

The Architecture of SAP ERP

Understand how successful software works

von

Jochen Boeder, Bernhard Groene

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3.7 Logistics Execution

The **Logistics Execution (LE)** component controls and organizes both the movement of material within the enterprise (warehouse management) and also transportation between enterprises. Movement of material includes the outbound processing of sending materials to customers, the corresponding inbound processing of receiving materials from vendors, and organizing and monitoring the transportation of material.

3.7.1 Architecture Overview

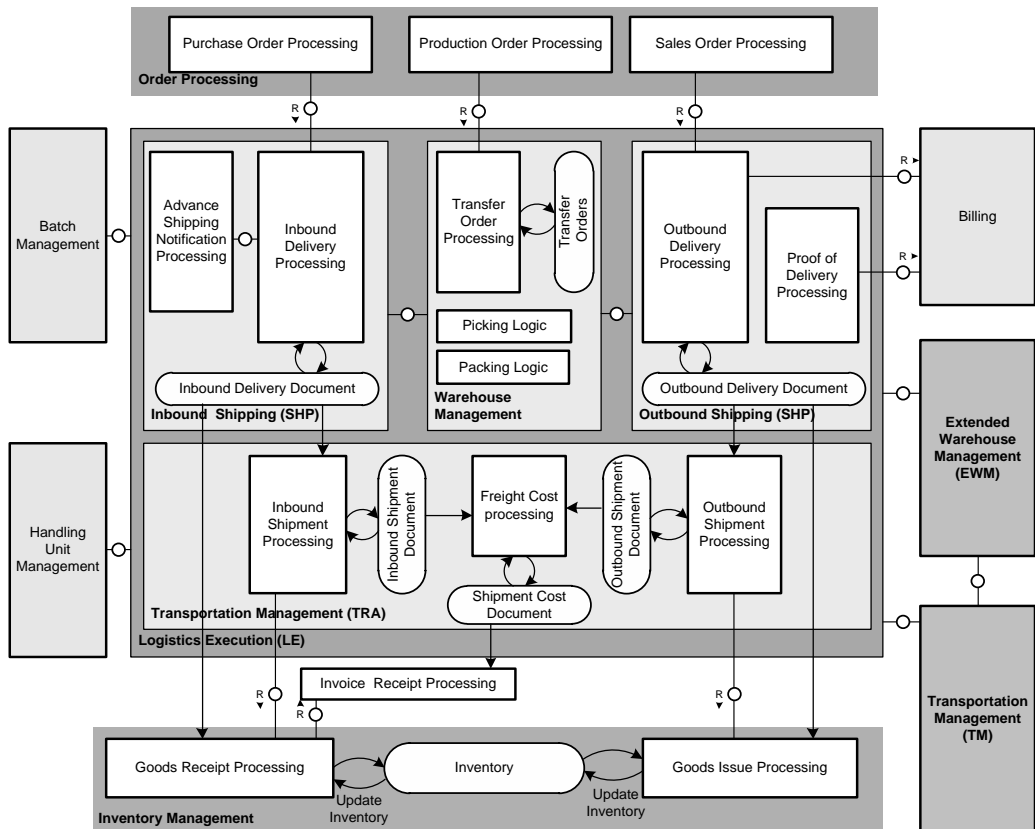


Figure 3-27: Architecture of Logistics Execution.

From architecture perspective, LE is divided into the following areas (see figure 3-27):

- Inbound delivery processing, which covers receiving goods from the vendor and storing them in the company's warehouse
- Warehouse management, which supports stock transfer, picking, and packing
- Transportation management, which supports inbound and outbound shipment processes
- Outbound delivery processing, which includes picking the goods and transporting them to the customer

Typically, logistics execution is initiated by purchase order processing in MM or sales order processing in SD. The inventory itself is part of MM. Logistics execution processes are closely integrated with inventory management, which maintains the actual inventory

3.7.2 Integration Architecture

3.7.2.1 Integration with SAP ERP

LE is integrated with SD and MM using database integration. SD triggers LE to perform the order fulfillment process for a sales order, in particular the delivery processing. In this case an outbound delivery document is created referencing the sales order.

When material is received by a company, LE creates an inbound delivery with reference to the purchase order and triggers goods receipt processing in MM.

3.7.2.2 Integration with SAP Business Suite

LE can be integrated with SAP SCM to extend its functional scope. SAP EWM can be connected to the warehouse management component of LE to provide additional warehouse management functions in the areas of advanced shipment notification (ASN), work assignment, and picking bin determination. Deliveries are created in LE and transferred to SAP EWM using queued RFC.

The transportation management functionality of LE can be replaced by SAP Transportation Management, which supports transportation request management, transportation dispatching, and execution. In this case LE forwards all transportation requests to SAP Transportation Management (SAP TM) using asynchronous message transfer.

3.7.3 Inbound Delivery Processing

Inbound delivery processing only starts after the enterprise has purchased material (raw material, goods) that the vendor has confirmed by sending a purchase order confirmation. If the procured material needs to be transported to the enterprise, inbound shipment processing is performed. It is part of transportation management (see chapter 3.7.5)

To be prepared to receive the ordered material, inbound delivery processing is initiated in one of the following ways:

- An inbound delivery document is created manually with reference to the purchase order.
- The vendor sends an advance shipping notification to the enterprise via IDoc, (see chapter 1.3.5) which triggers the creation of an inbound delivery document.

The vendor may send an updated version of the advance shipping notification, which updates the inbound delivery document if this has not been processed yet.

The inbound delivery document includes the following data:

- Header:
 - ID
 - Status
 - ID of corresponding purchase order
 - Vendor
 - Date of delivery
- Item:
 - Quantity and type of material to be received

The inbound delivery document is used to track the material's arrival, unloading, unpacking, and placement into the warehouse. When the material is received at the plant or warehouse, inbound delivery processing sends a proof of delivery (POD) as IDoc to the provider. In addition, the inventory is updated by goods receipt processing.

3.7.4 Outbound Delivery Processing

The outbound delivery processing within LE is mainly responsible for sales order fulfillment. If the vendor organizes the transportation of the material to the customer, outbound delivery processing initiates outbound shipment processing which is part of transportation management (see chapter 3.7.5). Outbound delivery processing is integrated with warehouse management if the materials are stored in the warehouse (see chapter 3.7.6).

Sales order processing initiates outbound delivery processing as soon as the requested material is available in the inventory (see figure 3-27). Then outbound delivery processing creates an outbound delivery document with reference to the sales order. It includes the following information:

- Header:
 - ID
 - Status
 - ID of corresponding sales order
 - Customer
 - Date of delivery
 - Ship-to party
 - Shipping point
 - Route
- Item:
 - Quantity and type of material to be delivered
 - Delivering plant or warehouse
 - Loading point

Outbound delivery processing performs the following tasks:

- Shipping point determination
- Delivery scheduling
- Route determination
- Receipt of POD (proof of delivery)

If the material is not picked up directly by the customer but transported to the customer's ship-to location, outbound shipment processing is performed.

Once the goods are delivered, the goods issue processing updates the inventory by reducing the quantity that was delivered. Subsequent financial documents are posted so that billing can be performed.

3.7.4.1 Shipping Point Determination

The **shipping point** is the organizational unit of a company that is responsible for a dedicated way of shipment (for example, the mail depot or a plant rail station). Within LE the shipping point is responsible for delivery creation, updating, and monitoring as well as goods issue processing. One delivery is processed by one shipping point only.

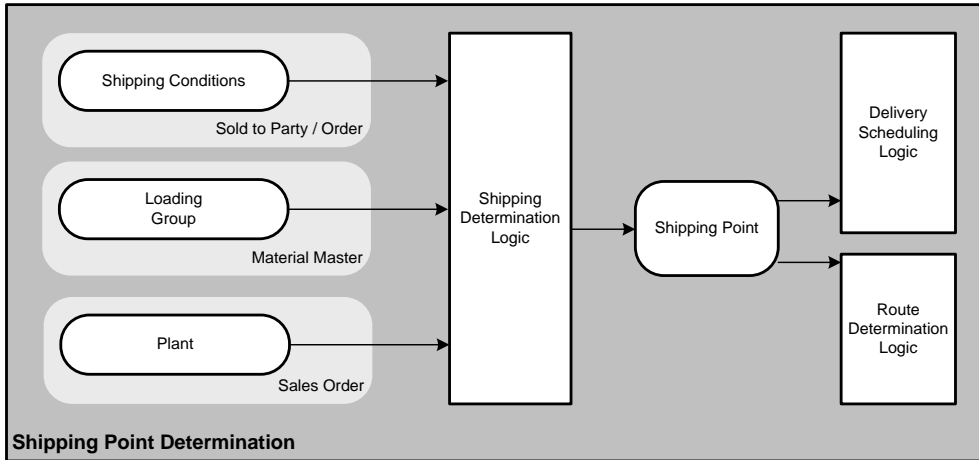


Figure 3-28: Shipping Point Determination.

Outbound delivery processing determines the shipping point for ordered material based on the following three input values (see figure 3-28):

- Shipping conditions (for example, that the material should be delivered as soon as possible)
- Plant that delivers the material (provided within the sales order document)
- Loading group that defines the way of loading (for example, that the material must always be loaded with a crane or a forklift)

For each possible combination of values, the corresponding shipping point is defined in customizing tables. So outbound delivery processing looks up the corresponding shipping point. The shipping point is a prerequisite for delivery scheduling and route determination.

3.7.4.2 Delivery Scheduling

Delivery scheduling defines a timeline for all activities that have to be carried out before the material can be delivered to the customer (for example, picking, packing, and loading the material). To do so, delivery scheduling determines the material availability deadline, at which point the material must be picked from the bin and packed, as well as the loading deadline, at which point the material must be available for loading.

3.7.4.3 Route Determination

A **route** describes a course of travel between the shipping point and an end point. A transportation planner maintains routes, which are stored in customizing tables. At run time the route determination logic checks if there is a route that connects the shipping point to the ship-to location of the sales order. The following attributes determine the route selection (see figure 3-29):

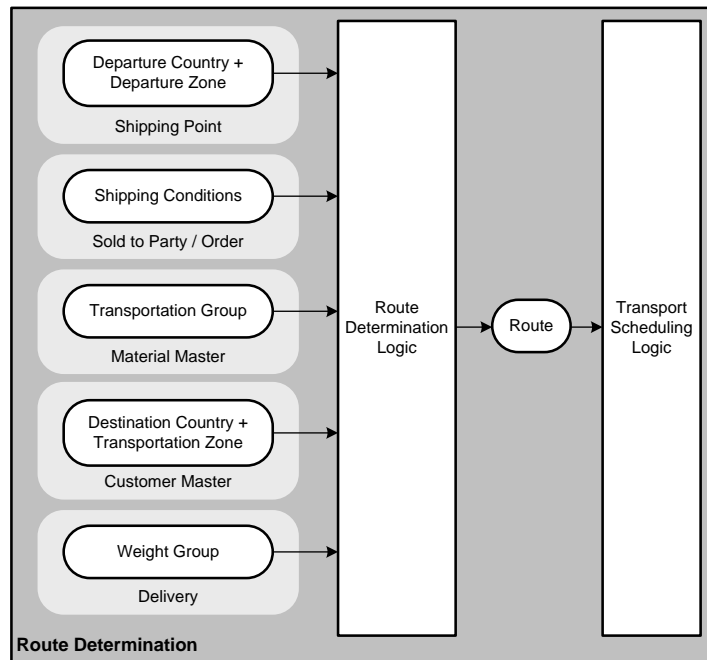


Figure 3-29: Route Determination.

- Departure country and zone from where the materials are to be shipped (this information comes from shipping point).
- Shipping conditions, which defines how the materials are to be delivered (this information comes from the sales order).
- Transportation group (this information comes from material master).
- Destination country and transportation zone, which indicates where the materials are to be delivered (this information comes from customer master).
- Weight group (relevant for delivery), which indicates how much of materials can be delivered. The weight group is determined on the basis of the total weight of the delivery.

Based on the above input values, the route is determined during the creation of a delivery. Route determination is a prerequisite for transportation scheduling, which defines the timelines for preparing and carrying out the transportation. Transportation scheduling determines the following two deadlines:

- The transportation scheduling deadline is the date on which transportation of the goods must be organized.
- The goods issue deadline is the date on which the goods must leave the company in order to arrive at the customer location without any delays.

To do so, it calculates, for example, the transit time of a foreign forwarding agent and the transportation lead time for arranging a truck.

3.7.4.4 Proof of Delivery Processing

Customers can send a proof of delivery (POD) document to LE to confirm that they received the ordered material. The POD is required in business processes in which an invoice is issued only after the customer has confirmed the receipt of the delivery.

The POD includes the following attributes:

- POD date
- POD time
- Actual quantity that arrived
- Reason for possible differences in quantities, if any. This is especially important for deliveries in which the delivery quantity varies because of the nature of the goods or for which the exact delivery quantity is unknown from the start.

The POD document reflects the actual delivery status thereby facilitating an accurate billing process and eliminating unnecessary credit memos. The ship-to party transfers the POD to SAP ERP Operations via IDoc. The message is received by POD processing. Now billing is initiated based on the POD quantity.

In case the customer also uses SAP ERP, inbound delivery processing sends the POD via EDI technology. Inbound delivery processing calls output determination, which determines the system address to which the POD has to be sent. Then inbound delivery processing creates an IDoc, which is transmitted to the vendor's SAP ERP application. For more details on output determination, see section 3.4.3.3

3.7.5 Transportation Management

Transportation management embraces inbound shipment processing as well as outbound shipment processing. It is triggered by the respective delivery processing.

Transportation management includes the following functions:

- Transportation planning and shipment completion
- Service agent selection
- Shipment costs calculation
- Shipment costs settlement
- Billing of customer freight
- Follow-up and supervision of shipments
- Management of shipment costs

Inbound as well as outbound shipment processing creates a shipment document that first of all defines which deliveries is part of one shipment. In addition, the following information is maintained in the shipment document:

- Service agent or logistics provider that is responsible for the transport
- Mode of transport, such as rail, truck, or plane
- Shipment type
- Estimated freight cost

During shipment processing, the **shipment document** is used to keep track of the shipment status. In addition, the system does a leg determination, which provides information about how the material reaches the destination from the source by calculating subsequent legs and transfer points (mode of transport: air, land, water) from the point of departure to destination. The determination is based on the simple rules maintained in the customizing and does not involve optimization algorithms and also has no geographical intelligence.

One aspect of the transportation management is to handle the freight costs or the shipment costs that were involved when the material was delivered. The handling of freights is an integral part of the LE transportation functions and always happens in SAP ERP even though an external transportation management system is used. In this case the freight requests are initiated by the external system to do the freight cost settlement in SAP ERP. The costs incurred during the freights are booked separately, and separate financial documents are generated for this purpose to settle the freights. The freights can be handled by the manufacturer or a third-party logistics provider.

3.7.5.1 Shipment Costs Processing

The following explains how the shipment costs are calculated in SAP ERP Operations with respect to the inbound and outbound point of view.

Shipment Costs: Inbound Shipment Processing

As mentioned, the inbound delivery processing creates a delivery document based on the purchase order. If transportation is required, an inbound shipment document is

subsequently created with reference to the delivery. The shipment document specifies who transports the material to the customer and when.

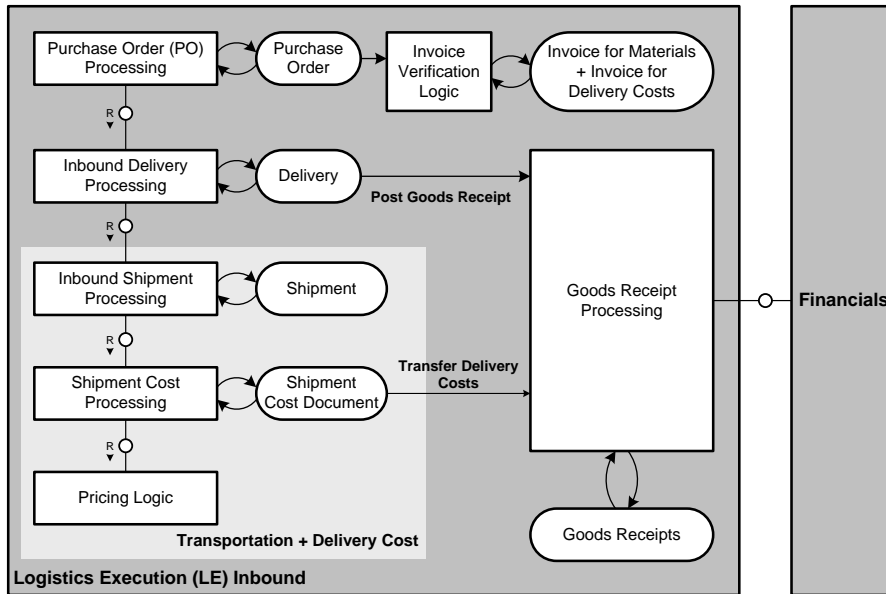


Figure 3-30: Inbound Shipment Cost Processing.

If the transportation cost is not included in the sales prices, inbound shipment processing creates a shipment cost document. The shipment cost document stores the price of the transport, which can be entered manually or using price determination based on the customized pricing conditions. The second case is used if the enterprise has a contract with the transportation provider.

Afterwards the goods receipt processing is triggered, which calls the shipment costs interface to transfer the cost, as shown in figure 3-30. Thereby the shipment cost is transferred to goods receipt processing logic, which passes it on to SAP ERP Financials. The successful receipt of material is also documented in the purchase order, and the delivery costs are also updated in the purchase order.

The whole process ends with the invoice verification, in which two separate invoices are posted with reference to the purchase order: one invoice for the supplier and another for paying the delivery costs to the transportation agent. The payment is then initiated by SAP ERP Financials.

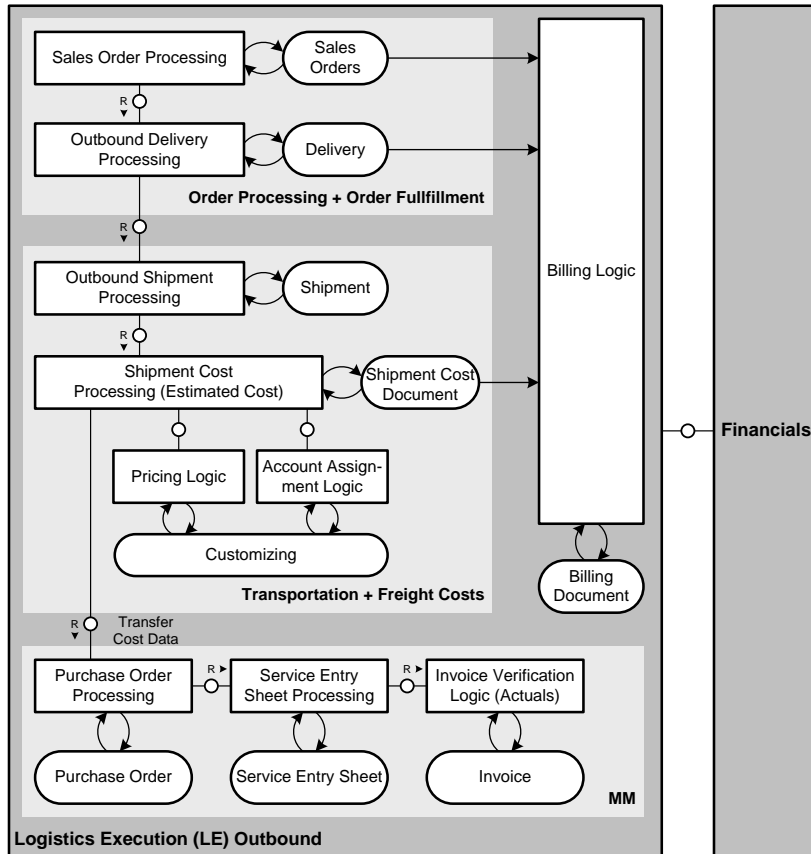


Figure 3-31: Outbound Shipment Cost Processing.

Shipment Costs: Outbound Shipment Processing

Outbound shipment processing creates a shipment document to manage the transportation of the material from the shipping point to the ship-to location. One shipment document can plan the transportation of one or more deliveries.

Shipment cost processing contains the functions for calculating and settling shipment costs that arise from material transportation. To do so, outbound shipment processing triggers the creation of a shipment cost document with reference to the original shipment document (see figure 3-31). The separate shipment cost document helps companies to effectively plan transportation with transparent cost.

Shipment cost processing calls the pricing engine to calculate the estimated shipment cost. The calculation of shipment costs is carried out using the condition

technique in pricing (see chapter 3.4.3.1). In addition, shipment cost processing triggers the account assignment logic, where the appropriate accounting object for the shipment cost is determined (for example, cost center).

If a third-party logistics provider is involved in the shipment, the shipment cost processing triggers the creation of a purchase order in MM to procure the corresponding services. The shipment cost as well as the account is passed to the purchase order. Now the process continues in MM: Once the materials are delivered, a service entry sheet is created with reference to the purchase order. As soon as the invoice from the third-party logistics provider is received and verified, SAP ERP Financials is triggered, which initiates payment of the invoice and billing of the shipment cost to the customer.

3.7.6 Warehouse Management

SAP ERP Operations keeps track of the material stock in the inventory provided by MM. Every movement of goods into or out of the company is reflected there. **Warehouse management (WM)** supports controlling the movement and storage of material inside the company, more precisely within the company's warehouse. The typical operations in a warehouse include receiving, put away, picking, packing, and transfer of material.

LE provides only lean warehouse management. But SAP ERP Operations can be integrated with the extended warehouse management functionality provided by SAP SCM.

3.7.6.1 Technical Representation of the Warehouse

Within Logistics Execution a warehouse is represented in the following way:

- Warehouse number
Each warehouse has an identifier, which allows for the management of multiple warehouses in parallel.
- Storage type
A warehouse can provide multiple storage areas, which are defined by the storage type. Examples are high rack storage, bulk storage, or fixed storage.
- Picking area (aka storage section)
Each storage type has a picking area, where the material is picked.
- Storage bin