



# Infor LN Manufacturing User Guide for Manufacturing

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# About this document

This document provides an overview of the Manufacturing package and setup process. Various manufacturing options are described as well as costing, configuration and routing settings that must be configured before production.

## How to read this document

### Comments?

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## Manufacturing

You can use Manufacturing to manage the production of items.

Use Manufacturing to:

- Define bills of material (BOMs), routings, and tool requirements.
- Calculate cost and sales prices.
- Plan projects and carry out network planning.
- Control the execution of production orders.
- Configure large numbers of variants of finished products with CPQ Configurator set up.
- Plan and generate assembly orders (p. 61).

Manufacturing also contains functionality for:

- Mass BOM changes
- Product classification
- Repetitive production
- Definition of customized items

## Job Shop Control (JSC)

The job shop control module handles the creation of production orders, planning of production orders, and the procedure related to the execution of these orders.

You can manually create and modify production orders in the Job Shop Control module. To create production orders automatically, you must use Enterprise Planning.

At macro level, the procedure consists of availability of materials and capacity, determining the order sequence, providing the necessary information through the help of various documents to the operators

in the job shop, recording all transactions of issuing material, and receiving the finished product in the warehouse. The time spent by a worker on a production order is also recorded, so the actual cost of a production order and the production efficiency can be obtained.

The Job Shop Control module can be used to replan production orders, especially to alter the timing of operations to take account of delays and changes in priorities. If you are unable to complete certain operations yourself, you can use the Job Shop Control module to subcontract operations.

## Assembly control overview

The Assembly Control module in LN is used to control processes in the job shop when producing FAS items.

### Assembly Lines

Assembly lines consist of a set of consecutive line stations. The items are manufactured by passing them from line station to line station and by carrying out operations at each line station. An assembly line is subdivided into a number of line segments separated by buffers. You must define this structure in the Assembly Control module. An assembly line can be either a main line or a supplying line.

### Assembly Orders

Assembly orders can either be generated from sales orders (demand), or by your configurator. They pass through a series of statuses, in an analogous manner to JSC production orders. Before you can carry out the order, assembly parts are allocated to the shop-floor warehouses of the line stations. When you have completed the order you can backflush the materials and hours.

### Line-Station Variants

When an assembly order is transferred to the Assembly Control module, line-station orders, line-station variants (LSVs) and exchangeable configurations are generated. LSVs are used to reduce data, by combining all the operations and materials with the same specifications for a particular line station.

### Line Sequencing

The orders that come from your configurator have an initial sequence (that is, the order in which they are processed on the assembly line). In Assembly Control you use a set of rules to place these orders and the demand orders in a final sequence. The rules include priority (for example, sold orders have a higher priority than stock orders) and operational considerations (for example, place orders with the same paint color next to each other, to avoid time wasted in changing paint nozzles).

## Assembly line costing

There are a number of important differences in the financial calculations carried out for assembly orders compared with JSC production orders. For example, results are not split into price variances and efficiency variances and there is no calculation of end-item unit costs.

# Origin of production orders

In the Production Orders (tisfc0501m000) session, you can manually define production orders. However, production orders generally originate from one of these packages :

- Enterprise Planning
- Warehousing

Orders generated in Enterprise Planning and Warehousing are transferred to the Production Orders (tisfc0501m000) session in Manufacturing. This session also allows you to manually enter production orders.

## Production orders from Enterprise Planning

Items with the order system **Created** are processed in the Order Planning module of Enterprise Planning. The item's **Customized** check box in the Items (tcibd0501m000) session defines the way Enterprise Planning handles the planning.

- If **No** is selected in the **Customized** field, Enterprise Planning creates planned production orders based on forecast. Planned production orders are generated in the Generate Order Planning (cprrp1210m000) session. You can also manually enter planned production orders in the Planned Orders (cprrp1100m000) session.
- If **Yes** is selected in the **Customized** field, the item is a customized item. Enterprise Planning can plan the requirements for these item types. Planned production orders are generated based on the customer orders that you enter in Sales.

You can transfer the planned production orders to the Job Shop Control module in the Transfer Order Planning (cppat1210m000) session in the Plan Transfer (PAT) module of Enterprise Planning. In this session, you can also transfer production plans to the Job Shop Control module. LN converts these plans into planned production orders before they are transferred.

## Production orders from Warehouse Management

Items with order system statistical inventory control ( **SIC** ) are processed in Warehousing. You can use the Generate Order Advice (SIC) (whina3200m000) session to generate production-order advices.

However, the item's supply system defined in the Item Data by Warehouse (whwmd2510m000) session also determines how production orders are generated in Warehousing:

- If the supply system is **KANBAN**, you must use the Generate Orders (KANBAN) (whinh2200m000) session.
- If the supply system is **Time-Phased Order Point**, you must use the Generate Orders (TPOP) (whinh2201m000) session.

Use the Transfer Production Order Advice (whina3202m000) session to transfer production order advices with status **Confirmed** to the Job Shop Control module.

## Production orders - functional overview

A production order comprises the order to produce an item and the conditions under which manufacturing takes place, such as the routing that is used, the delivery date, and the order quantity.

A production order can be used for:

- Production of anonymous items
- Standard-to-order production
- Production of customized items

### Note

If multisite functionality is active, production orders are generated for one or more sites.

Manufacture details may vary between sites.

- **Origin of production orders**

A production order is usually generated by a planning algorithm, such as master-based planning or order-based planning, and is subsequently transferred to a manufacturing module. You can also manually create production orders in Enterprise Planning

- **Processing new production orders**

When a new production order is created, the master data for the product is copied from the company level to the site where production takes place.

For more information on item data with multisite activated see: Item data

- **Duplicating production orders**

Click **Duplicate** in the menu or the toolbar to duplicate the production order, which means that the production header information is copied. The production order's original material and operations are *not* copied for a number of reasons:

- Some materials in the job shop bill of material, or some operations may be invalid because of engineering changes or changes in the planning cluster.
- The warehouses, item definition, standard cost, may have changed, which can lead to inconsistent orders.

- Operation texts or drawings can be linked to the production order. Note: LN cannot determine which data must be copied because this can differ for every occasion. LN cannot make a distinction between original and modified data.
- Production order costing can be different for the original and the duplicated production order, the production order may be manufactured at a different site in the same planning cluster, but linked to a different enterprise unit.
- All warehouse orders and related data must always be regenerated.
- **Order status**  
Production orders go through a number of order statuses, such as:
  - **Created**
  - **Printed**
  - **Released**The order status determines which actions can be performed on a production order.
- **Estimated and actual costs**  
The estimated costs for a production order are based on the BOM and the routing (estimated costing). During production, the hours that are actually spent and the materials that are actually used are posted (actual costing). When the production order is closed, the result of the production order is calculated.



## Production order status

The order status determines which actions can be performed on a production order. The order status is shown in the sessions in which production orders are handled.

These statuses are available for production orders

- **Created**

The initial status of a production order. All data of the production order can still be changed. Materials have not yet been issued. Materials can be added or removed, and quantities can be changed.

- **Printed**

The documents that accompany the production order have been printed. If the **Printing Production Order Documents Mandatory** check box in the Production Order Parameters (tisfc0100s000) session is selected, the production order cannot be released before the order documents have been printed. The **Printing Production Order Documents Mandatory** check box is not valid for repetitive items because printing order documents is never mandatory for repetitive items. For a description of the types of order documents, see [Contents of order documents](#).

- **Released**

If a production order is released for production, materials are issued to the job shop for production, and hours can be posted.

You can still do the following:

- Adjust planning data
- Change the estimated materials and estimated operation cost as long as the cost estimates have not been frozen

Production orders can be released by using the Release Production Orders (tisfc0204m000) session.

- **Active**

Work on the production order has started. The order status becomes **Active** as soon as any WIP transaction takes place for the production order. When the production order status is **Active**, hours are posted and materials are issued. The estimated costs cannot be changed after the production order is **Active**.

- **Production Completed**

The order has been reported completed. As soon as Warehousing finishes the inbound procedure for produced items that must be delivered into inventory, the production order status will be **Completed**.

- **Completed**

The order has been reported as complete and all completed products have been delivered into inventory. It is still possible to account hours and issue materials for the production order.

You report an order as complete in one of these sessions:

- The Report Orders Completed (tisfc0520m000) session to report one or more orders, partly or entirely, as complete.
- The Report Operations Completed (tisfc0130m000) session to report the final operation of an order as complete.
- The Report Operations Complete by Order Group (tisfc0205m000) session to report orders as complete by order group.
- The Report Production Schedules Completed (tirpt1201m000) session or the Report Production Orders Completed from Production Schedule (tirpt1502m000) session to report production orders in production schedules as complete for RPT items.

- **Closed**

The financial results of the production order have been calculated. Before a production order is closed, all materials for the order must have been issued and all hours must have been accounted. After an order has been closed, materials can no longer be issued nor can hours be accounted unless the order status is reset. You can close production orders with the Close Production Orders (ticst0201m000) session.

- **Archived**

The data of the production order has been moved to the archive.

## Product variants - Purchased configurable items

This topic explains the following functionality that pertains to purchased configurable items:

- Compare any configured item of the variant.
- Define product variant purchase price structure.

## Compare variants

You can compare two product variants to check the following:

- The inventory of a configured purchased subassembly.
- The possibility of using inventory of a matching configuration rather than order a new configured item.

### Note

You can consider two configured items as interchangeable if all the options are the same.

You can compare the following configured items of a product variant:

- The configured end item
- Any configurable child

To compare the configured items of a product variant, you can use the Option List ID. The configurable items are compared at the option set level. Two configured items that are created by a variant are considered as interchangeable if they have the same Option List ID.

The Option List ID is used for the following types of transactions:

- Manufactured assembly item transactions
- Purchased configured item transactions
- Inventory transactions

## Variant numbers and Option list IDs

The matching of demand and supply of purchased configurable items is based on the Option List ID.

The matching of the demand and supply of a manufactured assembly end item is based on the product variant. Example the demand for the manufactured assembly end item is generated when a product variant is created for a new sales order. The Option List ID for this variant matches with a redundant variant which is in stock. An assembly order is created to meet this demand is created as the variant numbers differ.

The variants numbers and Option List IDs are used in the following processes:

- Create assembly planning ( Calculate Assembly Part Requirements (tiapl2221m000)
- Generate assembly orders
- Generate warehouse outbound advice.

## Product variant purchase price structure

You can set up the purchase price for a configured item. The purchase price depends on the options of a configured item. You can calculate the purchase price of a variant during the configuration process.

You can do so, after you calculate the sales price. If you update the variant, you are prompted to re-calculate the sales price.

To re-calculate the sales price, the configuration date is used as the reference date for price list validation. You can set the configuration date in the Sales Parameters (tdsIs0500m000) session in the Sales package. The **Configuration Date (PCS)** can be:

- **Order Date**
- **System Date**
- **Delivery Date**

To calculate the purchase price for a set of variants, you can use the Calculate Product Variant Purchase Price Structure (tipcf5235m000)

To calculate the purchase price for the current variant, you can use the following sessions:

- Product Variants (tipcf5501m000)
- Product Variant Purchase Price Structure (tipcf5535m000)

The purchase price for the schedule is retrieved from the Generic Price Lists (tipcf4101m000) session and is based on the value selected in the **Purchase Price Date Type** field in the Pricing Parameters (tdpcg0100m000) session. Allowed values

- **Order Date**
- **System Date**
- **Delivery Date**

#### Important!

The purchase price structure is used for analysis only.

#### Note

Since different dates are used as reference date for sales price/purchase price calculation, the price on the schedule can differ from the price displayed in the variant data.

## Processing production orders

When a new production order is transferred to the Job Shop Control module or created manually, LN executes the following actions:

**Step 1: The relevant data from the Bill of Material, Routing, and Tools Requirement Planning modules is retrieved.**

If the materials include a phantom item, the materials and operations of that item are also retrieved.

**Step 2: The material costs are estimated. In the calculation of the required material quantities, the scrap and yield factors are taken into account.**

If it concerns a rework order or a production order for an item with item type Purchased or Product, the materials estimate is filled with the item itself.

**Step 3: The hours that are needed for each operation are estimated, based on the routing of the item.**

Operations of phantom items are also taken into consideration. Exception: if it concerns a rework order or a production order for a purchased item, the hours are not estimated. In that case the hours must be entered manually.

**Step 4: The tools requirements are calculated.****Step 5: The production orders are planned.**

This implies that the start and finish dates and times of the operations are set, except for rework orders.

**Step 6: If a production order has no operations, the order lead time defined for the manufactured item is used to plan the production order.****Step 7: Capacity utilization of work centers is determined, but not for rework orders.****Step 8: The planned inventory transactions in Warehousing are updated: allocations for materials and planned receipts for products are recorded.****Step 9: The calculation of the planned receipt date for the end product is made.**

For more information see the To determine on order dates topic.

**Step 10: Order-specific inspection data are generated in Quality Management.****Step 11: A workflow instance is created.****Note**

If the **Moment Freezing Estimates** field has the value **During Creating Order**, the estimated order costs are frozen immediately, and the estimated end item unit costs are calculated.

# Releasing production orders

## Releasing production orders

When you release a production order, the production order gets the order status **Released**. This means that the production can start: materials can be issued and spent hours can be accounted.

When you release a production order, LN performs the following actions:

- Warehousing orders are created in Warehousing. Through these warehousing orders, the issue of materials and receipt into inventory of end products are handled.
- Allocations of materials are moved to the shop-floor warehouse.
- Inspection orders are created in Quality.
- If the **Moment Freezing Estimates** field has the value **During Releasing Order**, the estimated order costs are frozen, and the estimated end-item unit costs are calculated.

## How to release production orders

You can release production orders by means of the Release Production Orders (tisfc0204m000) session.

### Note

If the **Printing Production Order Documents Mandatory** check box in the Production Order Parameters (tisfc0100s000) session is selected, the order status of a production order must be **Printed** before you can release it.

# Reporting operations as completed

When all items are processed in an operation, you can report the operation as complete. This is not mandatory, unless the operation is a count point.

You can do this in the Report Operations Completed (tisfc0130m000) session.

If you report an operation completed, the operation status changes to **Completed**. If necessary, you can reset the operation status to **Started**.

# Quality management

In certain situations you cannot report an operation completed before the inspection order for the operation has been processed. This is explained in the Using QM for manufacturing operations topic.

## Blocked operations

If an operation is blocked, you cannot report it completed.

## Quantities completed and rejected

You must specify which quantity of the item has been completed successfully and how much must be rejected for not meeting the required quality. For more information, refer to **Reporting quantities as completed and rejected**.

If you want to report an operation completed, while the reported quantities do not match the quantities reported in the previous operation, the previous operation can be updated automatically. This depends on the **Reporting Method for Previous Operations** field in the Production Order Parameters (tisfc0100s000) session.

If an operation has been reported completed, all previous operations must have been completed.

You can also report all previous operations completed in the same way. However, a count point operation cannot be reported automatically via a follow-up operation. Report these operations individually.

If you report items as rejected, LN sometimes requires you to enter a reason for the rejection.

## JSC Order groups

You can report the operations for all the production orders in an JSC order group completed in the Report Operations Complete by Order Group (tisfc0205m000) session.

## Reporting production orders as completed

### Reporting orders completed

When production is ready, you must report the production order completed. You can do this in the following sessions:

- Report Orders Completed (tisfc0520m000)
- Report Orders Completed Globally (tisfc0206m000)
- Production Schedules (tirpt1500m000) (only for repetitive items)

After you have reported a production order completed, you can still process material issues for the production order, or post hours to it.

### Quality management

In certain situations you cannot report a production order completed before the inspection order for the operation has been processed.

## Blocked operations

You cannot report a production order completed, if one of its operations is blocked.

## Completion of operations

If the **Reporting Method for Previous Operations** field in the Production Order Parameters (tisfc0100s000) session is **None**, all operations must be reported completed before you can report the production order completed. If the **Reporting Method for Previous Operations** field in the Production Order Parameters (tisfc0100s000) session is **Automatic** or **Interactive** you can report a production order and its operations completed at the same time.

## Posting of end products

If you use the Report Orders Completed Globally (tisfc0206m000) session, LN posts the current planned quantity of the product to inventory.

## The Tools Requirement Planning (TRP) module

When you report a production order completed, the tool's life of the used tools is reduced.

## JSC order groups

If you are using order groups, you can report completed all the production orders in a group simultaneously. Use the Report Orders Completed Globally (tisfc0206m000) session and select the **Production Order Group** check box.

# Archiving production orders

Closed production orders can be archived for future reference. This means that the production order is moved to another company number, which serves as archive. The order status changes to **Archived**.

General data and costing history data can also be archived. General data, for example work center data, does not pertain to a particular production order. Costing history data is about material usage, spent hours, and so on.

The archive company must be defined in the Implemented Software Components (tccom0500m000) session in Common.

Data can be archived by means of the following session:

- Archive/Delete Production Orders (ticst0250m000)

You must change to the company number of the archive company to print or display archived information.

# Integrations of JSC with warehousing

The following integrations exist between the Job Shop Control module and Warehousing:

- The Inventory Planning module stores on-order quantities and planned inventory transactions.
- The Warehouse Orders module handles the issue of materials and receipts of finished products.
- The Warehouse Orders module is also involved in the posting of financial transactions and the handling of inspection orders.
- The Inventory Analysis module plans items with order system SIC and generates production orders.

## Planned inventory transactions

When you create production orders in the Job Shop Control module, the Inventory Planning module registers the order's planned inventory transactions. The Inventory Planning module also registers:

- Material allocations
- Inventory on order. For more information, refer to To determine on order dates.

## Warehousing orders

The Warehouse Orders module handles the issue of materials and receipts of finished products with warehousing orders. The warehousing order determines:

- Inbound and outbound procedures
- Lot selection and identification
- Warehouse locations.

LN creates a warehousing order when you release a production order. When you modify the estimated materials, the warehousing order is updated automatically. You can control the issue of materials in several ways. For more information, refer to *Overview of material issue (p. 105)*.

## Inventory transactions

LN records all inventory transactions in the Warehouse Orders module in Warehousing. LN uses these inventory transactions to create the appropriate financial transactions. For more information, refer to *Integrations of JSC with finance (p. 28)*.

When a component is issued, or when an end product is received, the warehousing order triggers the inspection order associated with the production order.

## Generation of production orders

Items with order system SIC are planned in the Inventory Analysis module in Warehousing. You can transfer these orders to the Job Shop Control module.

## Integrations of JSC with Configurator

Use Configurator to configure generic items. The configuration of a generic item results in a product variant for which you can create production orders.

The way LN plans generic items depends on the order system. Generic items with **FAS** order system are called FAS items. You control the planning of FAS items completely in Configurator. Planned orders for FAS items are transferred directly from Configurator to the Job Shop Control module. You must carry out these orders with the line-sequencing functionality in the Assembly Control module.

Generic items with an order system other than **FAS** can be configured in Configurator, but the production orders for these items are planned in another package (as determined by the order system). LN creates a project for these items which you control in the Project Control module.

## Integrations of JSC with enterprise planning

LN plans items with Planned order system in Enterprise Planning. You can plan the item with master-based planning or order-based planning. You can transfer the generated planned production orders to the Job Shop Control module with the Transfer Order Planning (cppat1210m000) session.

You can also use Enterprise Planning to plan the replenishment of shop floor warehouses.

## Integrations of JSC with finance

Every inventory transaction and everything that changes the value of items results in a financial transaction. These transactions are posted to the General Ledger module in Financials.

The most important transactions for production orders are:

- The issue of materials for a production order.
- The booking of hours on a production order.
- The delivery into inventory of finished products.
- The WIP transfers between work centers.
- The application of a surcharge.

The selection of the financial company where LN posts the transactions depends on a number of parameters. See Multisite overview

For details about the setup of the ledger accounts, see Financial integrations - overview.

## Integration with JSC

Quality can be used to inspect the quality of

- Materials for production orders
- Intermediate products between operations (subassemblies)
- Finished goods of production orders

In Quality you specify the required tests and the quality standards.

You can control the inspections by means of inspection orders. Infor LN creates the inspection orders when you release a production order. The inspection orders for materials and end products are based on the warehouse orders by which you move the items from and to the warehouse.

An inspection order can in some cases (depending on the parameters) block a production order, until the inspections have finished. You can override these parameters for individual production orders, operations, or materials, by means of the Order Specific Test Procedures (qmptc0149m000) session.

Quality sends the results of the inspections of subassemblies and end products back to the Job Shop Control module. These results determine how much of a product you can report completed or rejected.

## Integrations of JSC with Tool Requirements Planning

You can define the tool requirements for the production of an item in the Operation (Step) - Tools (tirou1110m000) session in the Routing module.

Tool requirements for a particular production order can be maintained in the Estimated Tool Requirements (titrp0111m000) session in the Tools Requirement Planning module.

When a new production order is transferred to the Job Shop Control module or created manually, LN calculates the tool requirements.



# Chapter 3

## Production order planning

3

### Production order priority

Use the Print Production Order Planning by Priority (tisfc1410m000) session to identify production orders, work centers, machines, or tasks that require special attention.

LN prints the data in the order specified in the **Print Priority** field. You can also set limits for the criterion specified in the **Print Priority** field. For example, you can print all production orders which are more than five days behind schedule.

You can sort the data by one of the following criteria:

- **Critical Ratio**
- **Earliest Due Date**
- **Priority of Prdn Order**
- **Shortest Total Rem.Prd.Tm**
- **Slack Time**

The **Critical Ratio** criterion is the ratio of the number of days available for production until the delivery date, against the number of days needed for production. If **Critical Ratio** is less than 1, the production order is behind schedule.

The **Earliest Due Date** criterion is the time left up to the production order's delivery date.

The **Priority of Prdn Order** criterion is the value of the **Priority** field in the Production Order (tisfc0101s000) session.

The **Shortest Total Rem.Prd.Tm** criterion is the total number of days still required to work on a production order. You can use this to print orders which are almost finished.

The **Slack Time** criterion equals the number of days available for production until the delivery date minus the number of days needed for production. If the **Critical Ratio** is negative, the production order is behind schedule.

For more information, see the online help for the Print Production Order Planning by Priority (tisfc1410m000) session.

The **Priority** is also used to decide which order to return a tool to.

## Planning production orders in JSC

Production order planning provides the facility to modify and preplan the production order. The planning is a process of determining the start and end dates of the individual operation and production order. When the production order is planned, the lead-time of the operations and the production order is calculated. The load on the corresponding machines and work centers is also calculated and displayed.

Production orders can come to the Job Shop Control module from a variety of *Origin of production orders* (p. 15) including:

- Enterprise Planning
- Warehousing
- Configurator

You can also create production orders manually in the Production Orders (tisfc0501m000) session.

### Note

Orders generated by Configurator are normally used only for assembly lines, but you can use the sessions covered in this topic to adjust the planning of operations carried out at non-assembly line work centers after the assembly line. These are known as post-process operations. You can use these, for example, to customize products for customers that require extra features.

However, you might want to modify the planning of these orders in the job shop, for example to cope with a backlog, or an order gaining a higher priority because of customer demand for the end item.

### Overview sessions

The Utilization by Week (tisfc1502m000) session gives an overview of each week of what capacity you have planned to use, including:

- planned orders
- work centers and operations for the orders
- quantities planned for the orders
- estimated production time to complete the orders.

If you have selected the **Update Method Day Utilization** check box in the Production Order Parameters (tisfc0100s000) session, you can use the Utilization by Day (tisfc1503m000) session to give similar information to the above session.

You can also see a similar overview organized by work center or machine and by week or day in the following sessions:

- Work Center Utilization by Week (tisfc1501m000)
- Work Center Utilization by Day (tisfc1506m000)
- Machine Utilization by Week (tisfc1504m000)

- Machine Utilization by Day (tisfc1505m000)

## Editing Job Shop Planning

A production order has one or more operations planned. You can alter the order in which the operations are carried out, in the Operation Relationships by Order (tisfc1102m000) session. You can use the Production Planning (tisfc0110m000) session to modify the network routing for one operation, by changing the **Next Operation** and the **Task** assigned to the current operation.

To change the dates for the uncompleted operations of several production orders collectively, use the Shift Production Planning (tisfc1202m000) session. You select the earliest operation that is not yet completed, and adjust its **Shift Planning to Date**. LN adjusts the dates of the other operations in that production order, and of the other production orders that you have selected, to take account of your change.

If you want to change the dates of an individual operation, you can use the Production Planning (tisfc0110m000) session. You can alter several variables, including:

- **Remaining Production Time** (if you change this, other dates for the operations are updated by LN)
- **Cycle Time (min)** and **SetupTime(Avg)**
- **Production Rate** unit time

You can also adjust the **Shift Planning to Date** by starting the graphical planning board from the Production Planning by Planning Board (tisfc1120m000) session. This lets you reschedule operations by dragging a graphical representation of them with your mouse. You can see a graphical representation of machine planning with the Machine Planning by Planning Board (tisfc1140m000) session and of work center planning with the Work Center Planning by Planning Board (tisfc1130m000) session.

If you discover that your scrap or yield is different from expected, you can also modify this in the Production Planning (tisfc0110m000) session, and LN will modify the planned quantities to take account of your changes.

After you have made changes to the BOM or routing, you will need to use the Reprocess Production Orders (tisfc1203m000) session to make new production orders to take account of the changes you have made.

## Calendars in Manufacturing

To plan production orders or to calculate available capacity in Manufacturing, LN needs to know the hours that are available. In LN, calendars are used to record the availability of resources.

## Lead times and production planning

In production planning, LN uses lead times to determine when an operation is finished, and the next operation starts. To obtain reliable planning dates, the availability of resources must be taken into

account. For example, a work center can be occasionally unavailable, due to weekends, holidays, or maintenance.

For more information, refer to the online manual topic *Lead times in Manufacturing* (p. 35).

## Calendar codes

The following table shows how to link calendars to various resources.

To do this...	Use this session...
To define the company calendar	Companies (tcemm1170m000)
To define an <u>enterprise unit</u> 's calendar	Enterprise Units (tcemm0130m000)
To define a <u>work center</u> 's calendar	Work Centers (tirou0101m000)

### Note

It makes no difference whether you define a work center's calendar in the Work Centers (tirou0101m000) session or the Departments (tcmcs0565m000) session. Every work center is also a department. What you enter in one session is also visible in the other.

## Availability types

To do this...	Use this session...
To specify the <u>availability type</u> for production order planning	Job Shop Master Data Parameters (tirou0100m000)
To specify the availability type for Assembly Control	Assembly Control Parameters (tiasc0100m000)

To view the available combinations of calendar codes and availability types, start the Calendar Availability Types (tcccp0150m000) session. You can sort the records by calendar code or by availability type.

To view a calendar's working times, efficiency factors, and capacity percentage, use the Calendar Working Hours (tcccp0120m000) session and find the applicable calendar code and availability type.

If a planning date is not within the period defined by the start date and finish date of the selected calendar, that is, no calendar working hours are available for a specific date, LN uses the workweek.

# Lead times in Manufacturing

In LN, the lead time is the time to produce an item, from the production start date till the delivery date. Lead times are used for production planning purposes in Enterprise Planning and Manufacturing.

## Lead time elements

The lead time consists of the following lead time elements:

- Queue time
- Setup time
- Run time
- Wait time
- Move time

## Operation lead time

In Manufacturing, you can define lead time elements for every routing operation. LN uses the lead time elements to calculate the operation lead time.

LN defaults the queue time, wait time, and move time in the Job Shop Routing Operations (tirou4101m000) session from the Work Centers (tirou0101m000) session. You can change the defaulted values in the Job Shop Routing Operations (tirou4101m000) session.

## Production order lead time

LN calculates production-order lead times by adding up all operation lead times. If operation overlap takes place because transfer batch quantities are defined, LN uses more complex calculations to determine lead times and production order planning. For more information, refer to Production order lead-times (transfer batch quantity).

## Critical items

An item that you define as critical is one that can cause a bottleneck in a production process, such as an item with a long or uncertain lead time.

## How to define a critical item

- Create an item in the Items (tcibd0501m000) session. You can also create the item using Engineering data management summary.

- Define the item as a plan item in the Items - Planning (cprpd1100m000) session. You can zoom to the Items - Planning (cprpd1100m000) session from the Items (tcibd0501m000) session. You must define an item as a plan item, before you can define it as a critical item. Note the plan level of the plan item. You must use the same plan level for the critical item.
- In the Items - Planning (cprpd1100m000) session, select the **Critical in Master Planning** check box.

A critical item can be either **Manufactured** or **Purchased**.

## How to use a critical item

To define relationships between plan items and critical items:

- Use the Bill of Critical Materials (cprpd3120m000) session to define the relationship structure. The structure is similar to that of a Structure of a multilevel BOM.
- Generate the structure (that is, the critical bill of material) in the Generate Bill of Critical Materials (cprpd3220m000) session.

You can print the relationships you have defined in the Print Bill of Critical Materials (cprpd3420m000) session.

You can use master planning to plan the requirements of critical items.

## How to define a product model

Carry out the following steps to define a product model:

### Step 1: Product Configuration Parameters

In the Product Configuration Parameters (tipcf0100m000) session, determine the version of the product configurator. If the product model is in the creation stage, you must use the interpreter version. The advantage of this version is that the generic product model can be tested immediately if new constraints are created. If changes are made to these constraints, the constraints need not be recompiled first. Refer to the **Product Configurator Version** field in the Product Configuration Parameters (tipcf0100m000) session.

### Step 2: Items - General

In the Items (tcibd0501m000) session, enter the generic items that you need for the product model. If the item is a generic item, the following characters are not allowed in the item code:

% ' " ^ \ ! @ # \$ & \* ( ) | / ; ~ ` ? { } [ ] < >

The reason is that object files that are generated for constraints in the Product Configuration module cannot contain these characters.

You must decide whether you want to use a PCS budget and/or a PCS project when producing product variants, or you want to use PCF without PCS. A PCS budget is used to calculate the standard cost. A PCS project is used to plan, produce, and control the manufacturing process. Consequently, the structure of the product variant is generated by budget or project. The advantage of using PCS is that it provides an item with a detailed cost roll-up, and the possibility of pegging. However, in high volume environments, a detailed cost roll-up is often not necessary. Furthermore, using PCS requires extra time to calculate the project costs and to delete the project structure afterwards.

- If you want to use Project Control (PCS) for Product Configuration (PCF), the **Customizable** check box must be selected in the Items (tcibd0501m000) session.
- If you want to use Product Configuration (PCF) without Project Control (PCS), the **Customizable** check box must be cleared in the Items (tcibd0501m000) session.

If you configure items without PCS projects, standard items are generated instead of customized items. Pegging functionality is secured by the unique item codes of the configured items that can be related back to the sales order.

### Step 3: Product Features

In the Product Feature (tipcf0150m000) session, enter the required product features. You must define all required product features with possible options in this session.

### Step 4: Product Features by Generic Item and Constraints by Generic Item

In the Product Features by Configurable Item (tipcf1101m000) session, the product features are linked to a generic item. Product features are controlled by constraints, which you can define in the Configurable Item - Constraints (tipcf2110m000) session.

### Step 5: Generic BOMs and Generic Routing

In the Generic BOMs (tipcf3110m000) session and the Generic Routing (tipcf3120m000) session, you can enter respectively the product structure and the routing. The constraints in step 4 are used to ensure that the product structure and routing are in accordance with the selected options.

### Step 6: Price-List Matrix Codes, Price-List Matrices and Generic Price Lists

The Price List Matrix Codes (tipcf4110s000) session, the Price List Matrices (tipcf4120m000) session, and the Generic Price Lists (tipcf4101m000) session are not mandatory. If a sales price or a purchase price for a generic purchase item must be generated, the price list can be used to define a price list. You can use matrices for different features that have mutual relationships associated to the price. By defining the price list code and the price list matrices, the features and values in the matrices can be entered.

### Step 7: Settings for Generic Item-Data Generation

The Generic Item - Settings for Data Generation (tipcf3101m000) session is not mandatory. The item data that arises when configuring product variants can be defined generically according to your own

wishes and insights. You can use this session to create generic settings on how to generate the item code, item description, material, size, text, or standard for a generic item.

### **Step 8: Product Configuration Parameters**

After you defined the product model, you must change the product configurator version from **Interpreter Version** to **Object Version** in the Product Configuration Parameters (tipcf0100m000) session.

### **Step 9: Compile Constraints by Generic Item**

The last step is to compile the constraints to generate objects for each item in the Compile Constraints by Configurable Item (tipcf2201m000) session.

# Chapter 4

## Production orders with project

4

### Project types

The following project types exist:

#### Main Project

A main project is a separate project that is made up of several subprojects. Main projects and subprojects are both defined as projects. A main project acts as the driver for the planning of its subprojects or as the aggregate for the financial results of the subprojects. Recording a project structure using main projects and subprojects is especially important for extensive projects in an engineering-to-order situation. For main projects, only a limited number of project control functions is feasible.

#### Sub Project

A subproject is part of a main project. The network planning for the subproject is derived from the planning for the main project. Several parameters can be defined at main project level for a subproject. The project control functions for a subproject are also applicable for the single project.

#### Single Project

A single project is a separate project that is not divided into several subprojects.

#### Budget

A budget is used for planning and estimating, not for production execution.

## Main project and subproject parts

Working with main projects and subprojects has the following consequences:

- The main project contains the overall planning for its subprojects. This means that the start and delivery dates for the network planning of the subprojects are directly derived from the overall network planning for the main project! Umbrella activities can be defined for the main project in order to control the subprojects. This allows you to perform a rough cut of capacity requirements planning, depending on the value of the rough capacity requirement which can be recorded for each activity by means of the Activities (tipcs4101m000) session.
- Logistically, the main project lets you perform rough-cut planning and control the subprojects. A main project is not clearly relevant for detailed planning of the flow of materials and capacities. Therefore, NO customized product structures can be recorded for a main project.

For a main project, a variety of project data can be recorded which is also applicable for subprojects, unless data has been recorded separately for the subprojects. This data includes:

- Operation rates
- Subcontracting rates
- Cost-price surcharges
- Chart of accounts

The umbrella activities of the main project can be included in the estimated data of the (main) project. The main project acts as the aggregate project for the subprojects. So, some data of the subprojects is automatically aggregated to the main projects, that is:

- Rough capacity, aggregated capacity and hours spent by means of the Generate Network Planning (tipcs4210m000) session.
- Budgeted costs, estimated costs, actual costs and total invoice amount by means of the Calculate Standard Costs by Project (tipcs3250m000) session.

Various functions are performed for the main project. This is performed for the subprojects as well, that is:

- Network planning
- Cost price accounting
- Closing project
- Archiving project

The following cost and revenue transactions are possible for main projects:

- Hours that are or are not directly posted to an activity of the main project
- Sales orders or sales invoices for services rendered

# Network planning

Maintain the following data in order to carry out a network planning:

- General project data
- Activities by project
- Activity relations
- Capacity load table codes
- Capacity load tables

A network planning consists of all the activities required to execute a project (but not a budget). An activity may represent one or more operations. Each activity has a specific lead time. The relations within the network indicate which activities depend on each other. Analyzing the network will inform you about the total duration of the project. The method used is the Precedence Method.

The advantages of a network planning are as follows:

- The project planning is independent of the project structure as recorded in LN
- A network planning can be generated when the project structure is only partly-defined
- Network planning offers optimum facilities to monitor the project's progress. If activities are behind schedule, the influence on the project's finish date can be directly calculated and the appropriate measures taken in order to make up for the delay.

When you set up a network planning, the sequence order in which operations and activities are to be carried out is an important aspect. Activities can relate to other activities. They can be executed consecutively or they can overlap.

Depending on the planning method recorded in the Projects (tipcs2101m000) session, you can plan forwards (based on the start date) or backwards (based on the finish date).

The relations between activities determine whether there is any float in the planning. Free float is the number of days by which you can delay an activity without affecting the next activity. Total float is the number of days by which you can delay an activity without affecting the project's start or finish date.

The capacity required for the activity can be distributed over the activity's duration in terms of a percentage of the total capacity via the capacity load table.

You can indicate in the table whether customized operations must be automatically linked to activities when this has not yet been done. If the customized operation cannot be linked to an activity, it will be reported by LN.

The setup time, cycle time, man occupation for setup, man occupation for production, and machine occupation are recorded per operation by means of the Routing Operations (tirou1102m000) session.

The following examples show how the capacity requirements for a project activity are planned:

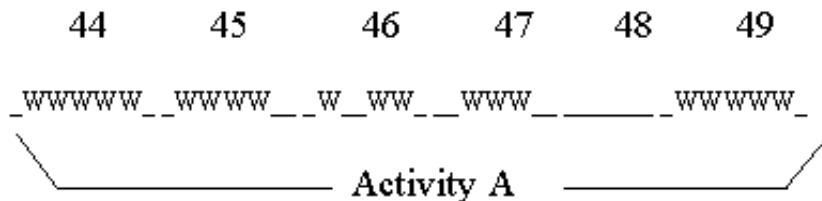
Example 1: *Example 1: Activity has not yet started (p. 42)* Example 2: *Example 2: Activity has already started (p. 43)*

## Example 1: Activity has not yet started

Activity A has not yet started. No hours have been spent, there is no project structure, and there is no detailed capacity planning.

- Activity duration (project days): 15
- Rough capacity requirement : 200
- Earliest start date : day 4 week 44 year 92
- Percentage completed : 0%

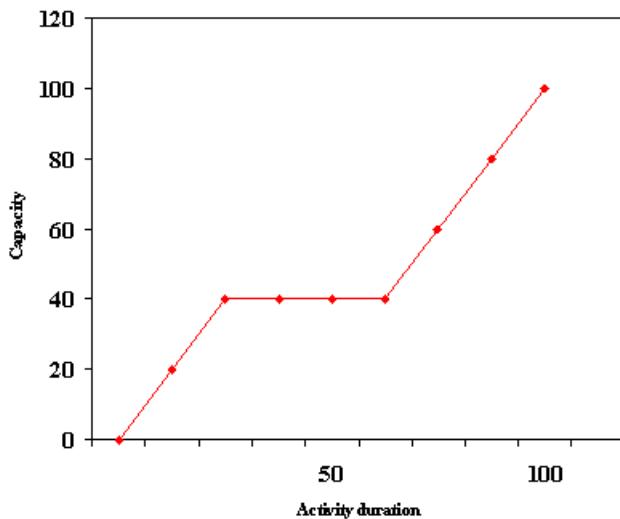
The current date lies before the earliest start date. The following figure depicts activity A being carried out:



### Legend

W Workdays  
- Non-workdays

The capacity load table assigned to the activity is shown in the following figure:



The capacity for activity A is 200 hours. The capacity load per week is as follows:

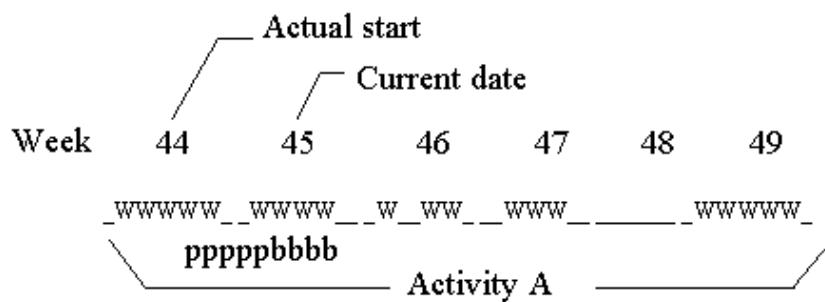
Week	Number of days	Percentage of Activity Duration	Percentage of Capacity Requirement	Difference Compared to Prev. Wk.	Capacity Requirement (per Week)
44-92	2	13%	17.3%	17.3%	34.6
45-92	6	40%	40.0%	22.7%	45.4
46-92	9	60%	40.0%	0.0%	0.0
47-92	12	80%	70.0%	30.0%	60.0
48-92	12	80%	70.0%	0.0%	0.0
49-92	15	100%	100.0%	30.0%	60.0

## Example 2: Activity has already started

Activity A has been started, hours have been spent, and a capacity planning has been carried out per project.

Activity duration (project days)	15
Rough capacity requirement	200 in work center 10
Actual start date	day 4 week 44 year 92
Hours spent	30 in work center 10
Detailed capacity requirement	100 in work center 10
Percentage completed	20%

The following figure depicts activity A being carried out:



### Legend

- W Workdays
- Non-workdays
- p progress
- b backlog

20 percent of activity A has been completed. In other words, 20 percent of the planned capacity for activity A is ready. Hours to be spent:  $0.8 \times 200 = 160$  hours. Based on the capacity load table, LN computes what percentage of the activity duration has lapsed. The capacity load table shows that 20 percent corresponds to 15 percent of progress in activity duration.

This progress is equal to  $0.15 \times 15 = 2.3$  days of the lead time. Planned progress (6 days) is  $6/15 \times 100\% = 40\%$  of the activity duration. The backlog =  $6 - 2.3 = 3.7$  days. According to the capacity load table, this corresponds to a capacity backlog of  $20\% = 40$  hours. These 40 hours must be added to the remaining lead time of 9 days. Capacity to be utilized according to the original planning:  $60\% = 120$  hours. To achieve the finish date of the activity, extra capacity must be added:  $40/120 = 33\%$ . The capacity load per week is then as follows:

Week	Number of days	Percentage of Activity Duration	Capacity Requirement (per Week)
46-92	9	60%	0
47-92	12	80%	60+20=80
48-92	12	80%	0
49-92	100%	100%	60+20=80

## Lean PCS projects

In a make-to-order production environment, production only starts when a customer places an order. Contrary to an engineer-to-order environment, a product in a make-to-order environment has, for the most part, fixed features and specifications that are unlikely to be changed. In LN, the type of make-to-order without any engineering is also called standard-to-order. The product then has a standard BOM and a standard routing, and is, therefore, a standard product.

Standard-to-order products are mostly products that are not desired to keep in stock, for example, because the product is very expensive or very voluminous. If you produce standard-to-order, the finished products can be transported directly to the customer that ordered them, which saves you most of the inventory costs.

There are two types of projects you can use in Project Control for the production of to-order standard items:

- You can set up a standard project
- You can set up a lean PCS project

Using a lean PCS project, you can peg activities to specific sales orders, with cost known by the PCS project. When a project is generated to manufacture the specified item, no BOM or routing is copied in to the project as those are standard and no engineering is possible once the item goes in projection.

The BOM and routing of a standard to order item are stored independently of the projects making use of them, preventing redundant data.

To use PCS for standard-to-order production, carry out the following steps:

### **Step 1: Create a sales order for the standard-to-order item.**

The order policy of the item in the sales order line must have the **Customizable** check box selected, which you can define in the Items (tcibd0501m000) session. As a result, the **Make Customized** check box in the Sales Order Lines (tdsIs4101m000) details session is selected, which indicates that a PCS project can be generated.

### **Step 2: Trigger the production of a standard-to-order item**

In LN, you can trigger the production of a standard-to-order item directly from the sales order. Select a sales order line, and start the Generate (Project PCS) Structure for Sales Orders (tdsIs4244m000) session from the appropriate menu to generate the project structure for the standard item. You must select **Standard-to-Order** in the **Generation Method** field. The item in the sales order line is copied as a customized item to the PCS project. In other words, a project code is added to the standard item, which makes the item a customized item. However, the BOM and the routing are not copied to the project, so no customized BOM or routing is created at any level in the project structure.

Dependent on the settings in the Generate (Project PCS) Structure for Sales Orders (tdsIs4244m000) session, the project code for the newly created customized item is based on the sales order number, if the **Equate Project (PCS) with Sales Order** check box is selected, or on a project series, if the **Project Series** field is filled.

### **Step 3: Generate planned orders**

After a project structure is created for the standard-to-order item by running the Generate (Project PCS) Structure for Sales Orders (tdsIs4244m000) session, planned orders can be generated for all items under the PCS project in the Generate Order Planning (cprrp1210m000) session in Enterprise Planning. Planned orders are created for materials in the project that are standard-to-order items, but also for materials that are **No**. For this purpose, the BOM is exploded. The BOM that is used for the BOM explosion is the standard BOM of the item from which the customized item is derived. The item from which the customized item is derived can be found in the **Derived-from Item** field in the Items (tcibd0501m000) details session for the customized item.

The BOM is exploded in the following way: if the encountered material in the BOM is a customized item, Enterprise Planning checks the item's inventory to determine the lowest inventory level in the future. The calculation is as follows:

on hand inventory + future receipts - future deliveries

Excluded in the calculation are:

- Production plans
- Purchase plans
- Planned orders

If sufficient inventory is available, Enterprise Planning creates a customized item for the standard-to-order item, and allocates inventory for the customized item instead of for the standard item. After this, the BOM explosion comes to a halt.

If inventory is insufficient, Enterprise Planning creates a customized item for the standard-to-order item, and BOM explosion continues.

If the material on the BOM line is an anonymous item, a planned order is created in case of insufficient inventory. However, the item is not customized.

In short, every material in the BOM with **Customizable** check box selected that is encountered during BOM explosion, is changed by Enterprise Planning into a customized item. BOM explosion stops when sufficient inventory is available for a material.

## Float times

The float time is the time in working days between activities. Float times can vary.

Float times that concern an activity:

- **Total Float:** The extension allowed for an activity expressed in working days.
- **Free Float:** The free float-time between one activity and the next. The free float-time indicates how many days the activity can be extended without jeopardizing the progress of other related activities.

The calculation is done as follows: If the value of the **Relationship Type** field is equal to **ES (End-Start)** (the next activity starts when the preceding activity has ended) then

```
free float-time (ES)=
    Earliest start date of the next activity - relation float times -
activity
    duration - earliest start date
```

If the value of the **Relationship Type** field is **SS (Start-Start)** (the next activity and the preceding activity start simultaneously) then

```
free float-time (SS)=
    Earliest start date of the next activity - relation float times -
earliest
    start date
```

Both float times are calculated after you run the Generate Network Planning (tipcs4210m000) session. If both float times are zero, the activity belongs to the critical path. The absolute relational float between activities is maintained in the Activity Relationships (tipcs4110m000) session.

*Float times can be entered in two ways:*

- **Float Time(Day)** The float time between the preceding activity and the next one expressed in working days. This float time is used to determine the start date of the next activity. The relation type is an important factor: The value **ES (End-Start)** indicates that the start date of the next activity is equal to the finish date of the preceding activity plus the relative float-time. The value **SS (Start-Start)** indicates that the start date of the next activity is equal to the start date of the preceding activity plus the relative float-time.
- **Float Time(in Perc)** The same float time as the **Float Time(Day)**, but expressed as a percentage of the duration of the preceding activity.

One of the two sorts float-times can be entered in the Activity Relationships (tipcs4110m000) session.

## Rough capacity consumption in PCS

If you use PCS network planning, the work center capacity displayed in the Resource Order Plan (cprrp0530m000) session or the Resource Master Plan (cprmp3501m000) session can be undesirably consumed by the PCS rough capacity (defined for the activities in PCS) and the capacity required for JSC production orders and planned production orders in Enterprise Planning.

This online manual topic describes the usage of the **Use rough PCS capacity requirement** check box in the Work Centers (tirou0101m000) session. You can use the check box to prevent double consumption of work center capacity.

## Backgrounds on activities and network planning

In PCS, you can define activities. An activity represents a stage in the execution of a project, for example, engineering, production, final assembly, or inspection. After defining activities, you must define activity relationships to indicate dependencies between the activities. You can use activities and activity relationships to perform a network planning to represent an overall planning of the PCS project.

If you define an activity in the Activities (tipcs4101m000) session, you must enter a work center for the activity. You must enter the number of hours that represent the work center's rough capacity requirements. After you perform network planning, you can view the work center's capacity in the Resource Order Plan (cprrp0530m000) session, or the Resource Master Plan (cprmp3501m000) session. The rough capacity requirements from the Activities (tipcs4101m000) session is expressed by the **Capacity Used for PCS Activities** field. The work center's **FreeCapacity** is calculated by subtracting the **Capacity Used for PCS Activities** from the **AvailableCapacity**.

If an activity involves production, JSC production orders and/or planned production in Enterprise Planning are present. Capacity on a work center is demanded by the activity and by the production orders. If the work center on the production order(s) is the same as the work center defined on the activity, double consumption of work center capacity can occur. In the Resource Order Plan (cprrp0530m000) session or the Resource Master Plan (cprmp3501m000) session you can view the required JSC capacity in the **Capacity Used for Production Orders** field as well as the rough capacity in the **Capacity Used for**

**PCS Activities** field. With double consumption, the **AvailableCapacity** of the work center is reduced by both the **Capacity Used for Production Orders** and the **Capacity Used for PCS Activities**.

## Usage of the Use rough PCS capacity requirement check box

Double consumption of work center capacity is not always desirable. Using the **Use rough PCS capacity requirement** check box in the Work Centers (tirou0101m000) session prevents this:

- If the **Use rough PCS capacity requirement** check box is selected, the PCS rough capacity defined for activities in PCS, and the capacity required for JSC production orders and planned production orders in Enterprise Planning are subtracted from the work center's available capacity. Therefore, double consumption of work center capacity occurs.
- If the **Use rough PCS capacity requirement** check box is cleared, the work center's available capacity is consumed by the capacity required for the JSC production orders and planned production orders in Enterprise Planning. The rough capacity requirements defined in the Activities (tipcs4101m000) session are not taken into account.

## Closing a project

Before a project is closed, LN checks the current status of the project. Only projects with the status **Finished** can be closed.

LN checks that:

- All subprojects have the status **Closed**, if there is a main project.
- All production orders for the project are closed.
- All purchase orders have the status **Closed**.
- All purchase receipts are invoiced, and the invoice matching procedure are carried out in the financial accounting.
- All sales orders are closed with the Process Delivered Sales Orders (tds1s4223m000) session.
- All service orders for the project are processed in history.
- All transaction hours for the project are processed.
- No project inventory is still present. The project inventory value cannot exceed the value entered by the users. Remaining inventory less than this value is automatically deleted.
- All internal invoices from the PCS project to the financial companies of the sales office, service department, and/or warehouse are sent and completed.

If these conditions are not met, the project cannot be closed.

If the project *can* be closed, the following steps are taken:

1. Any current inbound and outbound advice for warehousing orders in the Inventory by Warehouse, Item and Effectivity Unit (whwmd2116s000) session is deleted.

2. Project costs and results are calculated. To do this, LN automatically starts the Calculate Standard Costs by Project (tipcs3250m000) session.
3. The project status is changed to **Closed**.

#### Note

- If there is a main project, before the main project is closed, all subprojects are closed first according to the previous procedure.
- If you select the **COGS and Revenues restricted to Financial Company of PCS Project** check box in the Project Control Parameters (tipcs0100m000) session, financial transactions are posted on the financial companies of the sales office, service department, and/or warehouse instead of on the financial company of the PCS project. If internal invoices are sent from the PCS project to those departments, and the internal invoices are not completed yet, the Close Project (tipcs2250m000) session sets the project status to **To be Closed** instead of to **Closed**. You must first complete the internal invoices, and then run the Close Project (tipcs2250m000) session again to set the project status to **Closed**.

## Delete and archive in Project Control

With respect to Project Control within Manufacturing, the following is of importance.

- **Delete financial data in Project Control**  
If a PCS project is closed, you can use the Delete Financial Transactions by Project (tipcs3200m000) session to remove financial data. After removal of the financial data, you cannot print WIP and costs anymore. The PCS project is definitively closed and cannot be reopened. Note that after the data is deleted, you cannot use the Archive/Delete Projects (tipcs2260m000) session anymore to archive the data.
- **Archive projects**  
Use the Archive/Delete Projects (tipcs2260m000) session to archive or delete closed PCS projects. This includes the financial data, so running this session makes using the Delete Financial Transactions by Project (tipcs3200m000) session superfluous.

#### Note

For more information, refer to the *User's Guide for Archiving* (U9352\* US).

## Performance aspects

- Effect on CPU: Not applicable
- Effect on database growth: Yes

# Unit effectiveness in PCS

In the Project Control module in Manufacturing, effectivity units can be assigned to:

- Project parts
- Module planning by project

## Project parts

Project parts are used to determine the estimated costs of a project. They are entered manually, or generated from the sales order line (generate project structure from product variant). The PCS calculation of estimated costs uses the standard cost from CPR to calculate the estimated costs for a standard project part. However, when a standard part has an effectivity unit then the standard cost of the part is recalculated to determine the unit effective standard cost of that part. In case the BOM of the part has any exceptions for optional material, the unit effective standard cost can be substantially different from the standard cost.

## Module planning

Module planning is always entered manually. It is used to trigger Enterprise Planning to create demand when a sales order is not yet available. The effectivity number on the module is used by Enterprise Planning during explosion of the BOM and usage of the routing to determine which objects are valid.

## BOMs and routings of customized items

When items are copied to a new structure, an user can choose between two options:

- Copy all BOM lines and routings with all linked exceptions.
- Copy only BOM lines and routings that are valid for a specific effectivity unit. Attached exceptions are not copied.

You can choose those options from the following sessions:

- Copy Standard Product Structure to Customized Structure (tipcs2230m000)
- Copy Customized Product Structure to Customized Structure (tipcs2231m000)
- Copy Customized Product Structure to Standard Structure (tipcs2232m000)

## To customize unit effective items on a sales order

If you want to customize a unit effective item on a sales order by using the Generate (Project PCS) Structure for Sales Orders (tds1s4244m000) session, a full copy method is used. This means that the complete bill of material as well as all operations, applicable to all effectivity units, are copied to the PCS project. In addition, all exceptions linked to BOM lines and operations are copied.

If you make changes to an effectiveness unit in a PCS project, for example, by changing the effectiveness unit on the linked sales order, you do not need to regenerate the PCS project because all data related to the unit effective item is already present. Furthermore, the changed design of an effectiveness unit is automatically taken into account for the next order planning run in Enterprise Planning.

**Note**

Unit effective routings are not copied to the PCS project. Similar to routings that are not unit effective, either the default routing of the unit effective item, or a routing based on fixed order quantity or economic order quantity is copied to the PCS project.

# Chapter 5

## Assembly planning

5

## Assembly planning overview

You can use the Assembly Planning module to plan the assembly of product variants, and to generate assembly orders in Assembly Control. Assembly Planning does this for assembly lines in a mixed model flow production environment, which is characterized by high volumes, and many variants of complex products.

The main processes in Assembly Planning are as follows:

1. The product variant is generated
2. The product variant structure is generated
3. The assembly part requirements are calculated
4. The assembly orders are created

The following sections provide an overview of these processes. For detailed information, refer to the online Help of the related sessions, and to the related topics listed at the end of this document.

### Step 1: Set parameters

Before you can use Assembly Planning, you must set the APL parameters in the Assembly Planning Parameters (tiapl0500m000) details session. Note that the behavior of several sessions depends on one or more of the following parameters:

■ **Is Master Company**

If this check box is selected, your current company is defined as the master company. The master company can be one of the companies of the assembly line, or a separate company. The master company is used to store master data, such as product variants and BOMs.

If this check box is cleared, all the fields in the Configurable Item - Assembly Line (tiapl2500m000) session are disabled.

- **External Assembly Parts and Operations**  
If this check box is selected, an external source delivers the flattened assembly parts and operations to Assembly Planning.  
If this check box is cleared, the assembly parts and operation are flattened during the calculation of the assembly parts requirements.
- **External Product Variant Structure**  
If this check box is selected, the generic BOM relations between the generic end item and the engineering modules are delivered to Assembly Planning from an external source. LN provides no functionality to copy this information to the product variant structure.  
If this check box is cleared, the generic BOM relations between the generic end item and the engineering modules are copied from the generic BOM to the order-specific BOM when you run the Generate Product Variant Structures (tiapl3210m000) session.
- **Test Mode**  
If this check box is selected, the Assembly Planning module operates in test mode. You can maintain data that is otherwise maintained by external packages.  
If the **External Assembly Parts and Operations** check box is selected, this data is maintained externally:
  - Operations, that are displayed in the Operations (tiapl1500m000) session.
  - Operation assignments, that are displayed in the Operation Assignments (tiapl1510m000) session.
  - Product variant structures, that are displayed in the Product Variant Structures (tiapl3510m000) session.If the **External Assembly Parts and Operations** check box is selected, you cannot maintain this data from within LN, unless you operate in test mode.  
You can also run the Actualize Assembly Line Costing Data (ticpr0215m000) session for a manually chosen effective date.

## Step 2: The product variant is generated

The product variant is generated on sales order entry. In the Sales Order Lines (tdsIs4101m000) session, the sales order line specifies the generic item that is sold, and other data, such as the required offline date, price, and so on. One of the specifications can also be the effectivity unit, which can be used to configure the product variant.

For production purposes, the information that is entered on the sales order line is stored in a product variant. The product variant represents the specific product that is sold. You can view the product variant in the Product Variants (Assembly) (tiapl3500m000) session.

## Step 3: The product variant structure is generated

So far, the product variant is only a reference to the product without production data. This production data must be determined by generating the relations between the generic sub-items and engineering modules that make up the generic end item. These relations are solved based on effective dates and/or units.

When Product Configuration is not used the generic sub-items and engineering modules are retrieved from the generic BOM, which you can view in the Generic Bill of Material (tiapl2510m000) session. The result of this process is stored in the product variant structure, which is displayed in the Product Variant Structures (tiapl3510m000) session.

If you use Product Configuration, the relations to the generic sub-items and engineering modules that make up the generic end item are resolved against the generic BOM in the Product Configuration module.

The relations between the generic BOM and generic sub-items are resolved when you enter a sales order. The relationships to engineering modules are resolved in a separate process.

You can generate product variant structures in the following sessions:

- Generate Product Variant Structures (tiapl3210m000)
- Calculate Assembly Part Requirements (tiapl2221m000)
- Generate Assembly Orders (tiapl3201m000)
- Refresh and Freeze Assembly Orders (tiapl3203m000)

The assembly parts and operations that are required to assemble the end item are stored below the level of the engineering modules. In the Assembly BOM and Operations (tiapl2520m000) session, you can view the parts and operations per engineering module. The operations are defined in the Operations (tiapl1500m000) session. Operations are assigned to line stations in the Operation Assignments (tiapl1510m000) session.

Note the following

- Generic sub-items can also have their own generic sub-items. To each generic item one or more engineering modules can be related.
- If the **External Product Variant Structure** check box is selected in the details of the Assembly Planning Parameters (tiapl0500m000) session, only the relations between the generic items are solved. The relations to the engineering modules are delivered from an external source.
- In LN, there are three ways to retrieve the flattened parts:
  - **Import**  
To import the flattened parts and operations, you must select the **External Assembly Parts and Operations** check box in the Assembly Planning Parameters (tiapl0500m000) session.
  - **Manually**  
You can define the flattened parts and operations manually in the Assembly BOM and Operations (tiapl2520m000) session.
  - **Through EDM**  
You can obtain the flattened parts through EDM, which involves a flattening procedure.
- In LN, the flattened parts and operations are delivered from an external source. Therefore, the **External Assembly Parts and Operations** check box in the Assembly Planning Parameters (tiapl0500m000) session is always selected. As a result, you can maintain the data in several sessions only if you work in test mode.
- Product variants that are no longer required, can be deleted by means of the Purge Product Variants (tiapl3200m000) session.

## Step 4: The assembly part requirements are calculated

If the product variants and product variant structures are generated, the assembly part requirements can be calculated, and assembly orders can be created. Assembly part requirements are calculated, based on the product variant structures and the flattened assembly parts.

The assembly part requirements are calculated for product variants whose planned offline date falls in the demand time fence. The demand time fence is defined in the details of the Assembly Planning Parameters (tiapl0500m000) session.

The calculation is based on segment schedules that indicate on which date the assembly parts are required for each segment, based on the offline date of the assembly order. Segment schedules are displayed in the Segment Schedules (tiapl4500m000) session.

When the assembly part requirements are calculated, they are transferred to Enterprise Planning.

## Step 5: The assembly orders are created

Assembly orders are created for product variants whose planned offline date falls in the assembly order time fence of the roll-off line. The assembly orders are created by Assembly Planning, but are stored and executed in Assembly Control. In a multicompny situation, assembly orders are created for each company.

Assembly orders can only be created for assembly lines that are actualized, which means that the lines are released for use in the production process. Only assembly lines that are valid can be actualized. You can both validate and actualize assembly lines in the Actualize Assembly Lines (tiasl1231m000) session. You can also validate the assembly lines in a separate session: the Validate Assembly Lines (tiasl1230m000) session.

Assembly order creation uses the concept of line-station variants (LSVs). LSVs store the materials and operations per line station. You can use the Refresh and Freeze Assembly Orders (tiapl3203m000) session to refresh and freeze assembly orders. Orders that are refreshed, are updated with changes in the product variant or product variant structure. Orders that are frozen, are no longer updated automatically. Frozen orders can only be updated manually in Assembly Control.

The update of assembly orders also applies the concept of LSVs. The update actually determines whether the LSVs that can be created based on the new product variant and/or product variant structure, would differ from the existing LSVs. If that is the case, new LSVs are created, where required, and sent to Assembly Control.

In the Product Variant - Assembly Lines (tiapl3520m000) session, you can view on which assembly lines a product variant is assembled. The session also displays whether the required assembly parts are already allocated in Assembly Control, and whether the assembly order on the specified assembly line is frozen. Note that on another assembly line, the same order can be not frozen or only partly frozen.

### Note

- If you use LN integrations for some integrations, you must specify the bus components in the Company - Bus Components (tiapl0501m000) session.
- The **Is Master Company** check box can only be selected if no assembly orders are present in the company.

- The check box can only be cleared if no product variants are present in the company.

## Segment schedules

Segment schedules are schedules that indicate when the assembly parts that are required for the work in a particular line segment must be delivered to the job shop warehouse. For each segment on a line, a range of offline periods is defined. And, for each period, a date is scheduled on which the assembly parts are required. As a result, every product variant whose requested offline date falls within one of these periods requires its assembly parts for the segment in question on that date.

The advantage of segment schedules is that the assembly part requirements can be determined right from the schedule, if only the requested offline date of the product variant and the segment of the assembly parts is known. Compare this to the following procedure, which applies if no segment schedules are used:

1. Determine in which segment a part is required.
2. Offset that line segment by calculating the time between the start of the segment and the end of the roll-off line
3. Calculate the date on which the assembly part is required.
4. Determine the plan period in which this date falls.
5. Determine the delivery date of the part, which is the start date of the plan period.

Segment schedules are used for a rough planning of assembly part requirements, especially in the more distant future, that is, the period after the allocation time fence but before the demand time fence. However, the schedules cover the entire period in the demand time fence, including the allocation time fence. The segment schedules appear in the Segment Schedules (tiapl4500m000) session.

The assembly part requirements for product variants whose requested offline date falls in the allocation time fence are allocated by Assembly Control for each line station, in the Build Allocations (Server) (tiasc7240m001) session.

The assembly part requirements for product variants whose requested offline date falls in the demand time fence are calculated by the Calculate Assembly Part Requirements (tiapl2221m000) session per segment, and for a range of product variants at once. This is a simplified calculation with a high performance for large volumes.

The allocation time fence is defined in the details of the Assembly Control Parameters (tiasc0100m000) session. The **Demand Horizon** is defined in the details of the Assembly Planning Parameters (tiapl0500m000) session.

The segment schedules are determined as follows:

1. The plan periods for the current scenario are determined. The current scenario is selected in the **Scenario** field of the details of the Assembly Planning Parameters (tiapl0500m000) session. The plan periods are defined in the Scenario - Periods (cprpd4120m000) session.

2. The segments of the assembly lines are offset, which means that the time between the start of the line segment and end of the roll-off line is calculated, according to the lead times of the segments.
3. Now, for each plan period and each segment the offset time of the segment is added to the start time of the plan period. This way, for each segment, a new series of periods is created. These periods correspond with the original plan periods, but the new periods are shifted into the future a time span equal to the offset time of the segment concerned. Therefore, these periods indicate that a product variant whose requested offline date falls in one of these periods, requires his assembly parts for the segment in question on the start date of the corresponding original plan period.

## Example

Imagine an assembly line and plan periods with the following characteristics:

- The assembly line has no supply lines, so it is a roll-off line.
- The line has two segments.
- The lead time of segment A, where the assembly process starts, is 2 days.
- The lead time of segment B, which is the roll-off segment, is three days.
- The plan periods are defined as weeks.
- The first plan period starts on January 1, at 00:00:00.

If the segments are offset, the offset time of segment A is five days. The offset time of segment B is three days. Now the offset times of these segments are added to the start times of the plan periods. As a result, for plan period 1 and segment A, a new period is created that starts on January 6, at 00:00:00, which is the first moment after the five days offset time of segment A, which were added to January 1, 00:00:00. The second period starts on January 13, at 00:00:00, because this is the first moment after the three days offset time of segment B, which were added to the start of plan period 2, which is January 8, at 00:00:00. So, the first period ended on January 12, at 23:59:59.

For plan period 1 and segment B, a new period is created that starts on January 4, at 00:00:00, because this is the first moment after the three days offset time of segment B, which were added to January 1, at 00:00:00. The second period starts on January 11, 00:00:00, which is the first moment after the three days offset time of segment B, which were added to the start of plan period 2, which is January 8, at 00:00:00. So, the first period ended on January 10, at 23:59:59.

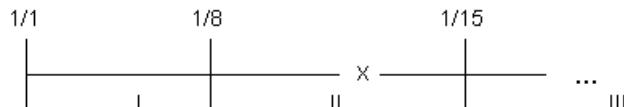
Now, if you have a product variant with a requested offline date of January 12, this date falls in period I for segment A, but in period II for segment B. As a result, assembly parts that are required in segment A, are required on the start date of plan period I, which is January 1. Assembly parts that are required in segment B, are required on the start date of plan period II, which is January 8. Refer to the following picture, in which the date of January 12 is marked with an X.

Assembly line:

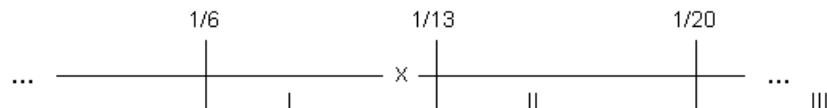


Offset time segment A:  $3 + 2 = 5$  days  
 Offset time segment B: 3 days

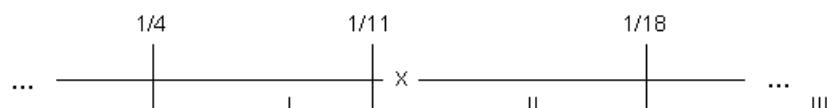
Plan periods:



Periods for segment A:



Periods for segment B:



### Note

Because the periods for the segments start somewhere in the future, a problem occurs when the requested offline date of a product variant is before the first period of a segment. In the previous example, when the requested offline date is, for example, January 3. This situation of course is not a normal situation, because this implies that you have a backlog, but this situation can occur. To cope with this problem the first period has no start date. As a result, if you view the schedule, you see that the **Planned Offline Date From** field is empty when the record displays the data for the first period of a segment. As a result, the **Date Scheduled** of that record applies for all assembly part requirements up to the **Planned Offline Date To**.

It is important that the Calculate Assembly Part Requirements (tiapl2221m000) session uses the most up-to-date schedule. Several types of changes require an update. Sometimes the Calculate Assembly Part Requirements (tiapl2221m000) session detects these changes and updates the schedule automatically. However, sometimes the update must be performed manually. You can update the schedule manually through the **Update** command on the appropriate menu of the Segment Schedules (tiapl4500m000) session, or you can select the **Update Segment Schedules** check box in the Calculate Assembly Part Requirements (tiapl2221m000) session to enforce an update when that session runs.

The schedule must be updated in the following cases:

- The line structure is changed. You must update the schedule manually.
- The calendar that is linked to one of the assembly lines is changed. The schedule is updated automatically when you run the Calculate Assembly Part Requirements (tiapl2221m000) session. The calendar is selected in the **Calendar Code** field in the Assembly Lines (tiasl1530m000) session.
- The scenario is changed, or the plan periods in the scenario are changed. If you use a rolling scenario, the plan periods change every period. The schedule is updated automatically when you run the Calculate Assembly Part Requirements (tiapl2221m000) session. However, if the plan period definition is changed, while the reference date is not changed, you must update the schedule manually.

## Assembly orders

Assembly orders are created for product variants whose planned offline date falls in the assembly order time fence of the roll-off line. The assembly orders are created by Assembly Planning, but are stored and executed in Assembly Control. In a multicompny situation, assembly orders are created for each company. Assembly orders can only be created for assembly lines that are actualized, which means that the lines are released for use in the production process.

### Assembly order statuses

An assembly order can have one of the following statuses:

- **Created**
- **Sequenced**
- **In Progress**
- **Production Completed**
- **Completed**
- **Closed**
- **Canceled**

### Assembly order progress

- An assembly order has the status **Created** when it is initially generated by Generate Assembly Orders (tiapl3201m000) session. When this happens, line-station orders, line-station variants and exchangable configurations are generated. The line station orders are generated both for the main line and the supplying lines of the same company. You must have already defined the assembly line structure (segments and line stations).
- The assembly order is **Sequenced** as described in the *Line sequencing and rule types in Assembly Control (p. 66)* online manual topic. When the order is sequenced, you can start it from the appropriate menu of the Buffer - Assembly Orders (tiasl6520m000) session. You can

arrange for a request from another line station, for an order to be started, using the Request Start - Assembly Order on Line Station (tiasc4200m000) session (or as part of workflows with the Process Trigger Definition (tiasl8100m000) session).

- When the first line-station order is reported complete, the status of the assembly order becomes **In Progress**. You can report a line station order complete with the Line Station - Assembly Orders (tiasl6510m000) or Report Line Station Order Complete Using Bar Code (tiasc2211m000) session. If the lines station orders are reported complete in a different sequence from the planned sequence, LN automatically reschedules the orders.

Before you can carry out the assembly order, you must allocate assembly parts. See the Help of the Build Assembly Part Allocation (tiasc7240m000) session for more details.

You can swap orders after they have been started, as long as they still have exchangable configurations. Use the Exchange Configurations (tiasl4240m000) session.

**Production Completed:** If the order is reported completed, LN sets the assembly order to **Production Completed** status.

**Completed:** As soon as Warehouse Management finishes the inbound procedure for produced items that must be delivered into inventory, the assembly order will get the **Completed** status. When line-station orders are reported complete, you can *Assembly backflushing* (p. 65) their hours and materials.

**Closed:** You can close assembly orders with the Close Assembly Orders (tiasc7210m000) session (from the Assembly Line - Line Mix (tiasc2501m000) appropriate menu). When you close the assembly order, LN creates the financial transactions for that assembly order. If that is impossible, LN produces error messages. The WIP transfer bookings are recorded in the calculation office of the assembly order.

## Serialized items in assembly control

The as-built structure for assembly lines is generated when you have confirmed the line sequence. If you are using serialized items (that is, the **Serialized** check box is selected in the Items (tcibd0501m000) session), the serial numbers (for example the VIN of a car) are generated at this stage.

The following actions you perform on assembly orders, affect the status of the as-built structure (that is, the serial numbers) of the serialized items of the assembly order:

- Confirm line sequence.
- Report assembly order complete.
- Close assembly order.
- Reopen assembly order.
- Undo completed line station order.

# Assembly Order Costing

Costing is a crucial aspect of the Assembly Control module. The manner in which costing is performed depends partially on how you define your cost components. Other aspects of costing that are described here are:

- Transaction-processing methods
- WIP transfers
- Calculation of final results
- Differences between Assembly Control module costing and *Job Shop Control (JSC)* (p. 13) module costing.
- Where to view financial data in the Assembly Control module.

## Note

The aspects of financial costing that are described here have no relation to the theoretical, mathematical costs associated with line sequencing.

### ■ Cost components

There are four types of cost components:

- Materials
- Operations
- Surcharges
- General Costs

Cost components must be posted on the aggregated and collect levels of the cost scheme, the detailed level is optional.

### ■ Transaction-processing methods

The Assembly Control module is intended for use by companies that produce many variants of complex products in a flow-assembly line. Assembly Control can also be used for low-volume assembly if you select **Order Based** transaction processing. Select your transaction-processing method in the **Transaction Processing** field in the Assembly Control Parameters (tiasc0100m000) session.

- Use **Line Station Based** transaction processing when you do not need to trace back to the original assembly order. Costs are posted to the assembly line. Results are calculated by period by assembly line.
- Use **Order Based** transaction processing when you want your costing performed on the basis of individual assembly orders. Costs are posted by order by assembly line. Results are calculated by order by assembly line.

### ■ WIP transfers

WIP transfers consist of:

#### ■ Generating the transfer order

A WIP transfer generates a transfer order. However, if the transfer occurs between line stations that are in different logistical companies, a sales order and a purchase order are generated.

- **Performing the material issue**

A WIP issue may unblock or immediately process the transfer warehousing order, dependent on your parameter settings. In multicompany situations, the normal sales procedure must be followed in order to ship the goods.

- **Performing the receipt**

A WIP receipt acknowledges the receipt of the WIP transfer order at a main assembly line that has received work from a supplying assembly line. Warehousing processes the inbound line automatically. If the assembly lines are from two different logistical companies, it is necessary to use sales orders and purchase orders (rather than WIP transfer orders). In multicompany situations, the normal receipt procedure must be followed in order to receive the goods.

You can select whether you want these processes to occur automatically, semiautomatically, or manually.

- **Calculation of financial results**

When you close an assembly line with the Close Assembly Lines (tiasc7220m000) session, the production results of the line are calculated. All the line station orders must have the status **Closed**. The financial results are the WIP transactions (which are estimated costs) minus the actual costs.

## Differences between costing in Job Shop Control and Assembly Control

- In Assembly Control, the quantity completed is always one.
- There is no scrap and yield in Assembly Control.
- WIP transfers are only created between different assembly lines, and not between line stations (of the same line).
- There is no set-up time in Assembly Control.
- End item unit costs (estimated material costs and hours costs for an order) are not calculated for an assembly order. This is not necessary because each end item uses the same assembly line, so there is no point in creating separate surcharges for each item.
- In case of **Line Station Based** transaction processing, variances are calculated for an assembly order and not for a generic item.
- Production results are not split into price variances and efficiency variances in Assembly Control.
- Financial results in Assembly Control are posted to the cost component of the assembly line.

### Where to view financial data in Assembly Control

- Financial Transactions (tiasc7510m000)
- Print Financial Transactions (tiasc7410m000)
- Print Financial Transactions by Assembly Line (tiasc7414m000)
- Print Costing by Assembly Order or Assembly Line (tiasc7411m000)

# Assembly backflushing

When a line station order is reported complete in the Line Station - Assembly Orders (tiasl6510m000) session or the Report Line Station Order Complete Using Bar Code (tiasc2211m000) session, the material requirements and hours budgeted for that order can be backflushed. You can backflush the materials and hours with the Backflush Requirements (tiasc7241m000) session.

The backflushing topics discussed here are:

- Floor stock
- Backflushing mode
- Quantity of parts backflushed
- Number of hours backflushed

## Floor stock

Floor stock items such as nuts and bolts are not backflushed in assembly control. To define an item as floor stock, select the **Floor Stock** check box in the Item - Warehousing (whwmd4600m000) session.

## Backflushing mode

Backflushing is carried out for each clustered line-station order (CLSO) (see the Clustered Line Station Orders (tiasc7530m000) session). The number of CLSOs produced each day, depends on the mode you select with the **Transaction Processing** parameter, which you define in the Assembly Control Parameters (tiasc0100m000) session. For **Order Based** processing, each individual assembly order provides a CLSO for each line station, creating many CLSOs each day. For **Line Station Based** processing, there is only one CLSO each day, for each line station. All the hours and materials for all buckets, all line-station variants, and all line-station orders are clustered into one CLSO for each line station. This mode is for high-volume production environments.

## Assembly parts

The parts required by the line station variant can be backflushed after the line station order is reported complete, with the Backflush Requirements (tiasc7241m000) session. The quantities required are calculated as described for the Build Assembly Part Allocation (tiasc7240m000) session. LN activates a warehousing order line which ensures the parts are delivered to the correct shop floor warehouse.

Floor stock items such as nuts and bolts are not backflushed in assembly control. To define an item as floor stock, select the **Floor Stock** check box in the Item - Warehousing (whwmd4600m000) session.

## Man hours and machine hours

Man hours (also known as person hours) and machine hours are backflushed to People.

The number of hours backflushed is the sum of CT x MO ( Cycle Time x Man Occupation or Machine Occupation) for each line station variant, summed for either the assembly line, if **Line Station Based**, or for the line station, if **Order Based**.

- If it is **Line Station Based**, the cycle time comes from the Assembly Line - Assignments (tiasc5510m000) session.
- If it is **Order Based**, the cycle time comes from the Line Station Variant - Operations (tiasc2122m000) details session. You define the occupation in the Assembly Line - Assignments and Line Stations (tiasc5520m000) session, if **Line Station Based**, and in the Line Station Variant - Operations (tiasc2122m000) session, if **Order Based**.

If hours are present, the hours transactions with the status **Closed** are posted to People and processed automatically. The hours are posted to the employee linked to the line station. You can view the hours with the Assembly Hours (bptmm1160m000) session. You can also enter additional hours with this session.

#### Note

In the Assembly Control Parameters (tiasc0100m000) session, the **Transaction Processing** field determines how hours are booked:

- **Order Based**  
Hours are booked for an individual assembly order. **Order Based** is used in low-volume environments.
- **Line Station Based**  
The hours for line-station orders is added together, for each line station, to form one clustered line-station order (CLSO) for each day. **Line Station Based** is used in high-volume environments.

The values that are visible in the Clustered Line Station Orders (tiasc7530m000) session are used by Warehouse Management. When material backflushing is performed, the inventory for the assembly part is backflushed from Warehousing, and the Planned stock transactions in the Order - Planned Inventory Transactions (whinp1501m000) are reduced.

## Line sequencing and rule types in Assembly Control

Assembly orders generated by Assembly Planning can be sequenced by using the sequencing engine, resulting in a line mix and line sequence. During this sequencing process, line rules are taken into account like clustering assembly orders based on items characteristics, or blocking assembly orders based on capacity rules.

The assembly line can be dedicated to one model, or to a mixed model. For example, a large number of product variants can be produced on the same assembly line.

Four major aspects of line sequencing are discussed:

- Sequence rules
- Sequence process

- Rescheduling
- Line sequence status

## SEQUENCE RULES

Sequence rules are made up of the following elements:

- Mixing process
- Mix rules, which exist in three types:
  - Capacity restriction rules
  - Proportional rules
  - Relative proportional rules
- Placement rules, which exist in three types:
  - Clustering rules
  - Blocking rules
  - Priority rules

## The (re)mixing process in Assembly Control

You can remix the orders within the Assembly Control module by using the Remix Line Mix (tiasl3220m000) session. Rules are defined for particular option combinations. Remmixing attempts to schedule the orders so that the number of orders for each option combination is as close as possible to the maximum number of orders for each option combination. The better the mix, the better the sequence quality.

### Mix rules

There are three types of mix rules:

- **Capacity Restriction**  
The total capacity of the line is limited, for example: maximum 500 cars with option combination CityCar in one day.  
For **Capacity Restriction** rules, you can select one of three types of dispersion:
  - **Average Dispersion** The option combination is spread evenly throughout the line sequence.
  - **Sliding Window Avg. Disp.** A window is a certain number of adjacent sequence positions. That window is being slid position by position. Within each window the product sequence is optimized. Adjacent sequence positions means a continuous range of sequence positions. In each window the option combination is dispersed as evenly as possible. For example, each group of 10 positions should have the same number of RedCars.
  - **Sliding Window Cap. Resr.** Within each window, there is a limit to the number of orders for the option combination. For example, no more than two RedCars in any window of 10 positions.

- **Proportional**  
Option combinations must be present in fixed proportion of the total order, for example, the ratio of CityCar to other orders must be 1:2.  
You can define two dispersion types for **Proportional** rules:
  - **Average Dispersion** The option combination is spread evenly throughout the line sequence.
  - **Sliding Window Avg. Disp.** In each window, there is a maximum ratio of a given option combination and any other option combination. For example, for every RedCar option combination, there must be at least one other option combination within any four option combinations (ratio = 1:2, window =4).
- **Relative Proportional**  
The same as **Proportional**, except that the **Method of Dispersion** is always **Relative Dispersion**. You must specify a second option combination in which the first option combination is dispersed in relation to. The option combination is placed in a particular relation to another option combination. For example, red cars and blue cars can only be assembled alternately; you cannot assemble two red cars in a row.

During remixing, the priority of orders is taken into account, as described in one of the following paragraphs.

Because rules can conflict with each other, it is possible that not all sequence rules can be met. In that case you can give some rules a higher priority. However, this results in a less efficient order sequence, and you must solve these conflicts by redesigning the assembly process, not by performing more line sequencing.

## Placement rules

Placement rules are used to determine how products are placed in relation to other products. There are three types of placement rules:

- **Clustering**  
Use this rule to place option combinations next to each other with the same options, when changing between option involves a long change-over time. For example, place all blue cars next to each other, because changing painting color takes a long time. Assembly Control clusters the option combinations (such as paint color), and a sequence number is assigned to every option combination.
- **Blocking**  
Certain option combinations must not be placed next to other option combinations. For example, light colors must not be painted after dark colors to minimize effects of paint contamination.

## Clustering Example

In this example, the assembly orders and their option combinations are planned for a day on line segment 1.

---

Order 1	Option combination red
Order 2	Option combination blue
Order 3	Option combination black
Order 4	Option combination red
Order 5	Option combination blue
Order 6	Option combination black
Order 7	Option combination red
Order 8	Option combination blue
Order 9	Option combination black
Order 10	Option combination red

---

The option combination list Color is defined in Assembly Control as:

---

Option combination red      sequence 1

---

Option combination black      sequence 2

---

Option combination blue      sequence 3

---

When the assembly orders are sequenced in Assembly Control, based only on the clustering rule Color, the result for line segment 1 is:

Order 1	Option combination red
Order 4	Option combination red
Order 7	Option combination red
Order 10	Option combination red
Order 3	Option combination black
Order 6	Option combination black
Order 9	Option combination black
Order 2	Option combination blue
Order 5	Option combination blue
Order 8	Option combination blue

---

## Blocking Example

In this example, the assembly orders and their option combinations are planned for a day on line segment 1.

---

Order 1	Option combination red
Order 2	Option combination blue
Order 3	Option combination black
Order 4	Option combination red
Order 5	Option combination blue
Order 6	Option combination black
Order 7	Option combination red
Order 8	Option combination blue
Order 9	Option combination black
Order 10	Option combination red

---

The option combination list Color is defined in Assembly Control as:

---

Option combination red      Option combination blue

---

Option combination red      Option combination red

---

The list Color is linked to the blocking rule Color, which is linked to assembly line 1. This rule says that the color red cannot be followed by the color blue or by the color red.

One result of this rule is the following sequence:

Order 1	Option combination red
Order 3	Option combination black
Order 2	Option combination blue
Order 4	Option combination red
Order 6	Option combination black
Order 5	Option combination blue
Order 8	Option combination blue
Order 7	Option combination red
Order 9	Option combination black
Order 10	Option combination red

---

## Priority

Priority rules are enforced in the following order:

1. Orders with a later **Requested Offline Date** are given a lower priority.
2. Orders that are sold (a demand order) have priority over orders not yet sold.
3. Assembly orders with a lower priority number are processed first (for example, orders with a priority number of 1 are processed before orders with a priority number of 4). You define the order priority in the Assembly Order (tiasc2100s000) session.
4. Cost function value.

## THE SEQUENCING PROCESS

When you add new orders to an assembly line, LN generates in the Simulate and Create Line Sequences (tiasl4200m000) session an initial sequence for the line for the appropriate offline date.

A line segment that follows a buffer can only be sequenced, if the buffer has more than one random access place. To define a buffer's number of random access places, enter a value in the **Number of Random Access Places** field in the Stations (tiasl1545m000) session.

**Note**

When you confirm a sequence, LN generates the As-built structure for the end item, such as the VIN number and header in the case of a car. You can edit the structure with the Serial End Item - As-Built Headers (timfc0110m000) and Serial End Item - As-Built Components (timfc0111m000) sessions. The serial numbers of the components are generated when you freeze the sequence. When you use the Print Work Instructions (tiasc5450m000) session, a space is provided on the printed form for you to enter the serial number of the components.

## RESCHEDULING

You can also manually alter the sequence with the Reschedule Assembly Orders (tiasl4220m000) session. The session uses two types of rules:

- **Move**  
An order is taken from one position and inserted into another position. All orders in between the two positions are shifted one position towards the initial position.
- **Swap**  
Two orders are interchanged, and nothing else is changed.

The automatic sequencing process uses the swap method. You can change the maximum swap/insert distance that is used in the automatic sequence generation in the Remix/Sequence Parameters (tiasl4110m000) session.

When you have swapped orders to another line mix, you can run the Remix Line Mix (tiasl3220m000) session for a better sequence.

## LINE SEQUENCE STATUS

A line sequence can have one of the following statuses:

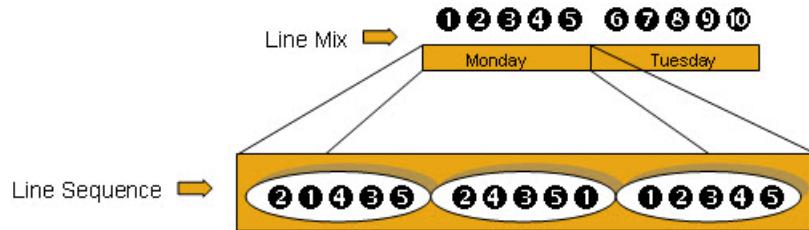
- **Planned**
- **Started**
- **Completed**

A line sequence has the status **Planned** when it is first created. When the first line-station order is completed, the status becomes **Started**. When the last line station order is completed, the status of that segment becomes **Completed**.

You can see the status in the Line Segment - Line Sequence (tiasl4500m000) session.

You can sequence the assembly orders on two levels:

- Assembly line level (line mix)
- Line segment level (line sequence)

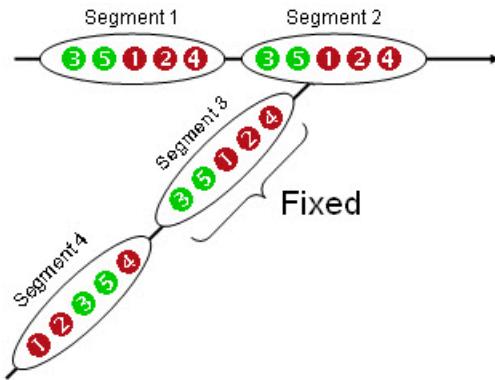


An initial line mix is generated by Assembly Planning. Remix assembly orders consider assembly orders with the status Planned and Sequenced, and use the existing assembly line mix as the starting point.

The remix process is important under these circumstances:

- When a backlog must be cleared.
- When an existing mix must be improved.
- Because offline dates of assembly orders have changed.
- Priority on assembly orders is altered.

A line sequence is generated based on the line mix. A line sequence specifies the order in which assembly orders must start on the corresponding line segments. For each line segment that is present in the assembly process, a line sequence must be generated. The line sequence algorithm takes the assembly order with the status Planned and Sequenced within a specific production period as input. On the last line segment of a supplying line, a line sequence is *fixed*. The line sequence of the connected line segment on the parent line determines the line sequence of the last line segment on the supplying line.



After sequencing, you can manually reschedule the assembly orders per line segment. Two types of rescheduling are possible:

- Move assembly orders



- Swap assembly orders (1 and 4)



# View Assembly BOM and Operations

## Note

### Assembly BOM

- You can select non-configurable items only for an assembly BOM.
- You can select non-configurable items only on a BOM line.

For more information on procuring purchased configurable items, refer to

- Procuring configured items in Assembly Control - Master Data Setup
- Procuring configured items in Assembly Control - BOM setup
- *Product variants - Purchased configurable items (p. 20)*

## Restrictions

If the **External Assembly Parts and Operations** check box in the Assembly Planning Parameters (tiapl0500m000) session is selected, the flattened parts and operations are delivered from an external source. As a result, you cannot change the data in the current session, except when you work in **Test Mode**. If that check box is cleared, the assembly parts and operations are flattened during the calculation of the assembly part requirements.

You can modify data in this session only if your current company is defined as master company.

## Procedure

After you change the data in this session, you must run the following sessions:

- Calculate Assembly Part Requirements (tiapl2221m000) or Calculate Assembly Part Requirements (Multiple Bshells) (tiapl2222m000)
- Refresh and Freeze Assembly Orders (tiapl3203m000) or Refresh and Freeze Assembly Orders (Multiple Bshells) (tiapl3204m000)

## Operations independent from assembly parts

To define operations which are not linked to a specific assembly part, leave the **Assembly Part** field empty. LN takes these operations into account when it creates line-station variants.

# Delete Assembly Orders

You can delete the assembly orders for which the work has not started yet. The assembly orders that you want to delete must not be frozen which implies that none of the related line station orders are frozen.

You can delete the assembly orders from the following sessions:

- Assembly Line - Line Mix (tiasc2501m000): appropriate > **Delete Assembly Orders**
- Assembly Orders (tiasc2502m000): appropriate > **Delete Assembly Orders**

## Important!

Deletion of assembly orders - Required conditions

The assembly order must be in the **Created** or **Sequenced** status and

- None of its related line station orders are frozen.
- No supply messages for assembly parts are already generated and transferred to Warehousing or Order Management.

## Assembly order deletion-Important Points

- The deletion of an assembly order can only be initiated from the main assembly line also known as the roll-off line. In case of a multicompany assembly model, when you delete the assembly order on the main line, the related assembly orders on the supplying assembly lines are also deleted provided all related assembly orders on the supplying lines fulfill the conditions specified above. If one of the linked assembly orders on supplying lines cannot be deleted, the assembly order on the main line cannot be deleted either.
- The deletion of an assembly order is not allowed if the assembly order or one of its linked supplying assembly order is blocked. A message is displayed to inform the user about the order that has a blocking reason that must be resolved first before the assembly order can be deleted.
- The deletion of an assembly order means that the assembly order including its contents (operations, material requirements and so on) is deleted from the system. The assembly part requirements (part allocation) are updated accordingly.
- The deletion of an assembly order results in its removal from the line mix and line segment sequence. This means that the position of the deleted assembly order is made available again for line mixing and sequencing.  
You must (re)generate line mix and/or use sequencing engine to also reflect the changes in the line mix and line segment sequence.
- The deletion of an assembly order results in the update of line utilization to reflect the new line utilization.
- The deletion of an assembly order that has the **Sequenced** status results in the item serial inventory being set to 0 as the item on an assembly order is always serialized.

## Selling multiples of product variants for assembly

For assembly items, two types of sales order lines exist. Depending on the type of end item, Assembly Planning must be configured differently for both types of sales order lines.

Depending on the setting of the **Sell Multiples of Same Configuration** check box in the Assembly Planning Parameters (tiapl0100s000) session you either:

- **Sell single**  
If this check box is cleared, the order quantity on the sales order line has a fixed value of one. To sell multiple end items, you must create multiple sales order lines.
- **Sell multiples**  
If this check box is selected, the order quantity on the sales order line is one or more.

The following table displays the differences:

Sell single	Sell multiples
The <b>Sell Multiples of Same Configuration</b> check box in the Assembly Planning Parameters (tiapl0100s000) session is cleared.	The <b>Sell Multiples of Same Configuration</b> check box in the Assembly Planning Parameters (tiapl0100s000) session is selected.
The sales order line has a fixed quantity of one. You maintain sales order lines in the Sales Order Lines (tdsIs4101m000) session.	The sales order line has a quantity of one or more. Specified quantities must be whole numbers.
The end item has <u>item type Generic, Manufactured or Product</u> .	The item must be storable in inventory and have <u>item type Manufactured, or Product</u> . To store items with this item type, they must be linked to items of the type <b>Generic</b> in the Configurable Item - Assembly Line (tiapl2500m000) session. To keep track of information on the link between sales order, product variant and assembly line, use <u>demand pegging</u> .
Each sales order line corresponds with one <u>assembly order</u> .	Each sales order line corresponds with one or more <u>assembly orders</u> . All assembly orders have an order quantity of one.
The item's <u>serial number</u> is used to determine which completed item is delivered to the customer.	The item's <u>specification</u> is used to determine which completed item is delivered to the customer.

The **AssemblyStatus** field of the Product Variants (Assembly) (tiapl3500m000) session displays the progress of the assembly order for the product variant of the sales order line. The **AssemblyStatus** field of the Product Variants (Assembly) (tiapl3500m000) session always has value **Open**.

The requested offline date and planned offline date for the associated assembly order are displayed in the Product Variants (Assembly) (tiapl3500m000) session. No requested offline date or planned offline date can be displayed for the assembly order, the product variant may be in use on multiple assembly orders at once.

The product variant's reference type is **Sales Order**. The product variant's reference type is **Standard Variant**.

You can view demand related date in the Assembly Orders (tiasc2502m000) session for the assembly order information. You can view demand related date in the Assembly Orders (tiasc2502m000) session for the assembly order information. You can view demand related date in the Assembly Orders (tiasc2502m000) session for the assembly order information.

#### Note

- Selecting **Sell Multiples of Same Configuration** check box does not affect product variants already in use.
- You can configure product variants that contain purchased configurable items. Usually these items are configurable subassemblies that are part of the item structure and issued at the assembly link similarly to other assembly parts.



## Assembly control overview

The Assembly Control module in LN is used to control processes in the job shop when producing FAS items.

### Assembly Lines

Assembly lines consist of a set of consecutive line stations. The items are manufactured by passing them from line station to line station and by carrying out operations at each line station. An assembly line is subdivided into a number of line segments separated by buffers. You must define this structure in the Assembly Control module. An assembly line can be either a main line or a supplying line.

### Assembly Orders

Assembly orders can either be generated from sales orders (demand), or by your configurator. They pass through a series of statuses, in an analogous manner to JSC production orders. Before you can carry out the order, assembly parts are allocated to the shop-floor warehouses of the line stations. When you have completed the order you can backflush the materials and hours.

### Line-Station Variants

When an assembly order is transferred to the Assembly Control module, line-station orders, line-station variants (LSVs) and exchangeable configurations are generated. LSVs are used to reduce data, by combining all the operations and materials with the same specifications for a particular line station.

### Line Sequencing

The orders that come from your configurator have an initial sequence (that is, the order in which they are processed on the assembly line). In Assembly Control you use a set of rules to place these orders and the demand orders in a final sequence. The rules include priority (for example, sold orders have a

higher priority than stock orders) and operational considerations (for example, place orders with the same paint color next to each other, to avoid time wasted in changing paint nozzles).

## Assembly line costing

There are a number of important differences in the financial calculations carried out for assembly orders compared with JSC production orders. For example, results are not split into price variances and efficiency variances and there is no calculation of end-item unit costs.

# Assembly line station utilization

The utilization of an assembly line is the ratio of the actual number of orders for that line divided by the maximum number of orders for that line. You can display the utilization in the Assembly Line - Line Utilization (tiasl3500m000) session. If you have changed your order data, you must run the Rebuild Line Utilization (tiasl3200m000) session before you can see the utilization.

You can read further details about the number of orders planned for a line in the *Assembly orders* (p. 61) online manual topic.

The maximum number of orders for a line (for an option combination) is determined by:

- The line mix rules (see the *Line sequencing and rule types in Assembly Control* (p. 66) online manual topic).
- The assembly assignment of a line.

The assembly assignment is made up of the following factors:

- The cycle time for each period (non-average) or for the whole day (average).
- Man and machine resources for each line station.
- The time that the line station requires to process one assembly order. This time is expressed as a number of cycles. For instance, if the cycle time is two minutes, ten minutes is expressed as five cycles.

You define assembly assignments in the Assembly Line - Assignments (tiasc5510m000) session and link them to a particular line station in the Assembly Line - Assignments and Line Stations (tiasc5520m000) session.

When you have manually rescheduled orders, the utilization of the assembly line is altered.

You can use the Utilization by Critical Option Combination (tiasl3510m000) session to view the number of planned orders and the maximum number of orders on an assembly line for a given date, for option combinations that are used for line mix rules (that is, critical option combinations). You can also view this data as a graph with the Assembly Line - Line Utilization - Chart (tiasl3700m000) session.

# Line sequencing and rule types in Assembly Control

Assembly orders generated by Assembly Planning can be sequenced by using the sequencing engine, resulting in a line mix and line sequence. During this sequencing process, line rules are taken into account like clustering assembly orders based on items characteristics, or blocking assembly orders based on capacity rules.

The assembly line can be dedicated to one model, or to a mixed model. For example, a large number of product variants can be produced on the same assembly line.

Four major aspects of line sequencing are discussed:

- Sequence rules
- Sequence process
- Rescheduling
- Line sequence status

## SEQUENCE RULES

Sequence rules are made up of the following elements:

- Mixing process
- Mix rules, which exist in three types:
  - Capacity restriction rules
  - Proportional rules
  - Relative proportional rules
- Placement rules, which exist in three types:
  - Clustering rules
  - Blocking rules
  - Priority rules

## The (re)mixing process in Assembly Control

You can remix the orders within the Assembly Control module by using the Remix Line Mix (tiasl3220m000) session. Rules are defined for particular option combinations. Remixing attempts to schedule the orders so that the number of orders for each option combination is as close as possible to the maximum number of orders for each option combination. The better the mix, the better the sequence quality.

### Mix rules

There are three types of mix rules:

- **Capacity Restriction**

The total capacity of the line is limited, for example: maximum 500 cars with option combination CityCar in one day.

For **Capacity Restriction** rules, you can select one of three types of dispersion:

- **Average Dispersion** The option combination is spread evenly throughout the line sequence.
- **Sliding Window Avg. Disp.** A window is a certain number of adjacent sequence positions. That window is being slid position by position. Within each window the product sequence is optimized. Adjacent sequence positions means a continuous range of sequence positions. In each window the option combination is dispersed as evenly as possible. For example, each group of 10 positions should have the same number of RedCars.
- **Sliding Window Cap. Resr.** Within each window, there is a limit to the number of orders for the option combination. For example, no more than two RedCars in any window of 10 positions.
- **Proportional**  
Option combinations must be present in fixed proportion of the total order, for example, the ratio of CityCar to other orders must be 1:2.  
You can define two dispersion types for **Proportional** rules:
  - **Average Dispersion** The option combination is spread evenly throughout the line sequence.
  - **Sliding Window Avg. Disp.** In each window, there is a maximum ratio of a given option combination and any other option combination. For example, for every RedCar option combination, there must be at least one other option combination within any four option combinations (ratio = 1:2, window =4).

- **Relative Proportional**

The same as **Proportional**, except that the **Method of Dispersion** is always **Relative Dispersion**. You must specify a second option combination in which the first option combination is dispersed in relation to. The option combination is placed in a particular relation to another option combination. For example, red cars and blue cars can only be assembled alternately; you cannot assemble two red cars in a row.

During remixing, the priority of orders is taken into account, as described in one of the following paragraphs.

Because rules can conflict with each other, it is possible that not all sequence rules can be met. In that case you can give some rules a higher priority. However, this results in a less efficient order sequence, and you must solve these conflicts by redesigning the assembly process, not by performing more line sequencing.

## Placement rules

Placement rules are used to determine how products are placed in relation to other products. There are three types of placement rules:

- **Clustering**

Use this rule to place option combinations next to each other with the same options, when changing between option involves a long change-over time. For example, place all blue cars next to each other, because changing painting color takes a long time. Assembly Control clusters the option combinations (such as paint color), and a sequence number is assigned to every option combination.

- **Blocking**

Certain option combinations must not be placed next to other option combinations. For example, light colors must not be painted after dark colors to minimize effects of paint contamination.

## Clustering Example

In this example, the assembly orders and their option combinations are planned for a day on line segment 1.

Order 1	Option combination red
Order 2	Option combination blue
Order 3	Option combination black
Order 4	Option combination red
Order 5	Option combination blue
Order 6	Option combination black
Order 7	Option combination red
Order 8	Option combination blue
Order 9	Option combination black
Order 10	Option combination red

The option combination list Color is defined in Assembly Control as:

---

Option combination red    sequence 1

---

Option combination black    sequence 2

---

Option combination blue    sequence 3

---

When the assembly orders are sequenced in Assembly Control, based only on the clustering rule Color, the result for line segment 1 is:

---

Order 1	Option combination red
Order 4	Option combination red
Order 7	Option combination red
Order 10	Option combination red
Order 3	Option combination black
Order 6	Option combination black
Order 9	Option combination black
Order 2	Option combination blue
Order 5	Option combination blue
Order 8	Option combination blue

---

## Blocking Example

In this example, the assembly orders and their option combinations are planned for a day on line segment 1.

---

Order 1	Option combination red
Order 2	Option combination blue
Order 3	Option combination black
Order 4	Option combination red
Order 5	Option combination blue
Order 6	Option combination black
Order 7	Option combination red
Order 8	Option combination blue
Order 9	Option combination black
Order 10	Option combination red

---

The option combination list Color is defined in Assembly Control as:

---

Option combination red      Option combination blue

---

Option combination red      Option combination red

---

The list Color is linked to the blocking rule Color, which is linked to assembly line 1. This rule says that the color red cannot be followed by the color blue or by the color red.

One result of this rule is the following sequence:

Order 1	Option combination red
Order 3	Option combination black
Order 2	Option combination blue
Order 4	Option combination red
Order 6	Option combination black
Order 5	Option combination blue
Order 8	Option combination blue
Order 7	Option combination red
Order 9	Option combination black
Order 10	Option combination red

---

## Priority

Priority rules are enforced in the following order:

1. Orders with a later **Requested Offline Date** are given a lower priority.
2. Orders that are sold (a demand order) have priority over orders not yet sold.
3. Assembly orders with a lower priority number are processed first (for example, orders with a priority number of 1 are processed before orders with a priority number of 4). You define the order priority in the Assembly Order (tiasc2100s000) session.
4. Cost function value.

## THE SEQUENCING PROCESS

When you add new orders to an assembly line, LN generates in the Simulate and Create Line Sequences (tiasl4200m000) session an initial sequence for the line for the appropriate offline date.

A line segment that follows a buffer can only be sequenced, if the buffer has more than one random access place. To define a buffer's number of random access places, enter a value in the **Number of Random Access Places** field in the Stations (tiasl1545m000) session.

### Note

When you confirm a sequence, LN generates the As-built structure for the end item, such as the VIN number and header in the case of a car. You can edit the structure with the Serial End Item - As-Built Headers (timfc0110m000) and Serial End Item - As-Built Components (timfc0111m000) sessions. The serial numbers of the components are generated when you freeze the sequence. When you use the Print Work Instructions (tiasc5450m000) session, a space is provided on the printed form for you to enter the serial number of the components.

## RESCHEDULING

You can also manually alter the sequence with the Reschedule Assembly Orders (tiasl4220m000) session. The session uses two types of rules:

- **Move**  
An order is taken from one position and inserted into another position. All orders in between the two positions are shifted one position towards the initial position.
- **Swap**  
Two orders are interchanged, and nothing else is changed.

The automatic sequencing process uses the swap method. You can change the maximum swap/insert distance that is used in the automatic sequence generation in the Remix/Sequence Parameters (tiasl4110m000) session.

When you have swapped orders to another line mix, you can run the Remix Line Mix (tiasl3220m000) session for a better sequence.

## LINE SEQUENCE STATUS

A line sequence can have one of the following statuses:

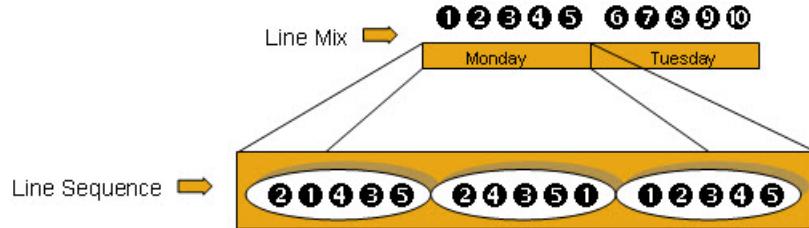
- **Planned**
- **Started**
- **Completed**

A line sequence has the status **Planned** when it is first created. When the first line-station order is completed, the status becomes **Started**. When the last line station order is completed, the status of that segment becomes **Completed**.

You can see the status in the Line Segment - Line Sequence (tiasl4500m000) session.

You can sequence the assembly orders on two levels:

- Assembly line level (line mix)
- Line segment level (line sequence)

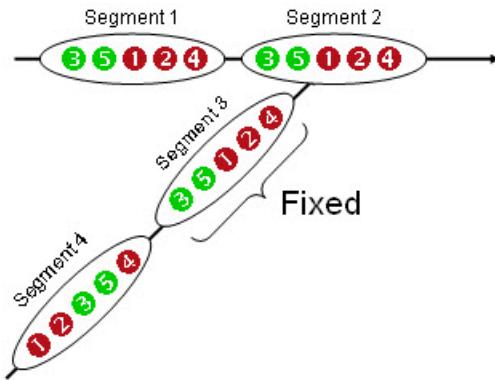


An initial line mix is generated by Assembly Planning. Remix assembly orders consider assembly orders with the status Planned and Sequenced, and use the existing assembly line mix as the starting point.

The remix process is important under these circumstances:

- When a backlog must be cleared.
- When an existing mix must be improved.
- Because offline dates of assembly orders have changed.
- Priority on assembly orders is altered.

A line sequence is generated based on the line mix. A line sequence specifies the order in which assembly orders must start on the corresponding line segments. For each line segment that is present in the assembly process, a line sequence must be generated. The line sequence algorithm takes the assembly order with the status Planned and Sequenced within a specific production period as input. On the last line segment of a supplying line, a line sequence is *fixed*. The line sequence of the connected line segment on the parent line determines the line sequence of the last line segment on the supplying line.



After sequencing, you can manually reschedule the assembly orders per line segment. Two types of rescheduling are possible:

- Move assembly orders



- Swap assembly orders (1 and 4)



# Line station variants and line station orders

Using the similarity of order data per line station line station variants reduce the data storage and improve performance in the execution system. When the order content on a specific line station is the same for multiple orders, that content is only stored once. This similar information is stored in a line station variant. The assembly orders only have a link to Line Station Variants.

## Example

You are making cars with many different features, including two types of wheels (broad and narrow). For the line station where the wheels are fitted, all cars with broad wheels are one line station variant, all cars with narrow wheels are another LSV, no matter what other specifications they have, because the other specifications are not relevant to the wheel line station.

An LSV can be shared by a number of assembly orders. That means that operations and material usage on that line station is the same of all of those assembly orders.

## Purpose

An LSV is a device to reduce unnecessary data, and so enhance performance. If you have one thousand orders for products, and the operations and materials at the first line station of the line are all identical, there is no point in storing identical information one thousand times. LN determines that the orders are all identical, and makes one LSV. When a new assembly order is generated, LN check the materials and operations for the order. If these are the different from existing LSVs, a new LSV is created.

## Sessions

You can display LSVs in the Line Station Variants (tiasc2520m000) session and print them in the Print Line Station Variants (tiasc2420m000) session. You can display and update the materials linked to LSVs in the Line Station Variant - Assembly Parts (tiasc2121m000) session, and display and update the operations in the Line Station Variant - Operations (tiasc2122m000) session (if the LSVs are order specific).

## Order-specific LSVs

LSVs are automatically generated by LN. If you want to alter the operations or components of an LSV, you must make the LSV order specific, by carrying out the following procedure:

1. In the Assembly Order - Line Station Orders (tiasc2510m000) session, select the LSV. The line station order must be **Frozen**.
2. On the appropriate menu, click **Make Order Specific**. LN makes a unique line station variant, which you can see in the Assembly Order - Line Station Orders (tiasc2510m000) session.
3. On the appropriate menu, click **Line Station Variants**.

4. The Line Station Variants (tiasc2520m000) session starts.
5. Select the LSV.
6. On the appropriate menu, click **Operations**.
7. The Line Station Variant - Operations (tiasc2122m000) session starts. Modify the operations as required.
8. You can modify the assembly parts linked to the operations from the appropriate menu of the Line Station Variant - Operations (tiasc2122m000) session.

## Line station order

When assembly orders are generated, line station orders are also created. A line station order is a production order for an assembly line station.

A line station order can have the following status:

- **Planned**
- **Frozen**
- **Ready to Start**
- **Completed**
- **Closed**

When line station orders are generated, the status is set to **Planned**.

### Clustered line station order

Represents all the material requirements for a line station for a day. A CLSO consists of user-defined buckets. The material requirements are combined for each bucket.

In Assembly Control, transactions can be carried out per line station and per period, instead of per order. LN can combine the same materials for a specific period into one material line. After doing so, the cumulated quantity is stored in the CLSO. This accumulation reduces the number of transactions that are necessary, because the transactions are performed for a specific bucket.

CLSOs are used in assembly part allocation and in backflushing to combine materials for a line-station order (for a day).

### Parameters

The **Transaction Processing** parameter determines the use of CLSOs. This parameter is defined in the Assembly Control Parameters (tiasc0100m000) session, and can have the following values:

- **Line Station Based** Only one CLSO is created for each line station each day.
- **Order Based** One CLSO is created for each assembly order.

CLSOs are used in assembly part allocation and in backflushing to combine materials for a line station order. A CLSO covers an entire day, in line-station based transaction processing, or an assembly order, in order-based transaction processing. The data for each time bucket is kept separate. In line-station based transaction processing, each time bucket results in a separated warehousing order line for the

assembly part allocation. In order-based transaction processing, an individual warehouse order is generated for each CLSO.

Through the appropriate menu you can perform the following actions:

- Change the status of a CLSO from **Closed** to **Open**.
- Start the Clustered Line Station Order - Assembly Part Requirements (tiasc7140m000) session to view the assembly part requirements for each CLSO.

## Bucket Definition

Allocation and backflushing are done per line station per bucket when you use **Line Station Based Transaction Processing**, which means that all the line station orders in one bucket are combined. This reduces the number of transaction, compared with **Order Based** transaction processing. The performance is further enhanced if you use larger buckets, because this reduces the number of transactions.

After you define the buckets, you must run **Generate Buckets**, which is available from the appropriate menu, to generate the buckets for the full allocation time fence in Assembly Control. The buckets for the period length must be the same as for the **Allocation Horizon**, which is defined in the Assembly Control Parameters (tiasc0100m000) session, because allocation is done within the allocation time fence.

It is best to define a whole number of buckets per day. If not, your buckets will be of different lengths. For example, if you enter 10 hours into this field, LN will generate two buckets each of ten hours and one bucket of four hours (for one day of 24 hours). If you make many changes to assembly orders you should make your buckets smaller than if you make few changes.

## Example

In the current session you enter the following:

Period	No. days	Bucket length	Unit
1	1	4	hour
2	1	8	hour
3	1	12	hour

In the **Allocation Horizon** field of the Assembly Control Parameters (tiasc0100m000) session you can enter, for example, 5 days.

When you select the **Generate Buckets** option, the following buckets are generated:

Bucket	Day num- ber	Start	End
1	1	00:00	04:00
2	1	04:00	08:00
3	1	08:00	12:00
4	1	12:00	16:00
5	1	16:00	20:00
6	1	20:00	24:00
7	2	00:00	08:00
8	2	08:00	16:00
9	2	16:00	24:00
10	3	00:00	12:00
11	3	12:00	24:00
12	4	00:00	12:00
13	4	12:00	24:00
14	5	00:00	12:00
15	5	12:00	24:00

The final two lines were created because the allocation time fence was filled.

#### Note

You can view the buckets you have defined with the Buckets (tiasl1501m000) session. You can print out the data you have entered in this session, by selecting **Print Bucket Definition** from the **File** menu.

# Clustering Line Station Order - Assembly Part Requirements

## Parameters

The **Transaction Processing** parameter determines the use of CLSOs. This parameter is defined in the Assembly Control Parameters (tiasc0100m000) session, and can have the following values:

- **Line Station Based** Only one CLSO is created for each line station each day.
- **Order Based** One CLSO is created for each assembly order.

So, in **Line Station Based** transaction processing mode, a CLSO is used for an entire day. However, the data for each bucket are kept separate, and each bucket gives rise to a separate warehousing order line, for planned stock transactions for the assembly part allocation in Warehousing. You can see that data in the current session.

You can see the CLSOs in the Clustered Line Station Orders (tiasc7530m000) session. You can define buckets in the Bucket Definition (tiasl1100m000) session.

### Note

In this session, you see only the assembly parts that have not yet been backflushed.

# Assembly Line Material Supply

Different supply methods are available for the supply of shop floor warehouse which are related to one or multiple line stations on the assembly line.

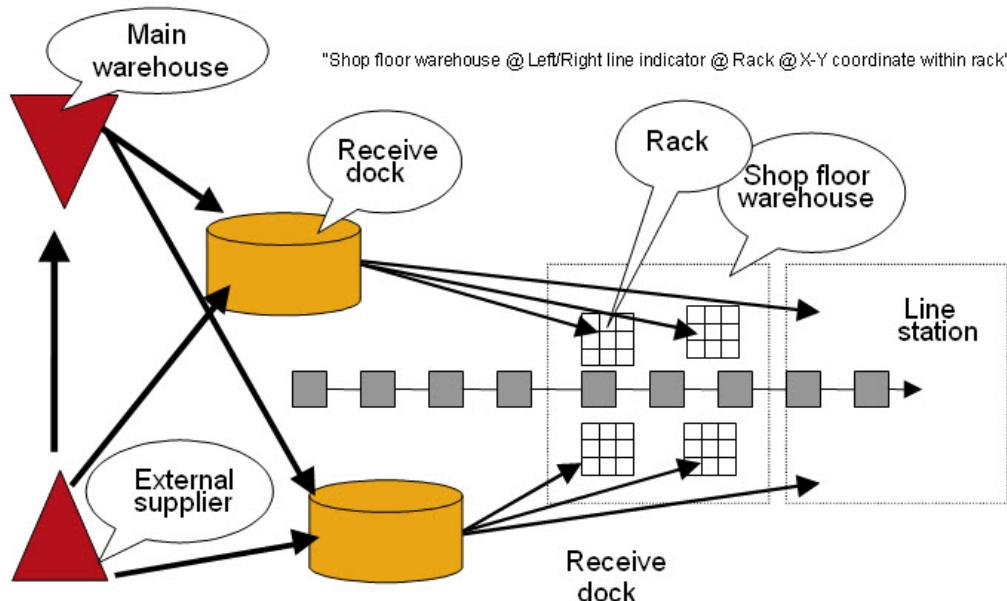
The internal and/or external supply methods are as follows:

- **Supplier**
- **Internal warehouse**
- **Production**

The material supply methods are as follows:

- **Push**  
The shop floor warehouse is supplied based on planning information.
- **Pull**  
The shop floor warehouse is supplied based on a supply trigger.
  - **KANBAN**  
The supply is based on a manual trigger, such as the scan of a bar code. This method is mostly used for floor stock items for which no registration at shop floor warehouse is required.

- **TPOP**  
The supply is triggered by a SIC run for the shop floor warehouse concerned.
- **Order Controlled / Batch (OCB)**  
The supply is completed anonymously for multiple assembly orders together, based on triggers in the assembly process.
- **Order Controlled / SILS (Supply In Line Sequence)**  
The supply is completed for every assembly order separately, based on triggers in the assembly process. The parts are delivered Just-in-time in the sequence that products are passing along the assembly line.



## Linking generic items to assembly lines

Use this session to define which generic item can be produced on which assembly lines. LN requires this information to determine the master company of the generic item. Several processes can run only in the master company. For example, if you enter a sales order, LN creates a product variant in the master company. In the Configurable Item - Assembly Line (tiapl2100s000) details session, you can specify a basic sales price and standard cost.

## Assembled items through warehousing after roll-off from main line

Store finished generic items - setup

This topic describes how to set up the items to be able to store the finished end product of an assembly order in inventory.

To store a finished generic item in inventory, you must define *two* items: a generic item and a standard item.

Both items represent the same physical item. In Assembly Control, you use the generic item. In Sales Control and Warehousing, you use the associated standard item.

To specify which standard item is associated with the generic item, use the Configurable Item - Assembly Line (tiapl2500m000) session.

### Item settings

For the generic item and the standard item, use the following item settings:

Session	Field	Generic item	Standard item
Items (tcibd0501m000)	<b>Item Type</b>	Generic	Manufactured or Product
Items (tcibd0501m000)	<b>Serialized</b>	Yes	Yes
Items (tcibd0501m000)	<b>Revision Controlled</b>	(Not used)	No
Items (tcibd0501m000)	<b>Order System</b>	FAS	FAS
Items - Warehousing (whwmd4500m000)	<b>Serials in Inventory</b>	(Not applicable)	Yes
Items - Warehousing (whwmd4500m000)	<b>Lots in Inventory</b>	(Not applicable)	(See below)

The **Serials in Inventory** check box must be selected because Warehousing would otherwise not be able to distinguish between product variants.

### Additional instructions

- The generic item and the standard item must have the same inventory unit.
- If you use unit effectiveness, you must define both items as unit effective items in the Items (tcibd0501m000) session.
- If the standard item is lot controlled, you must use the lot-in-inventory type of lot control. To make an item lot controlled, select the **Lot Controlled** check box in the Items (tcibd0501m000) session.
- To use the lot-in-inventory type of lot control, select the **Lots in Inventory** check box in the Items - Warehousing (whwmd4500m000) session.

## Standard cost calculation of the standard item

The standard item must have an effective cost component structure. The standard inventory valuation functionality for items in inventory requires such a cost component structure.

To specify the inventory valuation method, in the Item Data by Warehouse (whwmd2510m000) session, select a value in the **Inventory Valuation Method** field.

To obtain the most accurate inventory valuation, select an inventory valuation method based on actual costing. The recommended inventory valuation method is **Serial Price (Serial)**.

If the inventory valuation method is **Standard Cost**, which is not an actual costing method, you must calculate a standard cost in the Standard Cost Calculation module. In this case, LN evaluates the item against the calculated fixed transfer price (FTP) of the standard item and ignores differences between the product variants.

## Storing finished generic items

### Introduction

In LN, an item of type generic cannot be stored in inventory. To store a finished generic item in inventory, you must associate the generic item with a standard item. The item type of the standard item is **Manufactured or Product**.

Both items represent the same physical item. In Assembly Control, you use the generic item. In Sales Control and Warehousing, you use the associated standard item.

You can use this setup to carry out post-assembly operations in regular work centers after an item leaves the assembly line.

### Note

If you send the item to the customer immediately upon completion of the assembly order, you only need the generic item.

## Setup

The items must have the following properties:

- The order system of the generic item *and* the standard item must be FAS.
- Both items must be serialized items.
- If you use unit effectivity, both items must be unit effective items.

To specify which standard item is associated with the generic item, use the Configurable Item - Assembly Line (tiapl2500m000) session.

## Restrictions

If a manufactured item is associated with a generic item, you cannot do the following with that item:

- Use the item in Purchase Control
- Create a bill of material (BOM) for the item, or use the item as a component in another BOM

- Create a production order for the item, other than a rework order
- Plan the item in Enterprise Planning, because the item's order system is **FAS**

You cannot return an FAS item to the assembly line for rework.

#### Note

You can create routings for post-assembly operations of the standard manufactured **FAS item**.

### Procedure

#### Sales order entry

To define a sales order line for a generic item that must be stored in inventory after completion, enter the associated standard item on the sales order line.

Based on the standard item that you entered, LN retrieves the generic item that is linked to this standard item in the Configurable Item - Assembly Line (tiapl2500m000) session.

LN sets the **Delivery Type** field on the sales order line to **Warehouse**.

You must define the generic item's product variant in one of the following ways:

- Configure the generic item in Product Configuration or in Assembly Planning, as determined in the **Configurator** check box in the Assembly Planning Parameters (tiapl0100s000) session.
- Select a previously configured product variant.
- Use an external tool/system to deliver the configured product variant to LN.

#### Note

If a generic item has an associated standard item, you can still enter the generic item on a sales order line. If you enter the generic item on a sales order line, LN sets the **Delivery Type** field on the sales order line to **Work Center** and you cannot store the finished item in inventory.

#### Assembly order handling

If a sales order line has an item with the order system **FAS**, LN creates an assembly order in the Assembly Control module by running the Generate Assembly Orders (tiapl3201m000) session. The item on the assembly order is the generic item.

When the assembly order is sequenced, LN generates the end item's serial number.

When the assembly order's final operation is completed, LN completes the following actions:

1. LN generates a warehousing order to receive the finished item in inventory. The item on the warehousing order is the standard item.  
The assembly order status becomes **Production Completed**.
2. LN sets the **Ownership** field on the inbound-order line to **Company Owned**.
3. After the item is received in inventory, and any required inbound inspection has been performed, the assembly order gets the status **Completed**.

If the item is rejected or destroyed after inspection, the relevant product variant obtains the status **Canceled**. If a product variant obtained the status **Canceled**, to continue processing the assembly order, manually cancel the sales order and create a sales order by using another product variant.

The product variant is **Canceled** only when the following conditions are met:

- The **Sell Multiples of Same Configuration** check box is selected.
- A manufactured FAS item is listed on the sales order line.

LN links the as-built structure to the standard item instead of to the generic item.

#### Note

Before you can release the sales order line to Warehousing, a sales order line for a standard **FAS** item must have a serial number.

#### Post-assembly operations

To perform additional operations on an item after the item comes off the assembly line, create a rework order.

## Delivering to customers directly from the assembly line

Delivering to customers directly from the assembly line process is based on generic assembly items. For sales order processing, the **Delivery Type** field on the sales order is **Work Center**. A warehouse order is created and will be delivered from the work center to the customer.

For more information, refer to Product variants in Warehousing

## Offsetting Line Station Orders

An assembly order consists of several LSOs. These LSOs are linked to line stations that are grouped in line segments. These orders and segments all have their own start times and end times. These times are calculated on the following occasions:

- An assembly order is offset when you plan the order, that is, when LAC creates the assembly order in ASC.
- A line segment is offset when you confirm a line sequence in the Simulate and Create Line Sequences (tiasl4200m000) session.
- An LSO is offset in two instances:
  - When you plan the assembly order.
  - When you run the current session. This last instance is, of course, what we focus on now.

If you offset LSOs in the current session, the calculation depends on the status of the assembly orders. These statuses are:

- **Created.** If you only planned an assembly order, and you did not yet confirm a line sequence, the assembly order has the **Created** status.
- **Sequenced.** After you confirm a line sequence, the assembly order has the **Sequenced** status.

According to these statuses, offsetting is based on the following information:

- For **Created** assembly orders, the calculation is based on the lead-time of the line segments, as defined in the Line Segments (tiasl1540m000) session.
- For **Sequenced** assembly orders, the calculation is based on the sequence, assembly line calendar, and the assembly assignments of the assembly line.

The previous information implies that the start times and end times of LSOs can vary, according to the offset method that is used. Therefore, an LSO can have start times and end times on one of the following three levels:

- If the LSOs of a **Created** assembly order are not yet offset in the current session, they have the start times and end times of the assembly order. Of course these values are initial values that cannot be calculated in the current session.
- If you offset LSOs for assembly orders with the **Created** status, these LSOs get the same start times and end times as the line segments. This is because the start times and end times of the LSOs are calculated, based on the lead-times of the line segments.
- If you offset LSOs for assembly orders with the **Sequenced** status, these LSOs receive the start times and end times of the line stations.

To offset LSOs in the current session, you must specify a range, an **Offline Date To**, and the order type for which the LSOs must be offset. However, not all assembly orders that match these criteria are offset, but only those assembly orders that require offsetting. Assembly orders that require offsetting have the **Offsetting Required** check box selected. This check box is displayed in the following sessions:

- For **Created** orders, in the Assembly Order (tiasc2100s000) session, on the General tab. If the **Assembly Order Status** is not **Created**, the **Offsetting Required** check box is not displayed.
- For **Sequenced** orders, in the Line Segment - Line Sequence (tiasl4500m000) session.

Offsetting is required as soon as a change in the dates or times of an order occurs, or, in other words, as soon as the actual dates and times no longer match the planned dates and times. The **Offsetting Required** check box, therefore, is selected in the following instances:

- When LAC generates the assembly order in ASC.
- If you mix or manually move planned orders and, as a result, these orders receive another offline date/time.
- If you offset the LSOs of a parent order and as a result, this order receives another offline date/time, the check box is selected for the child orders; because the child orders must be synchronized with the parent order. Note that offsetting the LSOs of a parent order does not

result in new start times and end times for the LSOs of the child orders. The LSOs of the child orders must be offset themselves too.

- If you confirm a line sequence, in the Simulate and Create Line Sequences (tiasl4200m000) session, or manually change a confirmed line sequence, the line segments receive new start times and end times. As a result, offsetting is required for the LSOs. If the order has child orders, the check box is selected for the child orders too; because the child orders must be synchronized with the parent order.

Note that in all these instances, it is necessary to offset the LSOs of the orders in question, using the current session. The error messages for offsetting can be viewed in the Assembly Messages (tiasc0501m000) session.

## Assembly kits

An assembly kit is an order-dependent set of items that must be supplied together to the shop-floor warehouse.

You can define assembly kits in the Assembly Kit (whwmd4550m000) session. To specify which items are part of an assembly kit, you must link the assembly kit to a warehouse and item combination in the Item Data by Warehouse (whwmd2110s000) session. You can only make use of assembly kits if the supply method for the warehouse and item combination is order-controlled/SILS.

The items that are supplied to the shop-floor warehouse by means of an assembly kit can differ per order, however it is the same assembly kit.

Assembly Control can trigger a call-off of items for a specific item. If the called-off items are part of the same assembly kit, Warehousing must deliver the items together to the shop-floor warehouse.

To view the sequence in which the items must be delivered to the shop-floor warehouse, use the Shipping Sequence (whinh4520m000) session.

To view assembly kits call-offs and quantities, use the Assembly Part Supply Transfer (SILS) (tiasc8520m000) session.

## Example

Cars are manufactured with an option to fit a radio. If the assembly line requires the radio's components, they are delivered in the form of an assembly kit, called Radio. However, different radio sets can be ordered for the cars. These radio sets can all belong to the assembly kit Radio. For example, the assembly kit Radio contains the following items:

- Three types of radios: Radio 1, Radio 2, and Radio 3
- Three types of frames: Frame 1, Frame 2, and Frame 3
- Two types of aerials: Aerial 1 and Aerial 2
- Four types of speakers: Speaker 20W, Speaker 30W, Speaker 40W, Speaker 50W
- Cables

For item Car100, the following items that are part of assembly kit Radio, are called off by call-off 100:

- Radio 2
- Frame 2
- Aerial 1
- 2 Speaker 20W
- 2 Speaker 40W
- Cables

These items are delivered to the shop-floor warehouse together as assembly kit Radio for parent serialized item Car100 and call-off 100.

For item Car101, the following items that are part of the assembly kit Radio, are called off by call-off 101:

- Radio 3
- Frame 3
- Aerial 2
- 2 Speaker 30W
- Cables

These items are delivered to the shop-floor warehouse together as assembly kit Radio for parent serialized item Car101 and call-off 101.

## Overview of material issue

The entering of issues as part of the order procedure for production orders is required to issue the necessary materials from the warehouse to the job shop. Issuing can be done manually or by the system while the estimate is being built up.

When backflushing applies, issuing of inventory is automatically carried out.

**Note:** If multisite is activated, material issue is performed for a item linked to a specific planning cluster.

- **Backflushing**  
The automatic issue of materials from inventory, or accounting for the hours spent manufacturing an item, based on theoretical usage and the quantity of the item reported as complete. For more information, refer to Backflushing.
- **Floor stock**  
A stock of inexpensive material present on the job shop that can be used in production without recording each issue of material individually. Floor stock is not backflushed and is not part of the estimated costs. To account for floor stock materials, a surcharge is added to the standard cost of an end item. A Kanban triggers the supply of floor-stock items to the job shop. You can create a warehousing order of type **JSC Production** in which you determine from which warehouse and to what work center the material must be shipped.
- **Controlled material issue**  
Material is issued from the warehouse to the job shop in a user-defined way. You can choose to take tight control over the issue process, or you can choose to control the issue process more loosely. In general, the issue of material goes through the following stages:
  - **Allocate material in the warehouse**  
A planned production order results in planned inventory transactions. These transactions are used for planning purposes by the MRP planning engine. As soon as a production order is released, warehouse orders are created, which means that the material in the warehouse is allocated for the production order.

All materials specified in the bill of material (BOM) are allocated in the warehouses, which is reflected in the Estimated Materials (ticst0101m000) session.

If you use job shop warehouses, you can determine the moment that the material is allocated in the job shop warehouse.

- **Specify quantity to be issued**

You must specify the material quantity that you want to issue. Depending on the setting of the **Manual Issuing** check box in the Production Order Parameters (tisfc0100s000) session, LN automatically specifies the planned quantity, or you can manually specify the material quantity. Note that the material quantity is still blocked in the warehouse.

- **Release material**

If you release the material in the warehouse, the material becomes unblocked, which is a signal for the warehouse employees to start the warehouse outbound procedure.

- **Carry out the warehousing procedure**

A user-defined warehouse outbound procedure is carried out.

- **Receive material**

The desired material quantity is received on the job shop.

To handle material from the warehouse to the job shop, and from the job shop to the warehouse, you can use the Material to Issue for Production Orders (ticst0101m100) session.

To handle material in a more detailed way, you must use the Production Warehouse Orders (timfc0101m000) session. Particularly in case of serialized items or lot-controlled items, it is recommended that you use this session. All actions on material are laid out in so-called production warehouse orders, which you can view in the Production Warehouse Orders (timfc0101m000) session.

## Material issue parameters

The following fields and parameters influence the way LN issues materials:

- **Floor Stock**

Determines whether the material is floor stock. The **Floor Stock** check box is located in the Item - Warehousing (whwmd4600m000) session.

- **Backflush Materials**

Determines that LN issues material through backflushing. You can find this parameter in the Item - Production (tiipd0101m000) session. For more information refer to Setting up backflushing.

- **Manual Issuing**

Determines whether you need to manually specify the material quantity that must be issued. For more information, refer to *Material issue setup* (p. 109).

- **Direct Initiate Inventory Issue**

Determines whether material is automatically unblocked in the warehouse after the production order is released. For more information, refer to *Releasing material* (p. 110).

- **Direct Process Warehouse Order Line**

Determines whether the warehouse procedure is carried out automatically when you issue material. For more information, refer to Automatic processing warehouse order lines.

## Link materials to operations

Linking an operation to a material allows for:

- Phased issue of materials.

- Use of job shop warehouses.

- Application of operation scrap and yield.

- **Phased issue of materials**

Linking operations to materials reduces stockpiling of raw materials and intermediates, as it allows to determine accurate delivery dates. For instance, the Order Planning module in Enterprise Planning uses the operation by material to determine the delivery time concerning planned purchase and production.

- If a material is not linked to an operation, LN will assume that the material is needed at the start of the first operation.

- If a production order has no operations, LN will assume that the material is needed at the start of the production.

- **Use of job shop warehouses**

By linking an operation to a material, LN determines from which job shop warehouse the material is to be issued. A work center is linked to an operation, and a job shop warehouse is linked to a work center.

- **Application of operation scrap and yield**

The calculation of the estimated quantity of a material is affected by the scrap quantity and yield percentage of the operation where it is used. Materials must be linked to the operations where they are used in order to achieve an accurate estimate.

### Linking materials to operations

You can link materials to operations in two ways:

- **In the BOM**

In the Bill of Material (tibom1110m000) session, enter the operation in the **Operation** field.

- **In the BOM Line - Material-Routing Relationships (tibom0140m000) session**

In the BOM Line - Material-Routing Relationships (tibom0140m000) session, specify the routing code and the operation.

#### Note

- All warehouses and operations must be linked to the same site as the production order for which the materials are needed.

- An item can have several routings per site. In the bill of material (BOM), you can enter one operation number, which then applies to all routings of an item.

## Defining BOM Line - Material - Routing Relationships

For a manufactured item, you can define multiple routings. Every routing consists of a different series of operations. You can use the material-routing relationships defined in this session to determine for every routing on which operation a specific material must be present on the job shop.

In the Bill of Material (tibom1110m000) session, you must specify for a BOM line on which operation the material of the BOM line is issued to the job shop:

- If you enter zero (0) in the **Operation** field, the BOM Line - Material-Routing Relationships (tibom0140m000) session is used to determine on which operation the material is issued. If no material-routing relationship exists, the material is issued at the first operation.
- If you enter a value other than zero (0) in the **Operation** field, for example, 10, the material is issued at operation 10. This operation applies to all routings that are defined for the manufactured item. If the operation does not exist for the manufactured item's routing(s), the BOM line material is issued at the first operation of the routing.

### Note

- Material-routing relationship information is used in Enterprise Planning, the Standard Cost Calculation module, and job shop order generation.
- You can start this session from the Bill of Material (tibom1110m000) session. You can start the BOM Line - Material-Routing Relationships (tibom0140s000) session from a BOM line in the GBF browser for item engineering data. The GBF browser is invoked from the Item Engineering Data (GBF) (tiipd0203m000) session.

## Material issue strategies

### Methods

LN offers you various levels of control for the issue of materials. You can specify a different method for each material.

- Available methods to control the quantity of the issue:
  - Direct user control over the quantities to issue
  - Quantities determined by the allocations
- Available methods to control the time of the issue. LN issues the material:
  - After a user gives a command
  - At the allocation date

- Immediately when the production order is released
- Special methods:
  - Backflushing
  - Floor stock

You can influence the issue process with parameters such as:

- **Direct Process Warehouse Order Line**
- **Backflush Materials**

The **Manual Issuing** check box in the Production Order Parameters (tisfc0100s000) session influences the issuing process of all materials. Materials are issued when you choose the Transfer Subseq. Delivery to Issue command in the Material to Issue for Production Orders (ticst0101m100) session.

If you apply backflushing, LN issues the material when you report a quantity of the end product as **Completed** or **Rejected**.

You can keep inexpensive materials present in the job shop as floor stock. Floor stock is not allocated to a warehouse and is not included in material costs. To account for floor stock materials, a surcharge is added to the standard cost of an end item. The supply of floor-stock items to the job shop is triggered by Kanban. A warehousing order of the **Production** type can be created in which you determine from which warehouse and to what work center the material must be shipped.

## Material issue setup

In the Production Order Parameters (tisfc0100s000) session, you can use the **Manual Issuing** check box to specify whether you want to specify the material quantity that must be issued to the job shop floor manually or automatically.

If you select the **Manual Issuing** check box, you must use the Material to Issue for Production Orders (ticst0101m100) details session or the Production Warehouse Orders (timfc0101m000) session to specify manually the material quantity that you want to issue from the warehouse to the job shop.

The **Subsequent Delivery** field contains the planned quantity that is allocated. After the production order is released, you must specify the material quantity that you want to issue in the **To Issue** field in the Material to Issue for Production Orders (ticst0101m100) details session or the Estimated Materials (ticst0101m000) session.

The process to perform manual issuing consists of the following steps:

1. Release the production order. LN copies the estimated quantity to the **Subsequent Delivery** field.
2. Enter the quantity to issue in the **To Issue** field in the Material to Issue for Production Orders (ticst0101m100) details session. If you want to issue all materials for the order simultaneously, you must click Transfer Subseq. Delivery to Issue on the appropriate menu.

If you manually specify the material quantity, you are in full control of the issue process. You explicitly decide about the material quantity that is issued, which can be useful, for example, in case of expensive material.

## Automatic issuing

If you clear the **Manual Issuing** check box while you release a production order, LN automatically fills the **To Issue** field with the planned material quantity. You no longer need to specify the material quantity manually in the Material to Issue for Production Orders (ticst0101m100) details session or the Production Warehouse Orders (timfc0101m000) session, which saves time. LN issues the entire estimated quantity as soon as the warehousing order line is unblocked.

However, if you want to issue a different material quantity, or you must deal with partial deliveries, you can manually overrule the material quantity. Enter the desired quantity in the **To Issue** field in the Material to Issue for Production Orders (ticst0101m100) details session.

## Inventory shortage

If an item's inventory is insufficient, you cannot issue inventory unless the **Negative Inventory** check box is selected in the Inventory Handling Parameters (whinh0100m000) session. If a shortage arises, and the **Negative Inventory** check box is cleared, the issued quantity remains in the **To Issue by Warehousing** field, and a shortage report is printed. After the inventory is replenished, you must manually process the unblocked warehousing order.

### Note

- You can specify a negative quantity to return unused materials to the warehouse, or to cancel a quantity to be issued from the warehouse in the Material to Issue for Production Orders (ticst0101m100) session or the Production Warehouse Orders (timfc0101m000) session. To return or cancel lot-controlled material or serialized items, for best results, use the Production Warehouse Orders (timfc0101m000) session, in which you can specify lot numbers and serial numbers.
- The **Manual Issuing** check box does not apply to backflushing and floor stock.

## Releasing material

Unblock or release material in the warehouse is part of the material issue procedure. If material is released, the warehouse employees are notified to start the warehouse outbound procedure.

To specify whether the material must be released manually or automatically:

- **Direct Initiate Inventory Issue selected**  
LN automatically unblocks the warehouse order line for the material during production order release.
- **Direct Initiate Inventory Issue cleared**  
You must release the material manually. To unblock the material's warehouse order line, you must either use the Initiate Inventory Issue (tisfc0207m000) session, or click Transfer Subseq. Delivery to Issue in the Material to Issue for Production Orders (ticst0101m100) session. LN

now moves the material quantity from the **To Issue** field to the **To Issue by Warehousing** field.

- The activated warehousing order line:
  - Issues the requested quantity.
  - Increases the value in the **Actual Quantity** field by the issued quantity.
  - Subtracts the issued quantity from the **To Issue by Warehousing** field.

### Set the **Direct Initiate Inventory Issue** check box

You can set the **Direct Initiate Inventory Issue** check box on three levels to determine whether the material must be unblocked manually or automatically:

- In the Item - Production (tiipd0101m000) session, where you can set the default value for a specific item, or in the Item - Production Defaults (tiipd0102m000) session, where you can set the default value for a specific item group.
- In the Estimated Materials (ticst0101m000) session, where a production planner can determine whether the material must be unblocked manually or automatically.
- In the Material to Issue for Production Orders (ticst0101m100) session, where a person on the job shop can determine whether the material must be unblocked manually or automatically.

## Initiate Inventory Issuing

Enter a date in the **To Date/Time** field until which materials must be issued. Materials with an allocation date that is later than the date in the **To Date/Time** field, are not issued.

The current session is used to manually issue materials from inventory. You do not have to manually issue materials if:

- The **Manual Issuing** check box in the Production Order Parameters (tisfc0100s000) session is cleared:
- The item is defined as floor stock
- The materials are backflushed

You can issue inventory if the production order status is one of the following:

- **Released**
- **Active**
- **Production Completed**
- **Completed**

Select a range of orders and specify the operations for which you want to issue materials from inventory. You can only do this if you have specified an operation for the material on the BOM line.

If you are using JSC order groups, you can issue inventory for all the production orders in an order group at once. Select the **Production Order Group** check box and enter the JSC order group.

#### Note

If the **Direct Process Warehouse Order Line** check box in the Estimated Materials (ticst0101m000) session is cleared, the inventory will not be issued automatically. Only the warehouse order line will become unblocked.

## Process backflushed materials

LN backflushes the materials linked to the operations for which quantities are reported as completed. If a production order has no operations, LN backflushes all materials.

For details about the calculation of the quantities to issue through backflushing, see Calculate backflush quantity.

You can see the result of backflushing materials in the Production Order (tisfc0101s000) session.

LN subtracts the backflushed material quantity from the **Subsequent Delivery** field and adds the same quantity to the **To Issue** field. The corresponding warehousing order is immediately initiated.

#### Note

- LN does not decrease the value of the **Subsequent Delivery** field below zero.
- LN also prints the results of backflushing materials in a report.

## Assembly backflushing

When a line station order is reported complete in the Line Station - Assembly Orders (tiasl6510m000) session or the Report Line Station Order Complete Using Bar Code (tiasc2211m000) session, the material requirements and hours budgeted for that order can be backflushed. You can backflush the materials and hours with the Backflush Requirements (tiasc7241m000) session.

The backflushing topics discussed here are:

- Floor stock
- Backflushing mode
- Quantity of parts backflushed
- Number of hours backflushed

## Floor stock

Floor stock items such as nuts and bolts are not backflushed in assembly control. To define an item as floor stock, select the **Floor Stock** check box in the Item - Warehousing (whwmd4600m000) session.

## Backflushing mode

Backflushing is carried out for each clustered line-station order (CLSO) (see the Clustered Line Station Orders (tiasc7530m000) session). The number of CLSOs produced each day, depends on the mode you select with the **Transaction Processing** parameter, which you define in the Assembly Control Parameters (tiasc0100m000) session. For **Order Based** processing, each individual assembly order provides a CLSO for each line station, creating many CLSOs each day. For **Line Station Based** processing, there is only one CLSO each day, for each line station. All the hours and materials for all buckets, all line-station variants, and all line-station orders are clustered into one CLSO for each line station. This mode is for high-volume production environments.

## Assembly parts

The parts required by the line station variant can be backflushed after the line station order is reported complete, with the Backflush Requirements (tiasc7241m000) session. The quantities required are calculated as described for the Build Assembly Part Allocation (tiasc7240m000) session. LN activates a warehousing order line which ensures the parts are delivered to the correct shop floor warehouse.

Floor stock items such as nuts and bolts are not backflushed in assembly control. To define an item as floor stock, select the **Floor Stock** check box in the Item - Warehousing (whwmd4600m000) session.

## Man hours and machine hours

Man hours (also known as person hours) and machine hours are backflushed to People.

The number of hours backflushed is the sum of CT x MO ( Cycle Time x Man Occupation or Machine Occupation) for each line station variant, summed for either the assembly line, if **Line Station Based**, or for the line station, if **Order Based**.

- If it is **Line Station Based**, the cycle time comes from the Assembly Line - Assignments (tiasc5510m000) session.
- If it is **Order Based**, the cycle time comes from the Line Station Variant - Operations (tiasc2122m000) details session. You define the occupation in the Assembly Line - Assignments and Line Stations (tiasc5520m000) session, if **Line Station Based**, and in the Line Station Variant - Operations (tiasc2122m000) session, if **Order Based**.

If hours are present, the hours transactions with the status Closed are posted to People and processed automatically. The hours are posted to the employee linked to the line station. You can view the hours with the Assembly Hours (bptmm1160m000) session. You can also enter additional hours with this session.

### Note

In the Assembly Control Parameters (tiasc0100m000) session, the **Transaction Processing** field determines how hours are booked:

- **Order Based**

Hours are booked for an individual assembly order. **Order Based** is used in low-volume environments.

- **Line Station Based**

The hours for line-station orders are added together, for each line station, to form one clustered line-station order (CLSO) for each day. **Line Station Based** is used in high-volume environments.

The values that are visible in the Clustered Line Station Orders (tiasc7530m000) session are used by Warehouse Management. When material backflushing is performed, the inventory for the assembly part is backflushed from Warehousing, and the Planned stock transactions in the Order - Planned Inventory Transactions (whinp1501m000) are reduced.

## Production Bill of Material (PBOM)

Use the production bills of material (p-bom) models to model how the product is built, in multiple levels and sites.

This applies to:

- The way the product is produced
- The materials that are used
- The logistic handling
- The standard cost

The production bill of material differs from the E-BOM in structure, width and depth.

The structure of the P-BOM is based on the way the product is manufactured and you can add standard materials used across all sites.

Once a P-BOM is complete, a job shop bill of materials for a specific site is generated that will also contain the available machines and or subcontractors, sub-assemblies built or specific materials for the specified site along with a routing.

The production bill of material is revision controlled.

You can use the models to define aggregation relationships for planning purposes and a bill of critical materials for items that can cause bottlenecks in the production process.

From the Production Bill of Material (timfc3600m000) session, you can create production models for various types of manufacture:

- A job shop bill of material in the Migrate Original BOM to Job Shop BOM (tibom3200m400) session.
- A production model for repetitive manufacture in the Generate Production Model (tirpt2230m000) session.
- A subcontracting model in the Generate Subcontracting Model (tisub1220m000) session.

The following online manual topics are available:

- Modeling the Shop Floor
- Operation rates
- *Production Bill of Material (PBOM) Setup And Generation (p. 116)*
- *Job Shop Bill of Materials (p. 118)*
- *Job Shop Routing (p. 122)*
- Alternative materials in JSBOMs

#### Note

If the multisite functionality is active, the combination of product and site specifies which bill of material (BOM) is used for the manufacture of the end item.

## Production Bill of Material (PBOM) Setup And Generation

The global bill of material models the way the item is built, in multiple levels and in multiple sites, and contains all information that is intrinsic to the item.

P-boms are identified by the combination of an item code and the revision number of the p-bom.

The production bill of materials can be maintained manually or generated using the Engineering Data Management module.

#### Note

To use this session the **Job Shop by Site** parameter in the Implemented Software Components (tccom0100s000) session must be set to **Active** or **In Preparation**.

## New Production Bill of Material

### Step 1: Generate new revision

In the Production Bills of Material (timfc3100m000) session, use the **New Revision** command to generate a new production bill of material this will start the Production Bill of Material (timfc3600m000) session.

The generated production bill of material is generated with the status **New** and revision number 000001 in the **Revision** field.

### Step 2: Specify product

Click on the **Product** field in the Production Bill of Material (timfc3600m000) session to open the Item - Production (tiipd0101m000) session for which you want to define a new p-bom.

### Step 3: Assign revision

LN automatically assigns revision number 001 to a new p-bom.

### Step 4: Default the effective date

Unless otherwise specified the effective date is defaulted to the current date, with the expiry date set to 9999.

### Step 5: Add the production bill of material lines to the materials tab

Add the p-bom lines containing the materials.

Note: changes to the material lines can only be made as long as the p-bom status is **New**.

### Step 6: Validate p-bom

Use the Validate Production Bill of Material (timfc3200m000) session to check the new p-bom for consistency and generate a report.

### Step 7: Check production bill of material for consistency

Use the Check Production Bill of Material Consistency (timfc3200m400) session to check for looks in the p-bom structure, updates of the order system, unit effective supply and commingling restrictions, as well as project peg indicators and trade compliance.

### Step 8: Approve revision

In the Job Shop Bill Of Material (tibom3100m000) session, select the p-bom revision and use the **Approve Revision** command to change the status from **New** to **Approved**.

## New Production Bill of Material from a E-BOM

You can generate a production bill of material from an E-BOM:

1. Start the Engineering Item (tiedm0110m000) session.
2. Select the E-BOM you want to generate a production bill of material from.
3. Use the **Engineering Item Revisions** command to start the Engineering Item Revision (tiedm1100m000) session.
4. Select the revision you want to copy to a production bill of material.
5. Copy E-BOM header and lines to the production bill of material.
6. The new production bill of material is automatically assigned the status **New**, with the current date as the default effective date.

## Changing an existing production bill of material

To make changes to an existing production bill of material:

1. Start the Production Bills of Material (timfc3100m000) session.
2. Select the production bill of material you want to edit.
3. Use the **New Revision** command to generate a new revision.
4. Use the Copy Production Bill of Material (timfc3200m100) session to copy the PBOM header data and material lines to the new revision.
5. The revision is automatically assigned the status **New**, with the current date as the default effective date.
6. Make the necessary changes to the production bill of material header and BOM lines.
7. Use the Validate Production Bill of Material (timfc3200m000) session to check the new p-bom for consistency and if the materials needed are present before the status is changed to **Approved**.
8. Once the new production bill of material is approved, LN adjusts the expiry date of the previous revision in accordance with the effective date of the new revision.

## Job Shop Bill of Materials

With job shop bills of materials it is possible to plan and control production on all sites individually.

Prerequisite to generating a job shop BOM header:

- The site where manufacture will take place defined in the Sites (tcemm0150m000) session.
- The employees defined in the Employees - General (tccom0101m000) session.
- The units in which the quantities of product are measured in the Units (tcmcs0101m000) session.
- Products defined in the Item - Production by Site (tiipd0151m000) session.
- The production bill of material for the product defined in the Production Bills of Material (timfc3100m000) session.
- The reference designators in the Production Bill of Material Reference Designators (timfc3130m000) session.

### Note

To generate job shop bills of material the **Job Shop by Site** parameter in the Implemented Software Components (tccom0100s000) session must be set to **Active** or **In Preparation**.

To generate a job shop bill of materials

1. Start the Generate Job Shop Bill of Material (tibom3200m300) session.

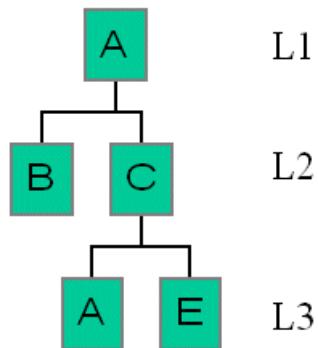
2. Clicking on the **Product** field opens Production Bills of Material (timfc3100m000) session. In this session, you must select the PBOM from which the JSBOM will be generated.  
Note: the PBOM must have the status **Approved** and be effective.
3. In the **Revision** field select the PBOM revision from which the JSBOM is generated.  
Note: A PBOM may have several revisions. The new JSBOM will automatically be designated revision 000001 on generation. If changes are made after it receives the status **Approved**, the revision number will go up.
4. Specify the site where the product will be manufactured.
5. Specify the production model in the **Model** field, from the Job Shop Bill Of Material (tibom3100m000) session. You can select a production model from the list of models available for the specified site. The production model contains the list of materials and routing for the job shop  
If you want to create a new production model range, select the **Create New Model Code** check box. You can define a new number group in the First Free Numbers (tcmcs0150m000) session that will start when you click on the **Model** field.
6. If you select the **Initialize Logistic Data** check box, routing data will be copied from the previous JSBOM revision.
7. If you select the **Remove Manual Material Lines** check box, material lines manually added to the previous revision are deleted from the list of materials.
8. Use the **Generate** command.
9. The new Job Shop Bill of Material can be selected in the Job Shop Bill of Material (tibom3600m000) session.

## Detecting Loops in Bill of Material

When you calculate cost prices and material requirements, LN checks multilevel bills of material for loops. You are therefore advised to run this session regularly, as it allows you to correct incorrect data at an early stage.

### Example

Manufactured item A is made up of purchased part B and manufactured item C. Manufactured item C in turn consists of manufactured item A and purchased part E.



**Legend**

A	Wheel
B	Rim
C	Hub
E	Ball bearing
L1, L2, L3	Level 1, 2, 3

The loop is A-C-A

## Routing

The planning data for the method of manufacturing is defined in Routing. A routing consists of operations, with each operation identifying the last to be carried out in a work center and/or on a certain machine defined for a specific site..

Routings can be as follows:

- **Standard Routing (p. 126)**  
A generic routing that can be attached to multiple items
- **Item specific**  
A routing that is applied to one item
- **Network routing (p. 127)**  
A routing containing sequentially ordered operations and parallel operations
- **Order quantity dependent routing (p. 127)**  
A routing that is defined for a specific quantity of items

You use the Routing module to record routings for manufactured items. You can define the following:

- **Work centers**  
A work center is where production activities are performed. Resources, such as people and machines, are lined to a work center. A work center is a group of resource units used as a functional planning unit. The operation rate code, which is linked to the work center, is used to calculate the standard cost of an item or the estimated and actual costs. The capacity load on a work center is used in the planning of production. Work centers can be part of enterprise units used for multicompny modeling purposes.
- **Machines**  
Machines are linked to work centers and are used to plan operations. The rate defined for a machine is used to calculate the actual machine costs. The capacity load on a machine is used for production planning.

- **Reference operations**

Classified according to the nature of the work performed, reference operations are used to describe activities that take place on the job shop. Reference operations are linked to operation rate codes, which are used to calculate the standard cost of an item or the estimated and actual costs. Reference operations are used in production planning.

- **Operations**

The operation data for standard and customized manufactured items is maintained with operations. Operation data is stored and maintained for standard items and customized items. A series of operations is performed to manufacture an item. The sequence of operations is defined as a routing in operations. Yield and scrap is defined per operation.

- **Norm times**

The run time and production rate of an operation are determined using norm tables. After a matrix is defined for two physical characteristics, such as length and width you can maintain a set of standard operation times for the X-Y coordinates. When tasks and routings are defined, the run time and production rate can be calculated by using a norm table.

- **Skills**

Certain skills may be mandatory to perform a specific operation. To ensure employees assigned to an operation possess the necessary knowledge, skills are linked to both employees and operations.

## Job Shop Routing

To support multi-site production and production and job shop bills of material, routings can now be linked to product on both the company and job shop level.

### Note

To use this session the **Job Shop by Site** parameter in the Implemented Software Components (tccom0100s000) session must be set to **Active** or **In Preparation**.

## Routing Master Data

To be able to define a routing, these must already be defined:

1. Define reference operations

Prerequisite:

- The work centers for site are defined in the Sites (tceomm0150m000) and the Work Centers (tirou0101m000) session.

For more information, refer to Activating sites and Defining entities for sites.

- Machine type (s) is defined in the Machine Types (tirou4160m000) session.
- The Machine capacity group(s) is defined in the Machine Capacity Group (tirou4161m000) session.

2. Link skills and tools.

Prerequisite:

- Skills are defined in the Skills (tcpp0110m000) session.
- Tools defined in the Tools (titrp0101m000) session.

3. Link process variables

Prerequisite:

- Process variable defined in the Process Variables (tirou0105m000) session.

## New Routing

### Note

A routing is always site specific and quantity dependent.

To define a routing for a product:

1. Use the Job Shop Routing (tirou4600m000) session to generate a new routing revision.

The revision is assigned the status **New** on generation.

2. Specify the site to which the routing will apply in the **Site** field.

3. Specify the product for which the routing will be used in the **Product** field.

Once the product is selected, the routing ID number and revision will automatically be generated. If a previous routing for this product and site combination exists, the revision number will be upped by one.

The new routing revision automatically receives the status **New**.

4. Edit the routing header as necessary.

5. Add operations to the routing

Note: Prerequisite to adding operations that reference operations have been defined in the Reference Operations (tirou4150m000) session.

6. Once all operations are added use the **Validate** command to check for consistency and change the routing status to **Approved**.

## Standard Routing by Site

A standard routing is a routing that can be coupled to multiple products. Using a standard routing can reduce maintenance.

For more information, refer to *Standard Routing* (p. 126)

# Maintaining Routing Operations

A routing is the sequence of operations required to manufacture an item. Different types of routings can be used for different types of manufacture.

## Note

- If multisite functionality is activated the routing is defined for an item and site combination.
- You must be authorised to manage the site for which you are creating a routing.
- You cannot use the same routing for more than one site.

In the **References** menu of the Item - Production by Site (tiipd0151m000) session use the **Routings** command to start the Item - Routings (tirou1101m000) session after you have selected an item and site. This will allow you to manage routings for the selected item.

- **For a nonstandard routing**  
Enter the code of an operation and manufactured item
- **For a standard routing**  
Select the routing from the list in the Item - Routings (tirou1101m000) session.
- Choose the first operation number and the associated reference operation.  
The other data is then displayed as default data from the Reference Operations (tirou4150m000) session. **Note:** You can only select tasks linked to the site.
- You can enter and maintain a routing operations for a specific item and site combination directly in the Job Shop Routing Operations (tirou4101m000) overview session, by double-clicking the BOM line to access the detail session.

## Changing the number of resources on operation

You can change the number of resources on an operation by changing the value of the **Man Occupation for Production** field in the Production Planning (tisfc0110m000) session. **Note:** While changing the number of resources does not affect the cycle time, and the production time remains the same, the total production costs are affected due to the cost of the extra resources.

- 

## Changing the number of resources on an operation

To prevent production costs changing when you change the man occupation, or the machine occupation, the cycle time must be recalculated. You can choose to do so, because when changing the man or machine occupation, a question pops up to ask you whether you want the cycle time to be recalculated:

- If you click Yes, the cycle time is recalculated. So, the man occupation or machine occupation is changed, including the total production time, but the costs stay the same. For more information on how the cycle time is recalculated, refer to Recalculation of cycle time when changing man occupation or machine occupation.

- If you click No, the changed man occupation or machine occupation does not affect the cycle time and the production time. However, the total production costs will change to reflect the change in man occupation or machine occupation.

## Place and functions of operations

To manufacture an item, a series of operations must be performed. The sequence order of such operations is called a routing in LN.

The Routing module lets you:

- define routings for standard items
- define item-independent routing (that is, a standard routing)
- define multiple routings for an item per site
- define an order quantity for each routing
- determine the work center (that is, the bottleneck work center) that governs the production rate of repetitive items
- calculate the production rate

Routings are important for production order planning in the Order Planning module of Enterprise Planning, and in the Job Shop Control module and the Standard Cost Calculation module.

You can define both standard routings and item routings. Item routings can refer to standard routings. For each item, you can record multiple routings per site.

## Defining Operation Steps

The operation steps are linked to a combination of an item, a routing, and a routing operation. For every routing operation you can define one or more operation steps.

The serial numbers of the operation steps indicate the sequence of the operation steps. You can also link a reference designator to the operation step to indicate where a specific components must be mounted on the item.

You can choose:

- To link process variables to the operation step in the Job Shop Routing Operation Process Variables (tirou4113m000) session.
- Instructions, to link instructions to the operation step in the Routing Operation - Instructions (tirou4115m000) session.
- To link tools to the operation step in the Job Shop Routing Operation - Tools (tirou4111m000) session.

# Standard Routing

A standard routing is a routing that can apply to multiple items. By using the Item - Routings (tirou1101m000) session, you can predefine a routing code.

**Note:** If multisite is implemented, you must be authorized to define and maintain routings for the selected site.

1. Start the Item - Production by Site (tiipd0151m000)
2. Select the item for which you want to manage the routings.
3. Select the site for which you are creating a routing. **Note:** You must be authorised to manage the site for which you are creating a routing.
4. In the **References** menu use the **Routings** command to start the Item - Routings (tirou1101m000) session. This will allow you to manage routings for the selected item.
5. Specify the required routing code and its description in the **Routing** field. The **Standard** field is now **Yes**.

## Manufactured item

Routing	111
Standard Routing	Yes

Later on, you can link the standard routing to one or multiple items in the Item - Routings (tirou1101m000) session by selecting a manufactured item and site when you record a new item routing code. First, select the **Standard** checkbox in the Item - Routings (tirou1101m000) details session. Next, select a standard routing to which the new routing can be linked. The operation data is adopted from the standard routing during the input of a production order.

## Manufactured item: bicycle saddle

Routing	222
Standard Routing	Yes, 101
item routing	standard routing

### Note

If the **Standard** check box is cleared, the routing is not linked to the standard routing. As a result, you must manually enter a routing.

## Order quantity dependent routings

Having an automatically selected routing tailored to a specific production order quantity can be useful. For example, if the production order quantity is large, a routing with high production rates is used. If the order quantity is small, another routing is selected.

You can set up these quantity dependent routings:

- Select the **Quantity-dependent Routing** check box in the Item - Production (tiipd0101m000) session.
- Enter the routing codes in the Item - Routings (tirou1101m000) session. Enter the maximum quantity for which a routing is valid in the **Up to Quantity** field.

### Note

If multisite functionality is activated, the routings available may vary per site on job shop bill of material selected. Differences in routings have impact on the standard cost calculation.

## Default routing

If the **Quantity-dependent Routing** check box is not selected, the default routing applies to an item. However, this default routing must also be linked to the item. To find out, LN checks the default routing code in the **Default Routing** field of Job Shop Master Data Parameters (tirou0100m000) session. Next, LN checks whether the default routing code is linked to the item in the Item - Routings (tirou1101m000) session. If so, the default routing applies to the item. If the default routing is not linked to the item, no routing is used.

## Network routings

A simple routing contains only sequentially ordered operations. A network routing can contain sequentially ordered operations and parallel operations.

LN offers three methods to define parallel operations:

- Manually, in the Operation Relationships by Order (tisfc1102m000) session.
- By inserting phantom components that have a routing.
- By defining parallel operations in the Job Shop Routing Operations (tirou4101m000) or Generic Routing (tipcf3120m000) session.

### Note

- If the **Sites** and **Job Shop by Site** parameters in the Implemented Software Components (tccom0100s000) are **In Preparation** or **Active** routings are maintained on site level.

- Only converging network routings are supported: two operations can a common succeeding operation, but they cannot have a common preceding operation. Every network routing has one final operation.

## To manually define parallel operations

To manually define parallel operations in the production order planning, complete the following steps:

1. Create a production order with a sequentially-ordered routing.
2. Start the Operation Relationships by Order (tisfc1102m000) session.
3. For each operation, enter the number of the next operation in the **Next Operation**. Enter 0 in the production order's final operation.

## To define parallel operations using phantom components

To define a routing that has a secondary branch that joins the main routing halfway, complete the following steps:

1. Define a phantom item that represents the subassembly created in the secondary routing branch.
2. Define the phantom item's routing, which is the secondary branch.
3. Add the phantom to the job shop bill of material of the main item.
4. In the Job Shop Bill Of Material (tibom3100m000) session, link the phantom to the operation that follows the secondary branch of the routing.

Alternatively, you can link the phantom to a specific operation for each routing in the BOM Line - Material-Routing Relationships (tibom0140m000) session.

LN connects the routing of the phantom item to the main item routing immediately before the main item operation that is linked to the phantom. For more information, see *Example network routing* (p. 130).

To link an operation to phantom for a specific production order, in the Estimated Materials (ticst0101m000) session, specify that operation in the **Operation** field. For an example, see *Example network routing* (p. 130).

## To define parallel operations in a routing

If the **Allow Parallel Operations in Routing** check box in the Job Shop Master Data Parameters (tirou0100m000) session is selected, you can define parallel routings in the Job Shop Routing Operations (tirou4101m000) session.

To define parallel operations in a routing, complete the following steps:

1. Before you enter the operations, roughly order the operations from first to last. Ensure no operation is followed by an operation that must be performed earlier.
2. Start the Job Shop Routing Operations (tirou4101m000) session.

3. Define all routing operations. At first, leave the **Next Operation** field at the default value, 0 (zero).
4. For each operation, in the **Next Operation** field, enter the operation that is performed next. The operation number of the next operation must be greater than the number of the current operation. For example, operation 40 cannot follow operation 50.  
For the final operation, enter 0 (zero) in the **Next Operation** field.

After you complete the routing, validate the routing and correct any errors. To validate the routing, on the **appropriate** menu, click **Validate Sequence**.

#### Note

When a production order is created, LN validates the routing and stops the process if the routing is incorrect.

## To define parallel operations in a generic routing

The procedure to define parallel operations in a generic routing is almost the same as that for regular routings. Instead of the Routing Operations (tirou1102m000) session, you must use the Generic Routing (tipcf3120m000) session.

## Example network routing

### Example network routing

Main item : Refrigerator  
 Component : Door  
 (Phantom)

Main item routing :

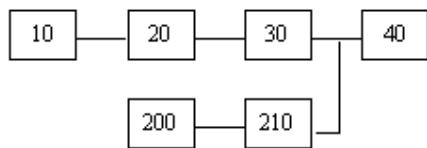


Phantom item routing :



Initial Value for Renumbering Operations : 200  
 Step Size for Renumbering Operations : 10  
 The phantom item is linked to operation 40 in the main item routing.

Network routing :



## Linking Operation/Operation Step - Tools

### Note

- To use this session the **Job Shop by Site** parameter in the Implemented Software Components (tccom0100s000) session must be set to **Inactive**.
- You can define tools in the Tools Requirement Planning module, a module that is used to control, track, and plan tools.

### To link tools to an operation

- If the sequence in which the tools are presented on the production order documents is not important, you can link tools directly to an operation.  
 To link tools to an operation:
  - Select a record in the Routing Operations (tirou1102m000) session.

- On the appropriate menu, click **Tools**.
- The Operation (Step) - Tools (tirou1110m000) session starts, in which you can link one or more tools to an operation.
- These tools are presented directly below the operation number on production order documents.

## To link tools to an operation step

Tools information linked to operation steps can indicate, for example, which tools are required to carry out a specific operation.

To add several tools to a specific operation in a specified order, you must link a tool to an operation step. After you defined operation steps for the operation in the Operation Steps (tirou1105m000) session, you can link one or more tools to each operation step.

- Select an operation step in the Operation Steps (tirou1105m000) session for the correct item/routing/operation combination.
- On the appropriate menu, click **Tools**.
- The Operation (Step) - Tools (tirou1110m000) session starts, in which you can link one or more tools to an operation step.

### Note

You can either link tools to a specific production order's operation or to operation steps. However, you cannot link tools to both an operation and operation steps, because planning of tools can only be performed on one level.

## Default value

If the current session is started for an operation that makes use of a task relationship to which tools are linked in the Task Relationship - Tools (tirou0115m000) session, the tools from the Task Relationship - Tools (tirou0115m000) session are defaulted to the current session. When operation steps are added, these defaults are removed again.

You can list and define the tools that are required for an actual production order's operation in the Estimated Tool Requirements (titrp0111m000) session. Based on the data in the current session, tools information is defaulted to the Estimated Tool Requirements (titrp0111m000) session on operation level, or on operation step level.

However, in the Estimated Tool Requirements (titrp0111m000) session, you can link additional tools to an operation, or to an operation step of an actual production order in the following ways:

- By inserting a new record
- By starting the Operation (Step) - Tools (tirou1110m000) session, in which you can define additional default tools information. To start the Operation (Step) - Tools (tirou1110m000) session, select a record in the Estimated Tool Requirements (titrp0111m000) session and on the appropriate menu, click Operation/Operation Step - Tools.

**Note**

If you add additional tools to the production order by means of the Operation (Step) - Tools (tirou1110m000) session, the inserted tools are defaulted to future production orders that make use of the relevant operation or the relevant operation step.

## Overview of reference designators

In LN, one or more reference designator can be linked to the items on a bill of material (BOM), or an EBOM line to indicate where the items must be inserted on the main item.

### Reference designators and (E)BOM

You can do the following:

- **Link a *single* reference designator to a *single* (E)BOM line.**  
One or more identical items on the (E)BOM line have the same reference designator.
- **Link *multiple* reference designators to a *single* (E)BOM line.**  
The identical items on an (E)BOM line have different reference designators.
- **Link a *single* reference designator to *multiple* (E)BOM lines.**  
Different items, on several (E)BOM lines have the same reference designator.
- **Link a *single* reference designator to *multiple* (E)BOM lines that contain the *same* item.**  
In other words, identical items in multiple (E)BOMs have the same reference designator.
- In EBOMs, you can use mass BOM change (MBCs) to add, delete, or replace (engineering) items in the EBOM. If reference designators are linked to items in the EBOM, you can also add, delete, or replace the reference designators.
- You can view and maintain reference designators for a production order's estimated material lines in the Reference Designators by Estimated Material (ticst0106m000) session, which you can start from the Estimated Materials (ticst0101m000) session.
- If you defined reference designators for (E)BOM lines, those reference designators are automatically present in the Reference Designators by Estimated Material (ticst0106m000) session. You can also define new reference designators for estimated material.

You can link stepwise information to the operation steps, for example, procedures and work instructions. This information, which can also relate to the reference designator, is printed on the operation notes, and can be used by operators in the job shop to do their work. In the instructions, you can explain, for example, how work must be carried out when you mount a specific item on the location indicated by the reference designator.

**Note**

Instructions are only printed on operation notes if the **Print Instructions** field in the Work Centers (tirou0101m000) session is **Yes**.

If reference designators are defined in the (E)BOM of a serialized (engineering) item, the reference designators are present in the as-built structure in the Serial End Item - As-Built Components (timfc0111m000) session. ERP creates a separate as-built component line for every reference designator. In case of reference designators, even for a non-serialized component in the (E)BOM, separate as-built component lines are created. You can view, maintain, and add reference designators.



## Tools Requirement Planning (TRP)

Use the Tools Requirement Planning module to control the tools that are required by production orders and service orders.

The Tools Requirement Planning module supports the following functions:

- Identification and marking
- Requirements planning
- Procurement (together with the Purchase Control module)
- Dispensing and scheduling
- Refurbishing
- Tracking and disposal
- Performance measurement

Tools are defined as purchased items with **Tool** item type specification. These items can be purchased and stored in a warehouse like any other item.

## Listing Tools Requirement Planning Parameters

To view the parameters, select the parameter settings and click Open on the File menu.

To change the parameters, select the first record without an effective date, and click Open on the File menu. The TRP Parameters ( Tool Planning Parameters (titrp0100s000) details session starts with the current parameter settings. You can use the *Tools Requirement Planning (TRP)* (p. 135) parameter (titrp0100s000) details session to change and save the new parameters. LN sets the effective date of the new parameters to the current date and time.

You can also use the Print Tools Requirement Planning Parameters (titrp0400m000) session to print and compare the parameter settings.

# Defining tools

To define a tool, perform the following steps:

## Step 1: Create a tool

Use the Items (tcibd0501m000) session to create a tool. You must define an item of the type **Tool** with the supply source **Purchase** or **Job Shop**. From the Items (tcibd0501m000) session, you must also define subentities, such as, costing data, warehousing data, purchase data, and ordering data. Calculate the standard cost for the newly defined tool.

## Step 2: Define tool type

Use the Tools (titrp0101m000) session to define the tool type in the Tools Requirement Planning module. Here, you can specify the general and refurbishing details of the tool type.

## Step 3: Set status to Active

Set the **Item Warehouse Status** field in the Item Data by Warehouse (whwmd2510m000) session to **Active**.

## Step 4: Define tools

Use the Tool Numbers (titrp0102m000) session to define tools for the tool type. Every tool type gets a tool serial number. You can specify the general and refurbishing details of each tool.

Note: The serial number of a tool is displayed in the Serialized Items (tcibd4501m000) session.

# Tools planning method

The purpose of tools planning is to estimate the tools that are needed for production orders, service orders, and work orders. If a production order is planned, the required tools are determined using the routing that is linked to the item.

After the tools are planned, the Estimated Tool Requirements (titrp0111m000) session checks the availability of the planned tools.

The tools planning procedure is used in the following sessions:

- Plan Tools Globally (titrp0211m000) session. The method is only used if the tool serial number is not specified.
- Replan Tools (titrp1202m000) session.
- Availability Check for Tools (titrp0213m000) session. This method is only used if the tool serial number is not specified.

The tools planning method takes into account the Tools Usage field in the Tool Numbers (titrp0102m000) session. The number of tools to be planned is determined by the Maximum Number of Tools to be planned. When LN plans tools with the Plan Tools Globally (titrp0211m000) session and with the Replan Tools (titrp1202m000) session, LN considers the alternative tool types. LN also takes into account the **Planning Method** field in the Tools (titrp0101m000) session. Depending on the value of this field, LN uses the following methods when planning:

- *Least Remaining Tool Life*. LN first considers tools with the least remaining life.
- *Maximum Remaining Tool Life*. LN selects tools with the maximum remaining tool life.
- *Based on Order Quantity*. For the planning, LN selects tools with a remaining tool life equal to or greater than the requirement considered for the planning.
- *Not Applicable*. The planning method is not applicable, which means the tool life is not applicable.

The tools planning method procedure considers all the previously-mentioned input and plans the tools. If the requirement cannot be satisfied in one check-availability procedure, a purchase quantity is recommended. If LN fails to plan the tools for the requirement, the requirement is not changed.

## Tool requirements planning

The tool requirement planning module is used to check the availability of tools for:

- **Planned Production Order** from the Order Planning module in Enterprise Planning.
- **Production Order Advice** from the Inventory Analysis module in Warehousing.
- **Production Order** from the Job Shop Control module in Manufacturing.
- **Service Order** from the Service Order Control module in Service.

Tools planning is based on the material resource concept. It is critical to plan tools at the right place, at the right time, and in the right quantity. Tools are considered items.

### Note

The scope of the Tools Requirement Planning module does not include revision control and renting of tools.

LN updates the tool requirement planning in the Availability Planning (titrp0513m000) session if one of the following is true:

- The production order planning is entered or updated in the Production Orders (tisfc0501m000) session.
- A **Service Order** from the Service Order Control module in the Service is entered or maintained.
- The tool type of an estimated tool requirement in the Estimated Tool Requirements (titrp0111m000) session is changed.

- The tool number of a tool type in the Estimated Tool Requirements (titrp0111m000) session is changed.
- The **Tool Usage** field in the Estimated Tool Requirements (titrp0111m000) session is changed.
- The Generate Availability Planning (Planned Production Orders) (titrp1213m000) session is used.
- The Generate Tools Availability Planning (whina3205m000) session is used.
- When a service order is entered.
- When you run the Service Order Resource Planning (tssoc2260m000) session in Service.

Store availability planning of tools in the Availability Planning (titrp0513m000) session. When you run the Availability Check for Tools (titrp0213m000) session, LN prints a report with the following information:

- Required tool usages, to check how many tools are actually required for the appropriate date of the operation, line number, or activity line.
- Planned tool usages available to complete the operation.
- The shortages of tools for each operation.
- Recommended purchase quantity required. LN calculates this quantity by LN with the following formula:

Shortage of the tool type / Tool life

If there is a shortage of tools, the data in the Production Orders (tisfc0501m000) session is not affected.

## Tools planning and tracking

Use tools planning and tracking to determine the planned and current locations of tools and the tooling historical data.

The tools defined in LN can be:

- Present in a warehouse.
- Planned or issued for a **Production Order**.
- Planned or issued for a **Service Order**.
- In maintenance.

The tools planning and tracking information is generated for the production order when the operations to which the tool is assigned are planned in the Job Shop Control module. The data is generated for service orders when the service activities are planned in Service.

In tool planning and tracking you can:

- Maintain the estimated requirements of tools for production orders/operations and service orders/activities.
- Check the availability of tools before the planned production is transferred from:
  - The Order Planning module.

- The Inventory Analysis module to the Job Shop Control module.

You can also print the time-phased availability for planning of tools, for planned and actual production orders, and for service orders.

## Tool tracking

Tool tracking contains the tooling data related to the requests for tools that are linked to the planned production order and operation, or that are linked to the planned service order, line number, and activity line.

The tool tracking is updated when the tools are returned with the Request and Return Tools (titrp0215m000) session. Tools are printed by order in the Print Tools Used by Order (titrp1412m000) session.

## Request tools

When a tool is requested, LN checks if there is a tool request present in the Tool Requests (titrp0515m000) session for the tool work-center combination.

If there is no request present at the work center, LN creates a request. Next, LN plans the tool requests available in the Tool Requests (titrp0515m000) session, based on the earliest request date and the highest priority.

### Note

If there is no request for the tool at any other work center or service center, this request has the **Available** status.

If the tool has already been requested at another work center or service center, the new request has the **Requested** status.

LN updates the **Tool Requirement Status** field in the Estimated Tool Requirements (titrp0111m000) session and the **Status** field in the Tool Numbers (titrp0102m000) session.

## Transfer tools to the next requirement

LN checks if there are more tool request details present at the work center where the tool is currently in use.

If there are more tool request details present in the Tool Request - Lines (titrp0516m000) session, tools are transferred to these requirements. If there are no more request details present, tools are assigned to a new request.

The new request to which the tool is assigned is priority-dependent:

- First, tools are assigned to orders for work centers of type line station. The tool is transferred to the order with the earliest **Request Date/Time** and the highest order priority.
- Next, tools are assigned to orders for work centers of type line segment. The tool is transferred to the order with the earliest **Request Date/Time** and the highest order priority.
- If there are no requests from work centers of type line station or line segment the tool is allocated to the order with the earliest **Request Date/Time** and the highest order priority.

#### Note

If there is no request for the tool, the status of the tool is set to **Available**.

When a tool is transferred to the next requirement for a tool request detail or for a new tool request, the status of the request is set to **Available**. The request status **Available** means that the tool is present at the work center or the service center that is linked to the request. LN selects the **Tool Present** check box.

## Transfer tools to the warehouse

When a tool is returned to the warehouse, LN checks if tool request details are present for the same tool request at the warehouse where the tool was currently in use.

If there are no additional request details:

- The request is deleted.
- The **Tool Present** check box in the Tool Request - Lines (titrp0516m000) session is selected.
- The Tool Tracking (titrp0512m000) session is updated.

If there are additional request details for the same request:

- The **Request Status** field in the Tool Requests (titrp0515m000) session is **Requested**.
- The status of the tool is **Available**.

## Transfer tools to the work center/service center

Before a tool is transferred to a warehouse, LN checks if there are additional tool request details present for the tool request.

If there are no additional request details for the same request:

- The request from the Tool Requests (titrp0515m000) session is deleted.
- The tracking data in the Tool Tracking (titrp0512m000) session is updated.

If there are additional request details for the same request:

- The **Request Status** field in the Tool Requests (titrp0515m000) session is set to **Requested**.
- LN checks if there is a request present for the tool at the specified work center.

If there is a request at the work center:

- The **Request Status** field in the Tool Requests (titrp0515m000) session is set to **Available**.
- Request details with the earliest request date and the highest order priority are planned first.
- The **Tool Present** check box in the Tool Request - Lines (titrp0516m000) session is selected.

If there is no request at the work center:

- The **Tool Present** check box in the Tool Request - Lines (titrp0516m000) session is cleared.
- The **Request Status** field in the Tool Requests (titrp0515m000) session is **Allocated**.

## Tool status

A tool can have the following statuses:

New

When you enter a tool, the status is **New** status. You can change the status from **New** to **Available**, or to **Blocked**.

Available

To allocate the status to a **Production Order** or **Service Order**, the status must be **Available**. You can manually change the status to **Blocked** or to **In Refurbishing**.

Blocked

Tools with this status cannot be planned or issued to a **Production Order** or to a **Service Order**. The status of the tool is set to **Blocked** if:

- The tool's life becomes less or equal to the total number of hours/times the tool is used.
- The status is manually changed in the Tool Numbers (titrp0102m000) session to **Available** or to **In Refurbishing**.

### Note

If the tool is **Blocked**, the tool is not considered when new estimated requirements are planned, or while performing the availability check for tools.

## Allocated

The **Allocated** status is assigned to a tool when it is issued to either a **Production Order** or a **Service Order**. You cannot manually assign the **Allocated** status in the Tool Numbers (titrp0102m000) session.

## In Refurbishing

The **In Refurbishing** status is assigned to a tool when the tool is requested by means of the Request and Return Tools (titrp0215m000) session for refurbishment. Tools with this status are not planned for issue to a **Production Order** or to a **Service Order** within the planned period of maintenance.

If the tool is returned with the Request and Return Tools (titrp0215m000) session, the status of the tool changes from **In Refurbishing** to **Available**.

# Tool identification

The master data of tools to be used in LN is first defined in this business object. The following data related to tools can be defined:

- [Tool](#)
- [Tool types](#)
- [Tool types by tool kit](#)
- [Tool number](#)
- [Tool components](#)

The first step is to define the tools. In the master data, tools are defined as a combination of tool type and tool number. The [tool's life](#), [refurbishing](#) data, and the planning method can be specified for each tool type. Tools are considered as items.

If more than one tool is required to perform an operation, you can group tools to form a tool kit. To use tools interchangeably, alternative tools can be defined. Alternative tools are tools that can perform the same operation.

The tool component list can be maintained in this business object for multipiece tools that can have detachable components.

# Request status

A request can have the following statuses:

## Requested

The tool is requested at the work center or the service center.

## Available

The tool is available at the work center or the service center.

## Return tools to an order

LN checks the requests for the work center or service center of the specific combination of order and operation. If the request is found, the request has the **Available** status.

If the tool request details or the request are not present, LN adds the missing request or missing details. The tool is then sent to this request.

### Note

If the next operation of the order also requires the tool used by previous operations of the order, the tool is transferred to this operation without considering the earliest request date and highest priority.

## Maintaining Tools by Tool Type

For each tool you record:

- Usage data
- Refurbishing data
- Status

If you add a tool, LN generates an adjustment order which can be viewed in the Adjustment Orders (whinh5120m000) session. The adjustment order is generated and automatically processed for the warehouse that you entered in the Tool Numbers (titrp0102m000) session. The reason for adjustment equals the reason defined in the **Reason for Adjustment Order** field in the Tool Planning Parameters (titrp0100s000) session. The available inventory for the tool in the Warehouse - Item Inventory (whwmd2515m000) session is increased when you add a tool.

When a tool is scrapped, LN also generates an adjustment order which can be viewed in the Adjustment Orders (whinh5120m000) session. The adjustment reason equals the reason defined in the **Default Scrap Reason** field in the Tool Planning Parameters (titrp0100s000) session.

Due to financial transactions, you must enter a purchase office for the particular tool. You can define a purchase office as follows:

- Use the Items - Purchase (tdipu0101m000) session to enter the item purchase data for this tool.
- Use the Purchase User Profiles (tdpur0143m000) session to check the user defaults.
- Use the Buy-from Business Partners (tccom4520m000) session to maintain the business partner data for this tool.

If you plan production orders, operations of the routing are also planned. If you plan service orders, the tools linked to the service activities are also planned. The planning is based on the tool type and the **Planning Method** session specified for the tool type.

If you close operations of a **Production Order** and/or service activities of an **Service Order**, and actual costing took place, the tool's usage field is updated.

## Modifying Estimated Tool Requirements

Tool requirements include data about the tool, and about the number of hours or times that the tool is required to perform an operation or activity. You can maintain tools that are estimated to be issued, or tools that are planned for the job shop or the service center.

The availability planning for actual orders is generated by means of the Availability Planning (titrp0513m000) session, after the orders have been entered in Estimated Tool Requirements (titrp0111m000) session.

### Note

- Tool requirements do not specify the work center where the tool is used.
- The estimated tool requirements for service orders or work orders are only displayed.

You can only modify production orders.

## Specific menu

The estimated tool requirements can be returned to the next requirement, to a warehouse, work center, or another order by using the Request and Return Tools (titrp0215m000) session. This session is started by clicking **Request and Return Tools** from the appropriate menu.

Click **Tool Requests** from the specific menu to start the Tool Requests (titrp0515m000) session. In this session you can view whether a tool is available at the work center or the service center.

### Note

There can only be one estimated tool requirement present for a refurbishing order. For a refurbishing order, the **Line** field is always filled.

## Planning Tools Globally

If the tool serial number is planned in the Estimated Tool Requirements (titrp0111m000) session, you do not need to run this session.

Specify the order type, order, operation, activity line, or line number ranges. If you click **Plan Tools**, LN scans all tool types linked to the order, and plans the tool types for which the tool-serial number is not present.

#### Note

If no tools of the required tool type are available, the alternative tool type is planned based on the required tool usages, planning method, and maximum tools to be planned. If the required usages for a tool type are not fulfilled by the maximum number of tools specified, no tools are planned for that requirement.

## Scraping Tools Globally

After you clicked **Scrap Tools**, two types of reports can appear:

- A success report, which prints the tools that are successfully removed from LN.
- An error report, which prints the tools that cannot be removed from LN, due to the tool's existing reference in Service or in Manufacturing.

#### Note

To scrap a tool, you must:

- Process the estimated tool requirements of the tool in the Estimated Tool Requirements (titrp0111m000) session.
- Delete the tool serial number in the Operation (Step) - Tools (tirou1110m000) session and the Machines (tirou0102m000) session.

If you scrap a tool, LN generates an adjustment order which can be viewed in the Adjustment Orders (whinh5120m000) session. The adjustment order is generated and automatically processed for the warehouse that you entered in the Tool Numbers (titrp0102m000) session. The reason for adjustment equals the reason defined in the **Default Scrap Reason** field in the Tool Planning Parameters (titrp0100s000) session.

Due to financial transactions you must enter a purchase office for the particular tool. You can define a purchase office as follows:

- Use the Items - Purchase (tdipu0101m000) session to enter the item purchase data for this tool.
- Use the Purchase User Profiles (tdpur0143m000) session to check the user defaults.
- Use the Buy-from Business Partners (tccom4520m000) session to maintain the business partner data for this tool.

# Requesting and Returning Tools

You can request or return one or more tools for a specific range of:

- Orders
- Operations
- Operation steps
- Line numbers
- Activity lines

If you select **Return** in the **Action** field, you can indicate on the second tab of the session to where you want to return the tool:

- *Transfer tools to the warehouse (p. 140)*
- *Transfer tools to the work center/service center (p. 140)*
- *Return tools to an order (p. 143)*

If you do not indicate to where a tool is transferred, the tool is transferred by default to the next requirement. For more information, refer to *Transfer tools to the next requirement (p. 139)*.

## Request status

If a tool is requested or returned, the status of the request changes. If a tool is requested, the status changes from **Available** to **Requested**. If a tool is returned, the status changes from **Requested** to **Available**.

### Note

- The order status of production orders that can be selected to request tools for, or to return tools to must be:
  - Released
  - Active
  - Production Completed
  - Completed
- The order status of service orders that can be selected to request tools for, or to return tools to must be:
  - Released
  - Completed
  - Costed

# Defining Calculations Details

For each calculation you can define various calculation lines, according to a specific syntax. This syntax defines how the calculation must be performed. The result of a calculation is always one single figure: the final result.

In a calculation you can use constant values and three types of variables:

- Answers to calculation questions (for type Dialog)
- Aspect values (for type Constraint)
- Intermediate results (results of a part of the calculation)

You can further use:

- Operators
- Brackets
- Functions

## Example

Calculate the angle of a triangle by using the following formula:

Angle=asin (length of side a/length of side  
c)

The following questions can be defined in the Calculation Questions (tigrt0131m000) session:

Question	Description
LA	Specify the length of side A
LC	Specify the length of side C

The formula is recorded by using two calculation lines:

Function	Question	Operator	Result
asin	( LA )	/	.
...	( LB )	=	Final result

**Note** If you start the Calculations (translated) (tigrt0585m000) session from the appropriate menu, you see a more user-friendly translation of the calculation.

## Listing Availability Planning

For the following orders the critical tool data is displayed:

- Production orders from Manufacturing.
- Service orders and work orders from Service.
- Planned Order Planning orders from Enterprise Planning. To include the critical tool data of planned RRP orders in the Availability Planning (titrp0513m000) session, you must run the Generate Availability Planning (Planned Production Orders) (titrp1213m000) session. Only the actual scenario is considered.
- Production-order advices in Warehousing. To include critical tool data of advices in the Availability Planning (titrp0513m000) session, you must run the Generate Tools Availability Planning (whina3205m000) session.

You can indicate that a tool is critical by selecting the **Critical in Availability Planning** check box in the Tools (titrp0101m000) session.

# Appendix A

## Glossary

A

account

See: *ledger account* (p. 160)

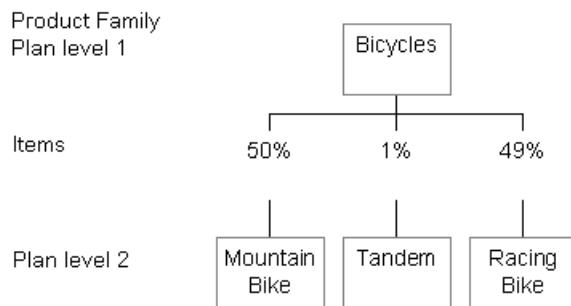
aggregation relationships

A specification, expressed as a percentage, how items are aggregated or disaggregated.

To aggregate items means that different items are grouped to form product families for planning purposes. This is also called a planning bill of material. To disaggregate items means that a product family is split up into smaller families, or into items.

Aggregation relationships can have the same structure as a single-level bill of material. However, similar to production bills of materials, also multilevel structures can be created.

### Example



allocation

An item quantity that is assigned to a specific order but that is not yet released from the warehouse to production.

## anonymous item

An item that is produced or purchased before a customer order is received.

If an anonymous item is a manufactured item, it is produced in a make-to-stock production environment. If an anonymous item is a generic item, a product variant is configured without using a PCS project.

## appropriate menu

Commands are distributed across the **Views**, **References**, and **Actions** menus, or displayed as buttons. In previous LN and Web UI releases, these commands are located in the *Specific* menu.

## as-built structure

The actually built structure of a product including the serial numbers.

## assembly item

An item with default supply source **Assembly**. The production of assembly items is controlled by an assembly order. Assembly orders are executed on an assembly line.

### Note

An assembly item can have item type **Generic**, **Manufactured**, **Engineering Module**, or **Product**.

## assembly line

A set of consecutive line stations in which FAS (Final Assembly Schedule) items are manufactured. The items are manufactured by passing the items from line station to line station and by carrying out operations at each line station. An assembly line is subdivided into a number of line segments separated by buffers. An assembly line can be either a main line or a supplying line.

## assembly order

An order to assemble a product on one or more assembly lines.

## assembly part

A component used on an assembly line.

An assembly part forms the link between Configurator and Enterprise Planning. Configurator generates the requirements for assembly parts and Enterprise Planning plans the production or purchase of the item.

## availability type

An indication of the type of activity for which a resource is available. With availability types, you can define multiple sets of working times for a single calendar.

For example, if a work center is available for production on Monday through Friday and available for service activities on Saturdays, you can define two availability types, one for production and one for service activities and link these availability types to the calendar for that work center.

## average setup time

The time required for setting up or changing over a machine before you start running the machine. Setup time can be long, for example, if you change over from using black paint to using white paint. Setup time can be short, for example, if you change over from using white paint to using yellow paint. The setup time must indicate an average of all possible setup times.

## backflushing

The automatic issue of materials from inventory, or accounting for the hours spent manufacturing an item, based on theoretical usage and the quantity of the item reported as complete.

## BCM

See: *bill of critical materials (p. 151)*

## bill of critical materials

A bill of critical materials (BCM) indicates the components which are regarded as critical during the production process of a plan item.

A bill of critical materials is a kind of summary of the BOM, which contains only the more important components.

Typical examples of critical materials are:

- Components with long lead times
- Subassemblies with a high capacity load for the internal or external production system

The Enterprise Planning package uses the bill of critical materials to generate the critical material requirements for critical materials.

Synonym: BCM

## bill of material (BOM)

A list of all parts, raw materials, and subassemblies that go into a manufactured item and show the quantity of each of the parts required to make the item. The BOM shows the single-level product structure of a manufactured item.

**bucket**

A quantity of time used for planning and backflushing.

**buffer**

An assembly line workstation where no operations are carried out, and where orders are waiting to enter the following work station.

You can use buffers to change the sequence of products from one line segment to another. Buffers in LN are random access type.

**bus component**

A bus components is an entry in an LDAP directory service. The bus component contains information about the server/client that uses Infor Integration, indicating the name, address, message queues, ports and so on. In addition, each component has one or more connection points that link the Integration Adapter for that component to the actual transport layer.

**calculation office**

A work center of the type **Costing** that is used to determine the enterprise unit for a project, or production order and also has an administrative function.

**Note**

When linked to production orders, the **Use as Calculation Office** check box in the Work Centers (tirou0101m000) session must be selected for the work center.

**calendar**

A set of definitions, that are used to build a list of calendar working hours. A calendar is identified by a calendar code and availability type combination.

**call-off**

To call up goods from a business partner based on a purchase schedule. Call-off involves sending a message (EDI) to notify a business partner that the scheduled items must be delivered. The message contains the item quantity and the date and time they must be delivered.

**capacity percentage**

The percentage of the available production capacity that is the basis for work center utilization views and reports. For example, if a work center's working times are 06:00 - 16:00 (10 hours), the effectivity factor is 1.0 and the capacity percentage is 80%. 8 hours of production order execution corresponds with a capacity utilization of 100%.

The default capacity percentage is 100%.

## classification

A process to group items according to predefined features. This also results in a coding system by which item codes can be generated. The reason for doing this is to easily retrieve items, matching certain features.

## CLSO

See: *clustered line station order* (p. 153)

## clustered line station order

Represents all the material requirements for a line station for a day. A CLSO consists of user-defined buckets. The material requirements are combined for each bucket.

In Assembly Control, transactions can be carried out per line station and per period, instead of per order. LN can combine the same materials for a specific period into one material line. After doing so, the cumulated quantity is stored in the CLSO. This accumulation reduces the number of transactions that are necessary, because the transactions are performed for a specific bucket.

Acronym: CLSO

See: bucket

## company

A working environment in which you can carry out logistic or financial transactions. All the transaction data is stored in the company's database.

Depending on the type of data that the company controls, the company is:

- A logistic company.
- A financial company.
- A logistic and a financial company.

In a multicompany structure, some of the database tables can be unique for the company and the company can share other database tables with other companies.

## company number

A logistic or financial unit for which you can define and maintain a data set.

Which includes, for example:

- Ledger account
- Customers
- Suppliers
- Order balances
- Production plans

## compile

To translate all the source code of a program from high-level language into object code prior to execution of the program. Object code is an executable machine code or a variation of machine code.

## configurable item

An item that has features and options and must be configured before any activities can be performed on it. If the configurable item is generic, a new item is created after configuration. If the item is manufactured or purchased, the configuration is identified by item code and option list ID.

- **Manufactured or Product** items with the default supply source set to **Assembly** and **Generic** items are always configurable.
- **Purchased or Product** items with a purchase schedule in use can be configurable.
- **Configurable Purchased or Product** items can be used within Assembly Control only.

## constraint

In LN, a means to check, restrict, or compel to avoid or perform some action.

In the Product Configuration module, a constraint is every possible decision rule or calculation conceivable that can be carried out during the definition of the product variants. You can use constraints in the product model for product features, generic BOMs, routings, price lists, and item data. You can use a constraint editor to define constraints.

Among other things, constraints allow you to indicate under which conditions certain combinations of options are acceptable, mandatory, or not acceptable for product features. You can also indicate which bill of material components and/or operations must be included or excluded, what the purchase or sales price structure for a product variant is, and so on.

In the Product Classification module, a constraint consists of one or more constraint lines that define the conditions under which certain return values or calculation results are included in the classification code during item classification.

## cost component

A cost component is a user-defined category for the classification of costs.

Cost components have the following functions:

- To break down an item's standard cost, sales price, or valuation price.
- To create a comparison between the estimated production order costs and the actual production order costs.
- To calculate production variances.
- To view the distribution of your costs over the various cost components in the Cost Accounting module.

Cost components can be of the following cost types:

- **Operation Costs**
- **Material Costs**
- **Surcharge**
- **General Costs**
- **Not Applicable**

### Note

If you use Assembly Control (ASC), you cannot use cost components of the **General Costs** type.

## count point

An operation in a routing, or work station, where the quantity of completed and rejected items must be determined explicitly. If an operation is a count point, completion of that operation must be reported separately. The quantity completed in follow-up operations must not exceed the quantity completed in the count point.

If an operation, or work station is not a count point, it can be set to **Completed** automatically upon completion of a follow-up operation. The quantities completed and rejected are then determined by the completed quantity in the count point.

## customized item

An item produced on a customer specification for a specific project. A customized item can have a customized BOM and/or a customized routing and is normally not available as a standard item. A customized item can, however, be derived from a standard item or a generic item.

## cycle time

The (average) time between completion of two separate units of production. For example, the cycle time of motors assembled at a rate of 120 per hour is 30 seconds.

The cycle time is also equal to the time that a product stays in one position on a assembly line, or the time that an operation is carried out on an item in a work station (excluding setup time).

## delivery date

The date the finished items are finished according to the planning.

## demand peg

A relationship between a planned order, or an actual supply order, and an item requirement that represents a definite commitment.

You can only use the demand pegged supply for the pegged requirement, unless either of these conditions applies:

- The peg is deleted.
- Parameters allow issuing unallocated inventory or inventory of a different specification for a demand-pegged outbound order.
- **Pegged supply**  
The pegged supply can be a purchase order, a planned purchase order, a production order, a planned production order, a warehousing order with transaction type transfer, or a planned distribution order.
- **Pegged requirement**  
The pegged requirement can be, among other things, a sales order line or a required component for a production order.

Related term: soft peg

## department

A company's organizational unit that carries out a specific set of tasks, for example, a sales office or a purchase office. Departments are assigned number groups for the orders they issue. The department's enterprise unit determines the financial company to which the financial transactions that the department generates are posted.

## effectivity unit

A reference number, for example a sales order line or a project deliverable line, that is used to model deviations for a unit effective item.

## efficiency factor

A variable that LN uses to take into account differences in the daily availability of a resource, such as when working overtime, hiring extra staff, or working in different shifts. For example, if an employee works six hours out of a possible eight hours on a project, the efficiency factor is 0.75.

Efficiency factors influence the lead-time calculation in Enterprise Planning.

**efficiency variances**

A part of the production result that is created by differences between the estimated and actual material quantities and hours.

The efficiency variance shows how efficiently materials and resources are used.

**end item**

An item that is ready to be delivered to a warehouse. An end item is produced at the end of a dangle routing (co-products and by-products) or a main routing.

**engineering module**

In Assembly Planning, a system, or, in other words, a logical unit of assembly parts, that is typically not manufactured as a separate physical unit.

For example, the electrical system of a car is the logical unit of all parts required for the electrical system. It is, however, not manufactured as a separate physical unit, but integrated in the dashboard, doors, and so on.

An engineering module has no routings, assembly lines, options, and so on, and is for design and planning purposes only. In the bill of materials (BOM), the engineering module is the top layer of the nonconfigurable section of the BOM.

**enterprise unit**

A financially independent part of your organization that includes entities such as departments, work centers, warehouses, and projects. The enterprise unit's entities must all belong to the same logistic company, but a logistic company can contain multiple enterprise units. An enterprise unit is linked to a single financial company.

When you carry out logistic transactions between enterprise units, the resulting financial transactions are posted to the financial companies to which each enterprise unit is linked.

**exception**

A deviation of an effective item's standard configuration. An exception indicates, for example, whether a specific BOM line or a specific routing operation is used for an effectiveness unit. Exceptions are often created as a result of customer requirements, or technology upgrades.

**exchangeable configuration**

A configuration is exchangeable with another configuration at a particular point on the assembly line, if at that point the two configurations have the same specifications.

## FAS item

A generic item with the FAS (Final Assembly Scheduling) order system.

FAS items are produced in a mixed model flow process on an assembly line.

## feature

Characteristics which can be combined and subsequently be linked to configurable items to compose a product variant. An example of a feature is color.

## financial company

A company that is used for posting financial data in Financials. You can link one or more enterprise units from multiple logistic companies to one financial company.

## financial transaction (FITR)

The transaction created to reflect a logistic event in Financials. The combination of a transaction origin (TROR) and the financial transaction (FITR) results in an integration document type.

## flatten

To bring down a multilevel structure to one level. As a result, all elements of the hierarchical structure are the direct children of the parent item. This process can be used to enhance the calculation of assembly part requirements.

### **Example**

Once in while, a product structure is flattened, and the result is stored separately. This way, LN does not need to browse the structure each time the assembly part requirements are calculated, because all parts that are required can be read at once.

## float time

The time between two activities, expressed in days.

### **Example**

If activity A and activity B have a end-start relationship with a delay of three, the network planning shows that activity B starts three days after activity A has finished.

## floor stock

A stock of inexpensive material present in the job shop that can be used in production without recording each issue of material individually. Floor stock is not backflushed and is not part of the estimated costs.

## generic BOM

Set of components, per generic item, from which product variants can be composed. The generic bill of material forms the basis for the variant bill of material which arises during the configuration/generation of a product variant. For each BOM line (component) a constraint rule may apply.

## generic item

An item that exists in multiple product variants. Before any manufacturing activities are performed on a generic item, the item must be configured to determine the desired product variant.

### Example

Generic item: electric drill

Options:

- 3 power sources (batteries, 12 V or 220 V)
- 2 colors (blue, gray).

A total of 6 product variants can be produced with these options.

## inbound

A procedure in which received goods are stored in a warehouse.

## inbound-order line

A warehousing-order line used for the inbound of goods. An inbound-order line gives detailed information about planned receipts and actual receipts.

For example:

- Item data
- Ordered quantity
- Warehouse and location of receipt

## inspection

To measure, examine, test, or gauge one or more characteristics of a product or service. After doing this, you can compare the results with the specified requirements to determine whether conformity is achieved for each characteristic.

Inspection is often performed on delivered goods upon arrival.

## inspection order

An order used to structure the inspection of products that are purchased, produced, or sold.

## inventory on order

The planned receipts. The inventory has been received and the inbound advice is generated. However, the advice is not yet released. This quantity is included in the economic stock.

Synonym: on-order inventory

## inventory transaction

Any change in the inventory records.

## inventory unit

The unit of measure in which the inventory of an item is recorded, such as piece, kilogram, box of 12, or meter.

The inventory unit is also used as the base unit in measure conversions, especially for conversions that concern the order unit and the price unit on a purchase order or a sales order. These conversions always use the inventory unit as the base unit. An inventory unit therefore applies to all item types, also to item types that cannot be kept in stock.

## inventory valuation method

A method to calculate the inventory value.

The inventory is valued at either its standard cost or its actual receipt price. Because inventory value can change with time, the age of inventory needs to be noted. In LN, the following inventory valuation methods are available:

### Valuation Method

## item type

A classification of items used to identify if the item is, for example, a generic item, a service item, or an equipment item. Depending on the item's type, certain functions will only apply to that item.

## lead time

The time between the production start date and the delivery date. The lead time can include order preparation time, transportation time, and inspection time.

## ledger account

A register used to record financial transactions and to accumulate the values of the transactions for reporting and analysis. The ledger accounts classify the transactions into categories such as revenues, expenses, assets, and liabilities.

Synonym: account

**line segment**

A set of consecutive assembly-line work centers on an assembly line between two buffers. The first buffer is the beginning of the segment, the next buffer is the first part of the next segment.

**line sequencing**

The determination of the sequence order used to start the production of items in a segment of a production line. The sequence order may be changed from one line segment to the next.

**line station**

A work center that is part of an assembly line. A line station is used in the production of FAS (final assembly schedule) items. A line station can have multiple positions, which enables more than one item to be present in one line station.

**line station order**

Production order for an assembly line station.

**line-station variant**

Holds identical operations and materials that are used at a specific line station for multiple assembly orders. In this manner, the identical operations and materials are stored only once, rather than for each assembly order. When line station variants are used, less data storage is required, and the performance is enhanced.

**Example**

You produce cars with various features, including two types of wheels: broad and narrow. In the wheel line station, in which the wheels are fitted, all cars with broad wheels are one line station variant, and cars with narrow wheels are another line station variant, regardless of any other specifications, because the other specifications are not relevant to the wheel line station.

Synonym: LSV

**location**

A distinct place in a warehouse where goods are stored.

A warehouse can be divided into locations to manage the available space, and to locate the stored goods. Storage conditions and blocks can be applied to individual locations.

**lot**

A number of items produced and stored together that are identified by a (lot) code. Lots identify goods.

**lot item**

An item that is subject to lot control.

## LSV

See: *line-station variant (p. 161)*

## machine

In LN, a mechanical object on which operations can be carried out to produce items.

Machines are linked to operation rates. The operation rate and the labor rate together form the basis for the actual costing of production orders.

## machine capacity group

The number of machines of a machine type in a work center and its logistical and planning properties.

## machine type

The definition of the machine at company level. For example: A Haas turning lathe ST30.

## main assembly line

An assembly line that produces end products. An assembly line is a set of consecutive line stations where FAS (Final Assembly Schedule) items (and sometimes other item types) are manufactured.

## main item

The end result of a production order.

A main item is either be changed to an end item (for delivery to a warehouse), or delivered directly to the customer in bulk.

## mass BOM change

A mechanism to simultaneously make multiple changes to the engineering bills of material of several items.

You can use mass bill of material changes to concurrently carry out several of the following actions:

- Modify EBOM lines
- Copy E-item revisions to production items
- Copy EBOMs to productions BOMs

Synonym: MBC

## master-based planning

A planning concept in which all planning data is accumulated into time buckets with predefined lengths.

In master planning, all demand, supply, and inventory data is handled in terms of these time buckets, and is stored in master plans.

In master planning, supply is planned in the form of a supply plan. This supply plan is calculated on the basis of demand forecasts, actual orders, and other information. For production planning, this planning method only considers critical requirements, as recorded in an item's bill of critical materials and bill of critical capacities.

### Note

In Enterprise Planning, you can maintain a master plan for an item, even if you plan all supply with order planning.

## master company

In a multicompany situation, a master company is used to synchronize data in all companies. Data that is entered or generated in the master company, for example, the line structure, can be replicated to the other companies. The master company can either be one of the companies of the assembly lines, or a separate company.

## MBC

See: *mass BOM change (p. 162)*

## move time

The time that a semifinished good is in transit from one operation to the next operation. After the last operation, the move time is the time required to transfer the finished good to the warehouse.

Move time is one of the lead-time elements LN plans according to a specific calendar.

## multicompany

From a logistical point of view, multicompany relates to the flow of goods or information between multiple locations, which are implemented in different logistic companies. Typically, these locations are situated in various regions or countries.

From a financial point of view, multicompany relates to the financial flow between financial entities, represented by departments and warehouses, which are implemented in different financial companies. Typically, these warehouses and departments are located in various countries or belong to different business units.

## multisite

Refers to the management of multiple sites within a single (logistic) company.

In a multicompany structure, which includes several companies, multisite applies to each of the logistic companies.

## network planning

The network planning includes all the activities required to carry out (plan and control) a project. The relations within the network show the interdependent activities.

## norm time

The time that is required to perform a task. That time is determined on the basis of two values in the norm table.

### Example

To drill a hole with a diameter of 5 mm (first value) in a sheet with a thickness of 8 mm (second value) takes 0.5 minute (norm time).

## on-order inventory

See: *inventory on order* (p. 160)

## operation

One of a series of steps in a routing that are carried out successively to produce an item.

The following data is collected during a routing operation:

- The task. For example, sawing.
- The machine used to carry out the task (optional). For example, sawing machine.
- The place where the task is carried out (work center). For example, woodwork.
- The number of employees required to carry out the task.

This data is used to compute order lead times, to plan production orders and to calculate standard cost.

## operation status

The status assigned to an operation. For example, **Planned**, **Ready to Start**, or **Completed**. This status indicates how far an operation has proceeded.

## option combination

A specific combination of product options, for example, color or style, that are related to an assembly order.

Each option combination is either a single option, or a combination of other option combinations.

## order-based planning

A planning concept in which planning data is handled in the form of orders.

In order planning, supply is planned in the form of planned orders. LN takes into account the start and finish dates of individual planned orders. For production planning, this method considers all material and capacity requirements, as recorded in an item's BOM and routing.

### Note

In Enterprise Planning, you can maintain a master plan for an item, even if you plan all supply with order planning.

## order controlled/SILS

A demand-pull system that regulates the supply of items to shop floor warehouses in the sequence in which they are needed.

In this supply system, items that are required for a specific assembly order, and at a particular line station of the assembly line, are called off at an earlier line station, called the trigger-from station. The number of items that is called off depends on what is needed for specific assembly orders in a specified time fence, called the maximum time interval.

In general, the items that are supplied to the shop floor warehouse by SILS, are fast movers and are processed in high volumes. There is a direct link between these items and the assembly orders they are used for. In addition, one warehouse order set can only supply the goods needed by one assembly order.

## order system

The order parameter that controls the way by which recommended purchase and production orders are generated.

Options:

- **FAS** (final assembly scheduling).
- **SIC** (statistical inventory control).
- **Planned** (schedule-based and order-based planning).
- **Manual** (manual reordering).

## outbound

The act of retrieving goods from a warehouse.

## person hours

The unit of work equal to one person working for one hour. The terms man-hours and person-hours are used interchangeably.

## phantom

An assembly that is produced as part of a manufactured item, and that can have its own routing.

A phantom is usually not held in inventory, although occasionally some inventory can exist. The planning system does not create material requirements for a phantom, but drives the requirements straight through the phantom item to its components. Phantoms are mainly defined to create a modular product structure.

### Example

The door of a refrigerator is defined as a phantom item in the bill of material of a refrigerator. The materials of the door are listed on the production order's material list for the refrigerator.

## plan item

An item with the order system **Planned**.

The production, distribution, or purchase of these items is planned in Enterprise Planning based on the forecast or the actual demand.

You can plan these items by means of the following:

- Master-based planning, which is similar to master production scheduling techniques.
- Order-based planning, which is similar to material-requirements planning techniques.
- A combination of master-based planning and order-based planning.

Plan items can be one of the following:

- An actual manufactured or purchased item.
- A product family.
- A basic model, that is, a defined product variant of a generic item.

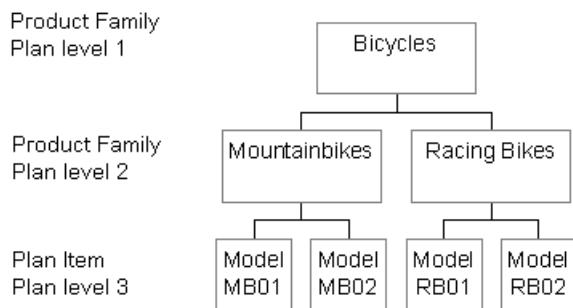
A group of similar plan items or families is called a product family. The items are aggregated to give a more general plan than the one devised for individual items. A code displayed by the item code's cluster segment shows that the plan item is a clustered item that is used for distribution planning.

## plan level

The level within a hierarchical planning structure.

When you plan on a higher plan level, plans are general and less detailed.

### Example



Plan level 1 is the highest plan level; the higher the number, the lower the plan level.

## planned inventory transactions

The expected changes in the inventory levels due to planned orders for items.

## planned offline date

The date when an assembly item is planned to roll off the assembly line.

Initially, the planned offline date equals the requested offline date, but the planned offline date can be changed later for planning reasons.

## planned production order

A planned order in Enterprise Planning to produce a certain quantity of an item.

## planning cluster

An object used to group warehouses for which the inbound and outbound flow of goods and materials is planned collectively. For this purpose, the demand and supply of the warehouses of the planning cluster is aggregated. Within a planning cluster one supply source is used, such as production, purchasing or distribution.

If multisite is implemented, a planning cluster must include one or more sites. The site or sites include the warehouses for which the planning processes are performed.

### price variances

The price variance of a production order is the part of the production result created by differences between the estimated and actual price of an item or hour.

The price variance indicates the effect of changing rates and prices on the production result.

### process variable

A setting or an input value related to a machine, a tool, or to process quality that is relevant to carry out an operation or an operation step. For example, cutting depth, cutting speed, and temperature.

See: operation step

### production order

An order to produce a specified quantity of an item on a specified delivery date.

### production-order advice

A recommendation based on the economic stock and the reorder point of an item. Production order advices must be confirmed and transferred to convert them into actual production orders.

See: economic stock, reorder point

### production plan

The planned receipts of manufactured items, specified by period.

These receipts are the quantity that must be produced internally.

Note that the production plan does not include the quantity of the plan item that is delivered by other companies or warehouse locations.

The production plan is part of the supply plan for a plan item.

### product model

Used in the definition of the product variant in making a sales order or quotations by translating the customer requirements into a product variant

### product structure

The sequence of steps by which components are put together to form subassemblies, until the finished product is produced.

The product structure is defined by a multilevel bill of materials, sometimes in combination with routing data.

## product variant

A unique configuration of a configurable item. The variant results from the configuration process and includes information such as feature options, components, and operations.

### Example

Configurable item: electric drill

Options:

- 3 power sources (batteries, 12 V or 220 V)
- 2 colors (blue, gray).

A total of 6 product variants can be produced with these options.

## product variant structure

The structure of the product variant, which consists of one configurable end item that is related to several configurable sub-items and/or engineering modules.

Configurable sub-items can also have their own configurable sub-items and/or engineering modules. The configurable items represent the product and the subassemblies of the product. The engineering modules are used for assembly items and represent logical units that may not constitute independent products, such as an electrical system. The product variant structure is generated by LN and, dependent on the options, holds a part of the bill of material.

## project

A collection of manufacturing and purchasing actions that are performed for a particular customer order. A project is initiated to plan and coordinate the production of the to be manufactured items.

For a standard-to-order production, the project is only used to link the item with the customer order. A project can also include these:

- Customized item data (BOMs and routings)
- Project planning (activity planning)

## project activity

An activity that is relevant for the (rough) planning of a project. Activities are used to plan the rough material and capacity requirements of the project. Activities are also used to control the (final) assembly planning of the project.

## project structure

The project structure indicates the subprojects that belong to the main project. Project structures are especially important where there are extensive projects in an engineer-to-order situation.

Project structures can be important for network planning. This is because the start dates and finish dates of subprojects can depend on the computed start dates and finish dates of the main project's activities.

The costs of subprojects are aggregated to the relevant main project in the project calculation.

The project structure only applies to a project with a type other than **Budget**.

You can only delete a project structure if the main project has the **Free** or **Archived** status.

## purchased item

An item that is typically procured from an outside source. A bill of material and routing can be linked to a purchased item.

## purchase office

A department in your organization that is responsible for buying the materials and services required by your organization. You assign number groups to the purchase office.

## queue time

The amount of time that an order remains at a work center before setup, or work is performed.

## reference designator

Indicates the location to insert a component on an item, for example, where to mount an electronic component on a Printed Circuit Board. Reference designators are often used in electronics, and can originate from a Computer-Aided Design (CAD) station.

## reference type

A product variant may relate to a sales quotation, sales order, budget or project, or it may concern a standard variant.

## refurbishing

The renovation of a tool after a number of usages.

## rejected item

A product that does not meet the quality standards set for the end product or subassembly. Also called a **reject**

## repetitive item

A repetitive item (also called RPT item) is a manufactured item whose production is controlled by schedules. A schedule contains multiple schedule lines that can be viewed, released, reported as complete, and so on, in one session.

### A repetitive item characteristics:

- Produced in large quantities
- Subject to repetitive demand
- Production is based on a rate
- Lead time is short

Anonymous items and to-order items can be repetitive. However, only to-order items that are **Standard-to-Order** can be used in RPT schedules. You cannot use generic items or **Engineer-to-Order** items in an RPT schedule.

## requested offline date

The date when an assembly item must roll off the assembly line in order to meet the delivery date on the sales order line.

## result

The financial results of, for example, a project or a production order. The results are reported in terms of variances. A variance is the difference between the expected (budgeted or planned) value and the actual value. You can distinguish between price variances, efficiency variances, and additional calculation-office variances.

## rework order

A production order to fix or upgrade an already produced or purchased item. The item that must be reworked is both input and output of the production order.

## roll-off line

The assembly line where a product is completed.

## routing

The sequence of operations required to manufacture an item.

For each operation, the task, machine, and work center are specified, as well as information about setup time and cycle time.

## routing code

A code that is linked to a routing. A routing code can be linked to a standard routing or an item-specific routing.

## run time

The time required to process a piece or lot at a specific operation.

Run time does not include setup time.

`run time = production time - setup time`

## sales order

An agreement that is used to sell items or services to a business partner according to certain terms and conditions. A sales order consists of a header and one or more order lines.

The general order data such as business partner data, payment terms, and delivery terms are stored in the header. The data about the actual items to be supplied, such as price agreements and delivery dates, is entered on the order lines.

## sales order lines

A sales order contains items that are delivered to a customer, according to certain terms and conditions. The lines of a sale order are used to record the items ordered, as well as the associated price agreements and delivery dates.

## scenario

The identification of an overall planning solution.

Each scenario represents one overall planning solution, and involves particular settings for the planning of items and resources. You can use scenarios to analyze and compare various planning options and to find the best planning solution. For example, you can vary demand forecasts or sourcing strategies.

One of the scenarios is the actual scenario, which corresponds with the actual planning situation. You can only transfer planned orders and production plans from the actual scenario to the execution level of LN.

## scrap

Unusable material or rejects of intermediate products, for example, because of faulty components, or products lost in cutting or sawing operations. The gross material requirements and/or an operation's input quantity must be increased to account for anticipated scrap.

In the BOM, you can define scrap as a percentage of the net material requirements, which is the scrap factor, and as a fixed quantity, which is the scrap quantity. A scrap quantity is mostly used to define the amount of material that is lost every time when you start producing, for example, to test the equipment.

For an operation, you can only define the scrap as a fixed quantity.

## segment schedule

A schedule that indicates when assembly parts are required. Based on the offline date of the assembly order, and the segment for which the assembly parts are required, the segment schedule indicates when the parts must be delivered to the line. Segment schedules are used for a rough calculation of assembly part requirements, when high volumes are processed, and the performance of the calculation is critical.

## serialized item

A physical occurrence of a standard item that is given a unique lifetime serial number. This enables tracking of the individual item throughout its lifetime, for example, through the design, production, testing, installation, and maintenance phases. A serialized item can consist of other serialized components.

Examples of serialized items are cars (Vehicle Identification Number), airplanes (tail numbers), PCs, and other electronic equipment (serial numbers).

## serial number

The unique identification of a single physical item. LN uses a mask to generate the serial number. The serial number can consist of multiple data segments that represent, for example, a date, model and color information, sequence number, and so on.

Serial numbers can be generated for items and for tools.

## service order

Orders that are used to plan, carry out, and control all repair and maintenance on configurations as present on customer locations or as present with the company.

## shop floor warehouse

A warehouse that stores intermediate inventory in order to supply work centers. A shop floor warehouse is linked to an individual work cell, an assembly line, or one or more work centers. A shop floor warehouse can be supplied with goods using replenishment orders, or by pull-based material supply.

The pull-based material supply methods are:

- **Order Controlled/Batch** (only applicable in Assembly Control).
- **Order Controlled/SILS** (only applicable in Assembly Control).
- **Order Controlled/Single** (only applicable in Job Shop Control).
- **KANBAN**.
- **Time-Phased Order Point**.

The items stored in the shop-floor warehouse are not part of the work in process (WIP). When items leave the shop floor warehouse for use in production, their value is added to the WIP.

## SIC

See: *statistical inventory control* (p. 175)

## site

A business location of an enterprise that can maintain its own logistical data. It includes a collection of warehouses, departments and assembly lines at the same location. Sites are used to model the supply chain in a multisite environment.

These restrictions apply to sites:

- A site cannot cross countries. The warehouses and departments of the site must be in the same country as the site.
- A site is part of a planning cluster. Consequently, all warehouses and work centers of a site must belong to the same planning cluster.
- A site is linked to one logistic company.

You can link a site to an enterprise unit or an enterprise unit to a site.

If an enterprise unit is linked to a site, the entities of the site belong to the enterprise unit. Conversely, if a site is linked to an enterprise unit, the entities of the enterprise unit belong to the site.

## skill

The specific know-how or technical expertise that an employee must have to carry out activities. For example, knowledge of electricity, specific equipment, and so on.

## specification

A collection of item-related data, for example, the business partner to whom the item is allocated or ownership details.

LN uses the specification to match supply and demand.

A specification can belong to one or more of the following:

- An anticipated supply of a quantity of an item, such as a sales order or production order
- A particular quantity of an item stored in a handling unit
- A requirement for a particular quantity of an item, for example a sales order

## standard cost

The sum of the following item costs as calculated by the standard cost calculation code:

- Material costs
- Operational costs
- Surcharges

Prices that are calculated against other price simulation codes are simulated prices. The standard cost is used for simulation purposes and in transactions when no actual price is available.

Standard cost is also an inventory valuation method for accounting purposes.

## standard-to-order (STO)

The production of non-customized items after receiving a customer order.

## statistical inventory control

An order system in LN that generates planned purchase or production orders to replenish stock.

The reorder point is usually calculated by adding the safety stock and the forecasted requirements during the replenishment lead time.

SIC items are planned by Warehousing.

Abbreviation: SIC

## subassembly

An intermediary product in a production process that is not stored or sold as an end product, but that is passed on to the next operation.

For subcontracting purposes, a manufacturer can send a subassembly to a subcontractor to carry out work on the subassembly. This subassembly has its own item code defined in the Item Base Data.

After work is finished, the subcontractor sends the subassembly back to the manufacturer. Also this reworked subassembly has its own item code defined in the Item Base Data.

## subcontracting

Allowing another company (the subcontractor) to carry out work on an item. This work can concern the entire production process, or only one or more operations in the production process.

## sub-item

A means to further classify items.

A sub-item can either be:

- A component item used in a bill of material.
- A material used in a formula.

## supplying assembly line

An assembly line which produces subassemblies that are used in another assembly line. It may additionally produce items that are not used on any assembly line. An assembly line is a set of consecutive line stations where FAS (Final Assembly Schedule) items (and sometimes other item types) are manufactured.

## surcharge

The indirect costs of an item, for example, overhead costs, storage costs, handling costs, and machine-maintenance costs. Surcharges can be defined as a percentage or as a fixed amount and can contribute to fixed and variable costs.

## task

An activity to manufacture or repair an item. For example, sawing, drilling, or painting.

A task is carried out on a work center, and can be related to a machine.

## time fence

The date until which an item's supply plan and planned orders are frozen.

The time fence is expressed as a number of working days or working hours from the date you carry out the simulation.

As a rule, Enterprise Planning does not regenerate the supply plan or the planned orders within the time fence. However, you can overrule this behavior when you run a master-plan simulation or order simulation.

The time fence is meant to prevent:

- Disturbance of orders that have already started (at the shop-floor level).
- Generation of planned orders with start dates in the past (that is, orders that are late).

Usually, the lead time of an item's production process is a reasonable value for the time fence.

## tool

A reusable resource, manual or mechanical, that is used to perform manufacturing and/or service tasks. When you have finished with the tool, it is returned to inventory to be used for the next requirement. The tool's life is reduced each time you use it. A tool can be identified in LN as a unique combination of tool type and tool serial number.

### Example

- **Hand tools**  
A saw or power drill.
- **Machine tooling**  
A jig, mould, pattern or cutting tools.
- **Instruments**  
A durometer or gauge.
- **Equipment**  
A shovel.

## tool component

A part of an assembled group of tool types.

## tool kit

A set of specific tools required to perform a single task. A tool kit can be linked to a machine, a task, and/or a routing operation to specify the tool(s) required to perform the task and/or operation.

**tool life**

The capacity of the tool expressed in the number of hours or times it can be used.

**tool number**

A number to identify a tool. The combination of a tool type, for example, hammer, and a tool serial number, for example, 1, is unique, and identifies a tool in LN.

**tool request**

A tool request is created when a tool is required. One request is created for each tool/work center combination.

A tool request displays data relating to:

- Request number.
- Tool type
- Tool serial number
- Work center / service center
- Request status

How, where, and when the tool is used in the work center is determined by the tool request details, which can be found in the Tool Request - Lines (titrp0516m000) session.

**tool request details**

The tool request specifies at which work center or service center the tool is used. In addition, the tool request details specify when, where, and how the tool is used at the work center. The following production order details are displayed:

- Request number
- Request date/time
- Order type
- Order number
- Operation
- Line number
- Activity line
- Presence of the tool at the work/service center

**tool serial number**

A number to identify a tool. The combination of a tool type, for example, hammer, and a tool serial number, for example, 1, results in a unique identification of a tool in LN.

## tool type

The tool type is the first level that is used to identify the tool in the coding system for tools.

Some examples of tool types are:

- Hammer
- Screwdriver
- Wheelbarrows

Hammer 1, screwdriver 2 and wheelbarrow 3 are examples of tool types in combination with a tool serial number, and represent unique tools.

## transfer batch quantity

The quantity or percentage of items for which an operation must be finished before you can start with the next operation. Even though an operation is not yet finished for all items in a production order, you can start the next operation for the items that are already finished.

In a production environment where kanban is used, the transfer batch quantity equals the kanban size (which is the standard container, or the standard lot size).

The transfer batch quantity replaces the previously used concept of overlap percentage on operation.

## unit effective item

An item for which an effectiveness unit can be defined on the sales order line or the sales quotation line. The effectiveness unit is used to model deviations for the unit effective item, and to peg purchase orders and production orders to a specific sales order line for the unit effective item.

## wait time

The time that an order remains at a work center after an operation is completed until it is moved to the next operation.

LN does not plan wait times according to a specific calendar. Planning of the wait time is based on a 7 \* 24 hours week schedule.

A typical example is the time required for drying after the application of paint.

## warehouse order

See: *warehousing order* (p. 179)

## warehousing order

An order for handling goods in the warehouse.

A warehouse order can be of the following inventory-transaction types:

- **Receipt**
- **Issue**
- **Transfer**
- **WIP Transfer**

Each order has an origin and contains all the information required for warehouse handling. Depending on the item (lot or non-lot) and warehouse (with or without locations), lots and/or locations can be assigned. The order follows a predefined warehousing procedure.

### Note

In Manufacturing a warehousing order is often called a warehouse order.

Synonym: warehouse order

## WIP transaction

Any action that affects the work in process (WIP) of a production order or work center.

WIP transactions can be any of the following:

- Issue of materials for a production order.
- Booking of hours on a production order.
- Delivery into inventory of finished products.
- WIP transfers between work centers.
- Application of a surcharge.

## WIP transfer

The transfer of the value of the work in process from one work center to the next, in accordance with a physical transfer of a subassembly to the work center where the next operation must be performed.

## work center

A specific production area consisting of one or more people and/or machines with identical capabilities, that can be considered as one unit for purposes of the capacity requirement planning and detailed scheduling.

## workweek

The seven days of the week, for which the available and non-available hours are defined.

## yield

The usable output from a operation expressed as a percentage of its input.

Example 1: An operation in the production process for light bulbs has a yield of 98%. So, out of every 100 light bulbs produced, 98 are good on average. The remaining light bulbs are faulty, and will therefore be rejected.

Example 2: Steel wires are twisted together to produce a steel cable. Due to the twisting, the cable is 10% shorter than the wires from which it is produced. So, the yield is set to 90%.

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