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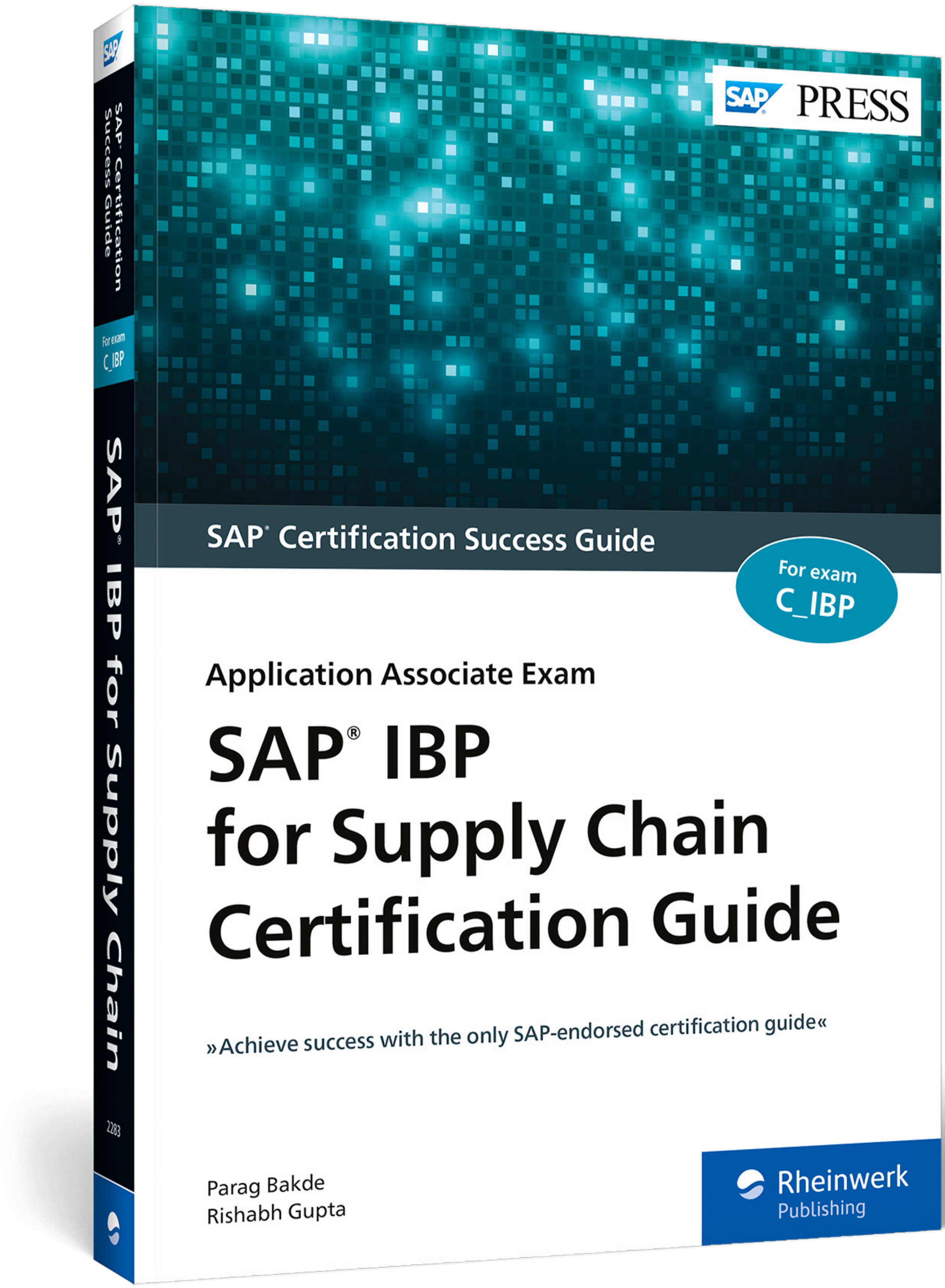

Reading Sample

In this chapter, you'll review a core functional area of the SAP IBP certification exam: inventory planning. You'll learn about multi-stage inventory optimization and test your knowledge with practice questions and answers.

Parag Bakde, Rishabh Gupta

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Chapter 3
Inventory Planning

Techniques You'll Master

- Keeping the right inventory at the right location and at the right time
- Understanding how an incorrect inventory position impacts your customer service level
- Calculating supply and demand variability to arrive at an optimized inventory plan and understanding the different factors within your supply chain that impact demand variability
- Understanding how SAP Integrated Business Planning for Supply Chain (SAP IBP) leverages multistage algorithms to arrive at safety stock values within your supply chain
- Positioning inventory correctly within your supply chain to attain the desired customer service level

This chapter covers all certification-relevant topics for the inventory planning process in SAP IBP for inventory. We'll describe the different steps and processes that you'll execute in the system to arrive at an inventory plan.

Inventory planning is a business process finds the right inventory mix to keep at a node in your supply chain. Planners need to balance the right mix of customer satisfaction and inventory cost to arrive at the right inventory. SAP IBP for inventory provides a platform for performing inventory planning in an optimized way to help fix the mix of inventory within the entire supply chain network.

Real-World Scenario

As a consultant, you'll need to understand the underlying features and functions of SAP IBP for inventory as an inventory planning solution, and you must be comfortable explaining this technology to your customers in simple terms. In an ideal world, a company wouldn't need inventory. When demand comes in, the vendor would supply raw material on time, the manufacturing plant would produce the product on time, and we would ship the product to customers on time and thus meet customer demand. In reality, you're dealing with variability, and to handle variability in raw materials and production, you'll need an inventory buffer at each node within your supply chain to meet customer demands on time. But how much inventory you should keep at each node? Do you need to keep inventory at each node, or is keeping inventory only at a customer-facing node enough? Can you handle this problem through flexibility in your manufacturing or logistics process? Another way of looking at this problem is that someone or something must wait, whether that's assets or logistics waiting to be expedited or engaged, inventory waiting for a customer order, or customers waiting for a delivery.

Thus, as a business, we are always making tradeoffs and must realistically balance between flexibility, inventory, and customer service. The *right* answer is almost always a combination of all three. We need to deploy inventory targets across the supply chain, meeting service level objectives at the lowest cost. If you cannot achieve the right balance and deploy too much inventory, your finance department won't be happy. If you don't have enough inventory, you cannot fulfill orders; thus, customers are unhappy. If you have right inventory but at wrong place, your supply planners are unhappy. Therefore, you need an advanced optimization algorithm, such those found in SAP IBP for inventory, that can provide the optimal calculation and information needed to decide where the balance of inventory should reside for your organization.

3.1 Objectives of This Portion of the Test

The purpose of this portion of the certification exam is to test your general knowledge on the inventory planning process in SAP IBP for inventory.

The certification exam expects you have a good understanding of the following topics:

- Overview of inventory planning techniques for safety stock
- Different components of inventory planning
- How to calculate demand and supply variability as an input for inventory planning
- Inventory planning with multistage algorithms
- Inputs and outputs for multistage inventory planning

Note
The topic of SAP IBP for inventory planning makes up around 8% of the total exam.

3.2 Inventory Planning Basics

In the real world, you're constantly dealing with uncertainty, and to deal with uncertainty within your supply chain, you need inventory. You'll also need a consistent, reliable, and optimal cost model so that the right decisions can be made. The following questions are important to ask:

- Should you handle variability and uncertainty by simply having inventory in stock?
- Should you handle variability and uncertainty through flexibility in manufacturing or logistics or expenditures?
- Do you require customer flexibility in service levels (or do we make them wait)?

Figure 3.1 shows how businesses must make tradeoffs, or more realistically, strive toward a balance between flexibility, inventory, and customer service. SAP IBP for inventory helps position the right amount of inventory within your supply chain with the objective of maintaining the end service level for your customer. While calculating the right inventory at each node, SAP IBP will consider demand and supply variability across your entire supply chain. Before we dive more deeply into multistage inventory optimization, let's try to understand some basic concepts behind inventory planning.

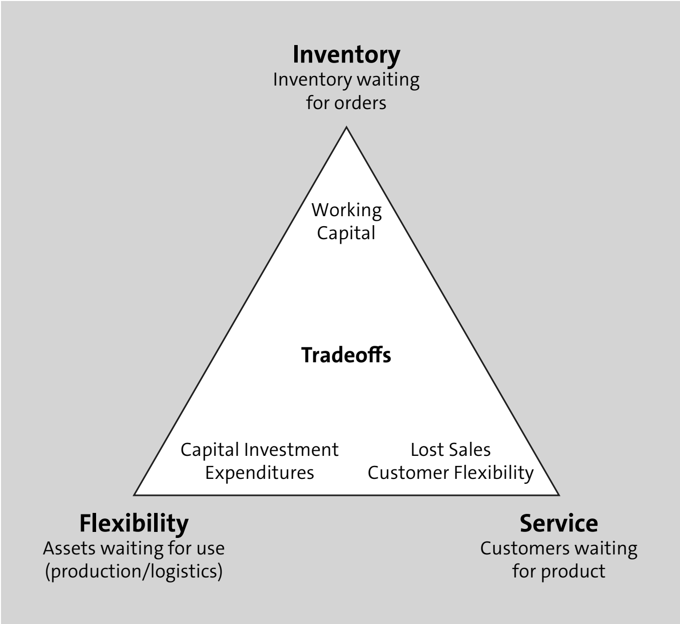

Figure 3.1 Inventory Balance

3.2.1 Inventory Planning Elements

Let's look at how an inventory planning process would work in an ideal world. Typically, in a planning process, you would start with demand planning and then create a supply plan against that demand, but between the demand plan and the supply plan, you must have an inventory strategy to help decide how much inventory you'll keep at each node. Once you have these numbers, then you can execute your supply plan or your material requirements planning (MRP) run, which will consider inventory as one demand element and ensure that the right inventory is maintained.

So, what's included in an inventory strategy? First, you'll need to define the following planning elements for a material:

- **MRP type**
  The MRP type is typically defined within an execution environment and essentially determines how and when a material is to be planned or to be made available for fulfilling a requirement. For example, a material of MRP type PD will be considered by an MRP run for planning and triggering a procurement proposal after the net requirements calculation is complete, also called *cycle planning*. For a material of MRP type VM, the system will calculate the reorder point and the safety stock using the past historical consumption data to derive future consumption patterns where the reorder point can be automatically calculated by the system.

- **Replenishment lead time**
  A replenishment lead time represents the total period of time required to procure or manufacture an item.
- **Lot or batch size**
  The lot or batch size essentially determines the order quantity for an order whenever they are placed for replenishment.
- **Safety stock and reorder point level**
  Safety stock is the minimum inventory level typically maintained to account for uncertainty in your supply chain. As soon as stock drops below the cycle stock level, an order is placed for products according to an automatic reorder point level so that you never need to dip into safety stock.

One of the most important elements for inventory planning is stock. Several types of stocks may exist in an inventory planning strategy:

- **Safety stock**
  The stock for products, materials, or raw materials typically used when the actual demand exceeds a sales forecast or if production output is less than planned. Seasonal supply and demand fluctuations may require that your organization hold safety stock at certain times throughout the business cycle. Likewise, geographic remoteness or the distance between your business and its suppliers could reduce the frequency of deliveries or necessitate longer lead times.
- **Cycle stock**
  The products, materials, or raw material ingredients that a company keeps for fulfilling its minimum production quotes. Cycle inventory is crucial to an organization because regular business operations use or "cycle" the inventory frequently. Managing cycle inventory effectively will help organizations ensure that the customer demand is meet with high-quality products.
- **Pipeline stock**
  The products, materials, or raw materials that are in transit between the various locations of your supply chain. Maybe the inventory is on its way to a factory from a large distributor, where it will be turned into finished goods inventory or on its way from a factory to a retailer to become merchandise inventory. The point to emphasize is that all pipeline stock has yet to reach its final destination.

3.2.2 Inventory Planning Methods

Two main methods for inventory planning exist, which we'll discuss in this section. The first method of inventory planning is cycle planning. Figure 3.2 shows cycle planning using safety stock, which requires the following setup:

1. The period between review parameter is defined.
2. An order schedule is assigned for each product. The product plan in created on a schedule.

3. On the day of an order, automatic cycle planning is performed according to the following formula:

   Requirement = Demand during period of the lead time and planning cycle + Safety stock – On-hand stock – Pipeline stock

Using cycle stock has certain advantages and disadvantages. One advantage is that it will reduce labor costs for requests and deliveries to be met according to schedule. Your organization can balance resources for production, transportation, storage, and procurement across weeks and months. One disadvantage is that the order is only placed on a specific planned day, and it is required to define and set the period between reviews.

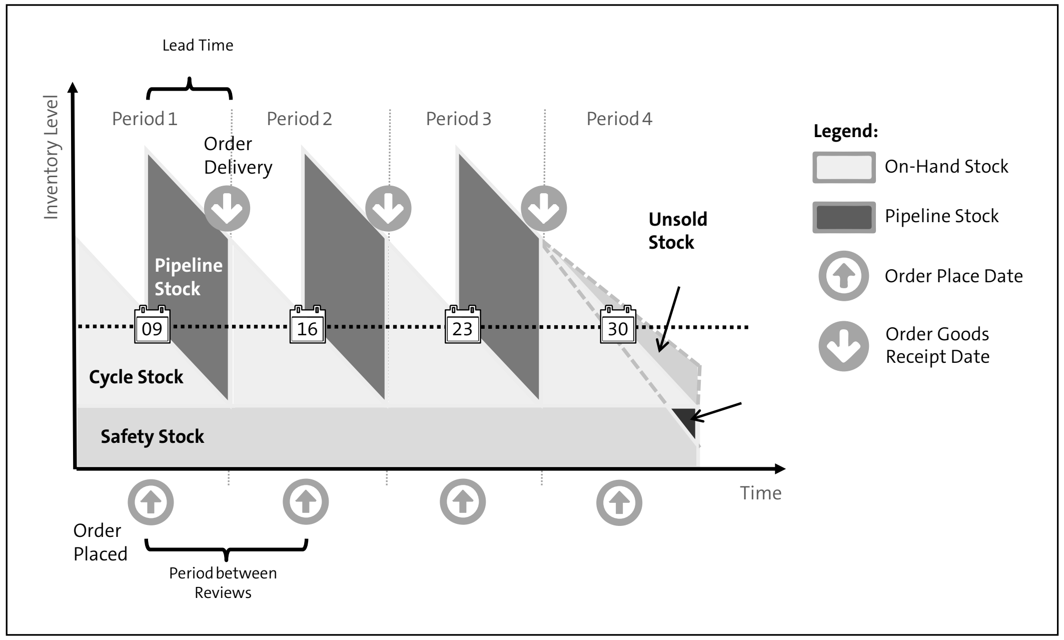

Figure 3.2 Cycle Planning Using Safety Stock

The second method of inventory planning is continuous review planning using a reorder point, as shown in Figure 3.3. Within continuous review planning, a reorder point parameter is defined. Orders are created as soon as the current stock plus the pipeline stock drops below the level of the reorder point. Automatic planning with reorder points is carried out according to the following formula:

Reorder point = Safety stock + Demand during lead time

Requirement = Order point – On-hand stock – Pipeline stock

Some advantages with the reorder point method are that the material is ordered on the same day that the stock falls below the reorder point and that typically the delivery size is fixed and equal to the lot size. Disadvantages include high labor costs for daily inventory review and that organizations must define and maintain lot sizes.

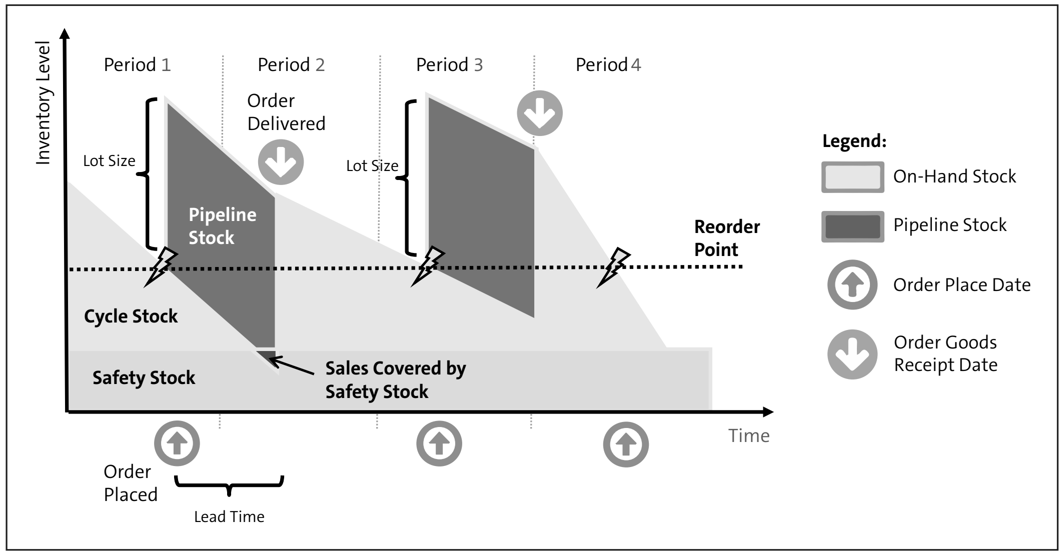

Figure 3.3 Continuous Review Planning Using Reorder Points

3.2.3 Inventory Demand Patterns

Organizations often carry many different kinds of products that follow different demand patterns, and thus, segmenting your products for inventory planning is important. Your inventory could be managed much like your refrigerator, where various products are managed according to different inventory and product/procurement principles in the following ways:

- **Uneven (lumpy): Refrigerator light bulb and cooling element (manual reorder point)**
  - If the light bulb in your fridge blows, or the cooling element breaks, we must buy new spare parts.
  - Predicting when the light bulb will blow is impossible, and getting a new bulb immediately might be difficult.
- **Erratic: Eggs and pasta (automatic reorder point)**
  - Occasionally, we buy eggs and pasta when we go shopping.
  - We monitor our inventory and make purchases accordingly.
- **Intermittent: Champagne and strawberries (make-to-order planning)**
  - We only buy champagne and strawberries for special occasions.
  - These products are too expensive and/or too perishable to keep as standard products in the fridge, so we only buy them for special occasions.

- **Stable: Milk and bread (cycle planning)**
  - We buy milk and bread every time we go shopping.
  - The demand is stable, and the likelihood that the product will expire before use is low.

The same principles can be applied when classifying products within your organization. One example of classification is the segmentation of products into groups based on demand variations (coefficients of variation [CVs]) and frequency of demand. SAP IBP for inventory offers a standard ABC/XYZ segmentation functionality to classify products. Figure 3.4 shows how products can be segmented based on demand variability and demand volume or cost.

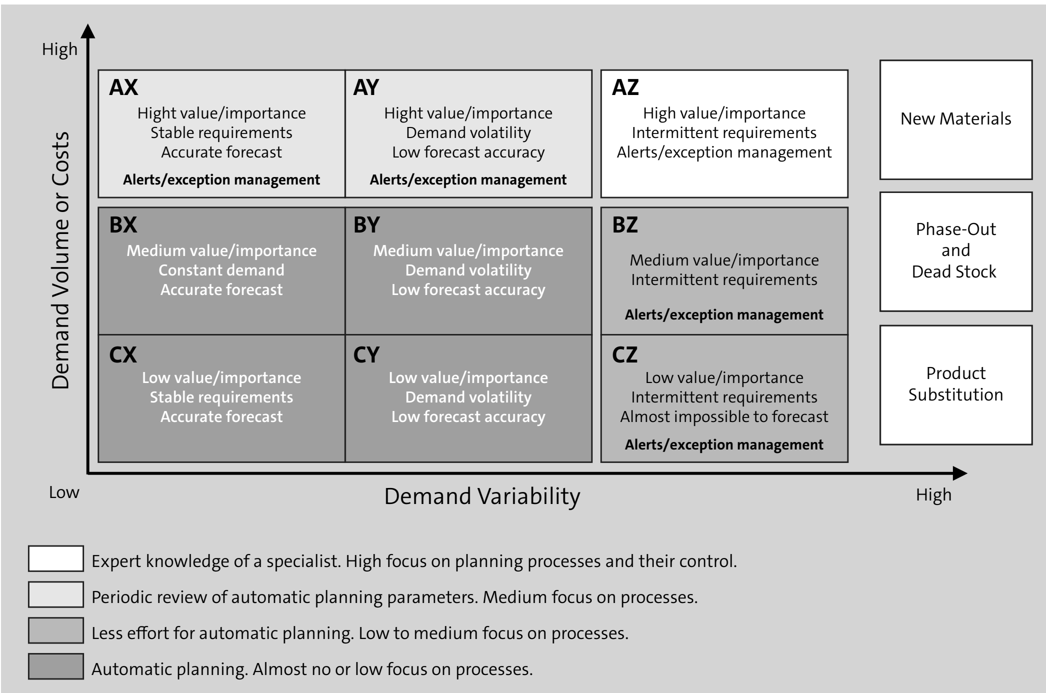

Figure 3.4 Product Segmentation

For example, a product that falls in the top-right corner of Figure 3.4 is of high value but has intermittent requirements—perhaps a new material introduced on the market. Expert knowledge from a specialist might be required for planning. In contrast, a product that falls in the lower-left corner features less demand variability and can be set up with automatic planning with almost no or low focus on the planning process.

3.2.4 Inventory Planning Drivers

For inventory planning with SAP IBP, five key drivers make up the following formula:

Target stock = Safety stock + Cycle stock + Pipeline stock + In-process stock + Vendor in-transit stock

Let's walk through each driver:

- *Safety stock* is driven by total propagated demand uncertainty through the exposure period, which includes lead time and period between review. Internal service level and lot size are additional parameters that drive safety stock.
- *Cycle stock* is driven by total propagated demand over replenishment frequency (period between review) and lot size.
- *Pipeline stock* is driven by total propagated demand over the length of internal sourcing lead time (internal transportation) and lot size.
- *In-process stock* is driven by total propagated demand over the length of manufacturing lead time and batch size.
- *Vendor in-transit stock* is driven by total propagated demand over the length of transportation lead time sourced from a vendor and lot size.

3.3 Demand and Supply Variability

In the real world, things work unexpectedly. Demand will be volatile, your supply may not fulfill inventory on time, and your production may face challenges in adhering to the production plan, all of which creates great uncertainty within your supply chain. To take care of such uncertainties, having enough safety stock is key. Let's consider a simple example of a main distribution center (DC) where we have demand from customers and from regional distributors, while the supply is coming from a supplier and from manufacturing plants.

Figure 3.5 shows that the demand side is not completely predictable. Multiple factors can impact demand, such as the following:

- You might simultaneously have an internal demand from a regional warehouse and an external demand from customers.
- You might have forecasted demand, but every forecast has forecast errors.
- Demand may follow various patterns (such as seasonal, trend, or intermittent demand patterns).
- Your customer-facing DC or warehouse will need to maintain specific service levels or fix inventory thresholds.
- Your forecast might have a consistent over- or under-forecasting bias.
- In certain cases, your demand might have outlier values due to promotions or some unknown factor.

Supply chains should consider all these factors to handle demand variability.

Similarly on the supply planning side, Figure 3.5 shows multiple factors that you must consider based on the source of supply (either in-house manufacturing or procurement from a supplier). Various factors that will impact your supply include the following:

- Procurement lead time from a supplier or a warehouse location
- Late supplies or delays in procurement from a supplier or a warehouse location
- Production or distribution batch or lot size
- Multiple sources of supply based on various parameters such as seasons
- Time-varying bills of material (BOMs) or product substitutions

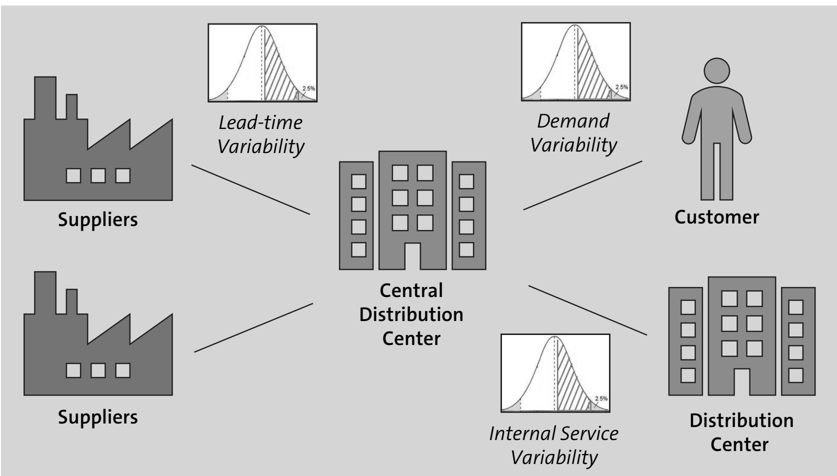

Figure 3.5 Uncertainty in Demand and Supply

We've listed various factors impacting demand and supply variability at an individual node within a supply chain, but imagine you have multiple nodes in your supply chain. Then, the cumulative effect of all these factors is multiplied. More often than not, supply chains are complex and have multiple nodes, and thus, the variability and uncertainly at every point in an enterprise-wide supply chain are linked. SAP IBP for inventory's approach is to have safety stock buffers to account for all possible forms of uncertainly in your supply chain.

3.4 Multistage Inventory Optimization

An important function of SAP IBP for inventory is the optimization of your inventory, also referred to as the *safety stock calculation*. In this section, you'll learn how the traditional approach to safety stock calculation has been optimized in SAP IBP for inventory via a multistage approach. We'll walk you through the key calculations in a multistage approach and discuss its associated formulas.

3.4.1 Traditional Approach for Safety Stock Calculation

Before we dive more deeply into multistage inventory optimization, let's first understand how safety stock is calculated in the traditional approach and explore the disadvantages of this approach. Within the traditional approach, demand variability is first calculated. The average sales over the historical period and the corresponding variability of actual consumption from the average are calculated. Then, you'll apply the idea that safety stock is needed to cover variations in consumption. The required safety stock depends on the boundaries of the variation. The boundaries determine what share of sales must be covered by safety stock. These boundaries relate to the target customer service level.

Figure 3.6 shows the traditional approach. Note how demand variability is calculated by leveraging a normal distribution curve. Products are analyzed based on sales data and compared to the forecast.

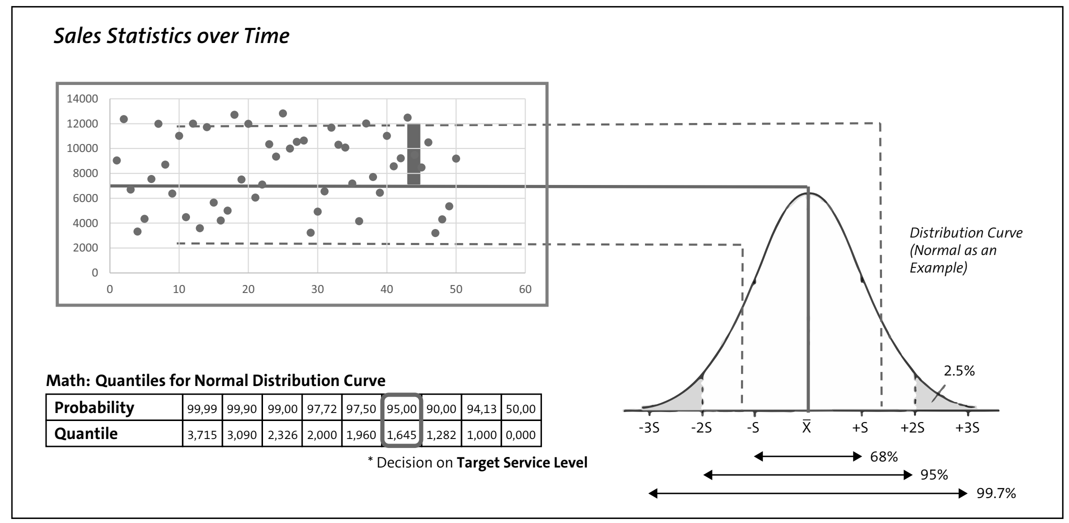

Figure 3.6 Traditional Safety Stock Calculation

Additionally, target service levels for each product and customer are defined. Based on these two inputs, safety stock is calculated with the following formula:

$$Safety\ stock = z * \sigma * \sqrt{LT}$$

Note

This equation uses the following variables:

- LT: Lead time
- z: Probability factor for target customer service level
- σ: Sales variability (standard deviation)

While using the standard formula for safety stock, several disadvantages should be noted:

- The standard formula will only consider a single node when calculating safety stock.
- The formula does not consider supplier reliability.
- Standard safety stock is not time dependent.
- The formula uses a normal distribution statistical function that may be unsuitable for all kinds of demand (such as intermittent demand).

3.4.2 Multistage Approach for Safety Stock Calculation

To address the challenges faced during traditional single-stage optimization, SAP IBP for inventory offers multistage optimization. Multistage optimization in SAP IBP for inventory will find the optimal service level, with the minimum total safety stock overall, within the whole supply chain across different locations and BOM levels to meet the target customer service level.

The left side of Figure 3.7 shows the traditional approach where the planner inputs the service level as one of the parameters at each node within the supply chain. The system will then calculate the safety stock and cycle stock at each node with the objective of maintaining a service level at the end node as well as for the internal nodes supplying the end node, ultimately increasing the total inventory in the supply chain.

With the multistage algorithm shown in Figure 3.7 on the right side, you only need to input the service level for the final customer-facing node, and the system will recommend the service levels for the other internal nodes with the objective of maintaining the service level at the end node, ultimately reducing the total inventory located at various nodes in your supply chain.

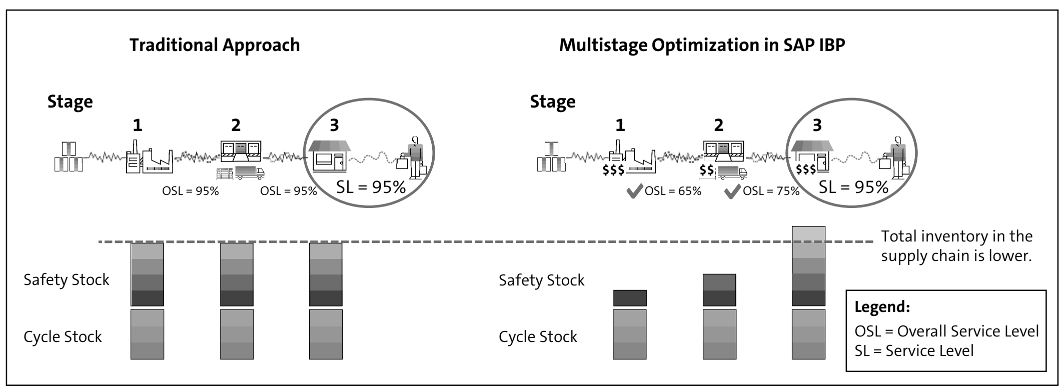

Figure 3.7 Traditional and Multistage SAP IBP Optimization

SAP IBP for inventory leverages gamma probability distribution when calculating future demand to describe the probability of the distribution of demand over the

exposure period, which includes the delivery period and the planning cycle. Using gamma distribution allows you to model demand patterns accurately and precisely. Some characteristics of a gamma distribution model include the following:

- A Gaussian distribution is a special case of a symmetric gamma distribution.
- A gamma distribution can be symmetrically/asymmetrically skewed.
- The demand described by a gamma distribution is always positive and continuous.
- An exponential distribution is a good approximation of the intermittent demand usually needed for slow-moving items.

Safety stock calculation is primarily focused on forecast error and service level targets. The forecast error is modeled using gamma distribution, which can be asymmetric or symmetric. If symmetric, then a normal distribution can be used in the calculation. As shown in Figure 3.8, gamma distribution was selected to improve the accuracy of the inventory targets for items with lumpy demand, items with intermittent demand, and for slow-moving items.

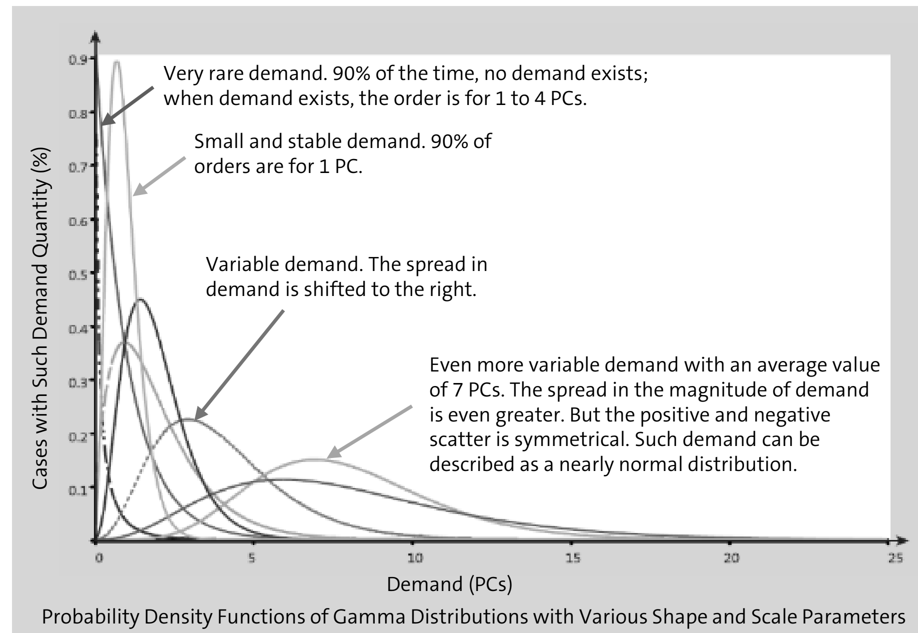

Figure 3.8 Gamma Distribution

3.4.3 Demand Uncertainty Calculation

You can incorporate demand uncertainty into safety stock calculations in two ways:

- **Review the demand history based on the average of actual sales**
  In this scenario, safety stock is at risk if the delivery is more than the average sale. Safety stock is also a fixed number throughout the time horizon and

doesn't vary with changes in forecasting. The CV is calculated by the difference between the average of actual sales compared to actual sales.

- **Review the demand history based on the forecast**
  In this scenario, safety stock is at risk if the delivery is more than the forecast quantity. The advantage over the previous method is that the safety stock varies per period, following the forecast. The CV is calculated by the difference between the sales forecast and actual sales.

To optimize safety stock, additional processing and classification steps are performed when calculating the forecast error CV in SAP IBP for inventory, via the Manage Forecast Error Calculations app. Within the forecast error calculation profile, you can input key figures based on which the forecast variability will be calculated, such as **IO Sales** and **IO Demand Forecast**, as shown in Figure 3.9. You also have the flexibility to select a forecast error method, such as mean absolute percentage error (MAPE) or mean absolute deviation (MAD), based on which the CV is calculated. Further, you can define an output key figure where the result will be stored, for instance, **IO Historical Forecast Error CV**.

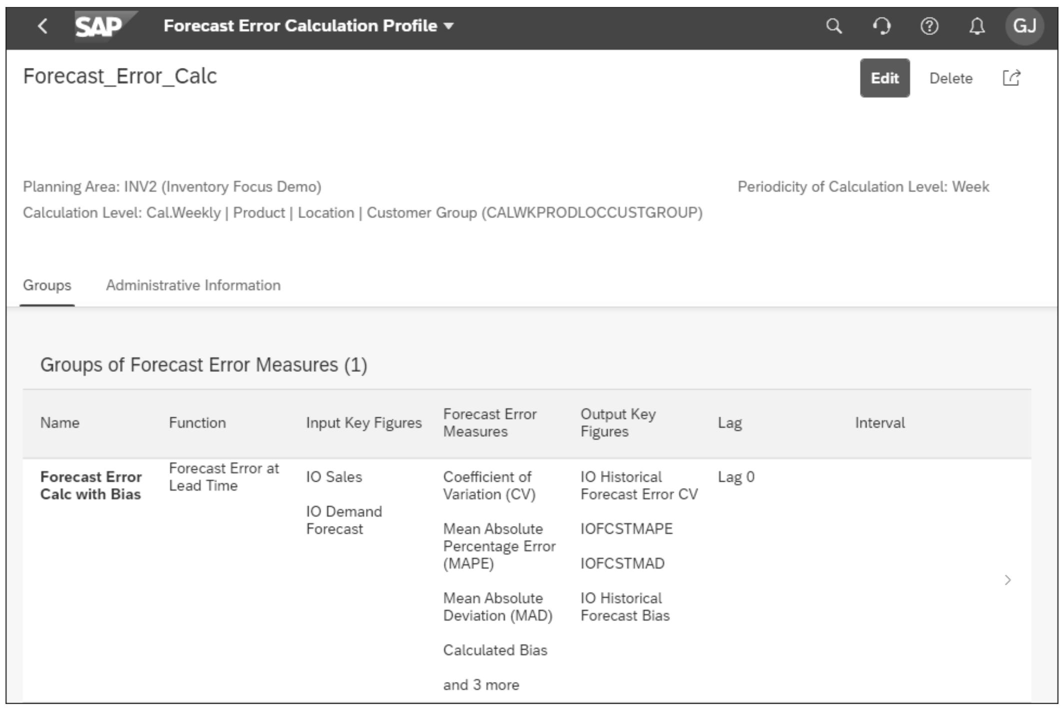

Figure 3.9 Forecast Error Calculation Profile

Key parameters to configure for this calculation include the following:

- Time periods in the past (offset used for time periods)
- Default CV value and maximum CV value
- Replace null value by zero

- Exclude outliers from forecast error
- Adjust bias of forecast
- Consider intermittency of sales history
- Basis of percentage error

3.4.4 Lead-Time Uncertainty Calculation

Another key input to calculate safety stock with SAP IBP for inventory is lead-time uncertainty, which may include uncertainty in procurement, production, and transportation lead times. For example, as shown in Figure 3.10, a delta value must be calculated based on the lead time (based on master data) compared to the actual lead time (based on a goods receipt for a shipment or an actual production order completion date).

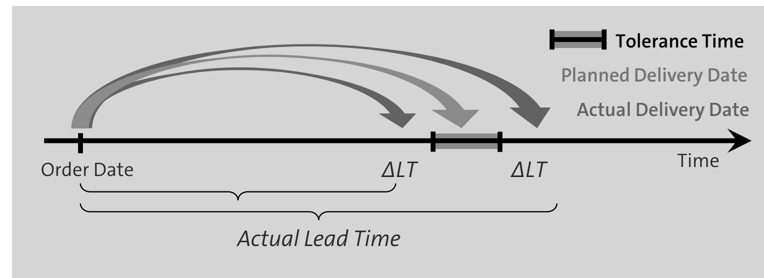

Figure 3.10 Lead-Time Variability

The lead-time CV is an input parameter for safety stock calculation in SAP IBP for inventory. The following factors are considered when calculating the lead-time CV:

- You must have enough orders in the past to perform lead-time CV calculation.
- If not enough orders are available, then user-provided values can be leveraged.
- Outlier detection considers both planned and actual lead times.
- The calculation for actual lead-time mean and lead-time CV uses the following formulas:
  Planned LT = Delivery date – Create date
  Actual LT mean = Maximum (GR dates) – Create date
  LT delta = abs (Planned LT – Actual LT mean)
  Lead-time CV = σ(LT delta) / average (Actual LT mean)

As shown in Figure 3.11, to calculate lead-time variation, you'll need enough purchase orders. If enough purchase order records are available, then you can calculate the lead-time variation based on actual lead time and shipment information. However, if a sufficient number of purchase orders is not available, then you must provide lead-time variability so that SAP IBP can generate a safety stock recommendation.

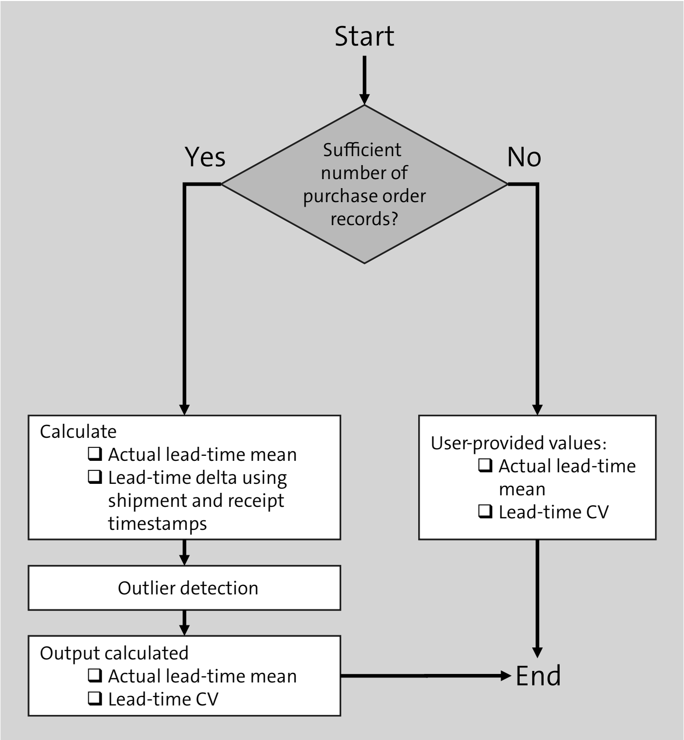

Figure 3.11 Lead-Time Calculation

3.4.5 Customer Service Levels

Our primary goal when calculating safety stock is to maintain customer service levels. But a key question is what customer service level you should target. The higher the customer service level you're targeting, the higher the inventory you'll need to maintain within your supply chain. Thus, an optimum level should be targeted based on your organization's goals. How can you measure achieving the customer service levels you are striving for?

You can measure customer service levels in two ways:

- **Quantity driven (fill rate)**
  The fill rate is the percentage of product demand fulfilled from the current inventory. The fill rate is calculated over a specific volume of demand rather than over time. For example, out of 1,000 units ordered by customers, 650 units may have been fulfilled from inventory on hand, so the fill rate is 65%.

  With SAP IBP for inventory, the setting for this service level type is F, also known as the *β service level*. Usually, the β service level is utilized within service-related opportunity cost. This service level accounts for partial deliveries and is related to some basic key performance indicator (KPI) definitions, such as fill rate and on time in full (OTIF).

  To calculate an β service level, you'll need to calculate the fill rate. In the example shown in Figure 3.12, out of the 150 PCS that were ordered, you were able to fulfill 142 PCs, and thus, the β service level is 94.6%. The following formula was used for this calculation:

  $$\beta\ service\ level = \frac{Total\ volume\ of\ orders\ supplied}{Total\ demand\ ordered}$$

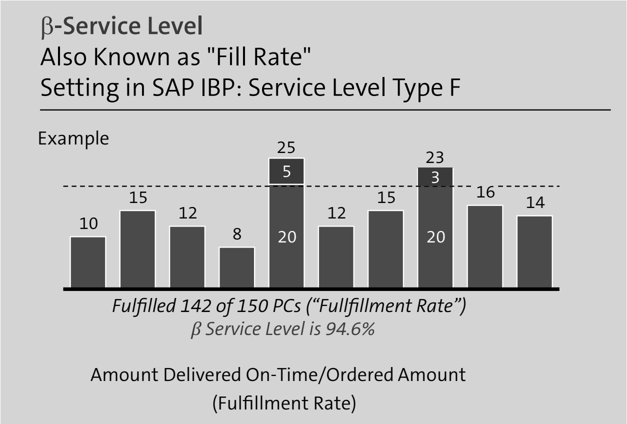

Figure 3.12 β Service Level

- **Event driven (order fill rate)**
  The order fill rate, also known as the *non-stockout probability (NSP)*, is the percentage of customer orders delivered in full from the available inventory. The order fill rate is calculated over a specific volume of customer orders received. For example, out of 1,000 orders received, 200 orders were fulfilled from the inventory on hand, so the order fill rate is 20%.

  In SAP IBP for inventory, the setting for this service level is A, also known as the *α service level*. Usually, the α service level does not provide much information about the duration of stockout or back log volumes. This calculation does not consider order queues or partial deliveries and is often used when backorders cannot be processed.

  To calculate the α service level, you must calculate the order fill rate for customer orders. In the example shown in Figure 3.13, out of 10 orders, 2 orders were incomplete or unfulfilled, and thus, the α service level is 80%. Calculating the α service level uses the following formula:

  $$\alpha\ service\ level = \frac{\#\ of\ cycles\ with\ no\ stockouts}{Total\ \#\ of\ cycles}$$

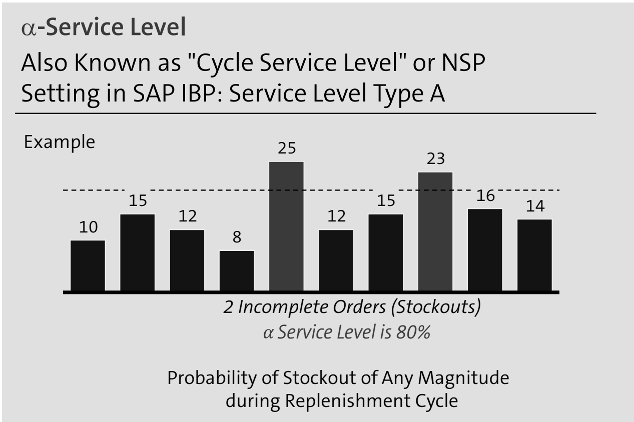

Figure 3.13 α Service Level

Table 3.1 shows an example of how the different service level types can impact the inventory level.

Period	Order Quantity	On-Hand Quantity	Percentage of Demand Met (Fill Rate)	Whether Demand Is Met Entirely (NSP)
1	1,000	1,000	100%	Yes
2	2,500	2,500	100%	Yes
3	3,000	2,500	83.3%	No
4	2,000	2,000	100%	Yes
5	0	0	100%	Yes
6	1,000	1,000	100%	Yes
7	1,500	1,500	100%	Yes
8	4,000	2,500	62.5%	No
Average			93%	75%

Table 3.1 Service Level Impact

Table 3.1 shows an example comparing the fill rate and NSP service level approaches. The modeling graph in Figure 3.14 shows that the equal stock of 200 may be triggered by a 90% fill rate or by a 50% NSP.

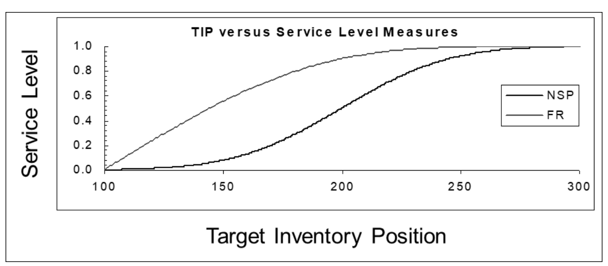

Figure 3.14 Target Inventory Position versus Service Level Measures

3.4.6 Multistage Safety Stock Formula

Now that you understand the traditional safety stock calculation, including its underlying concepts like demand uncertainty, lead-time uncertainty, and customer service levels, let's look at the formula in SAP IBP for inventory for the reconstruction of safety stock, as shown in Figure 3.15.

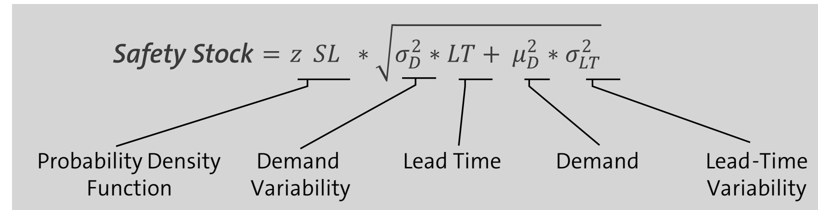

Figure 3.15 Multistage Safety Stock Calculation

This formula considers lead-time variability but does not consider lot sizes. SAP IBP for inventory does not rely on a simple relationship or a rule of thumb but rather uses a complex supply chain model and mathematical optimization to find the lowest cost inventory targets that meet the desired customer service levels. Based on the method you choose to calculate the customer service level (NSP or fill rate), your safety stock might vary.

3.5 Inventory Inputs and Outputs

To calculate safety stock with SAP IBP for inventory, some operations must be executed in sequence, as shown in Figure 3.16. First and foremost, the forecast error is calculated, which will act as an input in the global multistage inventory optimization process. Once the safety stock for finished products is calculated from global multistage optimization, then the last step is to calculate the target inventory for the required components.

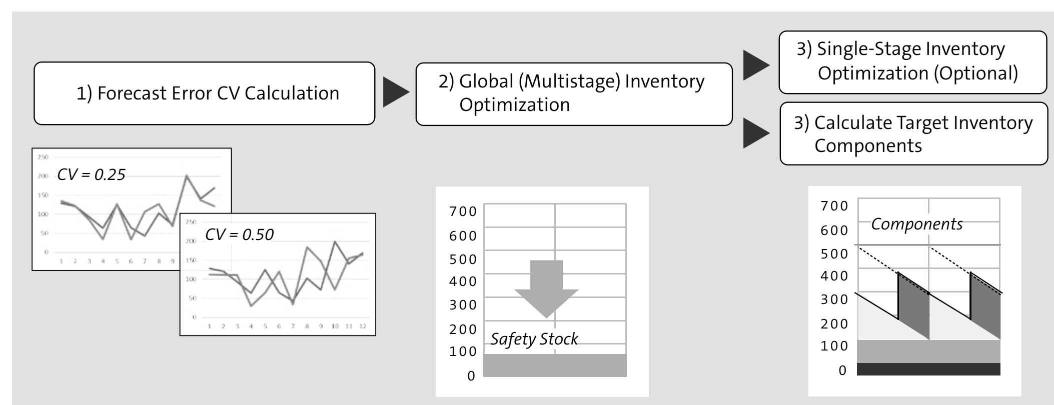

Figure 3.16 Relationships among Various SAP IBP for Inventory Operators

Let's walk through this sequence in more detail:

1. **Calculate forecast error CV operator**
   This operator calculates the forecast error CV and other error measures from the historical demand forecast and the actual historical demand. These outputs can serve as key inputs to the global (multistage) inventory optimization operator, which has the following capabilities:
   – Calculates values for the scope defined by planning filters or Microsoft Excel view filters
   – Allows for flexible operator settings to adjust the forecast error CV
   – Enables you to specify a past time horizon over which CV will be calculated
   – Inputs planning levels at which CV will be calculated
   – Uses the sales order as an input key figure and the CV as an output key figure
   – Allows adjustments in calculation method (MAD versus MAPE), in forecast bias, in outlier detection, and more
2. **Global (multistage) inventory optimization operator**
   This operator will optimize safety stock globally and simultaneously across all products and locations in your supply chain while considering demand uncertainty, supply uncertainty, supply quantities, lead times, costs, and service levels. Figure 3.17 shows the flow for a multistage inventory optimization process, which has the following capabilities:
   – Propagates forecast and forecast variability to internal (upstream) nodes of a supply chain network
   – Propagates forecast and forecast variability to stocking nodes that have customer demand
   – Optimizes internal service levels between internal (upstream) nodes of your supply chain network
   – Calculates safety stock targets, backorders, and average expedited quantities
   – Calculates values for your whole supply chain network

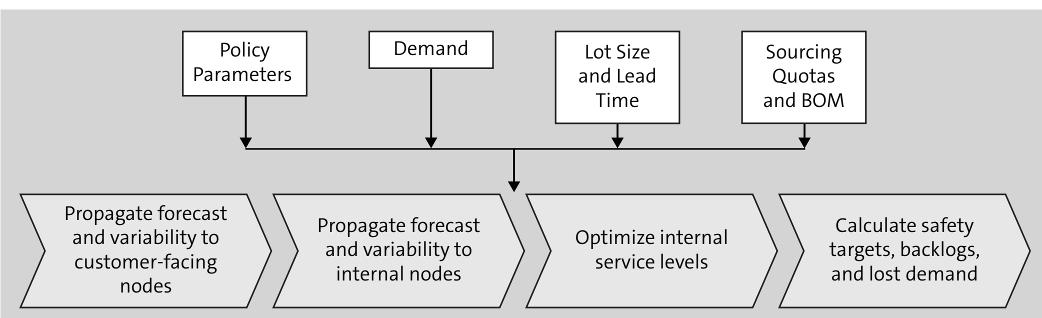

Figure 3.17 Global Multistage Inventory Optimization

3. **Calculate target inventory components operator**
   This operator will calculate target inventory components, as shown in Figure 3.18. Recommended safety stock, cycle stock, and pipeline stock are various component of target inventory. This operator has the following capabilities:
   – Runs a calculation with respect to optimal inventory targets
   – Estimates targets, average quantities and currency values of the inventory position, on-hand stock, cycle stock, pipeline stock, and merchandising stock
   – Supports minimum stock requirements and cost per unit as inputs
   – Calculates the reorder point and the days of supply for recommended safety stock and for on-hand stock (target, average, and end of period)
   – Calculates values for the entire network

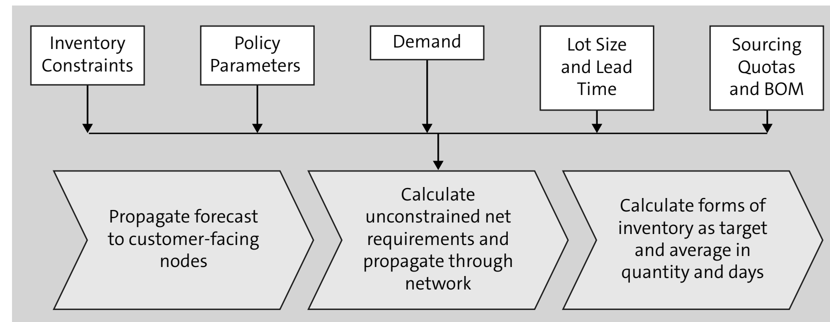

Figure 3.18 Target Inventory Component Operator

4. **Decomposed (single-stage) inventory optimization operator**
   In certain cases, you want to see the impact of multistage inventory optimization with changes in inputs at a certain location. To handle such a requirement, the single-stage inventory optimization operator can be executed, which will recommend the safety stock only for the executed location without the taking variability of the entire supply chain into account. Figure 3.19 shows the single-stage optimization process flow, which has the following capabilities:
   – Ideal for running simulations where you want to determine the impact on recommended safety stock for local changes to input key figures
   – Optimizes recommended safety stock locally for any combination of product and location
   – Requires a successful run of the global multistage inventory optimization operator
   – Calculates values for a scope defined by the planning filters or Microsoft Excel view filters
   – Additionally useful for producing missing data when you have an individual customer-facing node of the supply chain with incomplete inventory data

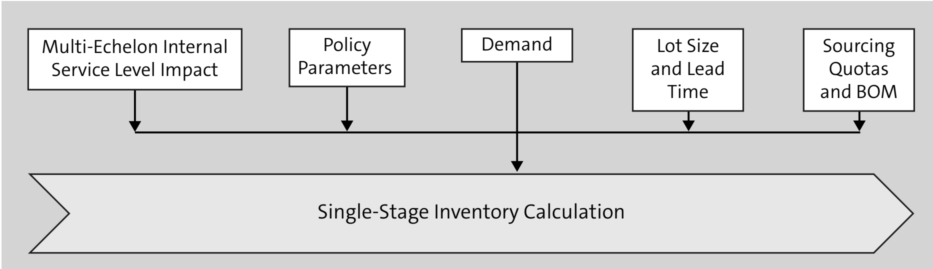

Figure 3.19 Single-Stage Inventory Optimization Operator

3.6 Key Terminology

The following terminology relevant to SAP IBP for inventory is important for the exam:

- **Customer service level**
  Customer service level is a key input to SAP IBP's inventory optimization algorithms. Based on the desired service level, the safety stock will be calculated. The greater the service level, the greater the recommended safety stock.
- **Cycle stock**
  The stock for products, materials, or raw material ingredients that a company keeps to fulfill minimum production quotes.
- **Demand variability**
  Demand variability is the variability that occurs between the forecasted quantity and the actual sales order.
- **Lead-time variability**
  Lead-time variability is the variability that occurs on the supply side. This variability could be related to a supplier not delivering by agreed dates or related to production not operating on schedule.
- **Multistage inventory planning**
  Multistage inventory planning is an algorithm that considers demand and supply variability across an entire supply chain and then calculates the right safety stock for each node to achieve the desired service level for the end customer.
- **Pipeline stock**
  The stock for products, materials, or raw materials that are in transit between the different locations of a supply chain.
- **Safety stock**
  The stock for products, materials, or raw materials typically used when the actual demand exceeds a sales forecast or if the production output is less than planned.

- **Single-stage inventory planning**
  Single-stage inventory planning is an algorithm that considers demand and supply variability one node at a time within your supply chain and then calculates the safety stock for that node to achieve the desired service level for the node.

3.7 Practice Questions

These practice questions will help you evaluate your understanding of the topics covered in this chapter. The questions shown are similar to those found on the certification examination. Although none of these questions will be found on the exam itself, they will allow you to review your knowledge of the subject. Select the correct answers and then check the completeness of your answers in the next section. Remember that you must select all correct answers on the exam and select only correct answers to receive credit for the question.

1. Which of the following are stock types for inventory planning? (There are three correct answers.)

☐ **A.** Safety stock
☐ **B.** Cycle stock
☐ **C.** Pipeline stock
☐ **D.** Projected stock

2. SAP IBP for inventory will assist organizations in managing supply chain uncertainty. True or false?

☐ **A.** True
☐ **B.** False

3. Which of the following are the three main outputs calculated by SAP IBP for inventory? (There are three correct answers.)

☐ **A.** Recommended safety stock
☐ **B.** Projected stock
☐ **C.** Reorder point
☐ **D.** Customer service level
☐ **E.** On-hand stock

4. Which of the following is *not* a type of uncertainty that can be modeled in SAP IBP for inventory?

- ☐ **A.** Demand variability
- ☐ **B.** Lead-time variability
- ☐ **C.** Production variability
- ☐ **D.** External service level variability

5. The multistage algorithm will consider demand supply variability at each node to come up with the right safety stock at each node. True or false?

- ☐ **A.** True
- ☐ **B.** False

6. What are the key inputs for the multistage inventory planning algorithm? (There are three correct answers.)

- ☐ **A.** Demand variability
- ☐ **B.** Supply variability
- ☐ **C.** Customer service level
- ☐ **D.** Internal service level
- ☐ **E.** Safety stock

7. Within an enterprise planning cycle, the output of an inventory planning process can serve as an input to which of the following planning cycles?

- ☐ **A.** Demand planning
- ☐ **B.** Supply planning
- ☐ **C.** Sales planning
- ☐ **D.** All of the above

8. After multistage inventory planning, safety stock might be increased at some stocking locations. True or false?

- ☐ **A.** True
- ☐ **B.** False

9. SAP IBP for inventory will help to calculate safety stock for which of the following material types?

- ☐ **A.** Finished goods
- ☐ **B.** Semifinished goods
- ☐ **C.** Raw materials
- ☐ **D.** All of the above

10. SAP IBP's multistage inventory algorithm can help organizations reduce overall inventory levels within their supply chains while maintaining the desired customer service levels. True or false?

- ☐ **A.** True
- ☐ **B.** False

11. Which forecast error method can be used currently in SAP IBP to calculate the coefficient of variation (CV) for demand variability? (There are two correct answers.)

- ☐ **A.** Mean absolute error (MAE)
- ☐ **B.** Mean absolute deviation (MAD)
- ☐ **C.** Root of the mean square error (RMSE)
- ☐ **D.** Mean absolute percentage error (MAPE)

12. Which service levels can SAP IBP calculate? (There are two correct answers.)

- ☐ **A.** Maintenance service level
- ☐ **B.** α service level
- ☐ **C.** β service level
- ☐ **D.** Gamma service level

3.8 Practice Question Answers and Explanations

1. Correct answers: **A, B, and C**
Safety stock, cycle stock, and pipeline stock are three different kinds of inventory needed to handle variability within your supply chain. Each stock type is needed for a specific purpose: For example, cycle stock is inventory created due to an order quantity, while pipeline stock inventory is created due to an on-order quantity. Projected inventory is a time phase-calculated number based on demand, supply, and current inventory.
2. Correct answer: **A**
True. The objective of inventory planning is to manage demand and supply uncertainty by maintaining the right levels of safety stock. In the real world, the forecast is not accurate (supply does not arrive on time), and thus, organizations must keep inventory to handle fluctuations and uncertainty while still maintaining the desired service levels for their end customers.
3. Correct answers: **A, C, and E**
The objective of SAP IBP inventory is to calculate safety stock to handle fluctuations. Safety stock, reorder points, and on-hand stock are output from SAP IBP

for inventory. Projected inventory is a time phase-calculated number based on demand, supply, and current inventory, while a customer service level is one of the objective functions of the multistage inventory algorithm.

4. Correct answer: **D**
   The multistage algorithm takes demand and supply variability into account while calculating safety stock. Supply variability includes lead-time and production variability. The algorithm works with an objective function of external service level, which is a fixed value that must be input into the algorithm. You can create various scenarios and different external service levels and compare the recommended stock levels side by side.
5. Correct answer: **B**
   False. SAP IBP's multistage inventory algorithm will consider demand and supply variability, not just at a single node, but throughout your supply chain. The algorithm will consider variability in your supply chain from end to end and then derive a safety stock number for each node in order to achieve the desired customer service level.
6. Correct answers: **A, B, and C**
   SAP IBP's multistage inventory algorithm needs information about demand variability, supply variability, and customer service levels as key inputs. The internal service level is an output calculated to achieve the desired customer service level. Optimized safety stock is a key output of the multistage inventory planning algorithm.
7. Correct answer: **B**
   Once safety stock numbers are calculated, these values are key inputs to the supply planning process where supply planning will consider that safety stock as a demand element and will thus plan against it to ensure that the right safety stock is always maintained. Demand planning and sales planning processes are also inputs into the supply planning process wherein supply is planned against the demand forecast number.
8. Correct answer: **A**
   True. The multistep inventory planning algorithm will reduce the overall inventory in your supply chain network, but at some stocking locations, the algorithm might increase the safety stock number to maintain the end customer service level. This approach is called *fix to mix*, and safety stock is reduced within your supply chain overall but might be increased in a few stocking locations.
9. Correct answer: **D**
   The multistep inventory algorithm will plan for entire network and for the entire bill of material (BOM). Thus, the algorithm will consider finished goods, semifinished goods, and raw materials when calculating safety stock.

10. Correct answer: **A**
    True. The multistep inventory algorithm looks at the overall variability within the supply chain network, which includes demand, supply, and production variability, and then comes up with a recommended safety stock to meet the desired service level. Since the multi-echelon inventory optimizer will look at the variability of your supply chain in total, it will help the organization to reduce the safety stock while maintaining the service level.
11. Correct answers: **B and D**
    As a part of SAP IBP, currently only MAD and MAPE are supported as a part of the CV calculation. Other forecast error methods can be calculated and displayed; however, they aren't part of the inputs for calculating the CV.
12. Correct answers: **B and C**
    The α service level and β service level are two methods based on which planners can decide which service level to target. For the α service level, you must calculate the order fill rate over a customer order, while for the β service level, you must calculate the order fill rate over the specific volume of the order.

3.9 Test Takeaway

In this chapter, you learned about key topics in the inventory planning process and how SAP IBP for inventory supports inventory planning across an organization. The system starts off with calculating various kinds of variability in your supply chain, which includes demand variability and lead-time (supply) variability. SAP IBP provides a multistage inventory algorithm, which unlike the traditional algorithm, takes demand and supply variability across all the nodes in your supply chain and, based on the end service level target, will calculate safety stock at each node. The internal service level at each node is calculated as a part the multistage algorithm. The system supports real-time analytics and dashboards, which enable you to review the results of the inventory planning process.

SAP IBP for inventory offers a comprehensive platform for calculating safety stock, which will be then input into your supply planning process. Multistage inventory planning can help your organization fix the mix of inventory, reduce the overall inventory level held in the supply chain, and still meet the desired customer service level. Keeping the right inventory level at the right location will then improve the working capital of your organization.

We've now completed our discussion of the inventory planning business process. The next chapter covers key topics related to the supply and response planning process in SAP IBP.

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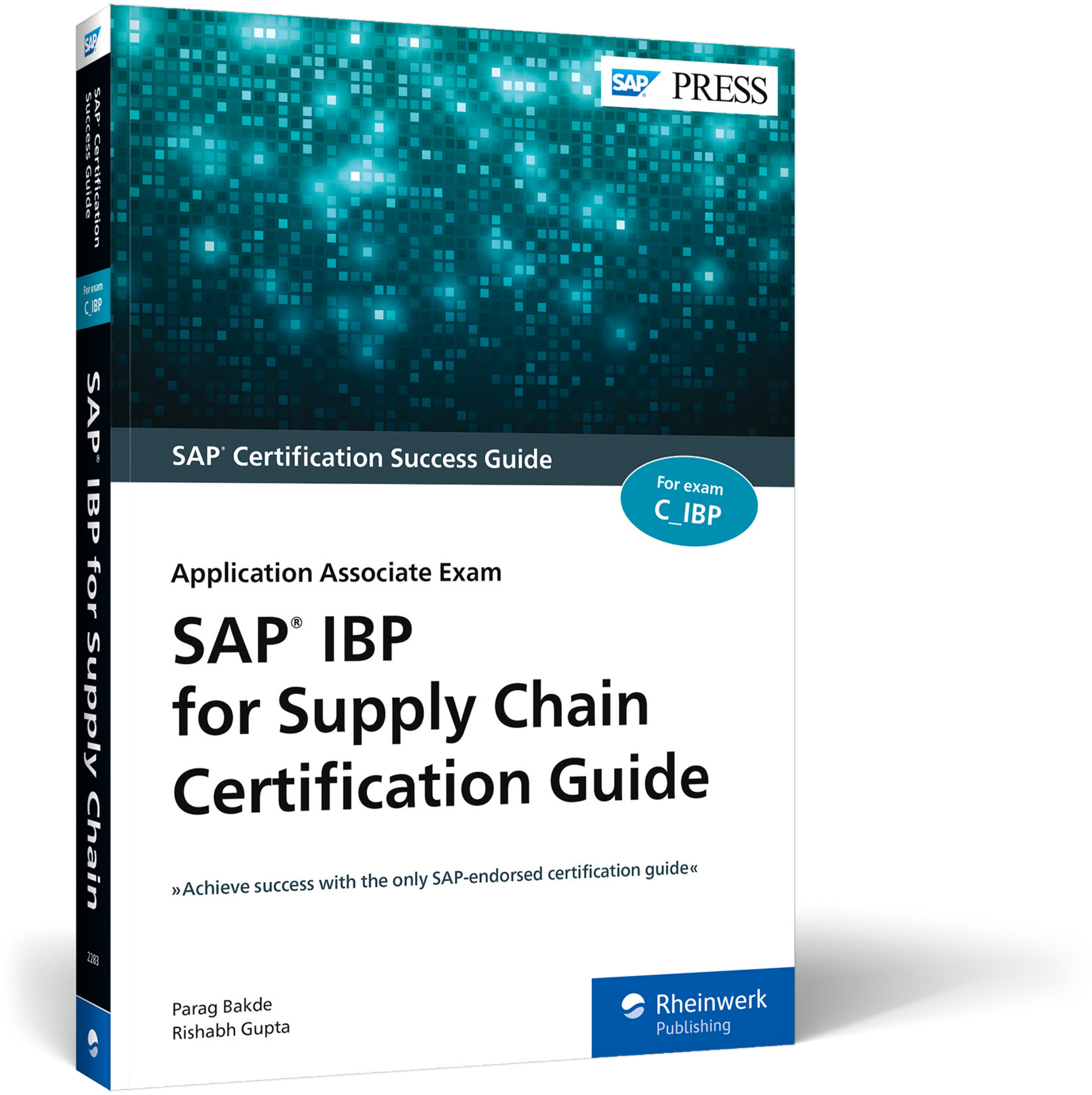

Parag Bakde is part of the customer innovation office at SAP, where he works as a principal solution advisor and provides SAP IBP solution expertise for various sales engagements. He joined SAP more than 22 years ago as a product developer and has worked as a platinum consultant, project lead, program manager, and subject matter expert, leading customers' digital supply chain transformation projects in the consumer goods, pharmaceutical, high-tech, and chemical industries. He has worked on various SAP planning solutions such as SAP ERP, SAP APO, SAP IBP, and supplier network collaboration. Earlier, as a customer success partner, Parag was also responsible for the adoption and value realization of SAP IBP solution within south market units.

Rishabh Gupta leads a team of experts that work in close collaboration with the SAP development team, helping customers safeguard their digital transformation journeys. He joined SAP 16 years ago, starting as a developer on a purely technical team and soon moving to a more functional team within SAP APO, where he architected and developed some of the key topics in production planning and detailed scheduling (PP-DS). In 2014, he joined the SCM Center of Expertise in SAP North America to help customers implement critical functionality. Since then, Rishabh has helped customers from different industries successfully implement their projects in the SAP IBP and SAP APO product areas.

Parag Bakde, Rishabh Gupta

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