This sample chapter describes the basic elements of inventory management, including preconfigured and custom movement types, the use of material and accounting documents, and the six most common inventory types. It then provides an overview of inventory costs which gives you the basis you need for cost discussions in later chapters.
Less emphasis on inventories, I think, may tend to dampen business cycles, because business cycles are typically in the grasp of inventory cycles and heavy industry cycles.

— Paul A. Volcker

1 Inventory Management Basics

Inventory management deals with the management of materials on a quantity and value basis, including all internal and external movement of goods in an enterprise, and the planning, entering, and documenting of these movements. Proper inventory management ultimately comes down to having the correct inventory in the right form and quantity, in the right place and time, at the right cost.

In SAP, each type of material movement is given a unique movement type, and for each movement posted, a material document will be created and stored in the database; we will address both of these concepts in this chapter.

A company carries many different types of inventory, the most common of which we’ll explore in more detail. We’ll also look at the costs related to storing and maintaining inventory over a certain period of time. First, however, we need a more in-depth definition of what a movement type is, as well as an understanding of its importance in inventory management.

1.1 Movement Type Concept

The movement type is a key concept in SAP Inventory Management: no movement can occur without a movement type. Whenever you enter a goods movement into the SAP system, you must also enter a movement type to indicate the type of movement that is to be executed.

Various movement types are distinguished by a three-digit number (key). For example:
A goods receipt against a purchase order or production order
A goods issue to production
A goods issue to cost center
A return to vendor
A sale to a customer
A scrap posting
A storage location-to-storage location transfer
A plant-to-plant transfer
A transfer from quality inspection stock into unrestricted stock
A transfer from consignment stock into own stock

The movement type has an important control function in inventory management: it enables the system to find predefined posting rules. Those rules determine how to post the financial accounting system’s accounts (stock and consumption) and how to update the stock quantity fields in the material master record. Furthermore, a movement type dictates which fields are required for entry of a document and which fields are displayed; it also determines whether a material document item can be printed with a certain movement type, and, if so, what kind of document is to be issued.

### 1.1.1 Change or Add New Movement Type

There are many movement types preconfigured in SAP for all kinds of receipt, withdrawal, and transfer postings, and they can be modified to allow for (or restrict) certain functionalities. It is also possible to configure new movement types in the system. However, because the configuration table and the settings therein are very complex, SAP recommends to always reference an existing movement type when setting up a new one. Doing so ensures that all of the important control indicators copy over to the new movement type, and that you don’t have to maintain them all manually.

**Note**

If you decide to add a new movement type in SAP, don’t forget to also define the associated reversal movement type and link them together!

You can change movement type settings, or add new ones, with the configuration Transaction OMJJ, or via the IMG (Implementation Guide) menu path MATERIALS...
Each movement type is set to either result in a consumption update or in no such update (as per setting in the field Consumption posting). Therefore, when you do any inventory posting, the system automatically knows whether that posting needs to update the material consumption table.

The movement type also controls whether the automatic creation of storage location data in the material master record will be allowed at the time of the first inventory posting (as per the checkbox labelled Create SLoc automat.). This is a helpful feature that can prevent unnecessary error messages during inventory posting. Note, however, that this control feature depends on whether your configuration settings at the plant level allow for automatic creation of storage location data.

These are just a few of the control parameters available in the movement type configuration table. Figure 1.3 provides some visual information on what other control parameters can be set.

If you execute an inventory posting, on occasion, you may need to reverse that posting. In SAP, you do so by using a designated reversal movement type. For each movement type, there is an associated reversal movement type. As a rule of thumb, the reversal key for a movement type is the original movement type plus one. For example, if you take movement type 101 (goods receipt), its reversal movement type is 102 (101 + 1). This logic holds true for all movement types in SAP.

Tip
A specific movement type value can be set as the default movement types in some of the SAP Inventory Management transactions, if needed. To do so, use the designated movement type parameter ID BWA, which can be maintained in a user’s profile. Parameter IDs can automatically fill a field with proposed values from SAP memory. However, the field only fills automatically with the value stored in the parameter ID if it is explicitly permitted in the transaction’s screen painter.

The various movement types are an important factor in SAP Inventory Management, as so is the creation of material documents upon posting any movements. We will explain this document creation principle next.
1.2 Document Principle

In SAP, the generally accepted accounting principle of “no posting without a document” applies. According to this principle, a document must be created and stored in the system for every transaction or event that results in a stock change.

Whenever a goods movement (receipt, issue, or transfer) is posted in the SAP system, two documents will automatically be created (as shown in Figure 1.4):

- Material document
- Accounting document

Note

There is an exception to this rule: if the goods movement has no relevance for financial accounting (i.e., an internal transfer from one storage location to another), no accounting document will be generated.

![Figure 1.4 Documents for Goods Movements](image)

We’ll discuss these two documents in more detail in the following sections.

1.2.1 Material Document

For each and every goods movement that is posted in SAP, a material document will be created. This document serves as proof of one or more material movements, and stores all details that pertain to the movements. Along with the material document year, the document number constitutes the key with which a material document is accessed in the system. The material document also provides information for downstream processes (i.e., it serves as a reference for invoice payment in the case of external procurement, if the purchasing document required a three-way-match).

Once an inventory posting is saved, the SAP system will automatically assign the next sequential material document number. These document numbers are internally assigned and are based on the transaction/event type that is allocated to each transaction in SAP Inventory Management. The transaction/event type allows for detailed document number assignment, and for the systematic storage of documents in the document file. Table 1.1 shows an example of transaction/event types.

<table>
<thead>
<tr>
<th>Goods Movement</th>
<th>Transaction/Event Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goods receipt for purchase order</td>
<td>WE</td>
</tr>
<tr>
<td>Goods receipt for order</td>
<td>WF</td>
</tr>
<tr>
<td>Goods issue, transfer posting</td>
<td>WA</td>
</tr>
<tr>
<td>Goods issue for delivery</td>
<td>WL</td>
</tr>
</tbody>
</table>

Table 1.1 Transaction and Event Types

Through this transaction/event type, a different group of number ranges is used for the various types of inventory postings. SAP is pre-set, and distinguishes the following postings and uses a different number range for each of them:

- Physical inventory documents
- Goods movements (goods issues and transfer postings) and inventory differences
- Goods receipts

Typically, SAP buffers a designated value of document numbers on the application server, and so it is not unusual for a gap in number assignments to occur. This is mainly done for system performance reasons.

Figure 1.5 shows an example of a material document, as displayed with Transaction MIGO. The material document consists of a header section and an item section. The header section stores the document date; the posting date; the date and time of data entry; the transaction/event type; the user ID of the person who
posted the transaction; and information on if a goods receipt slip has been printed, and what that receipt contains. In the items section, the movement type, material number, quantity posted, plant code, and storage location are stored. In cases where a posting is performed at the expense of a G/L account, additional account assignment information may be stored, as well.

Note
If you display the material document via Transaction MB03, the information displayed will look different, though the overall content will be the same as the information displayed via Transaction MIGO.

If a material posting is accounting-relevant, the generated accounting document can be accessed from within the material document via a document link (in the Doc. Info tab).

Once a goods movement has been posted and a material document is created, this document can no longer be changed. Only additional information, such as header or item comments, can be entered. If a document has been created in error, it cannot be deleted, but rather must be cancelled/reversed with either Transaction MIGO (or using menu path Logistics • Materials Management • Inventory Management • Goods Movement • Goods Movement), using the appropriate reversal movement type, or with Transaction MBST (or using menu path Logistics • Materials Management • Inventory Management • Material Document • Cancel/Reverse), referencing the material document number that is to be cancelled.

1.2.2 Accounting Document

If a posted movement is relevant for financial accounting (and therefore updates a G/L account), an accounting document parallel to the new material document is created. In most cases, there is a 1:1 correlation between the material document and the accounting document. However, it is possible that an inventory posting (with one generated material document) will result in the creation of more than one accounting document. This is the case if the materials posted point to different plants that belong to different company codes, because an accounting document number is unique per legal entity (company code).

The accounting document records changes in values in a company code arising from accounting transactions, such as transactions triggered in inventory management that result in inventory value changes.

Accounting documents are split into document types, which allow one to differentiate between different document number assignments. The transaction/event used in SAP Inventory Management determines which document type is used in the accounting document. In the standard SAP system, the accounting document types detailed in Table 1.2 are predefined for inventory management.

Each accounting document is uniquely identified by the document number, the company code, and the fiscal year. The document itself consists of a document header and at least two line items. Figure 1.6 shows an example of an accounting document, as displayed via Transaction FB03.
Once an accounting document has been posted, the system protects certain fields in that document from changes. The protected fields include the amount posted, the account, the posting key, the fiscal year, and the tax amount. These fields can no longer be changed, as they have already lead to an update of account balances upon posting.

Any accounting documents that have been created as the result of an inventory management posting must be reversed with functions in that area. This means that the transaction in inventory management must be reversed, which automatically leads to the creation of the associated reversal accounting document.

Now that we have explained the document principle, let’s move on to the various inventory types and examine how they are most commonly categorized.

1.3 Common Inventory Types

Inventory in manufacturing companies generally cycles through distinct stages, and these companies must account for inventory in each stage. One method of categorization in SAP is the use of a material type that groups together materials with the same basic attributes. (For example, raw materials, finished goods, semi-finished goods, or spare parts). Figure 1.7 depicts the current standard attributes for the aforementioned material types.

When running inventory reports or analyses in SAP, material type often serves as a selection criteria to narrow the search and report results.

Together with the plant, the material’s type determines its inventory management requirements, that is:

- Whether changes in quantity are updated in the material master record.
- Whether changes in value are also updated in the stock accounts in financial accounting.

There are more ways to categorize inventory than by material type. For example, inventory can be broken down based upon its primary purpose, its owner, or how it is managed in the supply chain. In the following section, we want to address the most commonly used inventory types that fall into these categories.

1.3.1 Raw Material Inventory

Raw materials are typically not sold; they are primarily externally procured materials or items that are used in the production process, and ultimately result in a finished good. They will undergo some kind of physical change as they are consumed in the production process.

Raw material inventory is defined as the total quantity and cost of all in-stock components which have not yet been used in either work-in-process or finished goods production.

Raw materials are divided into two subcategories:

- Direct materials that will become part of the finished product.
- Indirect materials that will not be incorporated in the finished product, but which are consumed during the production process nevertheless. For example, machine lubricants or similar products that may be needed in the manufacturing process.
Raw materials are mostly, but not exclusively, valued using a moving average price (i.e., a price that changes as a consequence of goods movements and the entry of invoices, and that is used to value a material) and the total cost of all raw materials on hand, which is reflected in the balance sheet as an asset. When a raw material is initially posted into inventory upon goods receipt, it is recorded into an inventory asset account, debiting the raw materials inventory account and crediting the accounts payable account. In today’s ERP systems, this posting, as well as any subsequent inventory movement, is done in real time, and SAP ERP is no exception to this fact.

From a financial point of view, raw material inventory is usually assessed at the beginning and end of each period, so as to determine the value of the total usage in that period, as well as the total value on the books.

From an inventory management point of view, raw material inventory is dealt with on a daily basis by ways of receipts, issues, and transfers. It is essential to always have enough inventory on hand to ensure continued operation and a smooth production process, while at the same time keeping the inventory level as low as possible.

Based on the industry a company resides in, raw materials may be classified under different names, such as components or ingredients.

### 1.3.2 WIP Inventory

Work-in-process (or WIP) denotes the part of the inventory that is currently within the production process, but which has not yet been completed and transferred to the finished goods inventory. You could start by thinking of WIP inventory as all the goods that are on the factory or shop floor, but it includes more than that. WIP inventory is an inventory account that reports the cost of all goods that are on the shop floor, which should include not only the cost of the direct material that has been issued to the floor, but also direct labor and the allocation of any production overhead for the goods on the floor.

WIP inventory is often misunderstood, as it does not strictly deal with a countable quantity of inventory. As the WIP goods become manufactured into a finished product, their cost will be credited to the WIP account and debited to the finished goods inventory account. What is left in the WIP inventory account thereafter is the value of in-process materials. These in-process materials are materials that no longer exist as specific stock items, and are not to be confused with semi-finished products, which are usually still tracked and inventoried by a unique item number.

Work-in-process is not based solely on the physical state of the materials, but rather upon the bill of material structure and their transactional status. For example, once a material is picked and issued to a production order and brought to the shop floor, it becomes part of WIP.

A company must disclose the cost of its work-in-process in its financial statement. WIP is usually calculated for production orders (or process orders) during the period-end closing. Thus, WIP is really more of an accounting classification than an inventory classification.

### 1.3.3 Finished Goods Inventory

Finished goods consist of those goods that have been manufactured in-house and are now waiting to be sold or shipped. However, a finished product can also be an item that is bought and then resold in the same form without adding any further value. These goods are known as merchandise or trading goods.

Finished goods inventory represents the amount and value of manufactured items in stock, ready and available to be sold to customers. It is usually valued with a standard price, which is a constant price that does not take goods movements and invoices into account. This standard price is typically updated once or twice a year (though some companies do it more frequently) based on product costing that looks at past production processes to determine the cost per unit of production.

Depending where a product is located in the supply chain, an item classified as a finished good for one location may be considered an unfinished product or component for another location. For example, wings for the Airbus aircraft are manufactured in the U.K., and in that manufacturing facility, a wing is considered a finished product. That wing is then shipped to the Airbus assembly plant in France, where it is considered a component of the entire aircraft.

In a typical process, once production is complete, the WIP account is credited and the finished goods inventory account is debited. A finished product is typically considered a short-term asset on an enterprise’s balance sheet, since it is expected that the goods will be sold within the foreseeable future. Once the finished product is sold, its value is transferred from the balance sheet to the income statement.
1.3.4 **Spare Parts Inventory**

Spare parts are interchangeable components that are used for the repair or replacement of failed or defective units, as well as for equipment maintenance in the plant. Spare parts are often also called MRO (maintenance, repair, and operating) parts, though this term may include more than just spare parts (e.g., office supplies). *Spare parts inventory* is vital to production operations. They are purchased and stored like any other part type, though some companies decide to not keep spares in stock, instead choosing to expense them directly at the time of purchase. Many manufacturers also maintain an inventory of essential spare parts for their finished product portfolio, which is often kept for the entire life cycle of these products. This is typically part of their aftermarket service and often included in sales negotiations.

Any of these spare parts are valuable assets for a company, and they are typically classified as such in the balance sheet.

Spare parts and MRO inventories are fundamentally different from other types of inventory that a company carries, as the need for such inventory is not driven by customer or production demand, and as such that need is rather unpredictable.

Spare parts have very distinguished characteristics pertaining to inventory and how it is managed. For example:

- Items that are rarely used must nevertheless be stocked.
- Stockout costs can be disproportionately high compared to the actual value of the item.
- Items of small value can be critically important.

All of the aforementioned inventory types are characterized by their primary use and purpose. We will now move on to another inventory type, which is instead characterized by who owns it: consignment inventory.

1.3.5 **Consignment Inventory**

Before we address *consignment inventory* directly, let’s step back and look at what consignment actually is.

We can define consignment as ...

... a quantity of goods that are sent to a person or place to be sold or consumed.

Consignment always refers to the timing of the transfer of ownership of the inventory. They key characteristic for consignment stock is that ownership always remains with the sender (supplier) until such time when this stock is withdrawn by the customer, either for production or selling purposes, or when it is taken into the supplier’s own inventory. Figure 1.8 illustrates the consignment inventory flow.

Consignment is also characterized by the fact that the liability of loss, damage, obsolescence, or theft remains with the supplier.

In SAP, we distinguish between two different types of consignment inventory, which we’ll discuss in the following subsections:

- Customer Consignment Inventory
- Vendor Consignment Inventory
Since consignment stock remains part of a company’s valuated stock, it must be managed in the SAP ERP system.

In SAP, customer consignment stock is:

- Managed separately from the rest of the inventory so that, at any given time, you know what inventory is stored at a customer’s location.
- Managed separately for each customer.

Customer consignment stock is managed as a special stock, using the special stock indicator “W”. Even when inventory moves from regular inventory into customer consignment stock, the total valuated stock remains the same, as your company is still the owner of the goods.

Vendor Consignment Inventory

Vendor consignment inventory is inventory that a supplier provides and stores on the purchaser’s premises. The supplier (vendor) remains the legal owner of the goods until they are withdrawn from consignment and put to use, or taken over into the purchaser’s own inventory. Only once materials are withdrawn is the purchaser (customer) liable to pay the supplier (vendor). Thus, payments and accounts payable transactions are deferred in the supply chain when such inventory is kept.

In SAP, vendor consignment stock is:

- Managed separately from the rest of the inventory so that, at any given time, you know what inventory you store which still belongs to the vendor.
- Managed separately for each vendor.

Vendor consignment stock is managed as a special stock, using the special stock indicator “K”. This special stock is updated on storage location level, as the material is actually stored by your own company. The consignment stock is not actually valuated, as it still belongs to the vendor. It is only when vendor consignment inventory is taken over into your own stock that this inventory is carried as an asset on your books.

1.3.6 Vendor-Managed Inventory (VMI)

Vendor-managed inventory (VMI) is an inventory practice where your inventory is controlled and replenished by the supplier, rather than via material requirements planning (MRP). Basically, the supplier assumes the role of inventory planning for the customer. This practice has gained acceptance in many industries, and what once was thought of as an experiment has become the preferred way of doing business for many manufacturers, retailers, and distributors.

In a VMI environment, the supplier is responsible for managing inventory at the customer’s facility. In that process, your supplier visits your company at frequent (and mostly pre-determined) times, and physically checks how much of an item (or items) you still have in stock. The inventory will then either be replaced immediately (in cases where the supplier may carry inventory with him), or a replenishment order is placed to stock missing parts as soon as possible. The vendor and the customer (your company) are usually bound by an agreement which determines inventory levels, fill rates and costs. The VMI inventory practice is best used for parts that are fairly consistent and predictable.

In many companies that work with sophisticated ERP systems, the supplier may even have visibility into their client’s VMI inventory in order to keep track of current inventory levels, which allows them to plan any required stock replenishment.

A VMI arrangement can improve supply chain performance by reducing inventories and eliminating stockout situations. The supplier can better prepare to replenish the customer because he can more easily predict and schedule his own production. Stockouts can be reduced or eliminated altogether, because you don’t have to reorder parts at the last minute, not knowing if the supplier can restock in time. Through this improved inventory management, costs may be reduced.

From a financial point of view, vendor managed inventory is not treated any different than the inventory that is managed by yourself. It usually does not constitute a different inventory account: if a spare part is managed by your supplier, it still will be classified as such in the balance sheet, just like any other spare part.

As we have seen, there are many different inventory types that a company deals with on a regular basis. We have only discussed the most common of these inventory types in the previous pages. Some other types of inventory that a company holds may, for example, be categorized as:

- Packaging inventory
- Non-valuated inventory
- PRT (production resource/tools) inventory
- Operating supplies inventory
But no matter what type of inventory you hold, it needs to be efficiently managed to ensure proficient production and sales processes.

There are numerous ways of describing inventory types. Beyond the aforementioned categories, inventory types can also be categorized based on the demand pattern that creates the need for inventory. If the need for inventory is not dependent upon the demand of any other item, then the inventory for such an item is considered independent demand; finished goods typically fall into this category.

However, if the need for inventory depends upon the demand of another item, then such inventory need is categorized as dependent demand; raw materials or components typically fall into this category, as their inventory needs depend on the demand for the finished product.

No matter how you categorize your inventory, ultimately you need to balance it so that customer demands can be fulfilled with the appropriate supply of goods. Remember, it comes down to having the correct inventory in the right form and quantity, in the right place and time, at the right cost.

Inventory is a major asset in most companies, and the cost of this asset is usually pretty well-known. But beyond the actual price of an item (moving average or standard price based on how the material is valued), there are other costs that will accrue as a result of holding inventory. We will have a look at these costs next.

### 1.4 Inventory Costs

We can define inventory costs as...

> ...the cost of keeping goods in stock. It is expressed as a percentage of the inventory value, including capital, warehousing, depreciation, insurance, taxation, obsolescence, and skimming costs.

Basically, inventory costs are all costs related to storing and maintaining inventory over a period of time. They can be categorized into three main components:

- Ordering costs
- Storage (or carrying/holding) costs
- Stockout (or shortage) costs

It is important to note here that ordering costs typically vary inversely with carrying (holding) costs. The more orders an enterprise places with its suppliers, the higher ordering costs become. However, ordering more of a product usually translates to smaller average inventory levels, and thus lower carrying costs. In other words, ordering excess quantity will result in carrying cost of inventory, whereas ordering less will result in increased replenishment and ordering costs (Figure 1.9 depicts this behavior).

![Figure 1.9 Ordering Cost versus Holding Costs](image)

More often than not, companies don’t know exactly how much costs are tied up in their inventory, and measuring inventory cost in itself is not easy. Many companies rely on their accounting department, and let them come up with an estimate for the costs of inventory. Other organizations just take some “benchmark” or “rule of thumb” numbers and apply the costs directly to the costs of goods sold. But no matter how you look at it, to really obtain accurate inventory costs, you have to look at all cost aspects.

The true costs of inventory consist of many components, and when assessing these costs, one has to understand that the relevant numbers won’t necessarily appear in your accounting records. In the following section, we will take a more detailed look at the main inventory cost categories in order to gain a better understanding.
on what these costs entail. As such we will focus on the costs of actual inventory owned, rather than those aspects that are related to the flow of goods.

1.4.1 Ordering Costs

Ordering costs (sometimes also called costs of replenishing inventory) are the incremental costs that are incurred each time an item is ordered. These costs are incurred for each purchase order, regardless of the lot size ordered, and are over and above the purchase order price. Examples of order costs include the cost of preparing a requisition; placing a purchase order; posting a goods receipt; inspecting received items; putting the goods away upon receipt; processing the vendor’s invoice; and remitting payment to the vendor.

Ordering costs are not based on the order’s quantity, but are rather the result of the instance of an order. In other words, if total annual costs do not change as the order frequency changes, then the cost should not be included in the ordering costs. If a specific cost remains the same when you switch from placing a single order every quarter to placing a weekly order, then it is not really an ordering cost.

Ordering costs can be further subdivided into:

- Order processing costs
- Inbound (third-party) logistics costs
- Goods receipt processing cost
- Inspection costs
- Other costs

Order processing costs

Order processing costs can be considered a fixed cost, as they operate independently of the number of units ordered. This includes the costs that are associated with:

- Determining the need to order, meaning the time and effort it takes someone to review purchase proposals.
- Creating the purchase order.
- Any purchase order approval steps that may be required.
- Monitoring, expediting or de-expediting purchase orders.

Based on a company’s policy, order processing costs may also include costs that relate to sourcing efforts and obtaining quotes from vendors. This is especially the case in an environment where a policy demands that you request new vendor pricing every time you order. To sum it all up: order processing costs are any incurred costs or fees that are directly associated with the ordering transaction.

Inbound (third-party) logistic costs

These costs are any transactional costs that relate to transportation, or which are associated with any freight-forwarder or other third-party logistics activities. As opposed to order processing costs, inbound logistic costs are variable because shipping costs typically depend on the total volume of product ordered.

Goods receipt processing costs

These are many costs that relate to the processing of incoming goods, and the receipt thereof. These costs are referred to as goods receipt processing costs, and includes costs associated with:

- Unloading trailers (if and where applicable).
- Handling bills of lading.
- Unpacking cartons.
- Checking items on the packing slip against the actual received quantity to ensure it matches.
- Entering the goods receipt into your system.

Order costs in that area are costs related to the actual process, rather than costs related to the received quantity.

Inspection costs

Some or all of the items you receive may require some kind of inspection before they can be put into stock. Inspection costs relate to quality inspection of incoming goods. This includes costs that are associated with:

- Preparing the quality inspection.
- Inspecting items.
- Capturing inspection results and entering them into the system.
Other costs
There may be additional costs that you want to include in your ordering costs. Example of these costs are:
- Clerical costs related to putaway received and inspected items.
- Clerical costs related to invoice entry/processing.
- Clerical cost related to invoice payment.

While all of the aforementioned types of ordering costs are described in relation to external procurement, please keep in mind that ordering costs do also occur for internal production each time an item is produced. This would, for example, include:
- Setup costs (for a production run), including any scrap costs, if setup produces any kind of scrap.
- Costs for picking and deliver components to the shop floor.
- Tooling if tool is unique to the production run.

Ordering costs can be stored in the MRP1 view of the SAP material master record for the purpose of calculating an optimal order lot size (for internal or external procurement). Figure 1.10 shows where we can maintain ordering costs in the material master.

Storage costs (sometimes also called carrying or ordering costs) are defined as the total price of holding (or carrying) a specific quantity of inventory. This includes any costs associated with the storage (i.e., warehouse lease costs, utility costs for the storage facility, maintenance costs for the storage location’s upkeep, insurance), or less tangible expenses, such as losses due to theft.

As a rule of thumb, you could say that if a specific cost does not change as the inventory level fluctuates, then it should not be included in storage costs, as storage costs are typically associated with the quantity of inventory that a company carries. Holding costs are generally expressed as a percentage of the inventory value.

Storage costs can be further subdivided into:
- Capital costs
- Storage space costs
- Inventory service costs
- Inventory risk costs

Some companies may want to divide their storage costs differently. For example, they may consider dividing them into capital and non-capital carrying costs.

Capital costs
Capital costs are associated with having capital tied up in inventory. They are the largest component among all inventory storage costs, and include everything that relates to the investment, the interests on working capital, taxes on inventory paid (where inventory is actually taxed), insurance costs, and other costs associated with legal liabilities, as well as the opportunity cost of the money invested in inventory.

Determining capital costs can be a complicated endeavor, or not, depending on the business. Many companies have debt associated with their inventory, and so one way to apply capital costs associated with having inventory is to use the interest rate paid on the debt. Another way to determine capital costs is to use the weighted average cost of capital (WACC), which is the rate at which a company is expected to pay, on average, all of its security holders, in order to finance its assets. It is also commonly referred to as the company’s cost of capital.

Capital costs are usually expressed as a percentage of the dollar value of the total inventory currently held. This may either be an objective figure, derived from a calculation, or a subjective figure, derived from experience or industry standards. Capital costs are often vastly underestimated: some companies simply apply a rate...
as less as 5%. However, for the great majority of companies, capital costs can reach 15%, according to Stephen G. Timme and Christine Williams-Timme ("The Real Cost of Holding Inventory," *Supply Chain Management Review*, 7/1/2003).

**Storage space costs**

*Storage space costs* include the cost of building rental (or mortgage) and facility maintenance, property taxes, and utility costs for utilities (i.e., lighting, air conditioning, heating, etc.).

Storage space costs depend on the kind of storage chosen; for example, whether the warehouse is company-owned or rented. In cases where the same building is used for different purposes, the portion of the building associated with receiving and storing inventory must be determined. Some of the costs are fixed, such as rent or mortgage, while others are variable, such as the handling of materials that will vary with the level of inventory.

Not all the inventory necessarily has the same storage space costs, since not all inventory items share the same storage cost characteristics. Case in point: items kept in a cold storage facility require a more costly storage environment when compared to a regular dry storage area; similarly, storing hazardous materials usually entails more costs than storing regular items. Furthermore, you are likely not calculating the exact storage costs for each individual item, but rather grouping them and applying costs this way.

At this point, it is helpful to mention that storage space saturation can result in an increase in costs. When a warehouse reaches the point of saturation, it may be difficult to move within the warehouse space, which can result in a halt in inventory flow. You may have to quickly find backup or overflow storage at additional or excessive costs to remedy the situation. Needless to say, a scenario like this can have an impact on your storage space costs.

**Inventory service costs**

*Inventory service costs* include insurance paid on the inventory, IT hardware and applications (including cost of purchase, depreciation, or rental or lease as the case may be), and the physical handling costs for moving materials in and out of the storage facility. Furthermore, material-handling equipment can be attributed to this cost category, as well as any expenses related to inventory control efforts and physical inventory or cycle counting processes.

The insurance costs in this category are pretty straightforward. The insurance that a company has to pay depends on the type of goods in the warehouse, as well as the inventory’s level: the higher the level of inventory stored, the higher the insurance premium will be.

Some literature also includes the tax that is assessed for the level of inventory in this cost category, while others assign the taxes to the capital costs category. In any case, the higher the inventory levels, the higher the taxes paid, and thus the higher the inventory costs.

Inventory service cost may also be straightforward to determine when using a third-party logistics (3PL) provider, as the costs might come as a package with the storage space costs.

**Inventory risk costs**

*Inventory risk costs* cover the risk of inventory decreasing in value over the period of time it is stored. The relevance of this category may differ based on the industry in which a company operates. For example, in the retail industry, the risk might be higher, because you don’t want to store too much inventory, as the demand changes based on the season, or with each new fashion collection. There is also a greater risk involved if a company deals with perishable goods, such as in the foods industry or in the cosmetics industry.

Inventory risk costs can be further expanded into:

- **Risk of shrinkage**

  *Risk of shrinkage* deals with the loss of products that may occur between the time of purchase (when inventory is first recorded upon receipt) and the point of use or sale (when you realize that the book inventory may not necessarily match the actual inventory). The cause for the shrinkage could be, for example:

  - The result of theft (including employee theft).
  - Due to administrative errors (if items are misplaced).
  - Due to the loss of items (or materials) during transit.

  The latter case depends much on the shipping terms (Incoterms) that have been agreed upon with the seller, which determine the point at which the risk of loss transfers to the buyer or seller.
Risk of damage

Risk of damage deals with the loss of products during the period of storage due to incorrect storage. The cause of damage could be, for example:

- Water damage.
- Heat damage, if a cold-storage item is not stored as such.
- Damage due to improper handling of the item.

Not every item or material is likely falling into this category: some may carry a higher risk of damage than others (i.e., glass products have a higher risk of damage than steel rods).

Risk of obsolescence

Risk of obsolescence takes into account the costs associated with items that are past their use-by or expiration date, and which therefore can no longer be used. It also includes items that become obsolete because of a new design or packaging.

Risk of spoilage

Risk of spoilage deals with loss of inventory due to wrong processing or other unexpected factors during the production process. This does not, however, include spoilage that is already accounted for with a scrap factor that is used in the process. Rather, this risk pertains to an additional, unforeseen spoilage.

In order to apply proper storage costs, you will likely have to group your materials into the various risk groups and assess each group individually to determine appropriate costs. Inventory risk costs need to be applied to an item based on its characteristics. Determining the proper costs may be difficult for one category, whereas for another category it can be easier and more straightforward. For example, if you are scrapping (or writing off) obsolete material and use a designated reason code when posting the inventory movement, you can pull information out of your system regarding the costs involved over a period of time, and then use this information to determine a cost percentage for that group.

Inventory risk costs are an important part of storage (holding) costs, because the higher your inventory, the greater the risk of shrinkage, damage, obsolescence, or spoilage. Sadly, this cost category is often neglected.

You can enter storage (carrying/holding) costs into the MRP1 view of the SAP material master record for the purpose of calculating an optimal order lot size. However, as opposed to the maintenance of order costs, which is done in an absolute amount, storage costs are expressed in a percentage via a storage cost indicator. Figure 1.11 shows where you can maintain ordering costs in the material master.

![Figure 1.11 Storage Cost Indicator in the Material Master](image)

As storage costs can vary greatly based on the characteristics of the materials involved, you can configure many storage cost indicators in SAP, each one expressing a different storage cost percentage value. Figure 1.12 shows an example of a storage cost indicator configuration.

![Figure 1.12 Configuration of Storage Cost Indicator](image)

Many organization underestimate the total costs of holding inventory. Expert evaluations generally put these costs anywhere between 20% and 50%, though some go even higher. To determine your storage costs, you should look at your capital costs (including the investment in inventory), as well as your product types.

Many companies use a “rule of thumb” value of 25% for their carrying costs, meaning 25% of their on-hand inventory value is assessed as storage costs.
Another method of calculating the cost of carrying useful inventory is adding 20% to the current prime rate for borrowing money (i.e., if the prime rate is 7.5%, then the storage costs would be 27.5% (20+7.5)).

It is difficult to come up with precise figures for each of these costs, but the following estimates can be used:

- Capital costs: 15%
- Storage space costs: 2%
- Inventory service costs: 2%
- Inventory risk costs: 6%

So far, we have emphasized storage (carrying/holding) costs in order to illustrate the importance of the category, as it is the largest of all inventory cost categories. However, there is one more category that we need to address: stockout costs.

1.4.3 Stockout (Shortage) Costs

Stockout costs (sometimes also called shortage costs) are the costs that a company incurs when a stockout takes place. It expresses the economic consequences of not being able to meet internal or external demand from the current inventory. Such costs can, for example, occur if higher shipping costs have to be paid for a material that needs to be expedited, or if the cost of replenishment is higher because you have to switch to another, more expensive supplier. These costs can also be seen as relating to the loss of customer loyalty or the loss of reputation a company may suffer. While the cost of the latter examples may be difficult to pinpoint, other shortage costs can be determined very easily (i.e., you usually know the additional shipping charges, or can compare vendor prices).

Inventory costs are typically counter-balanced by the possibility of having stockouts by using a service level percentage when computing the safety stock level.

Stockout costs can be of an internal or external nature. Internal costs can be accrued for:

- Delays
- Labor time wastage
- Lost production (idle production line)

External costs can be accrued for:

- Loss of profit from lost sales
- Loss of future profit due to loss of goodwill
- Costs involved trying to minimize customer dissatisfaction (i.e., offering incentives)
- Penalties payable to customers for failure to deliver on time (if contractually agreed upon)

A stockout situation is a scenario that most dread, because it can come with a significant cost to the company if you must stop production or if a customer order cannot be fulfilled.

Calculating and knowing the cost of stockouts, on the other hand, will often result in the realization that inventory levels may need to be improved, and will show where such an improvement is needed.

The costs surrounding inventory are significant: most companies don’t really know how much it’s costing them to hold inventory, and it’s difficult to make a precise assessment. However, knowing these costs is important to making the correct supply chain decisions. It can also be key to receiving approval for inventory management initiatives that otherwise might be rejected.

The impact that inventory costs do have on any supply chain initiatives should never be underestimated. S.G. Timme and C. Williams-Timme expressed this notion best...

...When evaluating supply chain initiatives, companies often discount or even omit the benefits of reducing inventory noncapital carrying costs because they do not possess credible estimates of these costs. Most agree that the benefits exist. But without credible estimates, the benefits typically are excluded from the analysis. This practice is understandable. Nevertheless, if the impact on these costs cannot be reasonably measured, the true value of many supply chain initiatives will be understated.
1.5 Summary

Managing inventory operations and understanding basic inventory management terms requires certain core competencies, as inventory procurement, storage, and management is associated with huge costs related to each of these functions.

Understanding the movement type concept is important in SAP, as every movement is indicated by a movement type, and choosing the correct type for each inventory movement is crucial. It is also important to know the different types of inventory your organization holds, and how each type needs to be treated.

Lastly, assessing inventory costs is essential and has repercussions on the finances of every company, as well as on its management.

Knowing all of these inventory basics is the key to effective inventory management. Now that we have set the stage, we are ready to move on to the inventory business processes; to dive deeper into each process and look at them in more detail.
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