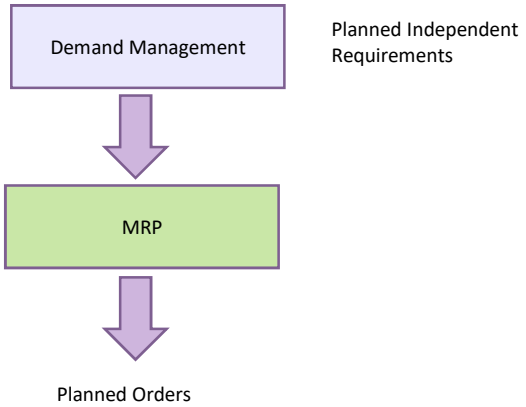
MRP Planning Engine Capacity Load

In the Demand Management, it is essential to enter new forecast items with a rolling approach while protecting the current plan before the planning time fence.
The Cumulative lead time can be estimated using the Planning Engine BoM DLT report.





Print BoM explosion DLT

Product	PF-001	Quantity	1,00 Units	LT (days)	5,00	
Bill of Materials	PF-001	Warehouse	Production Plant	DLT (days)	25,00	
BoM Type	Manufacture this product	MRP PP	☑	CLT (days)	25,00	

BoM Level	Product	Qty	UoM	Product Ty...	MRP PP	Make	Sub	Buy	RP	BoM	LT (days)	DLT (days)	CLT (days)	Critical Path
1	SF-001	1,00	Units	Goods	☑	☑	☐	☐	☐	PF-001	5,00	15,00	15,00	☐
2	RM-001	1,00	Units	Goods	☑	☐	☐	☑	☐	SF-001	10,00	10,00	10,00	☐
2	RM-002	1,00	Units	Goods	☑	☐	☐	☑	☐	SF-001	10,00	10,00	10,00	☐
2	Consumable 001	1,00	Units	Goods	☐	☐	☐	☑	☐	SF-001	10,00	10,00	10,00	☐
1	Sub_001	1,00	Units	Goods	☑	☐	☑	☐	☐	PF-001	10,00	20,00	20,00	☑
2	RM-001	1,00	Units	Goods	☑	☐	☐	☑	☐	Sub_001	10,00	10,00	10,00	☑
2	RM-002	1,00	Units	Goods	☑	☐	☐	☑	☐	Sub_001	10,00	10,00	10,00	☑
2	Consumable 001	1,00	Units	Goods	☐	☐	☐	☑	☐	Sub_001	10,00	10,00	10,00	☑
1	RM-003	1,00	Units	Goods	☑	☐	☐	☑	☑	PF-001	10,00	10,00	10,00	☐

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MRP Shop Floor Control

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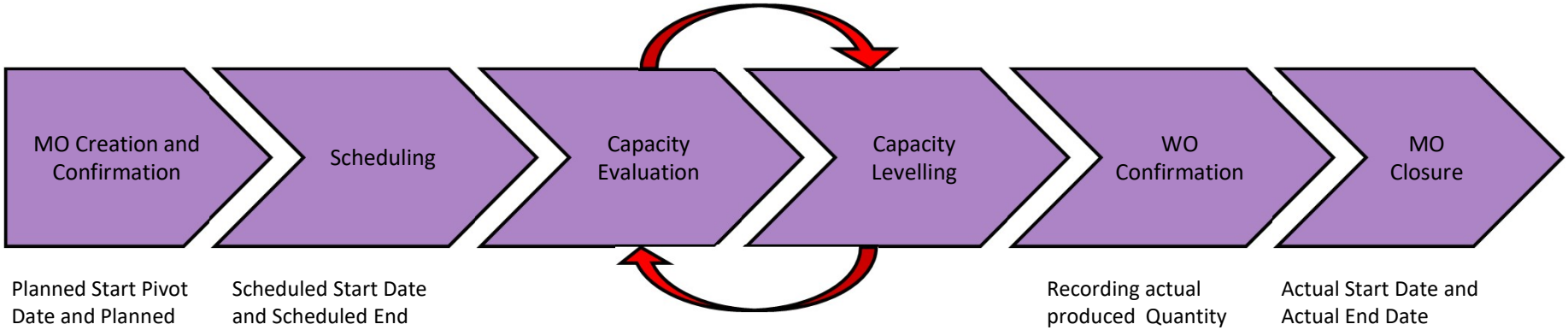
The Manufacturing Execution process



Planned Start Pivot Date and Planned End Pivot Date determination at Manufacturing Order level

Scheduled Start Date and Scheduled End Date determination at Manufacturing Order Level

Scheduled Start Date and Scheduled End Date determination at WorkOrder Level

Capacity Loading at WorkCenter Level

Capacity Check for evaluating the Manufacturing Plan feasibility

Capacity levelling performed through the Mid-Point Scheduling tool

Recording actual produced Quantity at single WorkOrder level

Recording actual duration times for single WorkOrder

Actual Scheduled Start Date and Actual Scheduled End Date determination at WorkOrder Level

Actual Start Date and Actual End Date determination at Manufacturing Order Level

The OpenValue MRP Shop Floor Control module supports the E2E Manufacturing Execution process from the manufacturing order creation to its closure

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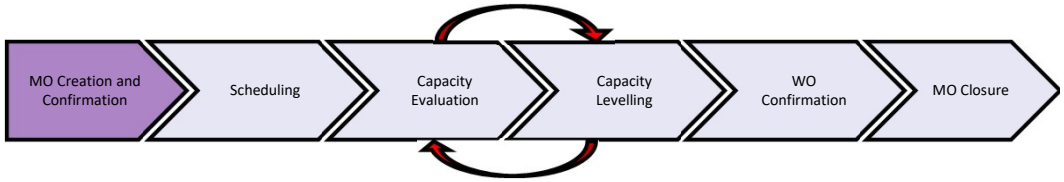
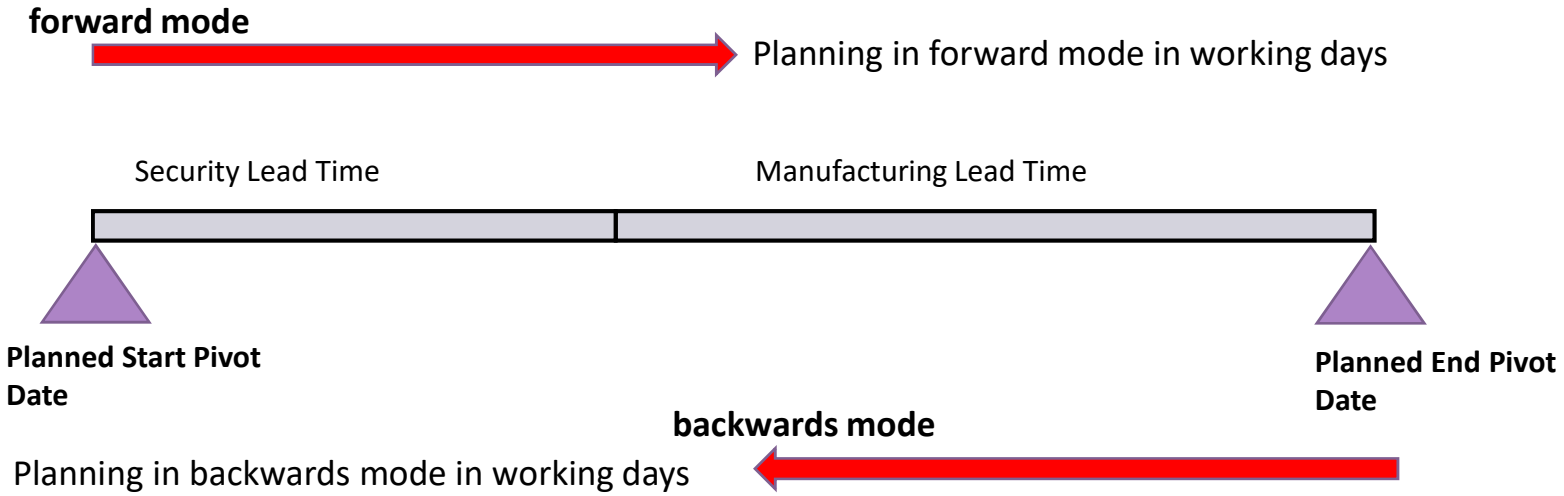
Manufacturing Order creation and confirmation



Planned Pivot Dates determination

- The planned pivot dates are determined by taking into account the **Manufacturing Lead Time** in product master data and **Security Lead Time** in the settings at company level
- According to the "**planning mode**" indicator, the planning is performed in **forward mode** starting from the Planned Start Pivot date or in **backwards mode** starting from the Planned End Pivot date
- The planning is performed in working days based to the working calendar set at warehouse level



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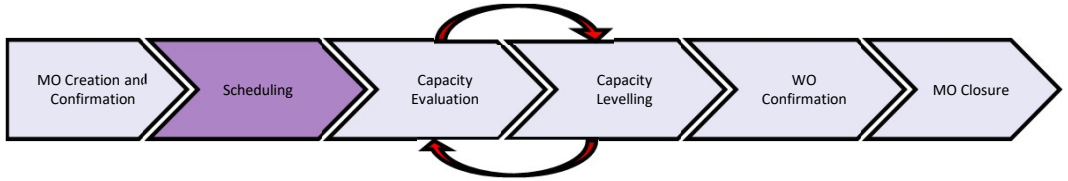
Workorders Scheduling and Work Center Capacity Loading

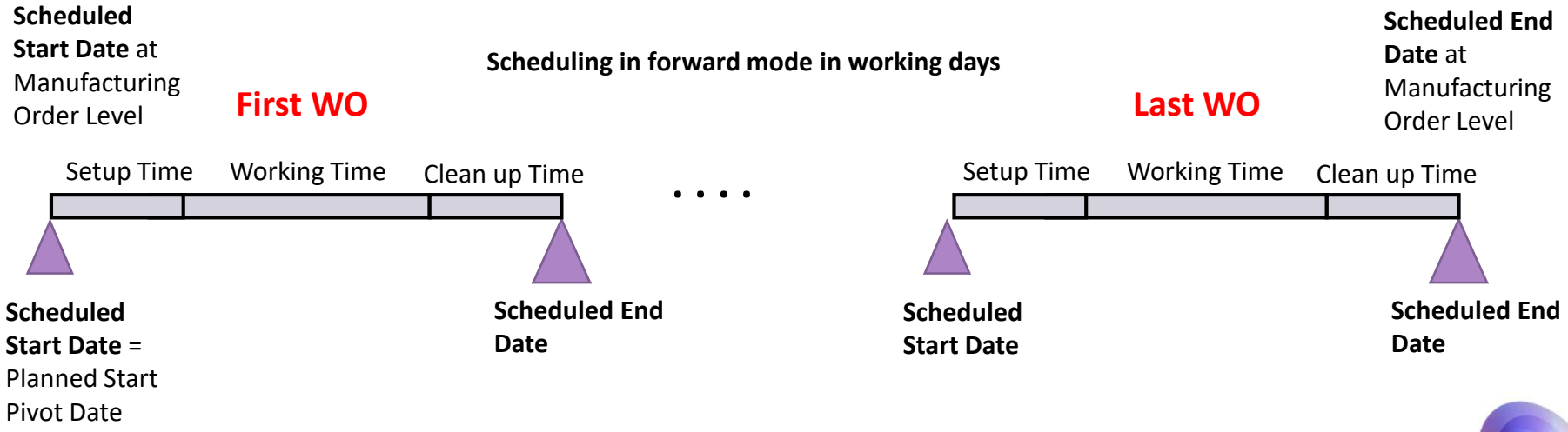


Scheduled Dates determination

the Workorder Scheduled Dates determination is performed in forward mode and based on the following times:

- ***cycle time***
- ***Setup time***
- ***Cleanup time***

The scheduling is performed according the working calendar entered in the Work Center for each operation in BoM. Rescheduling is possible until the next phase, workorder confirmation, has not been started.



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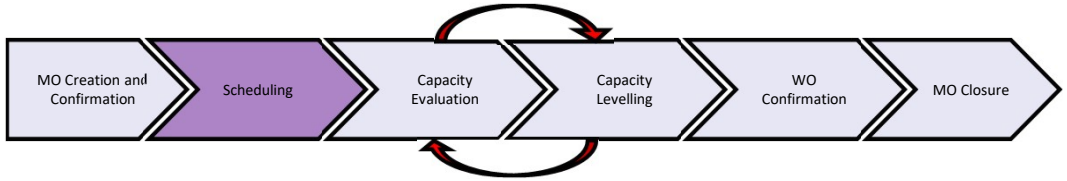
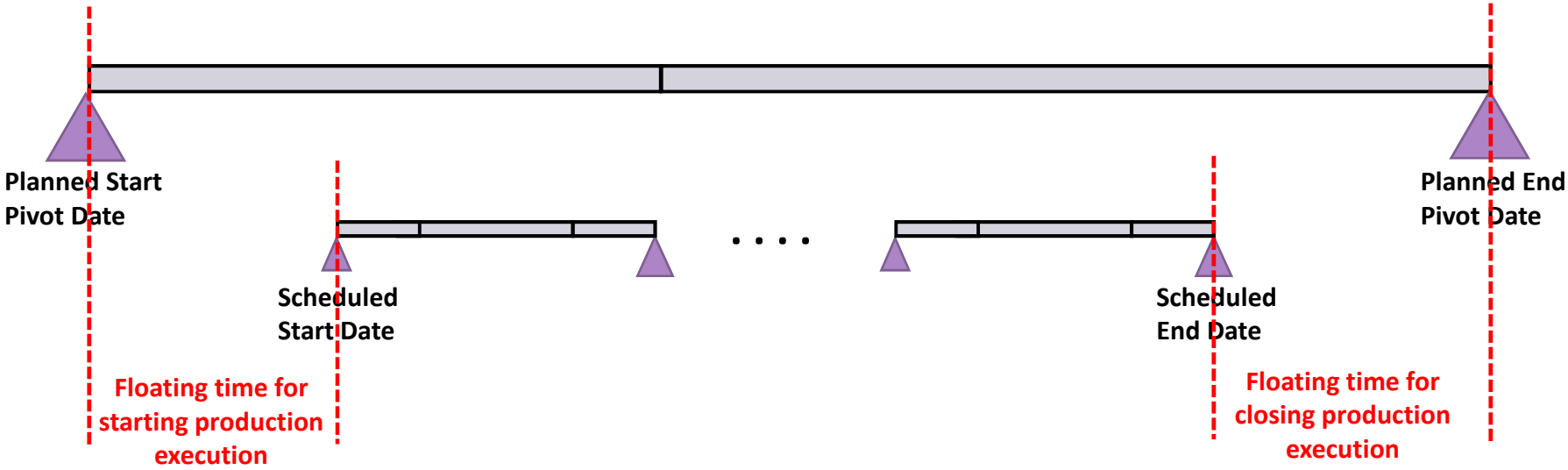
Workorders Scheduling and Work Center Capacity Loading



Planned Pivot Period and Scheduled Period

The comparison between the Planned Pivot Period and Scheduled Period is useful for checking the correctness of manufacturing master data (i.e. planned LT vs time cycles) and the delay in the overall supply chain planning



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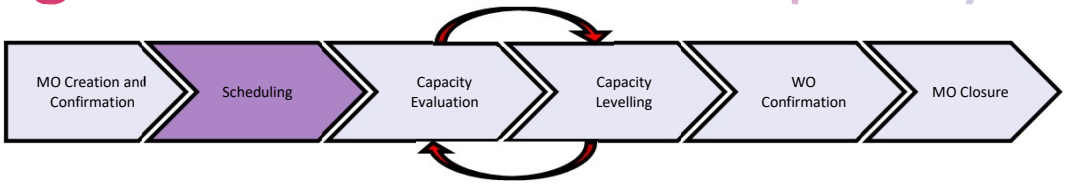
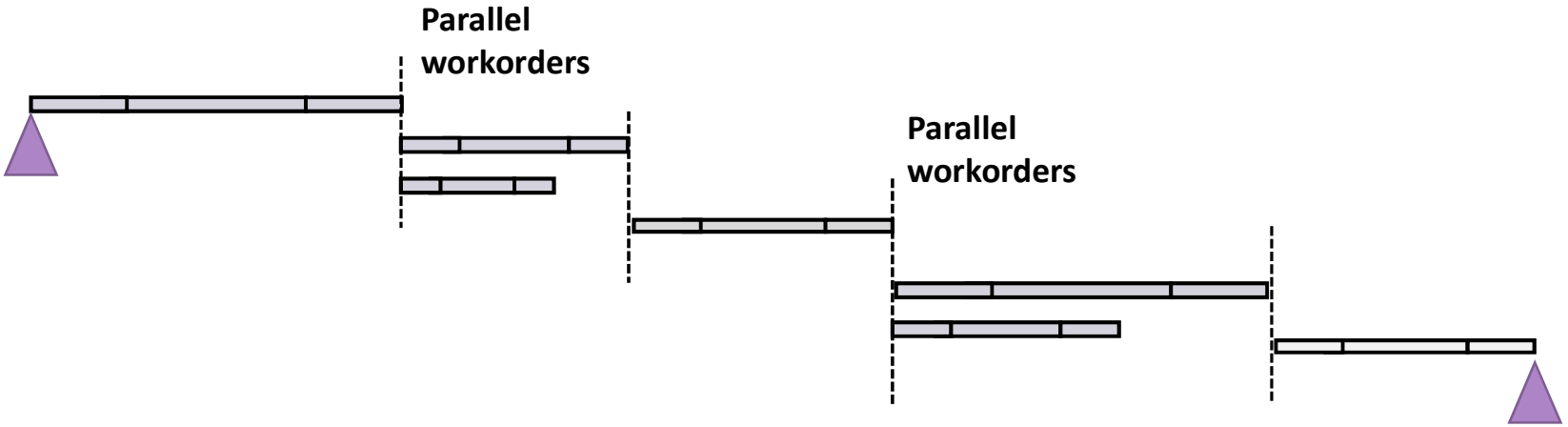
Workorders Scheduling and Work Center Capacity Loading



Workorders Sequencing

The workorders sequencing is based on the sequence assigned to each BoM's operation. The sequence can be changed in the manufacturing order.

Parallel workorders (operations with the same sequence in BoM's operations) are scheduled in overlapping with the same start scheduled date.



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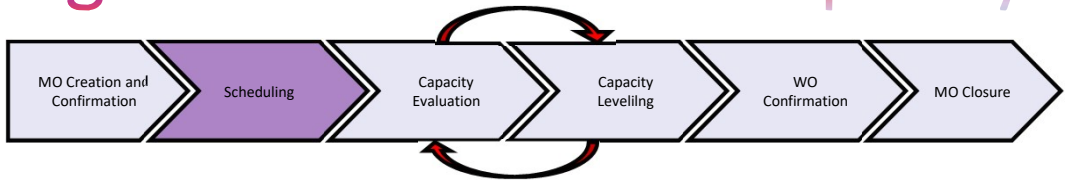
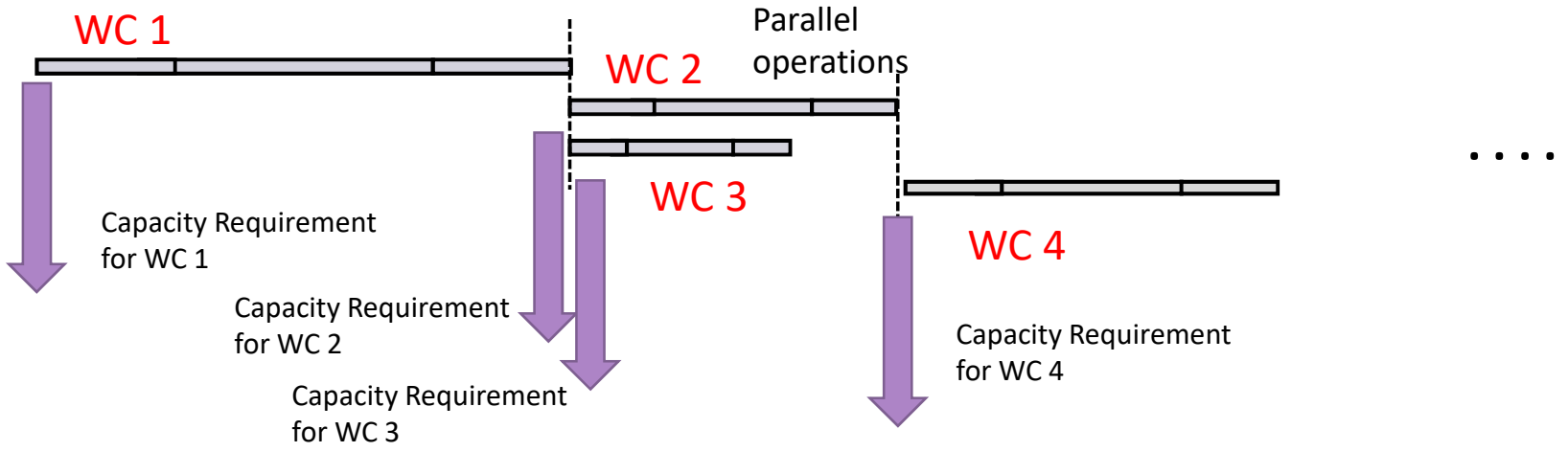
Workorders Scheduling and Work Center Capacity Loading



Work Center Capacity Loading

The Workorder Capacity Requirements are calculated in scheduling phase based on the scheduled working hours, hence capacity loading occurs for the corresponding Work Center.

The capacity requirements are to be compared with the available capacity in the subsequent capacity evaluation phase



Work Center

Week XX
Weekly capacity available
Capacity Requirements grouped per week

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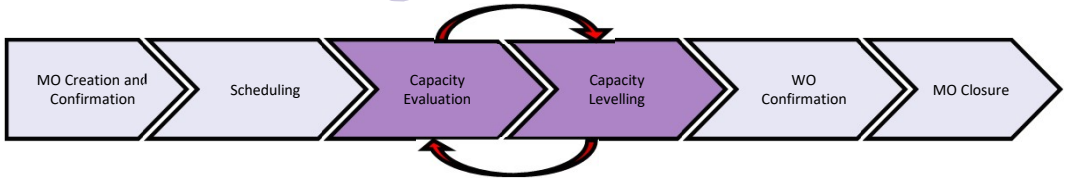
Capacity Evaluation and Levelling



Work Center Capacity Evaluation

To Evaluate the Manufacturing Plan feasibility for capacity point of view a Capacity Evaluation has to be performed for the bottlenecked Work Centers at least.
The following figures are provided:

- the weekly available capacity to be compared with the capacity requirements over the time, week by week, at Work Center level
- The work center capacity load in percentage and the remaining capacity are calculated for supporting the subsequent capacity levelling phase

The capacity load can be displayed in the manufacturing order to check immediately its feasibility

Capacity Levelling with Mid-Point Scheduling technique

Capacity levelling is achieved by moving workorders over the time so the corresponding capacity requirement is moved also. The **mid-point scheduling** logic has been implemented for determining new scheduled dates for all the remaining active workorders.

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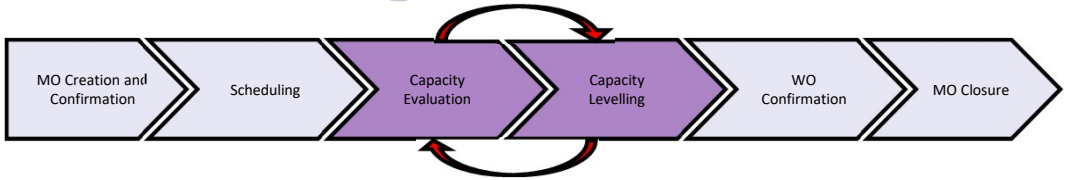
Capacity Evaluation and Levelling



Work Center Capacity Evaluation tools


Workcenter Capacity Evaluations

MEASURES | INSERT IN SPREADSHEET

	Total				
	W14 2022		W15 2022		W
	WC Weekly Available Capacity	WO Capacity Requirements	WC Weekly Available Capacity	WO Capacity Requirements	WC W
Total	60,00	53,36	55,50	60,48	
WC-001	120,00	7,83	141,00	5,00	
WC-002	40,00	20,12	45,60	13,55	
WC-004	40,00	20,12	45,60	13,55	
WC-005	40,00	5,29	43,50	28,38	

Work Center Capacity Evaluation: Pivot and Graph views for comparing capacity requirements with the available capacity over the time. The drill down is available on single figures for checking capacity records

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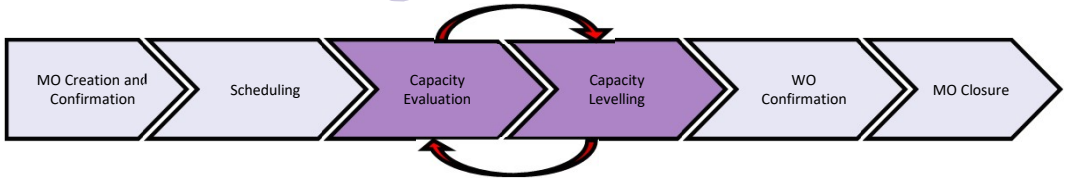
Capacity Evaluation and Levelling

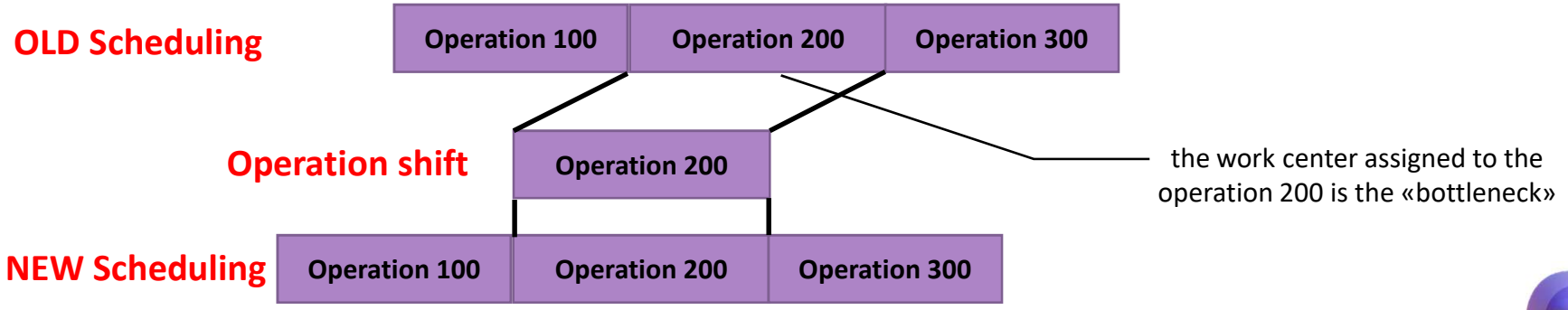


Mid-Point Scheduling tool

Operations placed on a work center overloaded (e.g. bottleneck) are to be moved over the time for determining new capacity loading.

By using the Mid-Point Scheduling tool, we have as follows:

- all other active workorders are moved in backward or forward scheduling according to if bottleneck is moved in backward or forward mode; therefore, all the capacity requirements are moved also
- Workorder in progress cannot be moved: check whether the new scheduling is compliant with the start date of workorders in progress
- Closed and cancelled workorders are not taken into account
- Parallel workorders are scheduled with the same scheduled start



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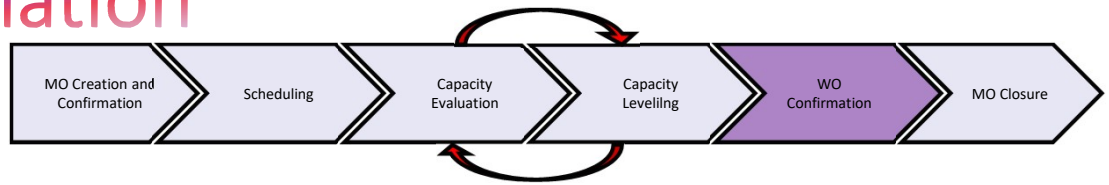
Workorder Confirmation



Workorder Confirmation tool

New tool supports workorder confirmation phase recording actual produced quantity for a single workorder and declaring actual times, i.e. actual working duration, actual setup duration and actual teardown duration; therefore, the effective actual overall duration is calculated.

All actual durations (i.e. Setup duration, Teardown duration, Working duration and Overall duration) are reported in time tracking section at workorder level; the overall duration is determined (the Odoo provides the elapsed one only)

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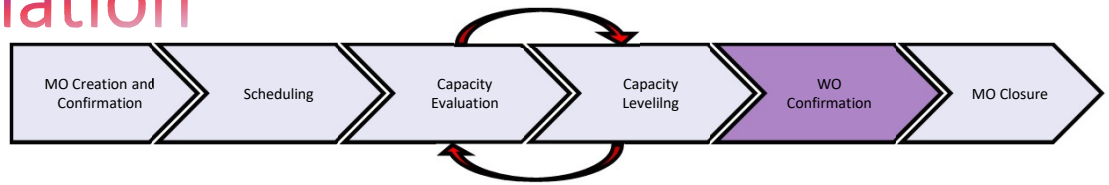
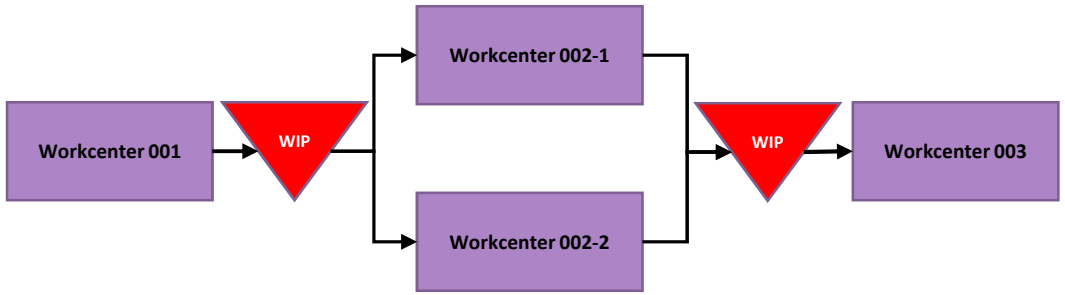
Workorder Confirmation



Workorder Confirmation tool: partial confirmation

By performing the workorder confirmation several times for partial quantities, the confirmed quantities are moved down in the production process as WIP quantity available for starting the next workorders. In this way, “one piece flow” procedure can be managed.



The WIP quantity is calculated on real time for each workorder based on its partial confirmations.

- It is possible to start workorders only if WIP quantity is available.
- A workorder confirmation can be set as the final one for closing the related workorder in case the whole produced quantity is less than the planned one (partial confirmation)
- Setup time is suggested by default only for the first confirmation and the clean-up time only if a confirmation is the final one
- Confirmed quantities and final confirmation indicator are also reported on confirmation records for future MES system integration also.

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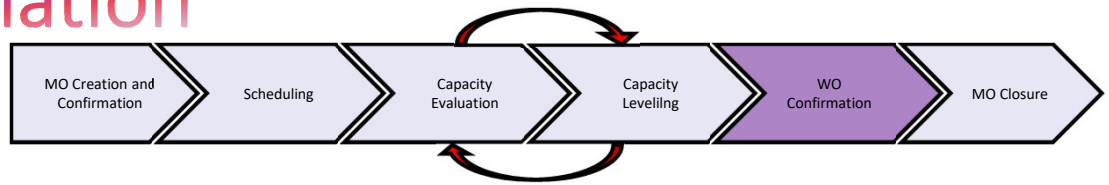
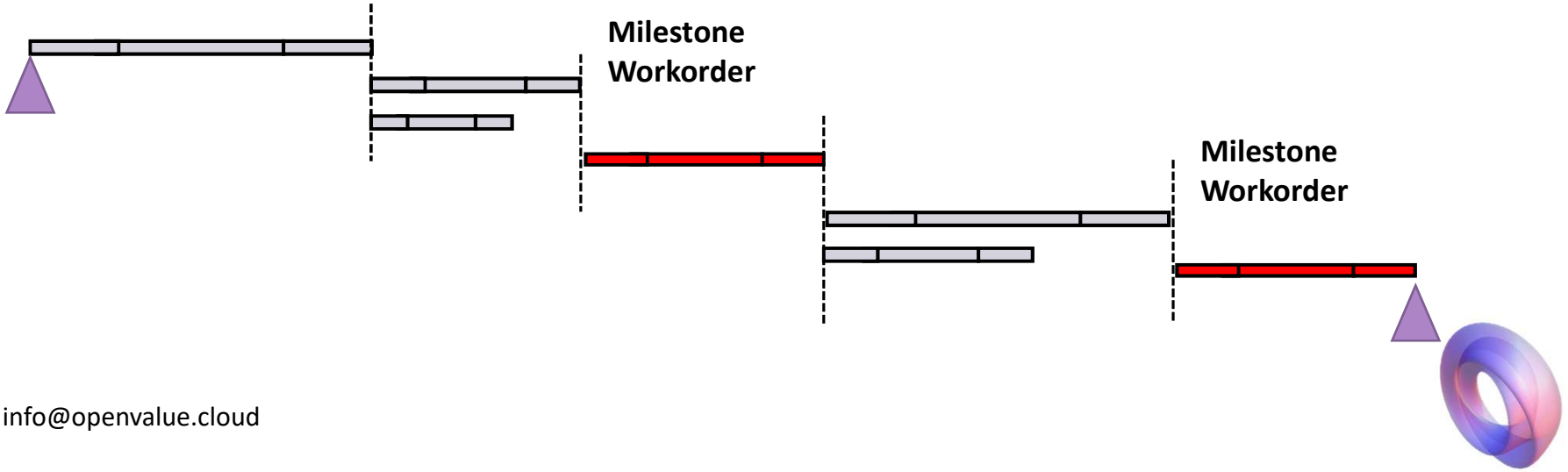
Workorder Confirmation



Milestone Workorder

Usually all workorders are to be confirmed in their sequence; therefore, it is not possible to confirm a workorder without confirming all the previous ones. Through the milestone feature it is possible to confirm a milestone workorder without having confirmed all the previous ones**: all previous workorders not yet closed are confirmed with standard times.**

An operation can be set as milestone at routing level and this attribute is reported when creating a manufacturing order at workorder level.
A workorder can be set manually as milestone one.
No parallel workorders or parallel operations can be set as milestone.



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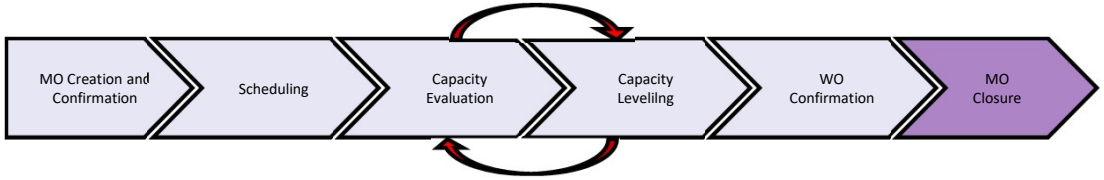
Manufacturing Order Closure



Manufacturing Order Closure

Manufacturing actual dates are determined based on times declaration in Work Order Confirmation phase; actual Dates are determined for production orders without workorders also.

The manufacturing order closure cannot be performed if any workorder has not been performed yet**.**

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Manufacturing Times classification

- ***Standard Times*** calculated based on the manufacturing data structure, i.e. BoM and workcerters; these are useful for engineering manufacturing dpt as reference for checking the correctness of scheduling data
- ***Planned Times*** calculated from operations in production order before their executing (freezing at production order confirmation phase) to provide a reference starting point to measure production department efficiency
- **Unplanned Times** calculated at confirmation phase from workorders created manually so without reference to operations
- ***Actual Times*** determined in real time during the manufacturing execution phase related to real workorders execution times

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Manufacturing Times figures

All times figures related to workorders scheduling and execution are reported at manufacturing order level

- ***Total setup time***
- ***Total working time***
- ***Total cleanup time***
- **Overall time = *Total setup time* + *Total working time* + *Total cleanup time***

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MRP Shop Floor Control External Operation

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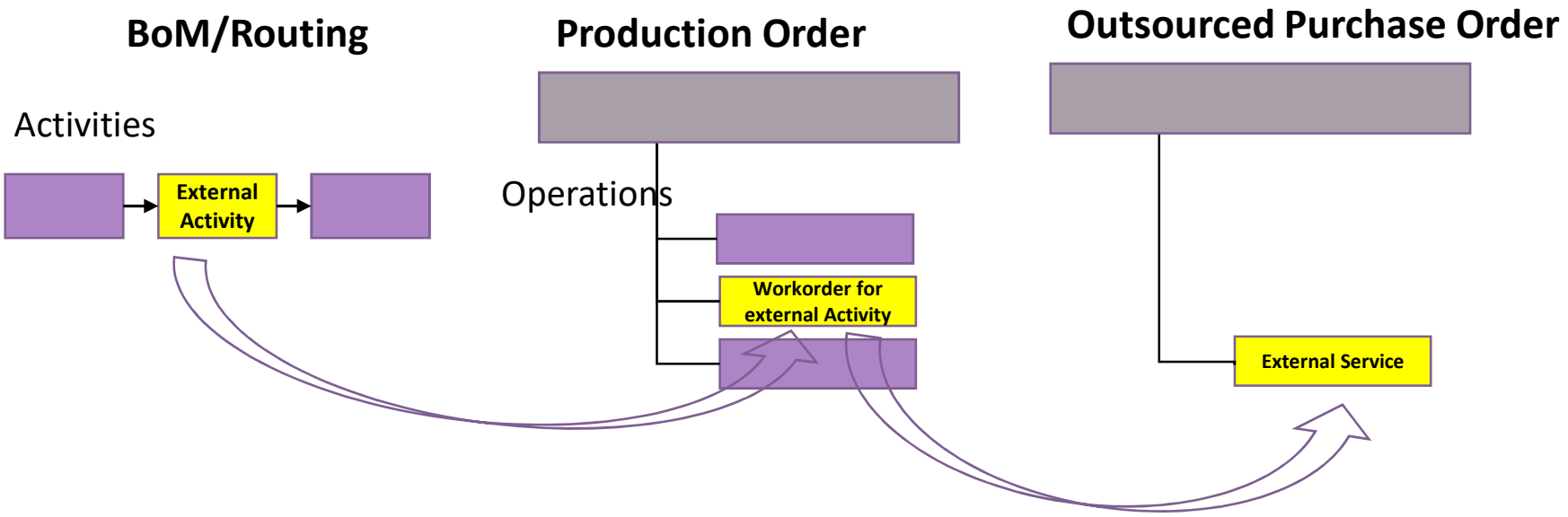
Shop Floor Control External Operation Process

Due to capacity constraints or technological specialization, some production activities (workorders) are to be outsourced to suppliers



For an effective solution in managing the outsourced production activities process, shop floor management is fully integrated with purchasing

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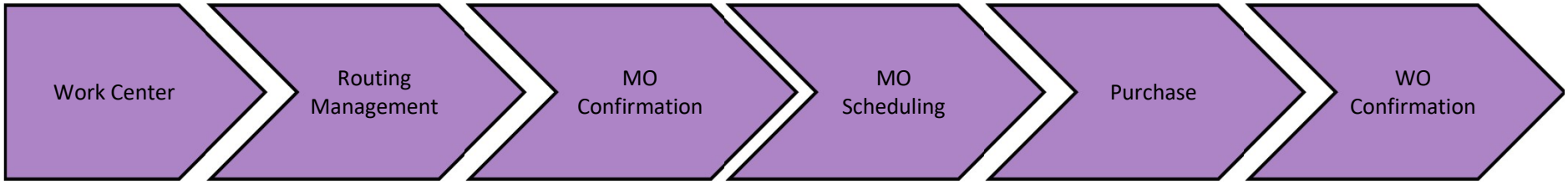
Shop Floor Control External Operation Process



Set a work center as external operation for managing production outsourcing activities

Checks are performed for operation times

A routing activity is set as external by assigning an external workcenter and an outsourced service product

Checks are performed for operation times

When confirming a Manufactiring Order, checks are performed to ensure full integration with purchase

Check is performed to avoid to cancel or reset the scheduling for MOs with confirmed purchase orders for external activities

In manufacturing order scheduling, a RfQ is automatically created for outsourced activities.

Manufacturing order scheduling is performed by taking into account purchase lead times

Purchase order automatically created reporting the reference to the MO.

The order and delivery dates are derived from order scheduling

Work Order Confirmation is designed specifically for external activity management.

An E2E process is supported from purchasing and production master data to purchase order invoice and work order confirmation

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MRP Shop Floor Control BoM Component Substitution

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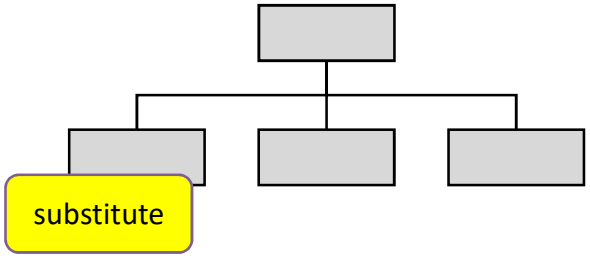
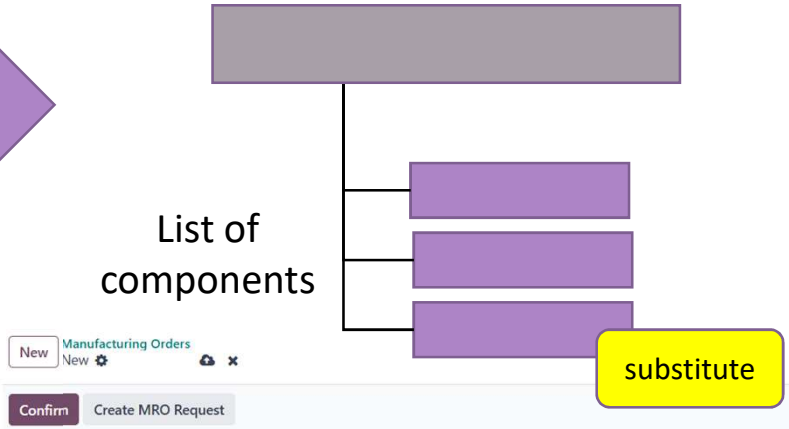
BoM Components Substitute or Alternative Components management

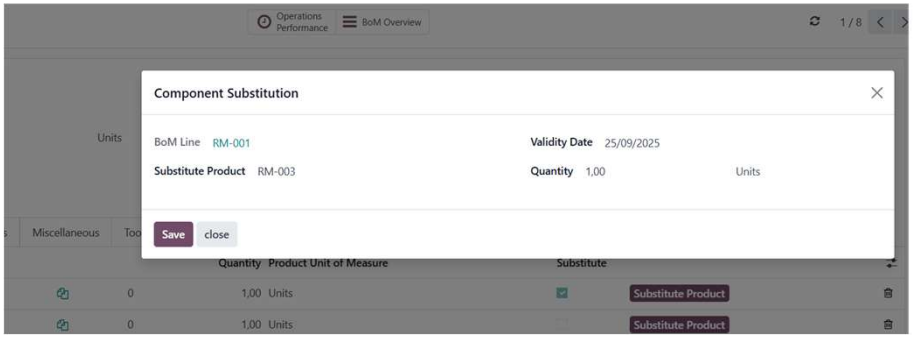
- It is possible to enter a substitute for each BoM item, detailing its code, quantity, unit of measure and Validity Date
- When processing manufacturing orders, single component can be substitute: this is useful for managing equivalent components with the main one, entered in the BoM line, in stockout or **Discontinued Parts process**

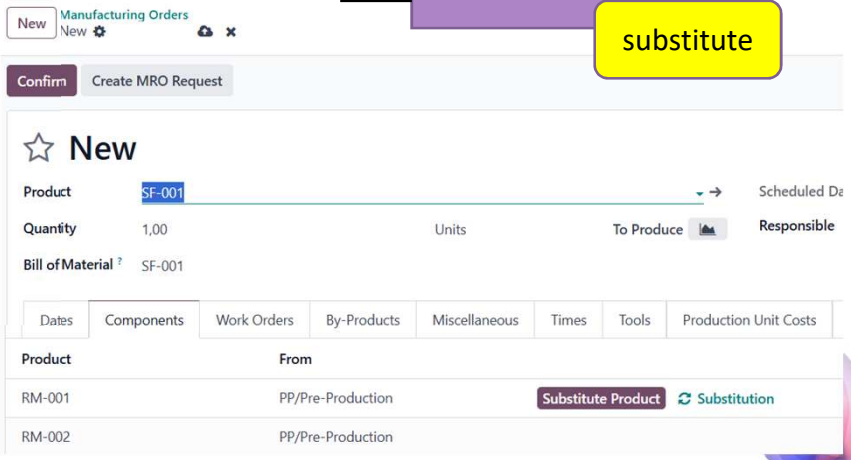
Bill of Materials



Production Order







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MRP Product Costing

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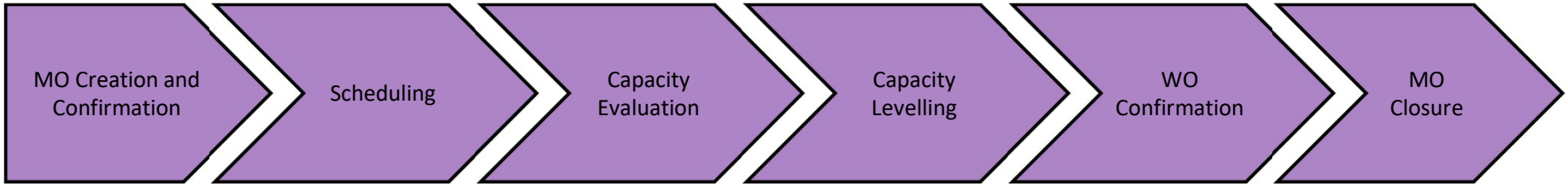
The Product Costing in the Manufacturing Execution Process



Standard Costs calculation

Planned Costs calculation and their freezing at manufacturing order confirmation phase

Actual Variable and Fixed Direct Costs determination

Financial and Analytic Postings for Actual Direct Costs

WIP calculated at Manufacturing Order Level

Variances Costs calculation

Financial and Analytic postings for Variances Costs

Overhead Costs and Full Industrial Cost determination

Analytic postings for Overhead Costs

The **OpenValue Product Costing** module supports the decision-making process in manufacturing execution providing with all necessary manufacturing costing figures

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Manufacturing Costs classification

- ***Standard Costs*** calculated based on the manufacturing data structure, i.e. BoM and standard costs in product master data; these are useful for engineering manufacturing dpt as reference to design costs

- ***Planned Costs*** calculated from components and operation in production order before its executing (freezing at production order confirmation phase) to provide a reference starting point to measure production department efficiency

- ***Actual Costs*** determined in real time during the manufacturing execution phase related to real components consumption and real workorders execution times; variances costs are determined and posted at production order closure

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Manufacturing Cost figures

All costing figures are provided both as unit and overall amount at manufacturing order level

- ***Component Consumption Cost***
- ***Variable Direct Cost***
- ***Fixed Direct Cost***
- ***ByProduct Amount***
- **Full Direct Cost =** Component Consumption Cost + Variable Direct Cost + Fixed Direct Cost - ByProduct Amount
- ***Full industrial Cost*** = Full Direct Cost + Overhed Costs

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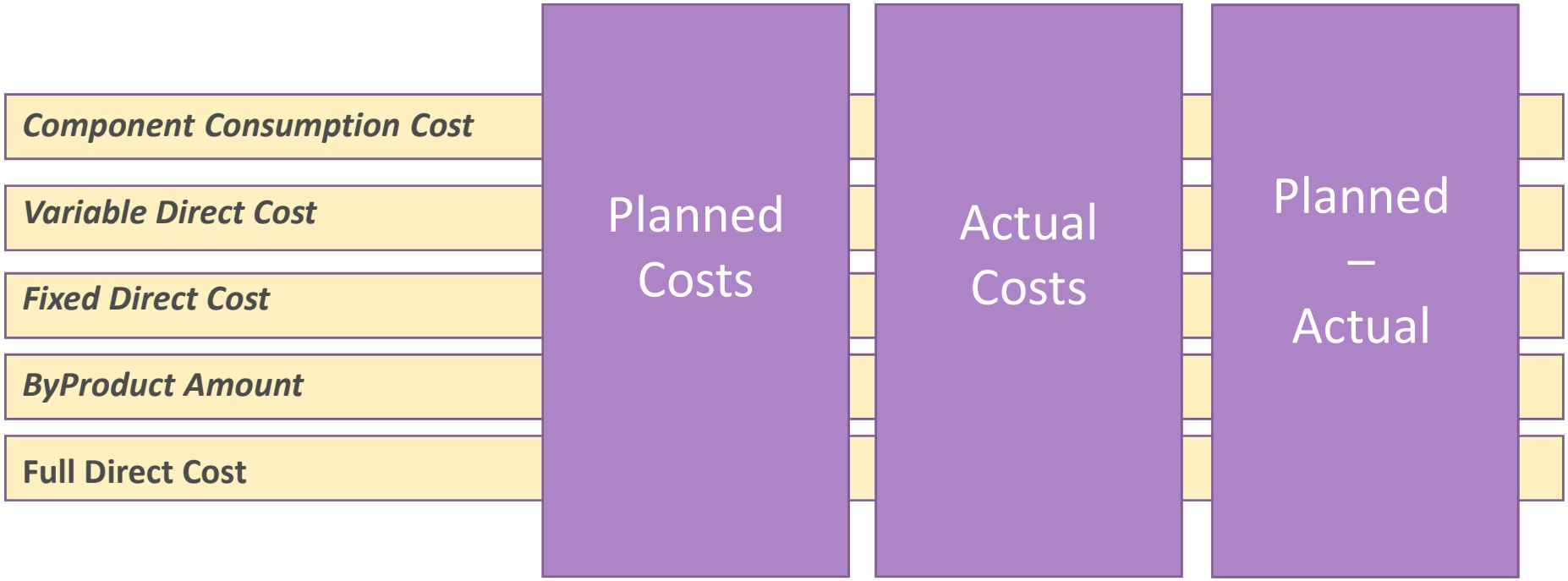
Production Cost delta analysis

delta analysis between planned costs and actual ones related to all direct costing figures at manufacturing order level



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Overhead Costs

- ***variable direct overhead costs*** calculated from actual workorder variable direct costs
- ***fixed direct overhead costs*** calculated from actual workorder fixed direct costs
- ***components consumption overhead costs*** calculated from actual components consumption costs

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WIP Calculation

WIP evaluation in real time by taking into account the following cost components:

- raw material consumption allocation at planned values (cancelled at order closure)
- components consumption overhead costs at planned values (cancelled at order closure)
- direct costs
- variable direct overhead costs
- fixed direct overhead costs
- raw material consumption cost

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Cost Variances

- ***Planned Costs Variance:*** standard cost compared to full planned direct cost
- ***Material and By-Products Variance:*** actual components consumption costs to the planned ones
- **Direct Costs Variance:** actual workorder times costs to the planned ones

Financial postings are to balance WIP account at manufacturing order closure

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MRO Maintenance

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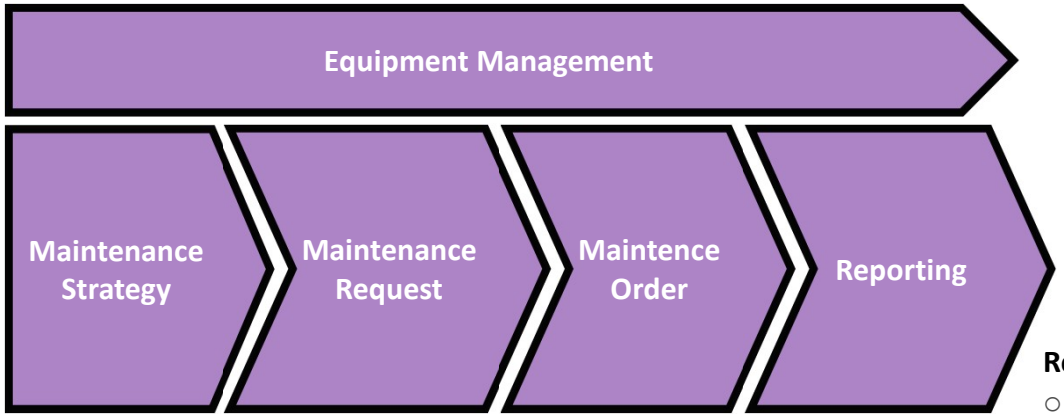
The Maintenance management overview

Maintenance master data
- Functional location
- Meter management
- Gauge management
- Spare parts
- Tool management
- Check list
- Maintenance task

Maintenance Team
- Dashboard
- Team members assignment
- Cost management

Equipment master data
- Location assignment
- Equipment status management
- equipment hierarchy
- Document management



Maintenance strategies
- Corrective
- Preventive
- On condition
- Periodic
- Maintenance Plan
- Inspection
- Retrofit

Integration features
- Priority management
- Accounting integration
- Email communication
- Activity management
- Document management

Reports
- equipment cost analysis
  equipment hierarchy cost analysis
- maintenance cost analysis
- tool utilization analysis

The “MRO Maintenance” supports maintenance processes management with different maintenance strategies.

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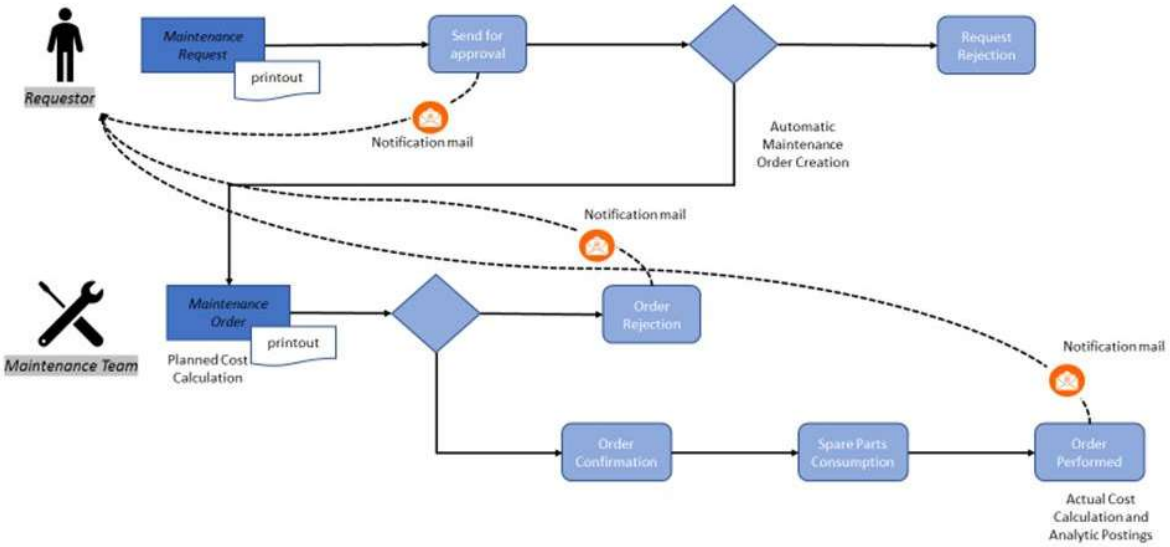
The main maintenance process



Remarks

- The maintenance request is for requesting maintenance job for the corrective, inspection and retrofit maintenance strategies.
- Maintenance orders can be created manually without any maintenance request as reference or automatically as result of maintenance procedures run (on condition, periodic and maintenance plan)

The maintenance process steps

- maintenance request creation and its printout
- approval request (communication via email)
- maintenance order automatic creation after approving maintenance request
- spare parts, tools and check list assignment to maintenance order
- scheduling execution dates with planned duration
- maintenance order printout
- maintenance order confirmation and maintenance planned cost automatic calculation
- execution of maintenance job checking material availability and reserving tools
- maintenance order closing and actual cost calculation and analytic account postings

Equipment management

- An Equipment is assigned to a Functional Location as:
  - Scrap location
  - Operative location with hierarchical structure
  - Warehouse location

- The Equipment Status management with the possible following values:
  - Warehouse,
  - Breakdown,
  - in Maintenance (maintenance order running),
  - Operative (installed) and
  - Scrapped (no maintenance order creation)

- The equipment status is automatically determined based on its functional location and its maintenance orders in progress

- Hierarchical representation of complex equipments' structure

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Key performance indicators

At equipment level, the following KPIs are available:

- **Mean Time To Repair (MTTR)** is an average time for performing corrective maintenance
- **Mean Time Between Failure (MTBF)** is an average time between corrective maintenance order actual closure dates and next corrective maintenance order planned request dates
- **Next maintenance date** from the next open maintenance order
- **Last failure data** from the last corrective maintenance order
- **Estimated time before next failure** calculated as Last failure data + MTBF

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Maintenance Request

Process steps:

- The maintenance request is created detailing equipment, request date, maintenance type, requester, priority and cause (detailed description of maintenance request, reported in the related maintenance order)
- After saving, a mail is sent out to the requester for maintenance request approval
- the requestor can approve it and a maintenance order with reference to this request is automatically created
- or reject it detailing the rejection reason, reported into the related maintenance request
- the maintenance order confirmation moves the maintenance request state in execution
- after performing the maintenance job, so closing the maintenance order, the maintenance request will be automatically closed (state done)

State management with the possible following values:

- Draft → initial creation state
- Confirmed → requester approval performed
- Execution → maintenance order running
- Done → maintenance order closed
- Rejected → maintenance request rejected
- Cancelled → maintenance request cancelled

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Maintenance Order 1/2

Process steps:

- A maintenance order is created manually or automatically by approving a request
- maintenance request is reported into the related maintenance order
- scheduling by entering the end schedule date and the planned duration (backward scheduling)
- maintenance manager can approve or reject maintenance order
- in case order rejection, a mail is sent out to the maintenance requester
- spare parts, tools, planned duration and check lists are suggested by default by selecting the proper task
- maintenance order printout (with all needed information for performing it)
- at order confirmation, the planned costs are automatically calculated and actual start execution date is set
- the order closing sets the end execution date, calculate the actual costing figures and performing analytic posting; a mail is sent out to the requestor to inform him/her the maintenance job has been performed
- analytic postings on analytic account set in maintenance team master data for spare parts costs, labor costs and tools utilization costs

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Maintenance Order 2/2

State management with the possible following values:

- Draft → initial creation state
- Released → order approved with waiting parts
- Ready → order approved with available parts
- Done → maintenance order closed
- Cancelled → maintenance order cancelled/rejected

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The maintenance procedures

- **On Condition Maintenance**
- **Periodic Maintenance**
- **Maintenance Plan**

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On condition maintenance procedure

- On condition maintenance is based on actual measures provided by a gauge installed to an equipment.
- A maintenance order is automatically created whether a measure is out of the allowed interval.
- Therefore, the process is triggered for “not processed” measures outside the allowed interval/thresholds for gauge assigned and installed to an equipment and an active maintenance order is not already running
- A new on condition maintenance order is created and all not processed measured are set as processed
- The reference to the new maintenance order is recorder on the related measure for tracking purposes

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Periodic maintenance procedure

- Periodic maintenance is based on actual equipment utilization provided by a meter installed to an equipment.
- A maintenance order is automatically created whether cumulated utilization or working time spent from the last maintenance order exceeded defined threshold.
- the process is triggered based on the following conditions:
  - the actual time calculated from the last periodic maintenance order (if none, meter installment date) is upper than a threshold
  - the actual utilization calculated as actual measure – “utilization from the last periodic maintenance order” is upper than a threshold
  - an active maintenance order maintenance order is not already running
- a new periodic maintenance order is created#
- the reference to the new maintenance order is recorder on the related measure for tracking purposes

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Maintenance plan procedure

- The Maintenance Plan defines a list of planned maintenance jobs for a specific equipment as a list of planned date, planned utilization and maintenance task.
- A meter has to be assigned to an equipment subjected to maintenance plan.
- Based on actual utilization and the current date compared with planned utilization and maintenance planned date a maintenance order is created.
- The process is triggered when one of the following two conditions occurs for a maintenance plan item and an maintenance order is not already running:
    - the planned date is in the past
    - the actual utilization calculated as actual is upper than the planned utilization
- a maintenance plan order is created and its reference is recorded on the related maintenance plan item for tracking purposes
- after processing the maintenance plan order the maintenance plan item is closed
- Maintenance plan procedure can be performed manually and reporting the maintenance order on the corresponding maintenance plan item.

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MRP MRO Maintenance Integration

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Maintenance integration in Work Center master data

- Workcenter can be assigned to an Equipment; therefore, all maintenance activities can be performed with reference to a workcenter
- A periodic maintenance as maintenance policy can be activated and collect automatically workorder confirmations as meter measures
- Maintenance Requests can be raised from the Workcenter master data; the user should have maintenance permission
- Maintenance Requests and Maintenance Orders with reference to the equipment linked to a workcenter are collected in the related Workcenter master data
- In case a Maintenance Order is running, the Workcenter status is automatically set from “Ready” to “On Maintenance”

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Maintenance integration in Manufacturing Order process

- Maintenance Request can be raised when Manufacturing Order is running
- All Maintenance Requests created for maintenance activities related to a manufacturing order processing are collected in the manufacturing order
- It is not possible to confirm a workorder when the related workcenter is “on maintenance” status
- It is not possible to confirm a milestone workorder whether a previous workorder to be closed is linked to a workcenter in “on maintenance” status
- In case periodic maintenance indicator has been activated at workcenter level, workorder confirmation creates automatically a meter measure
- Workcenter status is reported in the workorders list.

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