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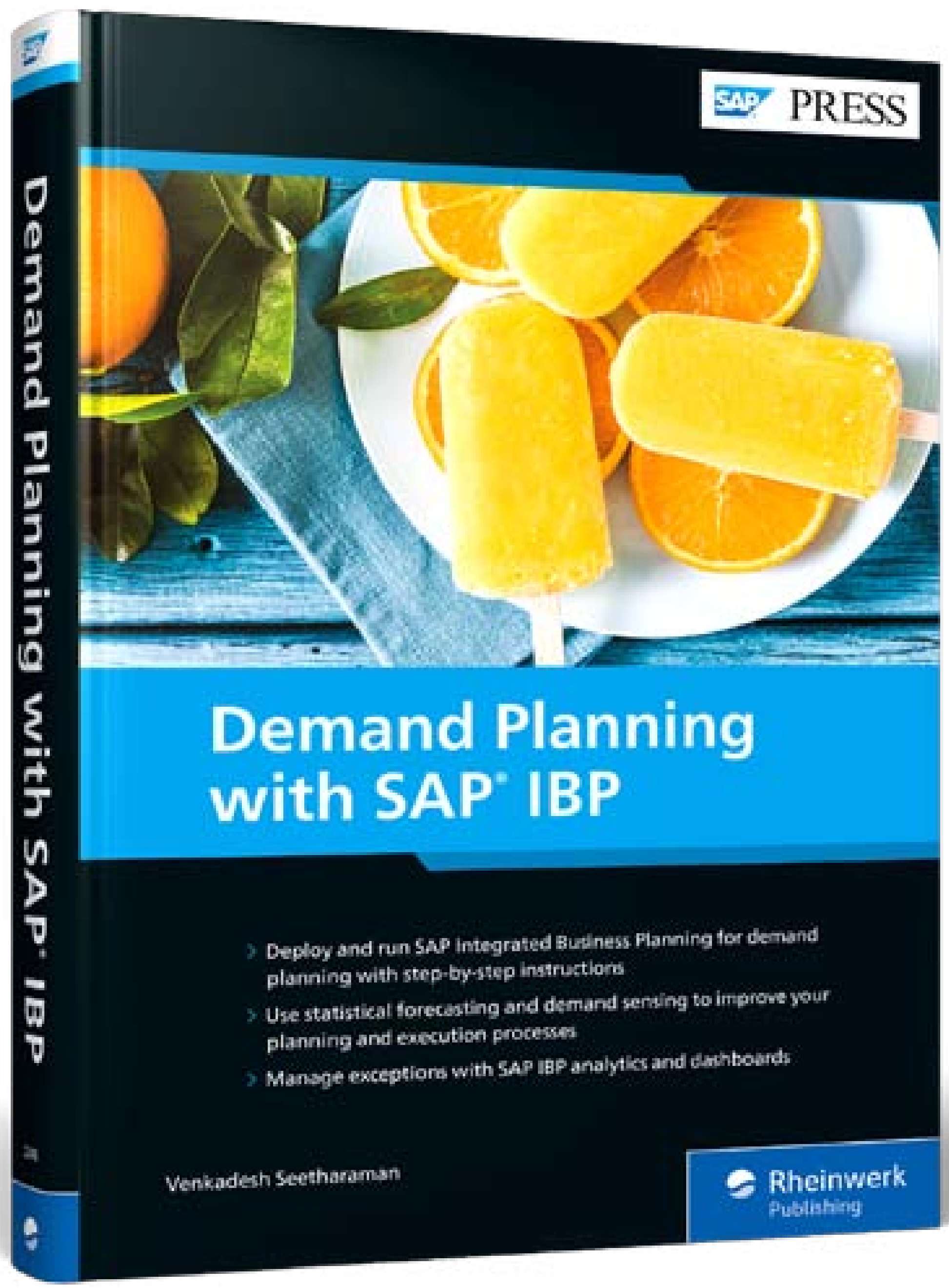

Reading Sample

In this chapter, you'll learn how to plan based on events using SAP IBP for demand. You'll see how to set up and use key functionalities such as product lifecycle planning, manual forecasting, external forecasting, driver-based planning, and more.

"Event-Based Planning"

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The Author

Venkadesh Seetharaman

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Chapter 5
Event-Based Planning

SAP IBP for demand's improved forecast accuracy comes from considering all constraints in the planning input due to internal and external events and repeatedly adjusting forecasts based on receiving event-based planning feedback before releasing the final forecast. We'll discuss these event-based planning processes in this chapter.

Every company needs to plan and replan based on events. Some events may have direct impacts such as weather changes or a competitor's new product launch, and some may have indirect impacts such as oil price increases due to war eventually increasing the cost of production. These changes must be predicted well for efficient forecasting.

SAP IBP for demand provides functionality for product lifecycle planning, manual forecasting, external forecasting, driver-based planning, promotional planning, and financial planning. We'll discuss each of these processes and how to set them up in this chapter.

5.1 Product Lifecycle Planning

Product lifecycle planning is mandatory in demand management and makes it possible to analyze a product's behavior from its development to withdrawal from the market, including its launch, growth, and maturity. There are five stages in the product lifecycle, as shown in Figure 5.1:

1. **Development**
   The development phase of the product lifecycle occurs before the product is released to the market and is always very important. This is the prereleasing stage to prepare the product for introduction to market.
2. **Introduction**
   This is the stage where the product is released to market, sales begin, and then sales gradually increase in the market.
3. **Growth**
   This is the stable stage of the product. In this phase, the product is familiar in the market and making profits.

4. **Maturity**
   This is the stage where the product has been in the market for some time and has matured enough. This will be longest phase for some products based on their sales in the market. However, the sales may grow year on year, but sales percentage will be small compared to past years.
5. **Decline**
   This is the stage where demand is starting to decline as the sales of the products start declining. Similar to the maturity stage, the decline stage lasts for a longer time for some products.

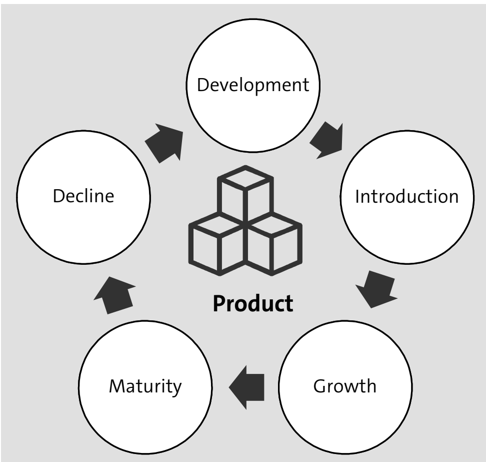


Figure 5.1 Stages of the Product Lifecycle

SAP Advanced Planning and Optimization (SAP APO) and SAP IBP for demand processes support lifecycle planning in the statistical forecast planning steps. We'll discuss how the process is supported, configured, and aggregated in the following sections.

5.1.1 Lifecycle Planning Process

In today's highly competitive market, customers expect fast changes in terms of quality and technology. The lifecycle of a product is very fast compared to past decades. So, companies must introduce new products time to time in their current product portfolio with new packaging or in an entirely new category. As demand planning is a starting point in the supply chain process, new product introduction has to be highly automated with reference to existing products or planned completely new based on the past product portfolio prediction. In the product lifecycle process, the introduction of a new product or phasing out of an old product can often disrupt the supply chain processes. The best possible option is to create forecasts for the new product with reference to an existing product. SAP IBP demand planning forecast models take in this

reference dynamically and plan the new products with various options to provide the output automatically.

The product lifecycle planning process in SAP IBP for demand includes the following:

- Identifying optimal material flow based on today's supply chain such as which markets/customers should be supplied from which terminals
- Proactively planning for inventory clearance before the product is actually phased out
- Determining up to what time the new product should refer to the sales history of the old product

The introduction of new products and the elimination of obsolete products from the market are critical in the lifecycle of a product and need to handled specially by the demand planners. If planned incorrectly, then the new product will be out of stock, and the obsolete product will be overstocked without sales in the market. In the SAP IBP for demand lifecycle planning process, the five stages of the product lifecycle are covered between phase-in and phase-out, as shown in Figure 5.2:

1. **Phase-in**
   In this phase, sales usually slowly pick up or show an exponential trend and then flatten after some time.
2. **Phase-out**
   This is the decline phase in which the product is slowly taken off the market using excess inventory. The product is then replaced by another product.

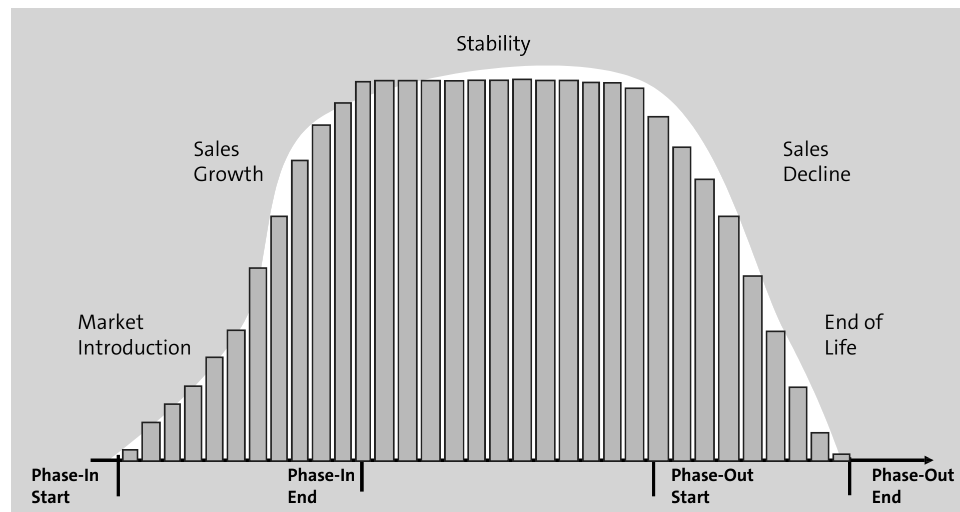


Figure 5.2 Managing the Product Lifecycle

The complete lifecycle planning process with SAP IBP is shown in Figure 5.3. Let's walk through the key steps:

❶ To define reference products for a new product in SAP IBP for demand, some prerequisites must be fulfilled in your planning area. These prerequisites are checked when users enter a new product:

– Define planning area attributes to represent the product ID

– Define planning objects to be created for the products assigned to the product assignments

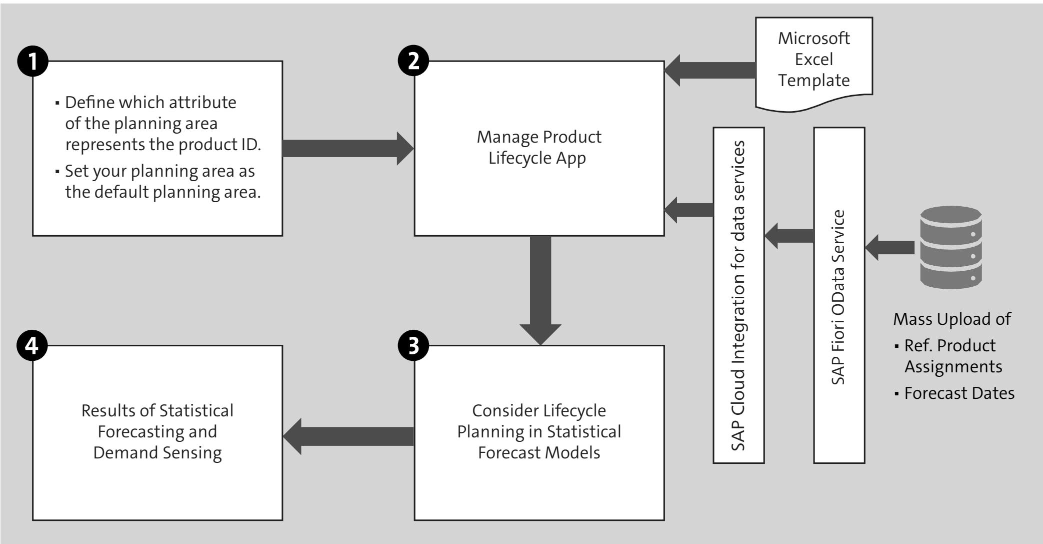


Figure 5.3 Lifecycle Planning Process

❷ In the Manage Product Lifecycle app, as shown in Figure 5.4, product references, weight factors, and forecast dates are maintained. You can upload and download products, forecast dates, and curves manually for single planning objects. For mass uploads, you can use comma-separated values (CSV) templates or externally use the SAP Cloud Integration for data services interface with OData.

❸ In the Manage Forecast Model app, you can check the **Consider Product Lifecycle Information** checkbox in the lower-right corner in the **GENERAL** tab, as shown in Figure 5.5.

❹ Results of demand planning and demand sensing with phase-in and phase-out of new product and reference products can be seen in the planning view of SAP IBP, add-in for Microsoft Excel. For more information on the planning view, see Chapter 8.

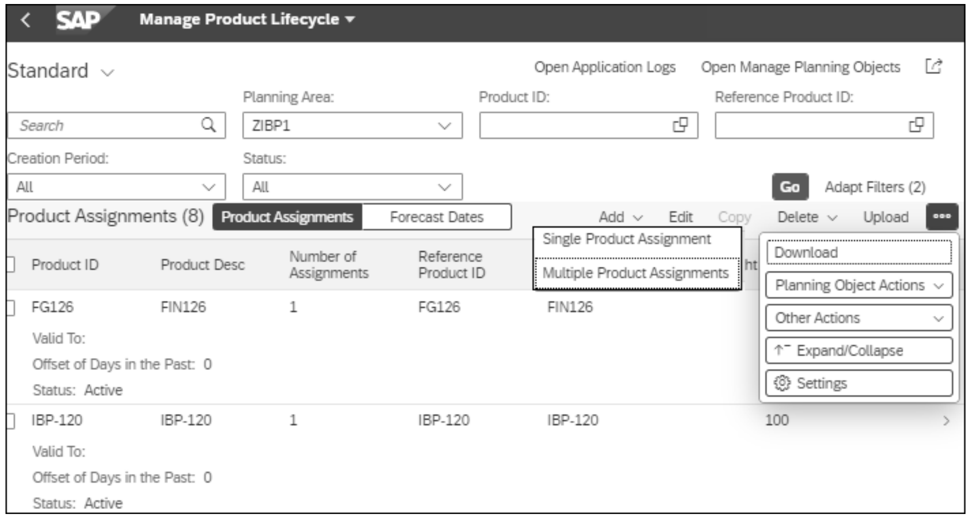


Figure 5.4 Manage Product Lifecycle App

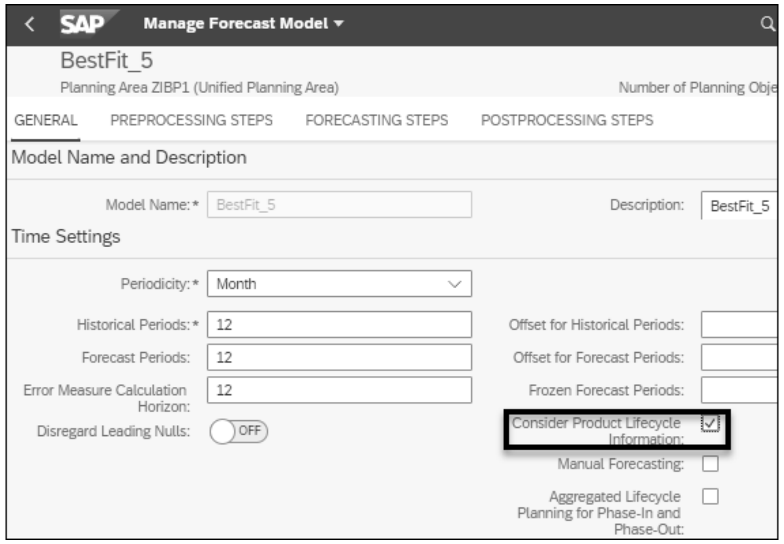


Figure 5.5 Consider Lifecycle Information

5.1.2 Configure Product Lifecycle Planning

You can set up the product lifecycle using the Manage Product Lifecycle app by defining product assignments and forecast dates that are used in demand planning. You can see the number of products in your default planning area within the tile itself and set the default planning area in the top-right corner of the screen in the settings.

The SAP IBP lifecycle planning process must be configured in the Manage Product Lifecycle app and includes product assignments, forecast dates, phase-in/phase-out curves, and data maintenance. We'll discuss each in the following sections.

> **Note**
> Product lifecycle planning is the prerequisite for running the statistical forecast, considering whether to stop forecasting for the phase-out products, and planning the new product based on the history of old products.

Product Assignment

In the **PRODUCT ASSIGNMENTS** section, you have to assign the products and reference products, and you can maintain multiple reference assignments to a product if required. The product can be referenced with 100% weightage or partial weightage as well. For each product assignment, if required, validity periods also can be given.

To create a new product assignment, click **Add • Single Product Assignment**, as shown previously in Figure 5.4.

It's mandatory to specify the **Launch Dimension** when you assign the product and reference product, as shown in Figure 5.6. A launch dimension describes the strategy of a new product that is introduced to the market. For example, a company might want to distribute a product to a specific location or region as the launch dimension and assign the specific forecast dates. This launch dimension also will be used to specify the phase-out product as well. Phase-in and phase-out are only applicable if the launch dimension is specified for the product.

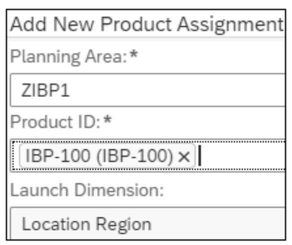


Figure 5.6 New Product Assignment

After you specify the **Planning Area**, **Product ID**, and **Launch Dimension** for the product assignment, you'll see the screen shown in Figure 5.7. Here, you have to assign **Key Figure**, **Historical Periods**, and **Periodicity**. If the planning object isn't created on the planning level or product, you can generate the product using the **Planning Object Actions** dropdown from the menu bar of the product assignment screen, as shown

previously in Figure 5.4. You can also go from here to the Manage Planning Objects app if you're activating multiple planning objects. You can simulate the assignment and validate the quantities based on the weight factor and validity, as shown in Figure 5.7. Finally, activate the product assignment if you're doing manual assignment. If there are any changes in the existing product assignments, such as historical periods, weight, or key figure, you can synchronize to reflect the changes.

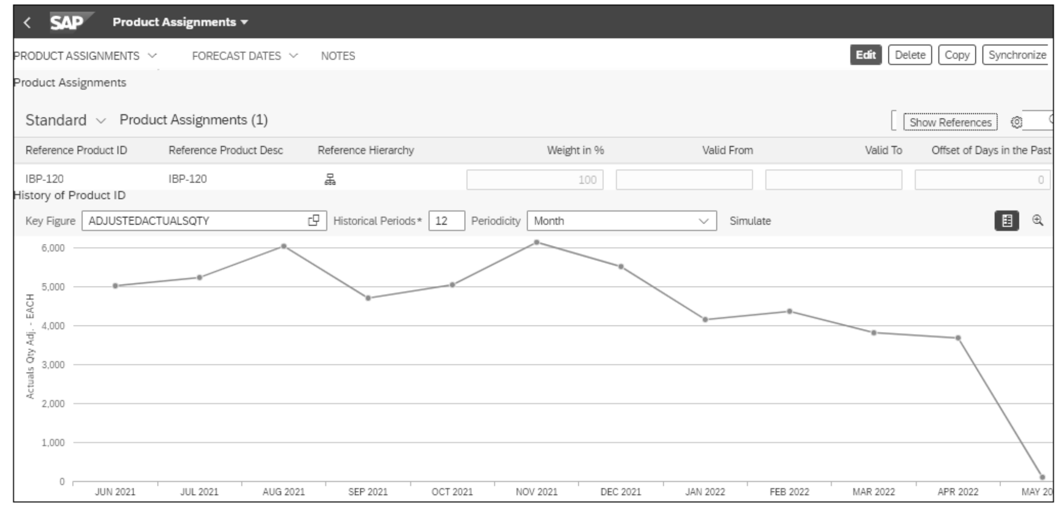


Figure 5.7 Product Assignment and Key Figure Simulation

> **Note**
> You have to assign the same key figure used in the statistical forecast model for forecasting.

The new product can be introduced in multiple ways with different product assignments and launch dimensions. Let's consider an example of product assignments with two cases, as shown in Figure 5.8:

- **Case 1**
  New product **NEW1** is forecasted based on the reference product **FG126** with 100% weightage.
- **Case 2**
  New product **NEW2** is forecasted based on the references of product **IBP-120** with 50% weightage and product **IBP-130** with 50% weightage.

Product ID	Product Desc	Number of Assignments	Reference Product ID	Reference Product Desc	Weight in %
NEW1	NEW-PRD1	1	FG126	FIN126	100
Valid To:					
Offset of Days in the Past: 0					
Status: Active					
NEW2	NEW-PRD2	2	IBP-120	IBP-120	50
Valid To:					
Offset of Days in the Past: 0					
Status: Active					
NEW2	NEW-PRD2	2	IBP-130	IBP-130	50
Valid To:					
Offset of Days in the Past: 0					
Status: Active					

Figure 5.8 Product Assignment

You can check the product and its reference linkage with weight by clicking the **Show References** button, as shown previously in Figure 5.7. References can be seen as a graph, as shown in Figure 5.9.

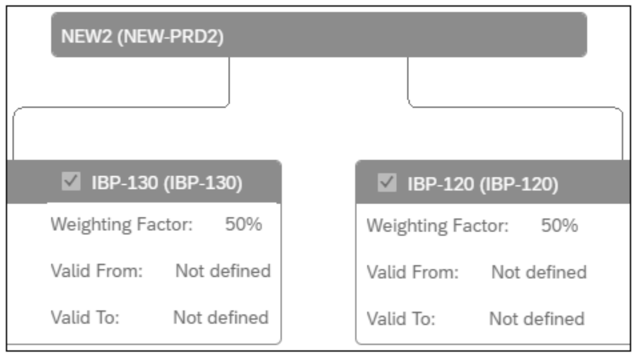


Figure 5.9 Product Reference Link

Forecast Dates

In this important step you make assignments in the **FORECAST DATES** section that will be the foundation for the launch dimension values and phase-in and phase-out dates. You can also maintain different phase-in and phase-out curves for products and their launch dimensions.

After going to the **Forecast Dates** tab and clicking **Add**, as shown in Figure 5.10, you'll see the following key fields:

- **Forecast Start**
  From these dates onward, the new product is included in the forecast runs.
- **Phase-In Start**
  This is the beginning of the forecast horizon. From this date onward, forecasting is generated for this new product.

- **Phase-In End**
  This is the date once the product has reached its maturity. In this phase, the forecasting is based on its own historical data.
- **Phase-Out Start**
  This is the date to reduce the sales of the product gradually and start to introduce a new product by this time.
- **Phase-Out End**
  This is the final date for the existing product to be completely removed from the market, and no forecasts will be generated after this date.

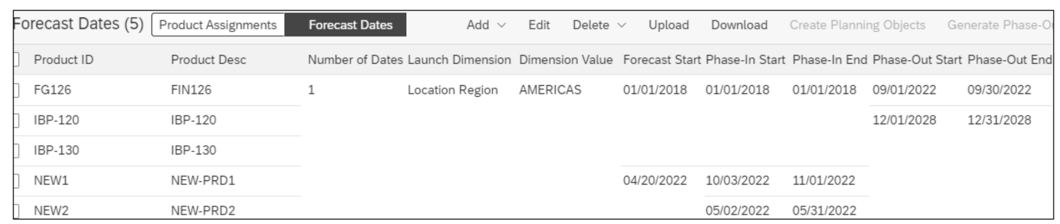
5

Note

Demand sensing now supports phase-out dates. It will propose new adjustments to the forecast during the phase-out period, and there will be no sensed demand computed after the product has phased out.

Let's maintain the forecast dates for the following two cases that we assigned in the product assignment for products **NEW1** and **NEW2** in location region **AMERICAS**. Forecast start dates for both cases are same from April 20, as shown in Figure 5.10.

- **Case 1**
  Product **NEW1** is phased in from October 1, 2022, and reference product **FG126** is phased out from September 30, 2022.
- **Case 2**
  Product **NEW2** is phased in from May 2, 2022, and phase out of this new product and its reference products **IBP-120** and **IBP-130** is until December 31, 2028.



Product ID	Product Desc	Number of Dates	Launch Dimension	Dimension Value	Forecast Start	Phase-In Start	Phase-In End	Phase-Out Start	Phase-Out End
FG126	FIN126	1	Location Region	AMERICAS	01/01/2018	01/01/2018	01/01/2018	09/01/2022	09/30/2022
IBP-120	IBP-120							12/01/2028	12/31/2028
IBP-130	IBP-130								
NEW1	NEW-PRD1				04/20/2022	10/03/2022	11/01/2022		
NEW2	NEW-PRD2					05/02/2022	05/31/2022		

Figure 5.10 Forecast Dates

Note

Forecast Start is important because it's the date when the forecast execution starts. The forecast start date is defined for the launch dimension values. If the forecast start date is defined as October 1, 2022, before that date, no forecast model is run for the location region **AMERICAS**.

Phase-In/Phase-Out and Seasonality Curves

You can plan phase-in and phase-out processes for a new product by defining the start and end dates and optionally assigning phase-in and phase-out curves, which show the expected demand development of a product. During phase-in and phase-out, the curves represent percentage time series. The percentages are multiplied by forecast results in the phase-in timer horizon defined in the phase-in start and end dates. The first period gets the value 0.1/0.9, and the last period is set to 0.9/0.1. The time buckets numbers are determined by the number of periods between phase-in/phase-out start and phase-in/phase-out end dates in the periodicity as defined in the forecast model.

The following curve types are available:

- **Linear**
  The linear curve is calculated by a linear interpolation between 0.1 and 0.9.
- **Sublinear**
  The sublinear curve applied the quadratic function to the time series that you obtain when you perform linear interpolation between .316 and .949. The boundaries are calculated in the reverse function to the standard boundaries between 0.1 and 0.9.
- **Superliner**
  The superliner curve applies the square root function to the time series that you obtain when you perform a linear interpolation between .01 and .81. The boundaries are calculated in the reverse function to the standard boundaries between 0.1 and 0.9.

You can also configure your own phase-in and phase-out curves. To do so, click the **Edit** button, go to the **FORECAST DATES** tab, and go to the **Curves** section. Select the existing curve **Type** and set the corresponding curve parameters to your needs. You can define the following parameters, as shown in Figure 5.11:

- Time periods that you want to display
- Function you want to calculate the curve, for example, square root
- Start and end values of the curve in the percentage

You can simulate the curve after maintaining the parameters via the **Simulate** button at the top of the screen, save it for future use via the **Save As** button if the results are acceptable to you, and assign this to the relevant launch dimension. You have the option to display or hide the values.

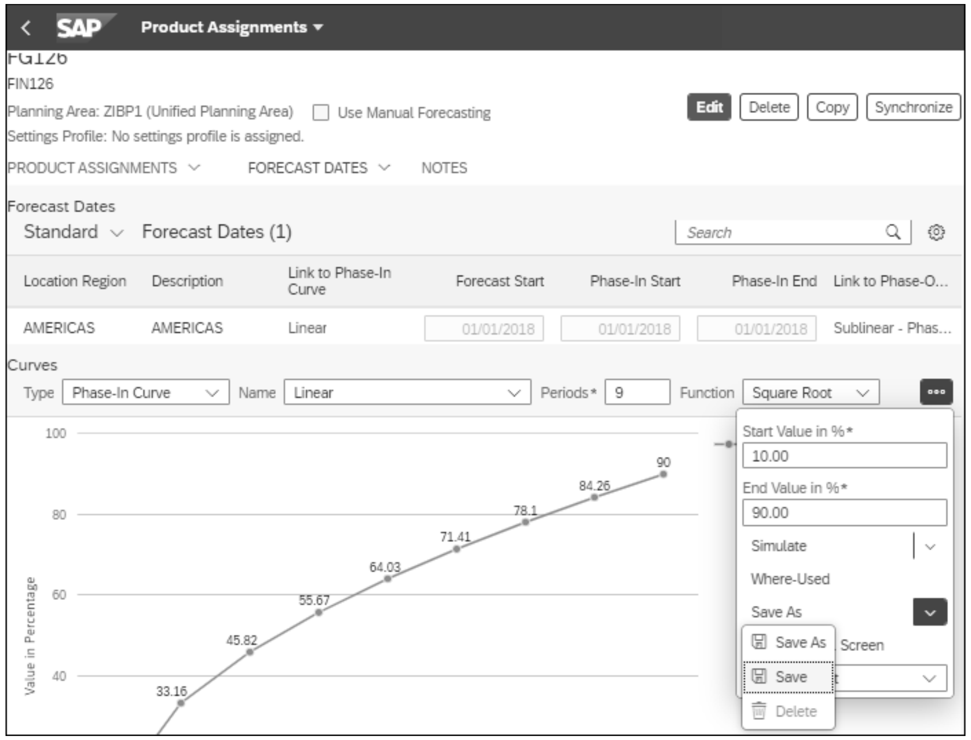


Figure 5.11 Curves Forecast Dates

Two overarching categories of curves are available:

- **Flexible curves**
  You can define flexible curves on your own by choosing the **Single Values** option, changing the existing curve, and manually changing the values. This type can't be used with seasonality curves. The start and end value fields and function field can't be changed. A flexible curve must have nine date points. You can use a flexible curve for 1 < N < 2 × N phase-in/phase-out periods. If the maximum period numbers are too big, then no phase-in/phase-out curve is applied during forecasting.

  Let's consider an example of a flexible curve with eight data points (single values): 10, 50, 20, 35, 35, 46, 70, 90. If N = 1, the first value is used; if N = 2, the first and last value of data points are used. If N = 3, the first, last, and midpoint values are used. If the interpolated curve has an even number of periods and the underlying flexible curve has an odd number of periods, the midpoint is used twice. Each value has a start, a midpoint and end point, and interspersed values. Some of these interspersed values are copied from the original flexible curve and interpolated. If the middle value doesn't exist, then the average of neighboring points is used. If N is increased, the system takes available values from the boundaries and from the average in the middle. The following example illustrates how the algorithm calculates with simulation from N = 1 to N = 8:

- N = 1: 10
- N = 2: 10, 90
- N = 3: 10, 35, 90
- N = 4: 10, 35, 35, 90
- N = 5: 10, 32, 50, 35, 60
- N = 6: 10, 32, 50, 35, 35, 60, 90
- N = 7: 10, 50, 20, 35, 46, 70, 90
- N = 8: 10, 50, 20, 35, 35, 46, 70, 90 (chart example)

You can change the values and simulate only after saving the flexible curves, as shown in Figure 5.12.

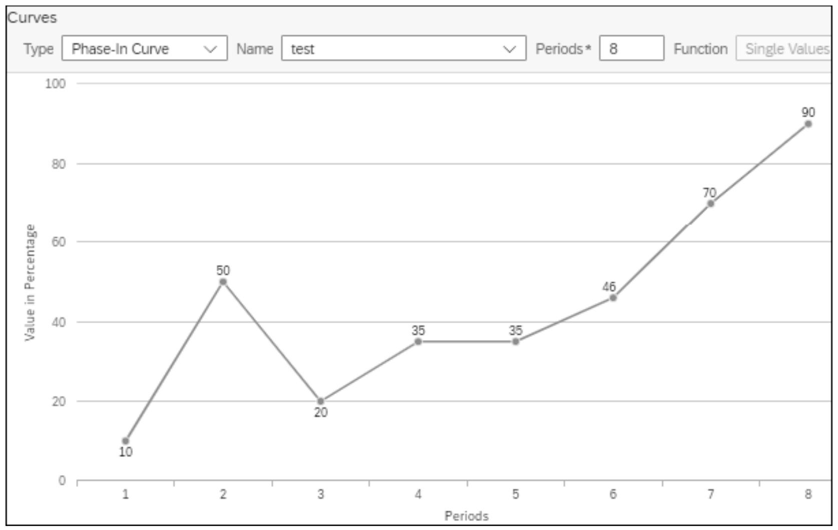


Figure 5.12 Flexible Curve

- **Seasonality curves**
  For seasonal curves, as shown in Figure 5.13, you can't have linear interpolation points from 0.1 to 0.9; instead, you can have the time periods and periodicity (days to year). Optionally, you can also specify a start date and click **Save As** to save this chart with a unique name in case you want to reuse the same curve.

Figure 5.13 Seasonality Curve

Under the curves umbrella, there are six different usage variants for phase-in and phase-out functions in SAP IBP:

- **Phase-In without Curve**
  In this phase-in, start and end dates should be similar, and the forecast for a new product is available from the selected date.
- **Phase-In with Curve**
  In this case, the phase-in start and phase-in end dates are different. The forecast of a new product is available starting from the selected date and increases in accordance with the selected curve. In this example, the product is simulated with different functions, as shown in Figure 5.14.

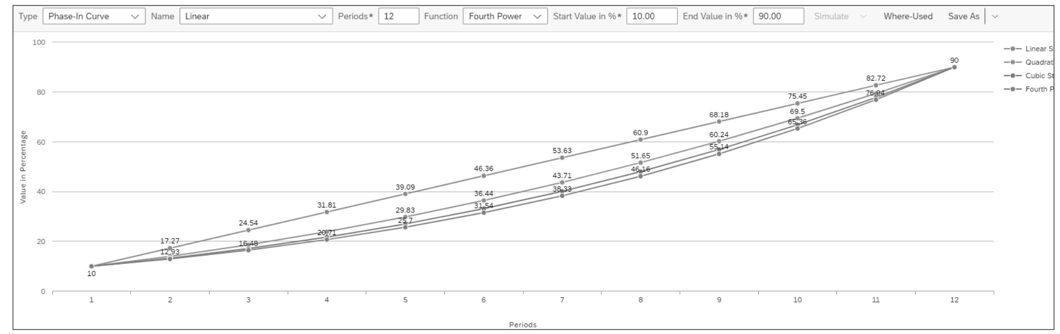


Figure 5.14 Phase-In with Curve

- **Phase-Out without Curve**
  In this case, the phase-out start date and end dates are similar. No forecast will be available to the old product starting from the selected date.
- **Phase-Out with Curve**
  In this case, the phase-out start date and end dates are different. The forecast of the old product isn't available from the selected end date. It decreases in accordance with the selected curve, as shown in Figure 5.15.

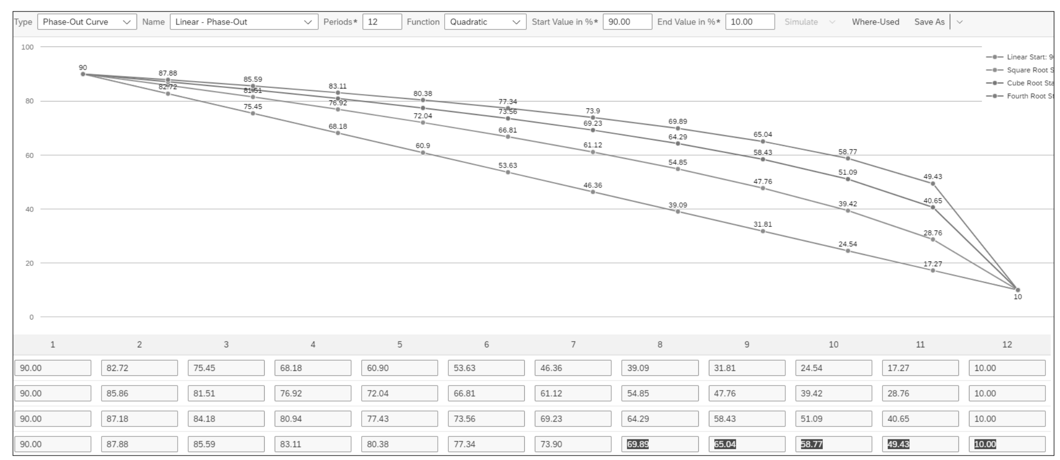


Figure 5.15 Phase-Out Curve

- **Replace without Curve**
  Phase-in start and end dates should be similar with the 100% forecast for the new product available from the selected date. You can choose the necessary curve with only one period inside, but you can generate the phase-out profile for reference products. The start and end dates should be aligned with the phase-in dates of the new product.

  At the same time, you can generate phase-out profiles for reference products. The start and end dates should be aligned with the phase-in dates of the new product.
- **Replace with Curve**
  Phase-in start and end dates should be similar. In this case, the 100% forecast for the new product is available from the selected date. Choose the necessary curve with more than one period. In this variant, you also can generate the phase-out profile for the reference products, but the start and end dates should be aligned with the phase-in dates of new products in accordance with the selected curve.

  At the same time, generate phase-out profiles for reference products. The start and end dates should be aligned with the phase-in dates of the new product in accordance with the selected curve.

Data Maintenance

It's important to maintain the product assignments and forecast dates in mass either via upload or download. Small volumes of data can be entered manually using single assignment. Alternatively, you can perform mass maintenance by copying and pasting from the clipboard using multiple assignments for products. To do so, select the **Product Assignments** dropdown, and click **Add • Multiple Product Assignments**; for forecast dates, select the **Forecast Dates** dropdown and click **Add • Multiple Forecast Dates** (see Figure 5.16).

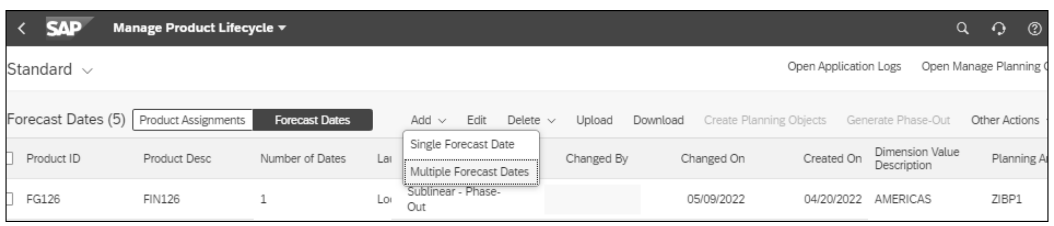


Figure 5.16 Multiple Assignments Forecast Dates

Mass maintenance helps to create, edit, or delete multiple product assignments and forecast dates in table view. You can create multiple product assignments and forecast dates at the same time and upload them using a CSV file. To upload the assignments, you need to use the CSV file with the specific format you require. You can do uploads for product assignments, forecast dates, and curves. For the formatting requirements, you can download the specific template (product assignments, forecast dates, and

curves) by clicking the **Download** button from the menu bar, selecting the **Separator** and **Type of Download Data**, and clicking **Download**, as shown in Figure 5.17.

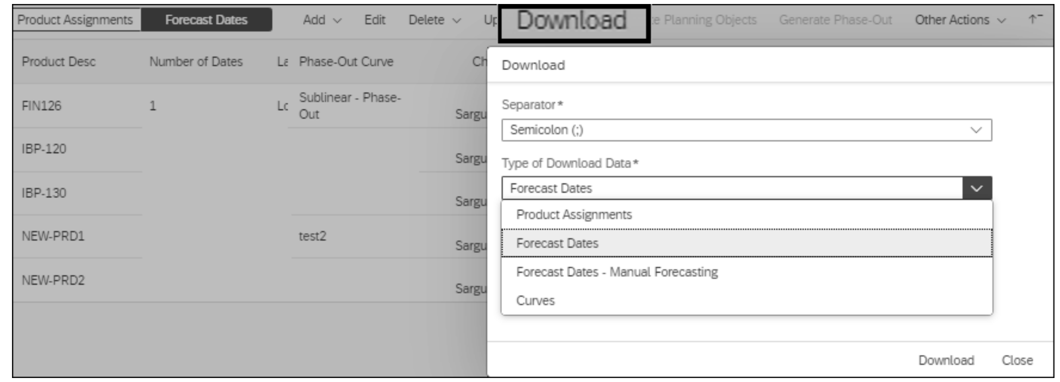
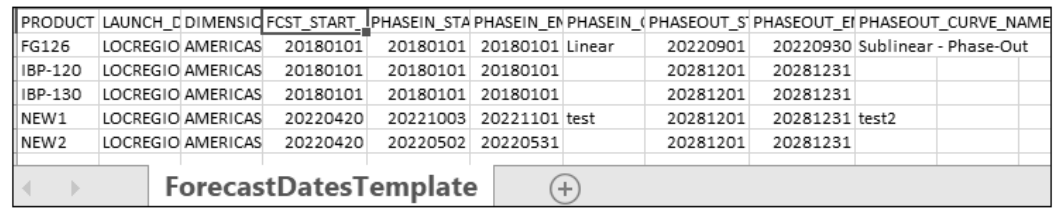


Figure 5.17 Download Option Lifecycle Planning

You can see the data downloaded in CSV format with the headings, as shown in Figure 5.18.



PRODUCT	LAUNCH_D	DIMENSIO	FCST_START_	PHASEIN_STA	PHASEIN_EN	PHASEIN_(	PHASEOUT_S	PHASEOUT_EI	PHASEOUT_CURVE_NAME
FG126	LOCREGIO	AMERICAS	20180101	20180101	20180101	Linear	20220901	20220930	Sublinear - Phase-Out
IBP-120	LOCREGIO	AMERICAS	20180101	20180101	20180101		20281201	20281231	
IBP-130	LOCREGIO	AMERICAS	20180101	20180101	20180101		20281201	20281231	
NEW1	LOCREGIO	AMERICAS	20220420	20221003	20221101	test	20281201	20281231	test2
NEW2	LOCREGIO	AMERICAS	20220420	20220502	20220531		20281201	20281231	

Figure 5.18 Download Template

Now you can use the downloaded template for the new data entries, and use it again for upload. Using the **Upload File** button from the Manage Forecast Model app, you can enter the new entries in the downloaded template and upload it again, as shown in Figure 5.19.

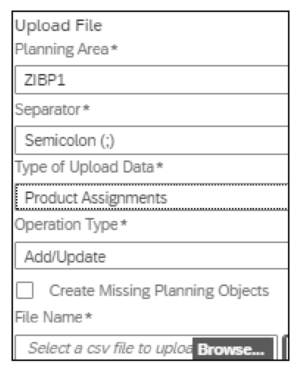


Figure 5.19 Upload Template

Before uploading, you need to consider the following points regarding the **Type of Upload Data** field:

- **Product Assignments**
  - If you upload references on the aggregated level of a product (e.g., product group), you still use the **PRODUCT** column for the first-level attribute in the template (see Figure 5.20).
  - If you're not specifying a weight in the template, the system will assign 100% weightage for the product automatically.
  - You need to specify **IS_ACTIVE** as **X** to make the assignment active.
  - If the upload contains values of **DIMENSION2** and **DIMENSION3**, both of the products must have a planning object. Otherwise, the assignment will be inactive.
  - You can't keep the validity dates, and the period offset should have different validity start and end dates.

PRODUCT	DIMENSION2	DIMENSION3	REFERENC	WEIGHT	PERIOD_C	IS_ACTIVE	STARTDAT	ENDDATE
FG126			FG126	100		X		
IBP-120			IBP-120	100		X		
IBP-130			IBP-130	100		X		

ProductAssignmentTemplate

Figure 5.20 Product Assignment Upload Template

- **Forecast Date**
  - The date format for phase-in/phase-out dates is YYYYMMDD or YYY-MM-DD.
  - Use the unique name of phase-in/phase-out curves `PHASEIN_CURVE_NAME` and `PHASEOUT_CURVE_NAME` and the not technical ID.

> **Note**
> The forecast dates upload automatically, creating a launch dimension as a wildcard along with specific launch dimension values even for those products without launch dimension values in the upload file. If you want to avoid this behavior, deselect the **Generate Forecast Dates for Any Attribute Value (*)** option in the **Upload File** popup (not shown).

In this upload, you have to specify the type of upload data in the **Separator** field. The CSV file upload supports the following separators:

- Semicolon (default)
- Comma
- Colon

In the **Operation Type** field, you can delete the product assignments, forecast dates, and curves with an upload by selecting **Delete** in the upload dialog. You can use the same

template CSV files to update and delete the entries. But for deletion, you can only have key fields such as product ID, reference product ID, and weight in the CSV template. You can also check the **Create Missing Planning Objects** checkbox while upload the data in case the planning objects for the new product are missing. The launch dimensions are uploaded with the forecast dates.

> **Note**
> You can only upload or delete 10,000 lines of data in a single upload.

Click the **Upload** button from the menu bar to upload the template. You can see the changes in product assignments, forecast dates or manual forecasting, and curves in the **Change Log** screen, as shown in Figure 5.21. From the menu bar, choose either **Product Assignments** or **Forecast Dates**, and then select **Other Actions •Show Change Log** to view the changes, apply filters of specific attributes, and search the changes of product assignments, forecast dates, and curves up to 120 days. You can also download the log in CSV format with the applied filters.

Change Log

Date and Time	Data Type	Type of (	Action	Product ID	Dimension Value	Number of Changed Products	Nu Lin	Details
05/05/2022, 21:40	Forecast Dates	Modify	Manual a Lifecycle			1	1	Forecast dates were saved for NEW2 and dimension value AMERICAS.
05/05/2022, 20:32	Curves	Delete	Manual a Lifecycle			0	1	Curve test1 was deleted.
05/05/2022, 18:11	Forecast Dates	Modify	Manual a Lifecycle			1	1	Forecast dates were saved for FG126 and dimension value AMERICAS.
05/02/2022, 20:33	Product Assignments	Modify	Manual a Lifecycle			1	2	2 assignments have been saved for NEW2.

Figure 5.21 Change Log

You can see the results in the Microsoft Excel planning view for case 1 example product **NEW1**, as maintained in Figure 5.10. The planning from phase-in started in October 2022 with history of reference product **FG126** of launch dimension location region **AMERICAS** until April 2023 (12-month forecast horizon), and **FG126** is phased out from September 2022, as shown in Figure 5.22.

Product ID	Location ID	Location Region	Key Figure	MAY 2021	JUN 2021	JUL 2021	AUG 2021	SEP 2021	OCT 2021	NOV 2021	DEC 2021	JAN 2022	FEB 2022	MAR 2022	APR 2022	MAY 2022	JUN 2022	JUL 2022	AUG 2022	SEP 2022	OCT 2022	NOV 2022	DEC 2022	JAN 2023	FEB 2023	MAR 2023	APR 2023
FG126	1710	AMERICAS	Actuals Qty Adj.	213	216	243	243	216	270	216	216	270	216	216	243	0											
			Statistical Fcst Qty													213	214	267	219	107							
NEW1	1710	AMERICAS	Actuals Qty Adj.																								
			Statistical Fcst Qty																		25	192	214	267	219	215	246

Figure 5.22 Case 1 Result

You can see the results in the Microsoft Excel planning view for the case 2 example product **NEW2** with two reference products **IBP-120** and **IBP-130** considering the weightage of 50% each (see Figure 5.9). The planning from phase-in started in May 2022 considering the 50% weightage of reference product 1 **IBP-120** and 50% weightage of reference product 2 **IBP-130** of launch dimension location region **AMERICAS** until April 2023 (12-month forecast horizon), as shown in Figure 5.23.

Product ID	Location ID	Customer ID	Key Figure	MAY 2021	JUN 2021	JUL 2021	AUG 2021	SEP 2021	OCT 2021	NOV 2021	DEC 2021	JAN 2022	FEB 2022	MAR 2022	APR 2022
IBP-120	1720	17100001	Actuals Qty Adj.	1,521	1,589	1,528	1,490	1,401	1,345	1,706	1,603	876	1,126	574	1,525
			Statistical Fcst Qty												
			50%weightage	0	0	0	0	0	0	0	0	0	0	0	0
IBP-130	1720	17100001	Actuals Qty Adj.	572	521	459	395	439	437	542	410	1,043	1,111	451	337
			Statistical Fcst Qty												
			50%weightage	0	0	0	0	0	0	0	0	0	0	0	0
NEW2	1720	17100001	Actuals Qty Adj.												
			Statistical Fcst Qty												

Product ID	Location ID	Customer ID	Key Figure	MAY 2022	JUN 2022	JUL 2022	AUG 2022	SEP 2022	OCT 2022	NOV 2022	DEC 2022	JAN 2023	FEB 2023	MAR 2023	APR 2023
IBP-120	1720	17100001	Actuals Qty Adj.												
			Statistical Fcst Qty	1,513	1,345	1,513	1,513	1,345	1,682	1,345	1,345	1,682	1,345	1,345	1,513
			50%weightage	757	673	757	757	673	841	673	673	841	673	673	757
IBP-130	1720	17100001	Actuals Qty Adj.												
			Statistical Fcst Qty	392	348	392	392	348	435	348	348	435	348	348	392
			50%weightage	196	174	196	196	174	218	174	174	218	174	174	196
NEW2	1720	17100001	Actuals Qty Adj.												
			Statistical Fcst Qty	953	847	953	953	847	1,058	847	847	1,058	847	847	953

Figure 5.23 Case 2 Result

> **Note**
>
> Say you're executing a statistical forecast at the product level, but the phase-in/phase-out is generated in the product/customer/location levels. The results of the statistical forecasting output won't reflect the phase-in and phase-out dates of products as the base planning levels are different. This is important to consider even when performing simulation runs in the Microsoft Excel planning view.

5.1.3 Aggregated Lifecycle Planning

Some business requirements necessitate forecasting at a higher level than the product or location level. For example, it's easy to judge the forecasting higher level because it fluctuates less compared to lower planning levels. For example, planning the forecasting for new products in a product family or product group level is easier because you're grouping the products at one time.

If you want to perform your forecast at the aggregated level, you have to activate **Aggregated Lifecycle Planning for Phase In and Phase Out** in the Manage Forecast Model app under the **GENERAL** tab, as shown in Figure 5.24.

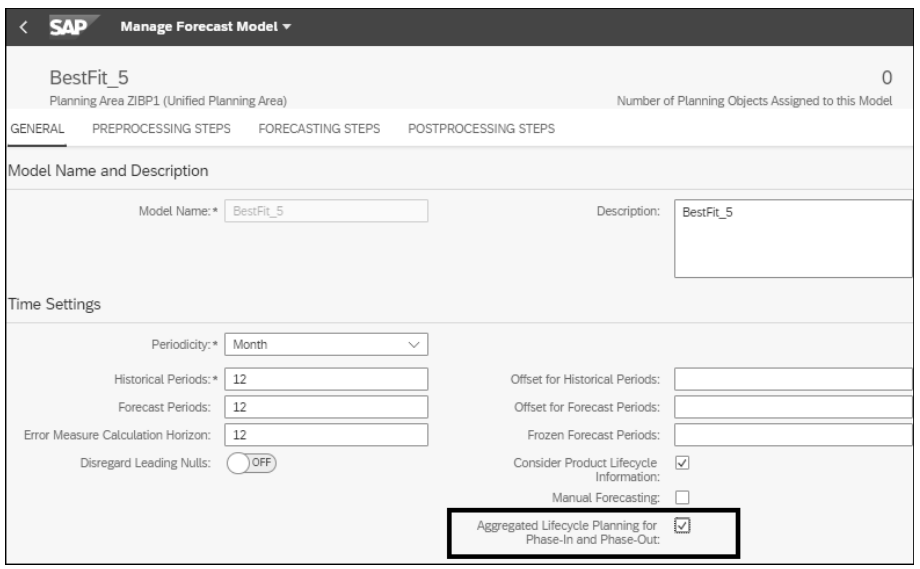


Figure 5.24 Aggregated Lifecycle Planning for Phase-In and Phase-Out

Now the forecast considers the forecast dates from a higher forecast level than the launch-dimension-level product ID.

> **Warning!**
>
> Aggregated lifecycle planning activation will significantly impact system performance—only activate if necessary.

When activating aggregated planning, consider the following points:

- A prerequisite is that an attribute from product master data must be part of the forecast level.
- The launch dimension must be part of the forecast key figure base planning level.
- `PRODUCTID` must be the root attribute of the base planning level of the forecast key figure.
- The forecast run considers the forecast dates and launch dimension values. If aggregated lifecycle planning is activated, it's important to use one of the product master data attributes (product family or product group) in the forecast run, even if the `PRODUCT ID` is maintained in the Manage Lifecycle Planning app.
- The value of the forecast will be reduced when running at the aggregated level as it's considering the definitions in the detailed level. In addition, the forecast level doesn't contain the launch dimension or the root attribute of the launch dimension.
- The disaggregation setting of the forecast key figure affects the result of the forecast.

5.2 Manual Forecasting

Manual forecasting is a unique functionality SAP introduced for when you want a new forecast without a reference for a short period of time. You can do this with seasonality and trend manually based on the planner experience. You can manage manual forecasting directly from the Manual Forecast app via the **Manual Forecasting** setting in the **Forecast Dates** tab. It doesn't require a product assignment because there is no reference product available for manual forecasting.

Prerequisites and restrictions of manual forecasting are shown in Figure 5.25:

- Forecasts can only be carried out for existing planning objects for the target key figure for forecasting. But planning objects aren't required for the input key figure. Filters of statistical forecast runs aren't considered.
- The product's periodicity must have been selected for the forecast model (e.g., week).
- The launch dimension attribute or the master data type key attribute is included in the aggregation level selected in the forecast job.
- A business meaning of target unit of measure (UoM) must have been assigned for the planning area attribute.

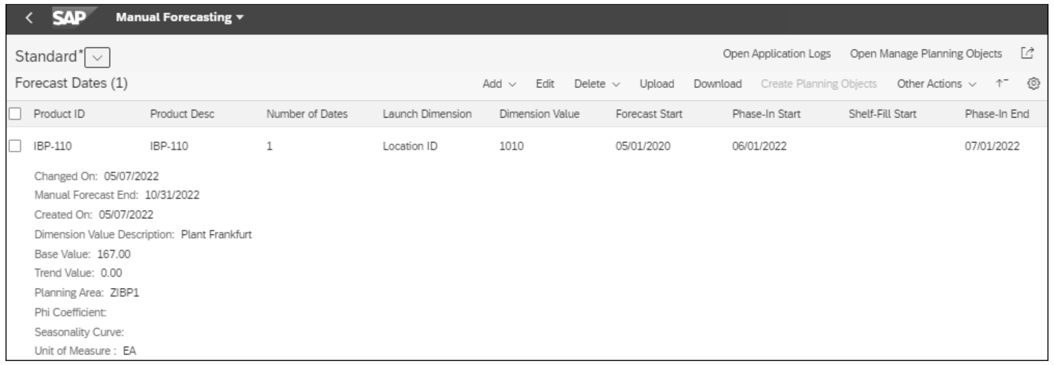


Figure 5.25 Manual Forecasting: Initial Screen

The **Manual Forecasting** option should be enabled in the **GENERAL** tab of the Manage Forecast Model app, as shown in the Figure 5.26.

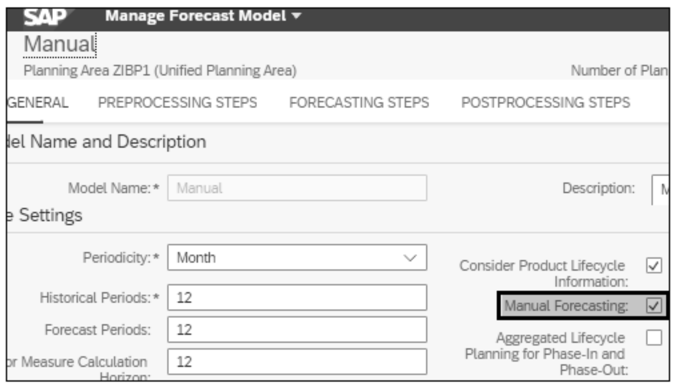


Figure 5.26 Manage Forecast Model: Manual Forecasting Option

You can maintain manual forecasting settings directly in the Manual Forecasting app. Let's consider an example of maintaining manual forecasting for product IBP-110 in location ID as the launch dimension and location ID 1010 as the launch dimension value. To access the parameters for our example, in the Manual Forecasting app, choose **Add • Single Forecast Date**, and enter the planning area, product ID, and launch dimension. Then the parameters of manual forecasting are as shown in Figure 5.27:

- **Shelf-Fill Start**
  In this optional step, you can enter a fixed value from a particular date (e.g., May 1, 2022). This date must be before the phase-in date and based on the shelf-life length.
- **Shelf-Fill Length**
  You can enter the length of your shelf-fill period. The period is based on granularity such as week or month (e.g., 6 months).

- **Shelf-Fill Value**
  Shelf-fill value is the overall value that you want to distribute from the shelf-life start date until the end of the shelf-fill length (e.g., May 2022 to Oct 2022).
- **Forecast Start**
  This is the date from when the forecasting starts.
- **Phase-In Start**
  This is the phase-in start of the new product considered in the manual forecasting. This date should only start after the shelf-life period is completed. For example, if the shelf-life starts from May 1, 2022, and the length is six months, then the phase-in can only start from November 1, 2022.

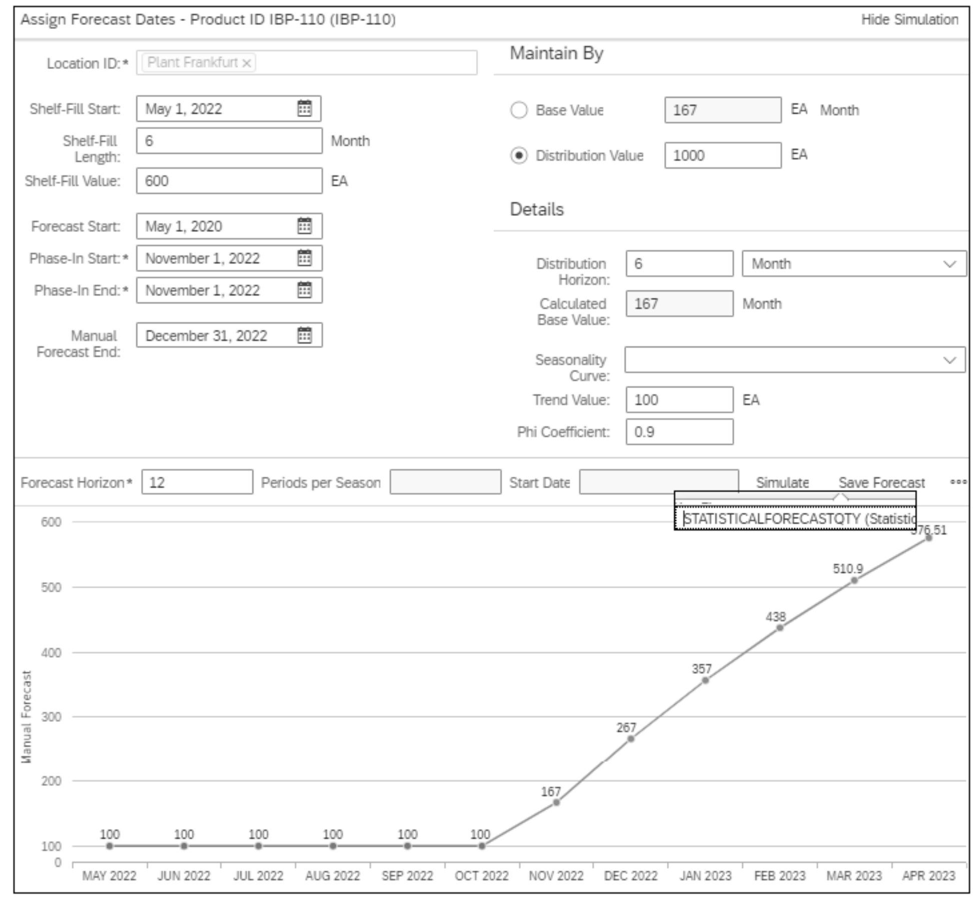


Figure 5.27 Manual Forecast Settings and Simulation

- **Phase-In End**
  This is the end date of the phase-in period. It can be the same as the phase-in start date or different.

- **Manual Forecast End**
  This is the date you want to keep the manual forecasting for the new product. You can extend or shorten based on the sales history of the new product.
- **Base Value/Distribution Value**
  The seasonality and trend are calculated based on the base value/period. The distribution value is the total value that you want to distribute for the manual forecasting from the phase-in period. The base value must be greater than 0.
- **Distribution Horizon**
  This refers to the distribution periods of the distribution value. For example, if the distribution value is 1,000 EA and this quantity is distributed over six months based on the distribution horizon, the *Calculated base value = Distributed value/distributed horizon*, so (1,000 / 6) = 167 EA.
- **Seasonality Curve**
  With this optional setting, you can choose a seasonality curve if required.
- **Trend Value**
  This optional value allows you to enter trend to potentially increase in the product sales. This value will be added to the base value of each period. For example, if your trend value is 50 pcs, base value is 100 pcs, and one forecast horizon is for 12 periods, then the forecasting will be 100, 150, 200, 250, 300 . . . 600.
- **Phi Coefficient**
  This is used to dampen the trend (e.g., 0.9).
- **Forecast Horizon**
  This is used to specify the forecast horizon (e.g., 12 months).

You can simulate the forecast with the parameters by clicking the **Simulate** button in the menu bar. Save the forecast results by clicking the **Save Forecast** button from the menu bar, as shown in Figure 5.27, in any of the key figures to be used as an input for the forecast model. You can also store the forecast directly in the **Statistical Forecast Qty** key figure.

Forecast calculation can be used with and without trend dampening. The system calculates the forecast starting from the forecast start date while considering the phase-in start and end dates. Calculations of forecast with trend dampening are as follows:

$\textit{Forecast} = (\textit{Base value} + \sum_{1}^{n} \textit{trend}) \times \textit{Seasonal index}$

$\textit{Trend} = \textit{Trend value} \times \textit{phi factor}$

$n = \textit{Number of periods}$

In the example, the total forecast horizon is 12 months with the shelf-fill period in the first six months (May 2022 to October 2022). The forecast value is calculated with trend dampening from November 2022 until the end of the manual forecast period (April 2023), as shown in Figure 5.28.

	Nov'22	Dec'22	Jan'23	Feb'23	Mar'23	Apr'23
Phi factor	0.9	0.9	0.9	0.9	0.9	0.9
Trend		100	90	81	72.9	65.61
Base value	167	167	267	357	438	510.9
Statistical Forecast	167	267	357	438	510.9	576.51

Figure 5.28 Forecast Simulation Calculation

You can see the manual forecast results in the Microsoft Excel planning view without **Actuals Adj. Quantity** key figure and reference product. The forecast simulated values are saved in the statistical forecast quantity, as shown in Figure 5.29.

Product ID	Location ID	Customer ID	Key Figure	MAY 2021	JUN 2021	JUL 2021	AUG 2021	SEP 2021	OCT 2021	NOV 2021	DEC 2021	JAN 2022	FEB 2022	MAR 2022	APR 2022	MAY 2022	JUN 2022	JUL 2022	AUG 2022	SEP 2022	OCT 2022	NOV 2022	DEC 2022	JAN 2023	FEB 2023	MAR 2023	APR 2023
IBP-110	1010	10100001	Actuals Qty Adj.																								
			Statistical Fcst Qty													100	100	100	100	100	100	167	267	357	438	511	577

Figure 5.29 Manual Forecast Result

5.3 External Forecasting

SAP offers all the key forecasting algorithms for statistical forecasting, but some client wants to use their own forecast algorithm in the forecasting process. In the past, it wasn't possible as part of the standard, so they had to use them in SAP IBP with workarounds. Now from SAP IBP version 2205, external forecasting algorithms can be integrated seamlessly into SAP systems. So, customers have complete freedom to use their own algorithms generated externally along with existing SAP-delivered statistical forecast algorithms and send them back to external tools as standard. We'll discuss the external forecasting process and setup in detail in the following sections.

5.3.1 External Forecasting Process

The external forecasting process starts from the historical data like other native forecast algorithms for SAP IBP, as shown in Figure 5.30. Refined data will be sent to external system such as RStudio, Python, or any other third-party tool. Next, the external system extracts required input data such as master data, key figures, and forecast data for further processing. Then, the forecast is performed using an external algorithm, which is sent back to SAP IBP. In SAP IBP, postprocessing is performed to fine-tune the forecast received from the external system and included with other SAP native forecast models using the Manage Forecast Model app to identify the best fit forecast. Finally, the new forecast results are saved in SAP IBP and continued on in other supply chain processes.

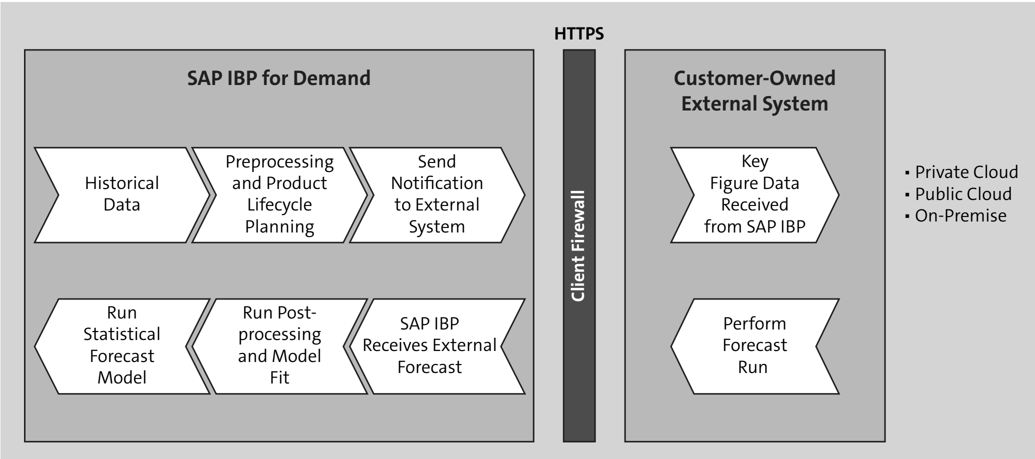


Figure 5.30 External Forecasting Process Flow

5.3.2 Configure External Forecasting

Now, let's walk through the setup for external forecasting. Follow these steps to configure external forecasting:

1. **Create communication for data exchange**
   To integrate external algorithms, you must use the new communication scenario `SAP_COM_830` to exchange the inbound and outbound data from SAP IBP. In addition, you need to implement an HTTP server in the external system to call up the `IBP_DEMAND_EXT_FCS_SRV` OData service to exchange the data between SAP IBP and third-party systems. To create communication in the Communication Arrangement app, as shown in Figure 5.31, the following prerequisite steps must be performed:
   – Create an HTTP server in the external system for inbound communication.
   – Create an inbound and outbound communication user (e.g., `External_Forecast_User`) in the Maintain Communication Users app and associate them with the `SAP_COM_030` communication scenario.
   – Create a new communication system using the Create Communication System app.

   Create a new communication arrangement for external forecasting, and specify that the inbound URL is from the external system and that the outbound services URL specifies the notification services to be sent to the external system from SAP IBP.

> **Note**
> Go to Chapter 12, Section 12.2.4, to see how to link communication systems and communication users to communication arrangements.

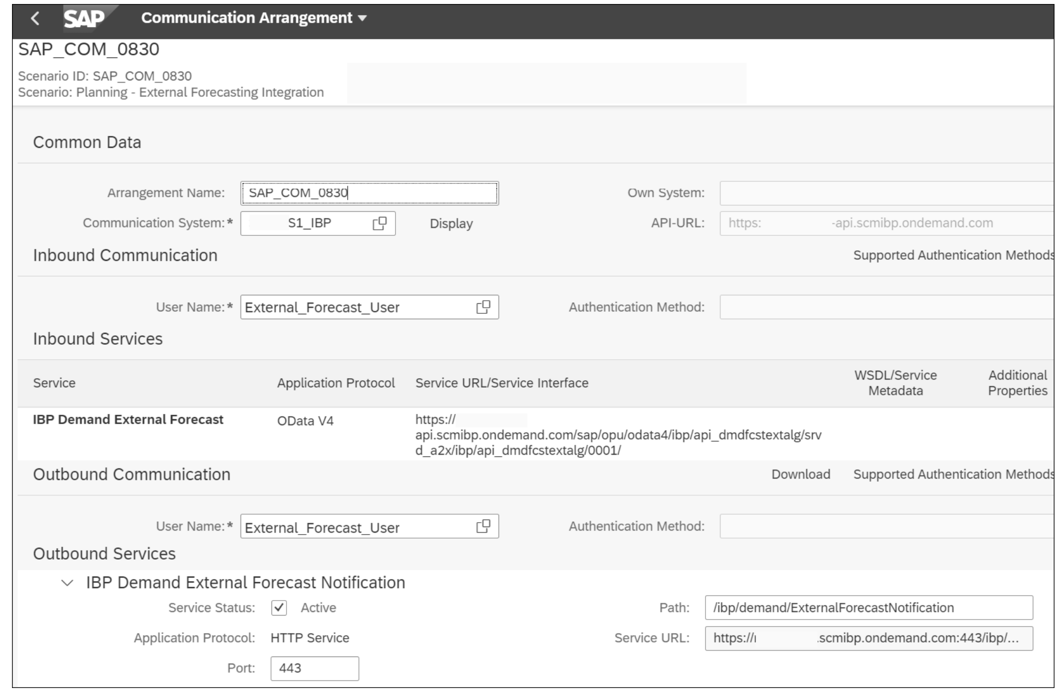


Figure 5.31 Communication Arrangement External Forecast

2. **Create the forecast model with the external forecast algorithm**
   Add a new forecasting algorithm from the **FORECASTING STEPS** tab of the Manage Forecast Model app, click the **+** icon, and go to the **External Algorithm** section, as shown in Figure 5.32. Specify the following parameters for each external algorithm:
   – **Algorithm Name**: Specify a name to identify the algorithm in the external system and forecast model output for further analysis if more than one external algorithm is used.
   – **Algorithm Parameters** (optional): Enter parameters that the external algorithm considers during forecasting. For example, you choose an error measure used in the external system. For each parameter, you need to specify a value as well.
   – **Independent Variables** (optional): Enter independent variables that you expect to have a significant effect on the forecast calculated by the external system. For each variable, you need to choose a time horizon as well. For example, if you know that future values of an independent variable aren't required for the forecast, choose the default **Time Horizon**, which is **Past** only. This will result in better performance. Three horizons are available to choose from: **Past**, **Future**, and **Past and Future**.

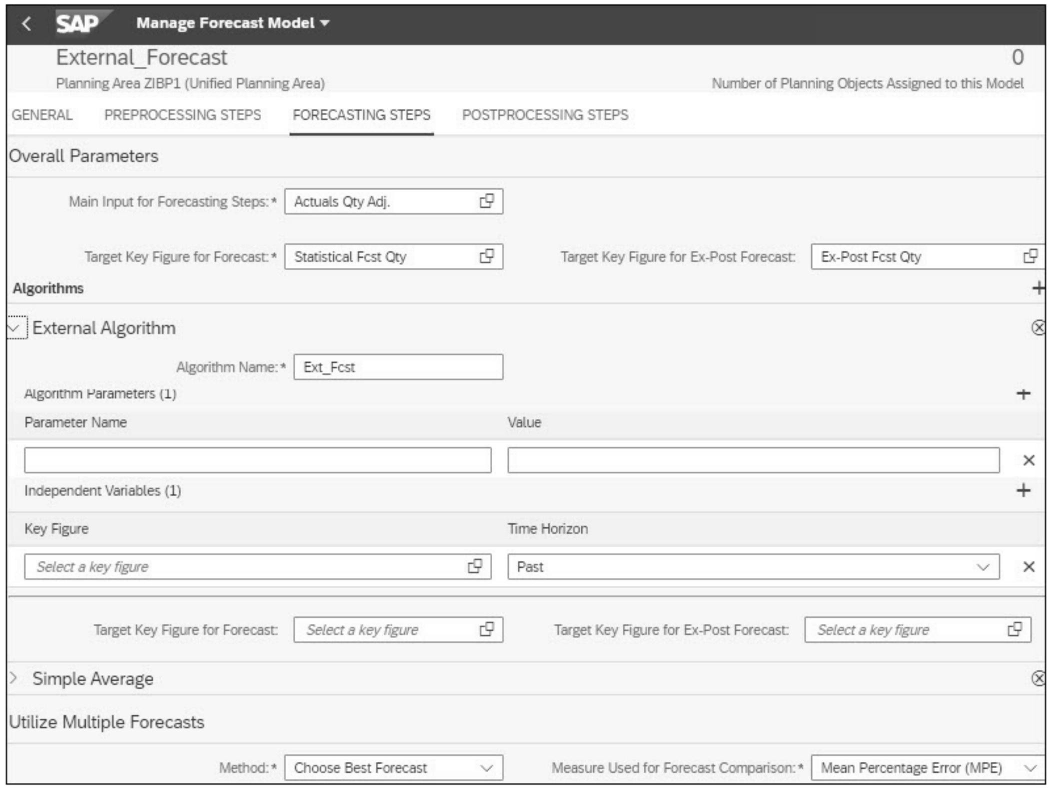


Figure 5.32 External Forecasting Algorithm

> **Note**
>
> Ex-post and forecast results are sent by the external system in a single string for each variable. It's important to limit the time horizons for each variable to improve data transfer and calculations performance.

- **Target Key Figure for Forecast** (optional): Enter the key figure to which you want to save the forecast calculated by the external algorithm. This is for reference only, so it's not mandatory because the final forecast values are saved in the main target key figure of the forecast model.
- **Target Key Figure for Ex-Post Forecast** (optional): Enter the key figure to which you want to save the ex-post forecast calculated by the external forecast algorithm for future reference. This is also not mandatory as the final ex-post forecast values are saved in the main target key figure for ex-post forecasting by the forecast model.

> **Note**
>
> SAP IBP for demand doesn't support external key figures or key figures with external key figures (order-based planning) in their calculations. So only SAP IBP time series-specific key figures can be used for target key figures.

3. **Use the external forecast algorithm to compute the forecast**
   You can run the statistical forecasting operator interactively from the Microsoft Excel planning view or run the forecast in a scheduled job in the Application Jobs app as you run other forecast models. You can also run simulations like other models as shown in Figure 5.33 by clicking **Simulate • External Forecast**. See Chapter 8, Section 8.3, for more information on running simulations.

> **Note**
>
> You can add external algorithms only after establishing the communication with your external system. Otherwise, you'll get an error code: **Error while processing your query; no communication arrangement exists for scenario SAP_COM_0830**.

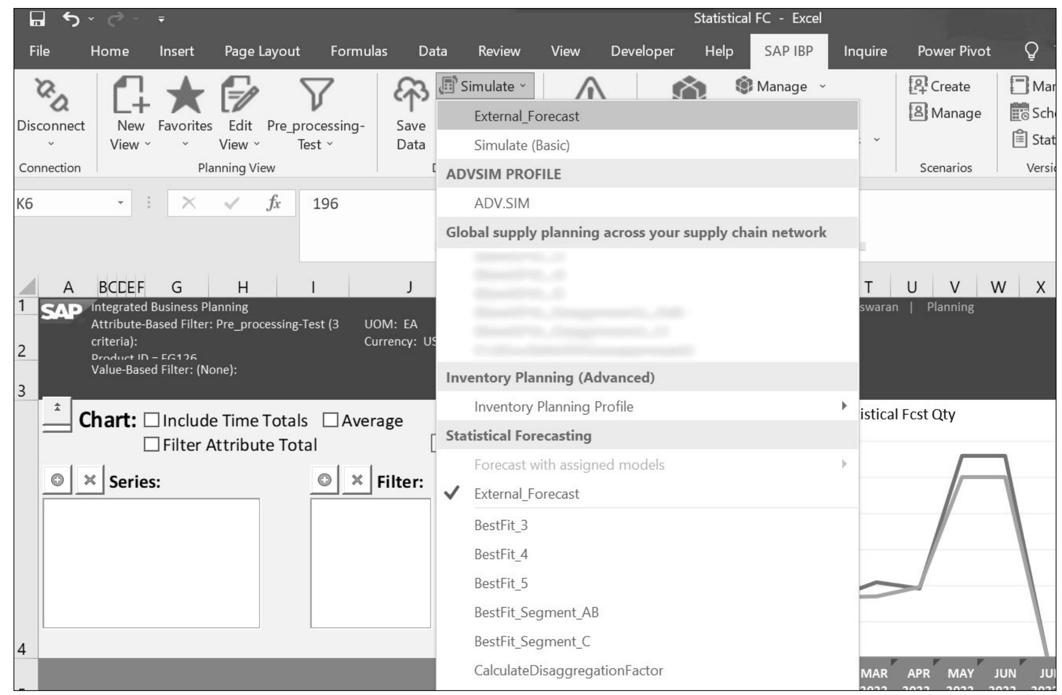


Figure 5.33 SAP IBP Execution

5.4 Driver-Based Planning

The large number of supply chain disruptions due to competition and other events (e.g., political changes, holidays, or government lockdowns) will make a planner's life difficult. SAP IBP for demand and sales and operations planning (S&OP) for supply need to wait until the next planning cycle, or you have to cover these changes with SAP IBP demand sensing in the short term. But for customers who aren't using demand sensing, SAP IBP driver-based planning can be used to dynamically adjust the forecast outcome based on the positive or negative impacts from the drivers in short- to medium-term forecasting and consider these drivers in your supply chain as well.

We'll discuss the driver-based planning process in the following sections and explain how to set it up in SAP IBP for demand.

5.4.1 Driver-Based Planning Process

Business drivers such as risks and opportunities can be captured with driver-based planning. Using key figure values for multiple planning levels, you can capture qualitative and quantitative information about their likely effects. There are both internal and external drivers of your organization's supply chain plan, such as business risks, opportunities, assumptions, and other events. By integrating these drivers into your supply chain plan, you can understand how they may influence your strategy and prepare to adjust if necessary. These drivers are captured during a planning cycle for a business unit, such as marketing, demand, or supply. During the review meeting with stakeholders from the different business units, the various drivers are consolidated and analyzed. The supply chain plan is then developed by determining which drivers are relevant. By identifying these drivers, you can adjust your supply chain plan in response to their possible effects.

The driver-based planning process is explained from the demand planning perspective, as shown in Figure 5.34. The sales manager reviews the inputs from the sales planner (e.g., sales forecasts), the marketing manager is responsible for promotion plans, and the demand planner is responsible for creating the forecast based on the input from the sales manager and marketing manager. Now, collectively, all these inputs are discussed in the S&OP meeting to finalize the consensus demand. In the consensus demand process, driver-based planning helps to adjust the demand dynamically by considering input and output drivers as risks and opportunities. If you're considering your drivers in the plan, then the consensus demand plan will adjust the demand, and the new demand can be seen in the consensus demand plan with risks and opportunities.

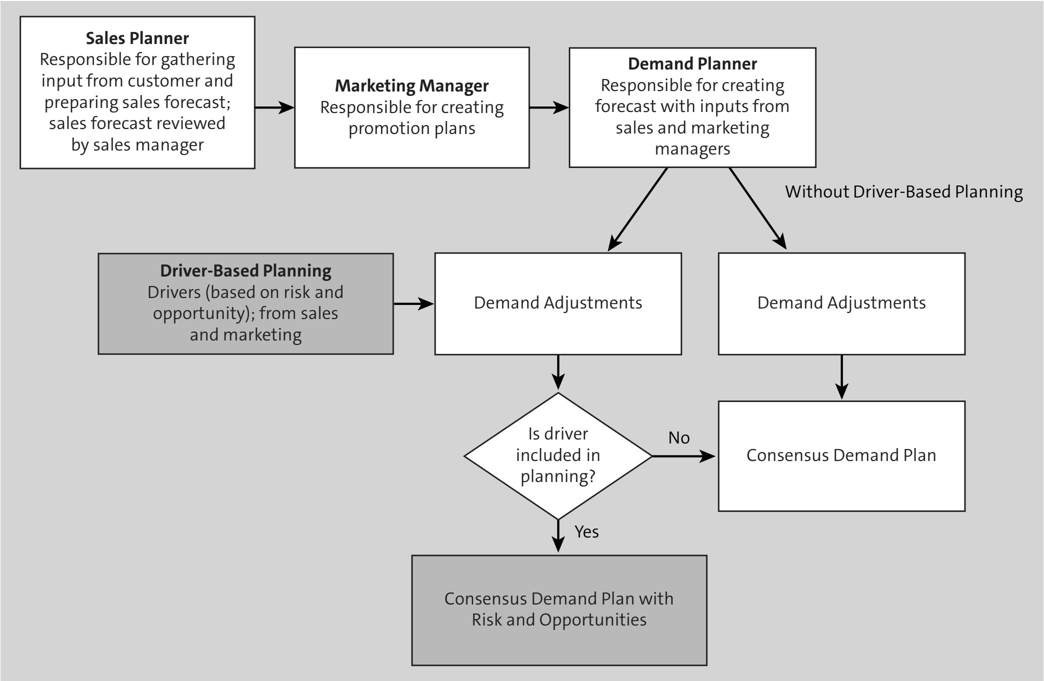


Figure 5.34 Driver-Based Planning Process

5.4.2 Configure Driver-Based Planning

Modeling driver-based planning requires some process changes and configuration changes in SAP IBP for demand. Driver-based planning master data types, attributes, planning levels, and key figures will be copied with sample planning area SAPIBP1 and supported application S&OP and supply planning selection. We'll walk through each in the following sections and then explain how to set up the driver planning view. For more information on these configuration items, see Chapter 2.

Master Data Types

Driver-based planning requires specific master data types that are available when you copy the SAPIBP1 unified planning area, as shown in Table 5.1.

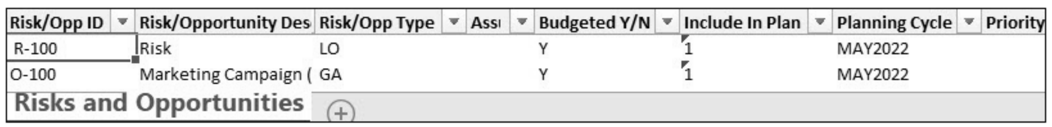
Master Data Type ID	Key Attribute	Description	Business Meaning
RISKOPP	ROPID	Risks and opportunities	Represents a driver that will affect your planning; can be risk or opportunity

Table 5.1 Master Data Type: Driver-Based Planning

Master Data Type ID	Key Attribute	Description	Business Meaning
ROPTYPE	ROPTYPEID	Risk and opportunity type	Represents the type of the driver; type can be risk or opportunity
PRIORITY	PRIORITYID	Priority	Represents the priority of the driver (e.g., high, medium, or low); can be used to sort or report
ASSUMPTION-CATEGORY	ASSUMPTIONCATID	Assumption category	Represents the assumption category for the driver, for example, weather, war, competition, or others

Table 5.1 Master Data Type: Driver-Based Planning (Cont.)

Figure 5.35 shows the material type risks and opportunities in the Microsoft Excel planning view with a unique risk and opportunity ID and other details such as drivers to be budgeted and inclusion in the plan or not.

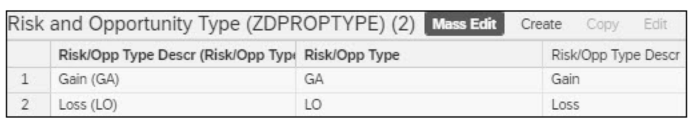


Risk/Opp ID	Risk/Opportunity Des	Risk/Opp Type	Assı	Budgeted Y/N	Include In Plan	Planning Cycle	Priority
R-100	Risk	LO		Y	1	MAY2022	
O-100	Marketing Campaign (	GA		Y	1	MAY2022	

Risks and Opportunities

Figure 5.35 Risk and Opportunities

Risk and opportunity type and description maintained as **Gain (GA)** and **Loss (LO)** are shown Figure 5.36 in the web view. You can also view or maintain driver-based planning master data in the Microsoft Excel planning view as well.

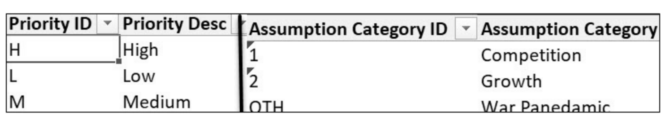


Risk and Opportunity Type (ZDPROPTYPE) (2) Mass Edit Create Copy Edit

	Risk/Opp Type Descr (Risk/Opp Type	Risk/Opp Type	Risk/Opp Type Descr
1	Gain (GA)	GA	Gain
2	Loss (LO)	LO	Loss

Figure 5.36 Risk and Opportunity Type Web View

Priority ID and **Assumption Category** master data types also must be set up, as shown in Figure 5.37.



Priority ID	Priority Desc
H	High
L	Low
M	Medium

Assumption Category ID	Assumption Category
1	Competition
2	Growth
OTH	War Panedamic

Figure 5.37 Priority and Assumption Category

You can upload the master data with a CSV file for master data types ROPTYPE, PRIORITY, and ASSUMPTIONCATEGORY.

Planning Levels

Driver-based planning key figures require several planning levels, including risk and opportunity, as shown in Table 5.2. See Chapter 2, Section 2.4, for more information on configuring planning levels.

Planning Level	Description
MTHROPRDFAMCUSTREG	Month/risk opportunity/product family/customer region
WKROPRODLOCCUST	Week/risk opportunity/product/location/customer
MTHRO	Month/risk opportunity
MTHROPRDFAMCUSTREG	Aggregation level: Month/risk opportunity/product/location/customer

Table 5.2 Planning Level: Driver-Based Planning

Key Figures

The key figures that are required for driver-based planning are shown in Table 5.3. For more information about configuring key figures, see Chapter 2, Section 2.5.

Key Figure	Base Planning Level	Description
ROAGGSLSQTY	MTHROPRDFAMCUSTREG	Key figure in which you enter the value for the risk and opportunity in the Driver-Based Planning app.
ROCALCSALESQTY	WKROPRODLOCCUST	Calculated key figure used to view the impact of the risk or opportunity at the level of consensus demand for the quantity key figure. It performs a split factor-based calculation to determine the ROAGGSLSQTY at the MTHROPRODLOCCUST planning level.
CONSENSUSCALCROQTY	WKROPRODLOCCUST	Key figure showing the consensus demand quantity key figure considering the risk and opportunities included, which will be used as the final demand planning key figure to transfer the data to supply.

Table 5.3 Key Figures: Driver-Based Planning

Key Figure	Base Planning Level	Description
■ HROSALESQTYIN-PLAN ■ HDEMANDRATIO ■ HCONSENSUSDEMAND-QTYRO ■ HAGGCONSENSUS-DEMANDQTYRO		Helper key figures used to perform a split factor-based calculation to promote a risk/opportunity defined at an aggregate planning level to the level of the forecast key figure, and to include the approved risks and opportunities in the consensus demand plan.

Table 5.3 Key Figures: Driver-Based Planning (Cont.)

You can see the three driver-based planning key figures as shown in Figure 5.38. The **RO Agg Sales Quantity** is a stored key figure and can be assigned to the Driver-Based Planning app.

Figure 5.38 Driver-Based Planning Key Figure

Figure 5.39 shows the overall configuration results with driver-based planning in the demand planning perspective. **Consensus Demand Plan Quantity** is the final outcome of demand planning after global demand planning quantity. Consensus demand planning quantity will be then transferred to supply because consensus demand is the process without driver-based planning. Now driver-based planning key figure **RO Agg Sales Quantity** will be multiplied with the helper key figure demand ratio and become **RO Calc Sales Qty**. This will add or subtract based on the attribute `INCLUDEDINPLAN` setting. If it's **1**, then the driver-based planning quantity will be considered in the new key figure **Consensus Demand Qty with RiskOpp**; if it's **0**, then it won't be considered in the plan, and **Consensus Demand Qty with RiskOpp** = **Consensus Demand Plan Qty.** In addition, in the right-hand side of Figure 5.39, the **Consensus Demand Plan Rev.** key figure calculation will be changed based on the **Consensus Demand Qty with RiskOpp** instead of **Consensus Demand Plan Qty**. Finally, the key figure **Consensus Demand Qty with RiskOpp** will be used in the copy operator to release the supply planning key figure **Consensus Demand**.

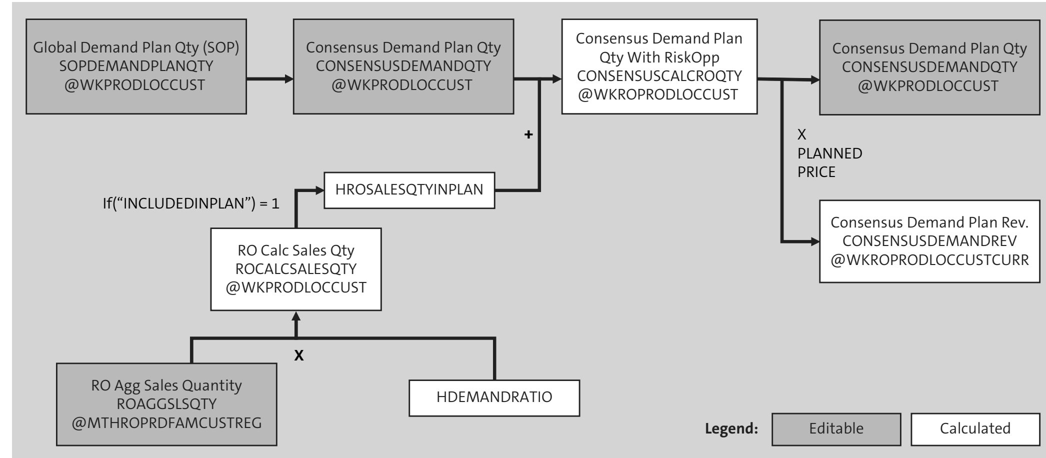


Figure 5.39 Overall Configuration with Driver-Based Planning

Setting Up Driver Planning View

You can create or view the drivers in the driver planning view with multiple steps in a single screen for a driver by going to the Driver-Based Planning app and clicking the **Create** button, as shown in Figure 5.40. This alternative to maintaining multiple steps of master data in SAP IBP, add-in for Microsoft Excel is managed by the planner who is responsible for creating drivers, such as risk or opportunity.

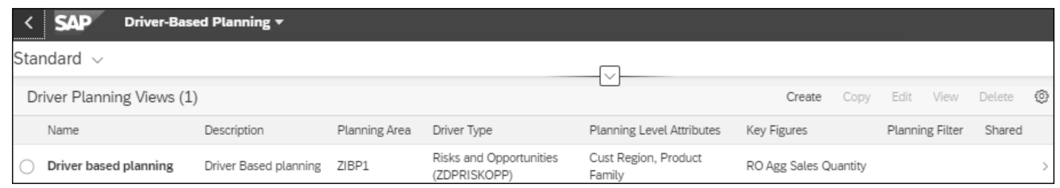


Figure 5.40 Driver-Based Planning App: Initial Screen

You can create specific driver types for each driver in a single planning view with the following settings:

- **General Information**
  Specify a driver **Name**, and assign a **Planning Area** and **Version**, as shown in Figure 5.41.

> **Note**
> Only **Base Version** is supported in the driver planning view.

- **Time Settings**
  Specify from and to time settings in the **Time Period** field, as shown in Figure 5.42.

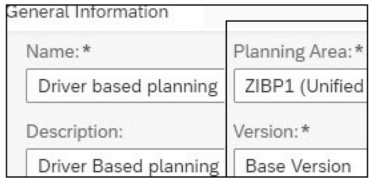


Figure 5.41 General Information

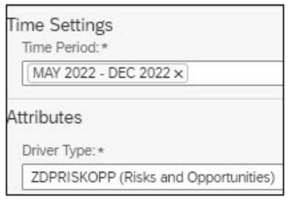


Figure 5.42 Time Settings and Driver Type

- **Driver Type**
  Select the **Driver Type**, and the required driver type attributes are added automatically.

> **Note**
> The driver types you can select here are single-key master data types. You can't change the driver type once you've saved the driver planning view.

- **Driver Type Attributes**
  The required attributes marked in red are automatically selected and are mandatory. If required, you can add or remove more attributes other than the red asterisk IDs. Planners can only select data for attributes that have a value help, as shown in Figure 5.43.

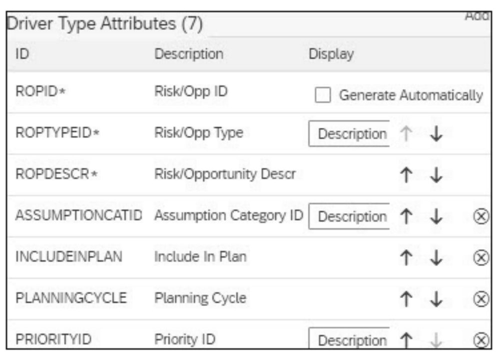


Figure 5.43 Driver Type Attributes

> **Note**
> Driver **ID** will be created by the system automatically if you select the **Generate Automatically** checkbox. The driver ID is automatically generated both the driver planning view and the separate driver view.

- **Planning Level Attributes**
  Create the planning level attributes based on the key figure that you're going to use in the driver-based planning, as shown in Figure 5.44.
- **Key Figures**
  Maintain key figure data for drivers on the base planning level. You also can select key figures with different planning levels based on your attribute selection.
- **Charts**
  View the potential impact of the drivers you've created in the Analytics app and assign the drivers here. You can navigate to the Analytics – Advanced app or the Monitor Custom Alerts app to get further information.
- **Filter**
  Apply planning filters or use ad hoc filters.

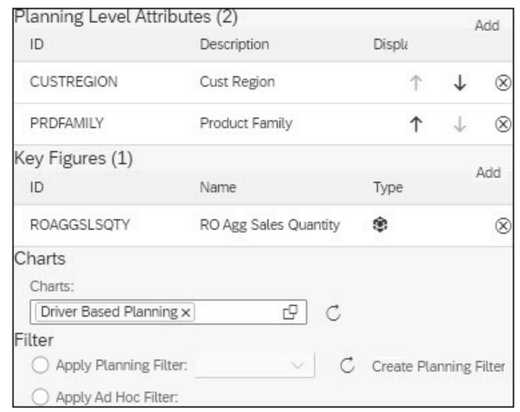


Figure 5.44 Planning Level Attributes in Driver-Based Planning

You can navigate to your driver-based planning view by going to the Driver-Based Planning app, choosing the radio button of your driver-planning view, and double-clicking. Now the driver-based planning view can be seen (see Figure 5.45). You can edit key figures and attributes after the planning view is created. If there are any changes in the planning view, you can synchronize the data to update the changes.

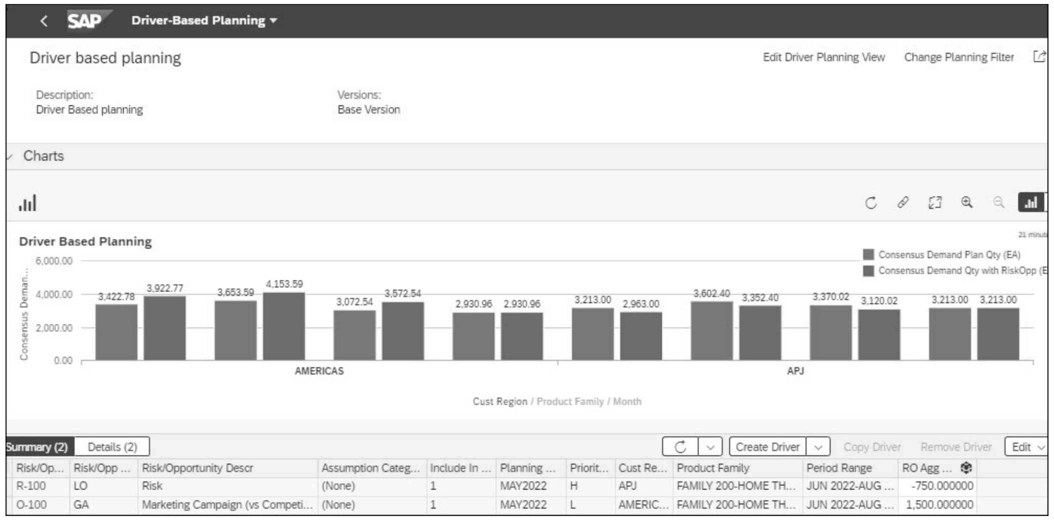


Figure 5.45 Driver-Based Planning View

Now you can see the Microsoft Excel planning view showing the risk and opportunity quantities that will be considered for **Consensus Demand Qty with RiskOpp**, if the risk and opportunity values are considered in the plan as **1**. In addition, if the budget is considered, then the **Consensus Demand Plan Rev.** will be adjusted and the revenue based on the risk and opportunity values, as shown in Figure 5.46.

Product Famil	Cust Regior	Key Figure	MAY 2022	JUN 2022	JUL 2022	AUG 2022
FAMILY 200-H	AMERICAS	Consensus Demand Plan Qty	4,307	3,423	3,654	3,073
		RO Agg Sales Quantity	500	500	500	500
		Consensus Demand Qty with RiskOpp	4,807	3,923	4,154	3,573
		Consensus Demand Plan Rev.	15,10,626	11,70,305	12,60,027	12,70,441
	APJ	Consensus Demand Plan Qty	4,113	3,213	3,602	3,370
		RO Agg Sales Quantity	-250	-250	-250	-250
		Consensus Demand Qty with RiskOpp	3,863	2,963	3,352	3,120
		Consensus Demand Plan Rev.	9,77,672	7,14,100	8,28,333	8,50,292

Figure 5.46 Microsoft Excel Planning View Output

5.5 Promotional Planning

Trade promotions are inevitable in today's competitive market. You can improve the sales volumes when you launch a new product with promotions. SAP IBP for demand focuses on the integration of promotions that are planned in the trade promotion planning system. Following are the key objectives to use promotional data in the planning and forecasting process in SAP IBP:

- Manage promotion sales lift in the planning process separately.
- Consider promotion sales uplift in the preprocessing during forecasting and demand sensing.
- Distribute the promotion sales to distribution centers based on certain rules.
- Facilitate collaboration and alignment on promotions between sales/marketing and demand planners.

Promotions are planned in planning tools such as SAP Trade Promotion Management in SAP Customer Relationship Management (SAP CRM) or simply Microsoft Excel. Promotion data is used to create more accurate demand forecasts. In addition to historical demand forecast data, promotion data is also added to create the final demand plan.

Promotion data is managed using the Analyze Promotions app to decide whether promotional planning should be included in the forecasting or not. You can decide interactively in SAP IBP, add-in for Microsoft Excel, or demand planners can decide whether to exclude the promotion during forecasting via the algorithm for accurate forecasting.

In the following sections, we'll explain the promotional planning process and how to set it up.

5.5.1 Promotional Planning Process

Promotional data transfer is the starting point in the promotional planning process. Promotion data is generally transferred from external systems such as SAP CRM, third-party systems, or Microsoft Excel uploads, as shown in Figure 5.47 ❶. To transfer the promotional planning data to integrate from the external system, consider the following points:

- Data is transferred from the external system used for promotional planning. The data to be considered must contain the promotion ID, data source of the promotion, time level, product ID, and status of the promotion. You can also include customer or customer group data and location data.
- The SAP IBP planning area that you use for demand forecasting is set up in demand sensing or for mid- to long-term forecasting and is enabled for the promotion data to be processed.
- You can use SAP Cloud Integration for data services to transfer the promotion master data and key figure values from the trade promotion planning systems to the SAP IBP system.

Alternatively, promotions can be created manually in SAP IBP itself ❷ using the Analyze Promotions app.

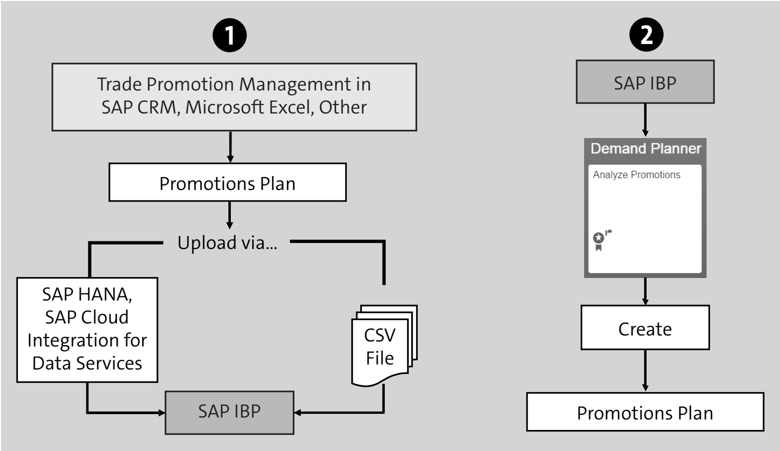


Figure 5.47 Promotional Planning Transfer

Promotions can be uploaded from SAP Cloud Integration for data services or by a CSV file upload into SAP IBP. When SAP Cloud Integration for data services is used, transformations and mappings can be performed. Loaded promotions must contain a product reference to product groups, customers, customer groups, brands, categories, or locations (if the location split was done outside SAP IBP). Note the following:

- The total values stored at the promotion level in SAP IBP aren't changed.
- The promotion data is distributed to locations using advanced copy operators.
- The demand planner analyzes the promotions and their allocations at locations. If needed, they adjust the location split using the Analyze Promotions app.

Figure 5.48 shows the complete promotional planning process with SAP IBP. Let's explore these key steps:

1. **Load promotion master data**
   Load promotion data using SAP Cloud Integration for data services from external systems or CSV file upload. You can also load sales lift promotions key figures using SAP Cloud Integration for data services or CSV file upload.
2. **Create the promotion in the Analyze Promotions app**
   The demand planner creates the promotion in the Analyze Promotions app. If data isn't loaded from an external system, then the promotion source ID attribute in the promotion master data type will be assigned by the system as IBP.
3. **Check the promotions transferred in the Analyze Promotions app (optional)**
   Customers can decide if they want to check the loaded promotions. If there are problems in the data, the demand planner may decide to keep the promotion or exclude the promotion from the planning.

4. **Distribute promotion data to locations**
   The promotion sales lift from the promotion level is disaggregated to the promotion disaggregation level based on the factors defined on the location split level via the following steps:
   - Calculate a promotion sales lift location split at the disaggregation level using the promotion split helper key figure for promotion split.
   - Copy the helper key figure for promotion split to the stored promotion uplift key figure to store the initial location split using the advanced copy operator.
   - Disaggregate the promotion sales lift from the promotion level to the promotion uplift key figure at the promotion disaggregation level proportionally to its existing values using the advanced copy operator. Time disaggregation will also help based on your data modeling.
5. **Run forecasting/demand sensing with the promotion sales lift elimination preprocessing step**
   Use the promotion sales lift elimination preprocessing step to remove promotion sales uplift from the historical forecast. This improves the data during the forecasting/demand sensing run.
6. **Calculate the consensus demand forecast result and add promotions**
   You calculate consensus demand as a forecast and add future promotions with it.
7. **Check and analyze results in the Analyze Promotions app**
   Check the forecast result in SAP IBP, add-in for Microsoft Excel, and analyze the results further in the Analyze Promotions app.

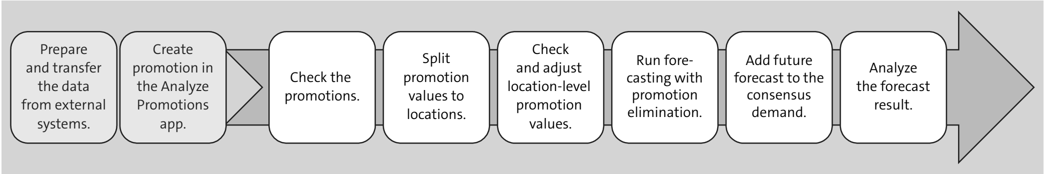


Figure 5.48 Promotional Planning Process

5.5.2 Configure Promotional Planning

To use promotions in SAP IBP for demand, your planning area must fulfill some prerequisites. These prerequisites are checked during the planning area activation. Modeling promotional planning in the system requires some process changes and configuration changes of SAP IBP demand planning for promotion planning-specific master data types, attributes, planning levels, and key figures. Detailed configuration for these items was provided in Chapter 2.

> **Note**
> The SAP6 sample planning area has promotional planning related to prerequisites. SAP recommends creating a new planning area copy from sample planning area SAP6.

Master Data Types

Promotional planning requires a specific master data type to be available in the system, as shown in Table 5.4. The promotion master data type must have an attribute with the promotion description business meaning assigned.

Master Data Type ID	Key Attribute	Description	Business Meaning
PROMOTION	PROMOTIONID*	Promotion ID	Represents a promotion ID. This root attribute is also a unique ID.
	PROMOTIONSOURCE*	Promotion data source	Represents a promotion source ID. This is also root attribute. You can identify the source of the promotion data, (e.g., SAP IBP).
	IBPPROMOSTATUS	Promotion status in SAP IBP	Represents the status of the promotion: 10, included, used in planning; or 20, excluded, not used in planning.
	NUMBEROFPERIODS	Promotion: Number of periods	Represents the promotion duration specified in number of periods.
	PROMOPERIODLEVEL	Promotion: Time level on which the promotion is created	Represents that the value set can only be a calendar week. No other period level is supported.
* Key attributes			

Table 5.4 Promotion Master Data

Planning Levels

Promotional planning key figures require specific planning levels, including promotion, as shown in Figure 5.49. **Promotion Level** is the base planning level of the Promotion Uplift (PROMOUPLIFT) and the Promotion Totals (PROMOTOTAL) key figures. A planning area can have only one promotion level.

Planning Levels (5)

ID	Description
PROMOLOCPRODCUSTUOMTOWEEKLY	Promotion Disaggregation UoM
PROMOLOCPRODCUSTWEEKLY	Promotion Disaggregation
PROMOLOCPRODCUSTWEEKLYHELPER	Promotion Disaggregation
PROMOPRODCUSTCALWEEKLY	Promotion Level
PROMOPRODCUSTUOMTOCALWEEKLY	Promotion Level

Figure 5.49 Promotional Planning Level

Key Figures

Specific key figures are required for promotional planning, as shown in Table 5.5.

Key Figure	Key Figure Name	Description
PROMOUPLIFT*	Promotion uplift (source)	This key figure is used to store promotion sales lifts. It's a stored key figure used at the promotion/product/customer/week level.
PROMOLOCATIONSPLIT**	Promotion location split	This key figure is used to store split factors. Split factors are used by the system to disaggregate the promotion numbers at the location level. Numbers can be uploaded or manually changed in SAP IBP, add-in for Microsoft Excel.
PROMOSPLITALL*	Promotion uplift (internal key figure)	This key figure is used to store the disaggregated promotion sales lift (PROMOUPLIFT) data. It's used only internally by the system because it includes all promotions. Promotions can have the status **Included** (**10**) or **Excluded** (**20**).
PROMOSPLIT*	Promotion uplift	This key figure is used to store the disaggregated promotion sales lift data for **Included** promotions. This is the promotion key figure used for planning and forecasting.
PROMOSPLITHELPER**	Helper key figure for promotion split	This is a helper key figure used internally by the system within the promotion disaggregation process.

Table 5.5 Key Figures: Promotional Planning

Key Figure	Key Figure Name	Description
PROMOBASELINE**	Sales history without promotions	This key figure is used to store values for the sales history with the promotion effects removed. It's calculated by the statistical forecast model within the promotion sales lift elimination preprocessing step.
* Mandatory when promotion data is used. ** Can be replaced by other key figure IDs.		

Table 5.5 Key Figures: Promotional Planning (Cont.)

Create Promotion

You can use the Analyze Promotions app to create or check the promotion data that has loaded into SAP IBP from an external system or has been manually created in SAP IBP. The Analyze Promotions app only shows the data in the baseline version.

You can do the following in the Analyze Promotions app:

- Check promotions data after it is transferred from the external system.
- Create new promotions from scratch.
- Include or exclude promotions from planning.
- Change the location split of promotion quantities, as shown in Figure 5.50.

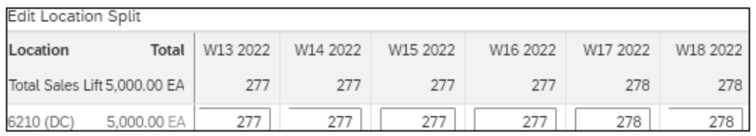


Figure 5.50 Location Split

- Review the promotion success.
- Add notes to a promotion.
- Share a promotion in a group on SAP Jam, and comment on a shared promotion.
- Delete promotions.

Before creating promotions, the following prerequisites need to be fulfilled:

- The promotion level contains a root attribute with the following business meaning: product ID, promotion source ID.
- The promotion level contains an attribute with the following business meaning: promotion description.

- You're allowed to create a maximum of five root attributes in addition to time, promotion ID, and promotion source.
- The attributes `STARTDATE`, `ENDDATE`, `IBPPROMOSTATUS`, `PROMOTIONTYPE`, `PROMOTIONUOM`, and `PROMOTIONUOMDESCRIPTION` are part of the promotion master data type.

Note

If the prerequisites aren't fulfilled, the **Create** button isn't visible in the Analyze Promotions app.

You can then click the **Create** button in the Analyze Promotions app to arrive at the screen shown in Figure 5.51. Here, enter the **Product** and **Customer** for the promotion, provide a **Description**, and choose a **Promotion Type**. Click the **Validate** button. If the validation is successful, the promotion can be created by clicking the **Create** button at the bottom of the screen.

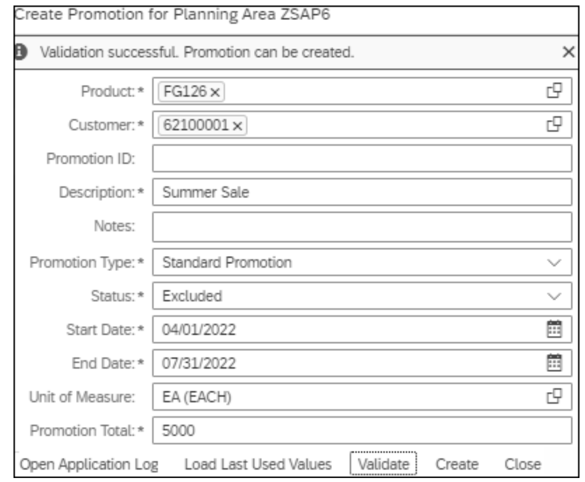


Figure 5.51 Promotion Creation

After creating the promotion, you can view it in the Analyze Promotions app, as shown in Figure 5.52.

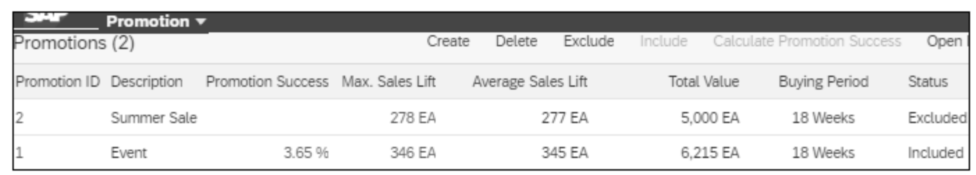


Figure 5.52 Analyze Promotions App

> **Note**
>
> You have to set the default planning area via the SAP IBP web UI home screen. Navigate to the user profile in the top-right corner and choose **Settings**. Select **SAP Integrated Business Planning (User Preferences)**; the Analyze Promotions app starts with this as the planning area. If the default planning area isn't set, you can create or view the promotions by specifying your planning area using the **App Settings** icon from the menu bar.

You can navigate to **Web Apps • Promotions** in the **Web Client** group on the **SAP IBP** tab in the ribbon from SAP IBP, add-in for Microsoft Excel, as shown in Figure 5.53. The Analyze Promotions app opens as your default browser.

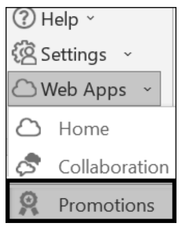


Figure 5.53 Promotions from SAP IBP, Add-In for Microsoft Excel

Let's consider promotions with two examples, one with promotion status included in and one excluded from the plan.

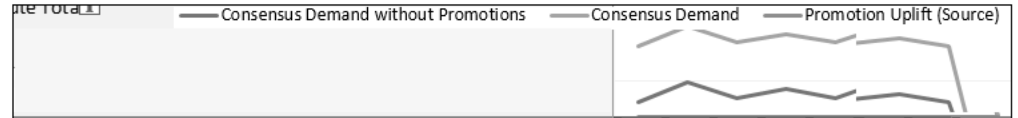
In the first example, promotion ID 1 is created for product **IBP-100** and customer **1010001** with a total promotion value of 6,215 pieces between January 1, 2022, and April 30, 2022, as shown earlier in Figure 5.52. Now promotion values will be split into location using these two copy operators when you copy from the SAP6 sample planning area, as shown in Figure 5.54.

SAP Copy Operator Profiles

ID	Name	Description
PROMODISAGG	Copy and split promotion values	Copy data stored on promotion level to the promotion disaggregation level by using the location split factors
PROMONORMALIZE	Normalize promotion data	Normalize promotion data: Ensure that promotion data sums up to 100% after location split

Figure 5.54 Copy Operator Promotional Planning

Now the promotion values 6,215 pieces are split equally into 18 weeks in location ID **3710**, **Customer ID 10100001**. As you can see in Figure 5.55, the key figure **Consensus Demand** is now showing the cumulative quantities of **Consensus Demand without Promotions** and **Promotion Uplift** for each period (e.g., week 52 2021 = 871 + 346 = 1,217 (consensus demand)) for the next 18 weeks as it's included in the planning.



Product ID	Location ID	Customer ID	Promotion ID	Key Figure	W52 2021	W01 2022	W02 2022	W03 2022	W04 2022	W16 2022	W17 2022	Total
IBP-100	3710	10100001	(None)	Delivered Qty	283	234	124	210	162	186	126	**4,277**
				Consensus Demand without Promotions	871	998	897	952	899	921	874	**16,396**
				Consensus Demand	1,217	1,344	1,243	1,298	1,245	1,266	1,219	**22,611**
			1	Promotion Uplift	346	346	346	346	346	345	345	**6,215**

Figure 5.55 Promotional Planning Results 1: Promotion Included in Planning

Let's look at the second example of promotion ID 2 created in SAP IBP for **Product ID FG126**, **Customer ID 62100001**, and location split **6210**. Promotion is excluded in the planning, so there was no promotion value in the **Promotion Uplift** key figure. The **Consensus Demand** and **Consensus Demand without Promotion** will be the same, as shown in Figure 5.56.

Product ID	Location ID	Customer ID	Key Figure	W13 2022	W18 2022	W19 2022	W21 2022	W26 2022	W27 2022	W30 2022	Total
FG126	(None)	62100001	Promotion Uplift (Source)	277	278	278	278	278	278	278	**5,000**
	6210	62100001	Promotion Uplift	0	0	0	0	0	0	0	**0**
			Consensus Demand without Promotions			599	568	1,367	870	553	**9,834**
			Consensus Demand	0	0	599	568	1,367	870	553	**9,834**

Figure 5.56 Promotional Planning Results 2: Promotion Excluded in Planning

Calculate Promotion Success

Promotion success is calculated in the promotion level root periodicity and includes the data that was loaded before the current period. The Analyze Promotions app allows you to calculate the success of past promotions by clicking the **Calculate Promotion Success** button, as shown in Figure 5.57. You have to select the key figure that contains the sales data you need to determine the average number of sold items. By default, the key figure with the business meaning **Actual Sales** is selected, and seasonality must be greater than 0.

Promotion Success	Calculate Promotion Success
Select Key Figure for Sales History: *	Delivered Qty
Number of Periods per Season in Weeks:	6

Figure 5.57 Calculating Promotion Success

The promotion success is calculated as follows:

Average number of sold items in promotion periods – Average number of sold items in periods without promotions ÷ Average planned uplift

The formula doesn't require a baseline calculation. Promotion success will be negative if fewer items are sold in promotional periods than in periods without promotion. Now you can see that the promotion success for promotion ID 1 is 3.65% with a seasonal period of 6 weeks, and the **DELIVQTY** key figure is considered for sales history, as shown in Figure 5.58. Now the calculation of the promotion success is as follows:

- *Promotion average = 237.61 (Average of delivered quantity)*
- *Unpromoted average = 225 (Average of delivered quantity without promotions)*
- *Planned average = 345.28 (Average of promotion uplift)*
- *Promotion success = (237.61 – 225) ÷ 345.28 = 3.65%*

Promotion success was calculated for promotion 1.
1: Promoted average:237.61 Each; Unpromoted average:225.00 Each; Planned average uplift:345.28 Each
Success of promotion 1: 3.65% = (237.61 - 225.00) / 345.28
108 unpromoted periods with values found in sales key figure DELIVQTY for 1.
Success of 1 was calculated with seasonal length 6 in periodicity Weekly.

Figure 5.58 Promotion Success

5.6 Financial Planning

The ultimate goal of a company is to improve profitability year on year. As you know, SAP IBP for demand is the starting point of the supply chain process, which means that inaccurate initial planning will impact the profitability of an organization either due to customer penalties from delivery delays or inventory and scrap resulting from excess planning. So, SAP IBP demand planning considers all the internal and external factors to improve the forecast efficiently and thereby increase profitability.

SAP IBP can now integrate the financial planning data with SAP Analytics Cloud for SAP S/4HANA. This feature is available from SAP IBP version 2111. The financial planning integration helps planners react faster to changes and assess the impact, which helps improve forecast accuracy. Supply chain planners in SAP IBP create a forecast each month during the S&OP process to determine the quantity of the consensus demand plan. Using the forecast value and the financial data in SAP S/4HANA, the financial planner calculates net revenue and cost of goods sold (COGS) using the sales and profitability planning in SAP Analytics Cloud. A financial planner sends the planning results back to SAP IBP during the business review phase to be analyzed and discussed.

Integrating these systems ensures consistency between quantity values and calculated values. Furthermore, the quantity planning data from SAP IBP will reduce the financial planning effort, while the results from financial planning in SAP Analytics Cloud will allow better decision-making during the S&OP management business review time period.

The financial planning process consists of the following steps, as shown in Figure 5.59:

❶ Monthly S&OP process output consensus demand plan quantity is calculated and transferred to SAP Analytics Cloud.

❷ SAP Analytics Cloud imports the consensus demand plan quantity from SAP IBP.

❸ The financial planner creates the sales and profitability plan based on the consensus demand plan quantity imported from SAP IBP.

❹ SAP IBP imports the annual operating plan revenue and COGS, and the supply planner uses the analytics function for S&OP management business review.

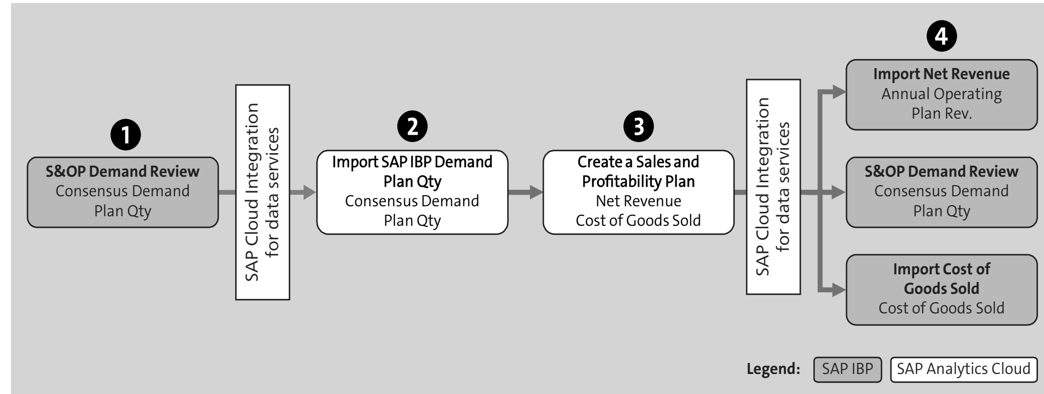


Figure 5.59 Financial Planning Process Integration

As SAP Analytics Cloud is beyond the scope of this book, we won't go into step-by-step detail to explain the configuration. Instead, we'll look at the financial planning integration of key figure results in SAP IBP, add-in for Microsoft Excel, where you can see the **Consensus Demand Plan Qty** is transferred to SAP Analytics Cloud and again imported as **AOP Rev.**, and **Costs of Goods Sold** is imported from SAP Analytics Cloud, as shown in Figure 5.60.

Product Family	Cust Region	Currency ID	Key Figure	MAY 2022	JUN 2022	JUL 2022	AUG 2022	SEP 2022	OCT 2022	NOV 2022
FAMILY 100-HEADPHONES	EMEA	(None)	Consensus Demand Plan Qty	6,011	4,836	5,290	4,940	4,595	5,449	4,462
			AOP Qty	5,714	5,713	5,162	5,713	5,532	5,713	5,528
		USD	AOP Rev.	6,61,760	6,83,980	6,83,870	6,17,760	6,83,870	6,62,090	6,83,870
			Cost of Goods Sold	50	1,367	1,024	1,206	1,187	1,369	1,133
			Margin	6,61,710	6,82,613	6,82,846	6,16,554	6,82,683	6,60,721	6,82,737
			Consensus Demand Plan Rev.	6,36,848	4,90,375	5,54,580	6,01,809	4,80,429	6,00,082	4,79,133

Figure 5.60 Financial Planning Output

Financial planning results and key performance indicators (KPIs) can be collectively seen in the Dashboard – Advanced app for S&OP management review, as shown in Figure 5.61. In this app, you can see the comparison of **Quarterly Constrained Demand Revenue vs AOP and Actuals**; **Constrained Revenue vs AOP and Sales Forecast**; and **Actuals Revenue YTD vs AOP Revenue YTD** (AOP = annual operational planning; YTD = year to date).

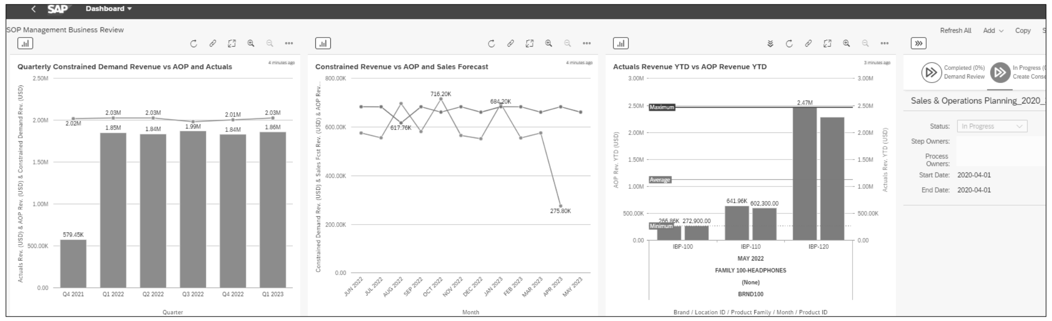


Figure 5.61 Dashboard: S&OP Management Review

5.7 Summary

In this chapter, you learned about lifecycle planning in SAP IBP and how it integrates with statistical forecast models to create forecasts without history for new products. You learned about manual forecasting in case you want to forecast without a reference product manually with trend and seasonality. We also discussed how internal and external drivers are considered in the forecasting with driver-based planning. You then saw how promotions are integrated with or without consensus demand in demand planning or demand sensing. Finally, you learned about the financial planning integration with SAP IBP demand and S&OP.

In the next chapter, we'll move on to operational demand planning with SAP IBP for demand.

Chapter 6
Operational Demand Planning

New and improved, sophisticated operational demand planning addresses changes in supply chain planning, helps to minimize stock-outs, and improves customer service levels due to day-to-day operational fluctuations in the supply chain.

Demand planning in other SAP products such as SAP Advanced Planning and Optimization (SAP APO) and SAP ERP systems can be used at mid-term planning from 1 to 12 months and can be used only at a weekly level at minimum granularity. But with market dynamics changing within a week, the forecast prediction goes wrong and the consensus demand generated from demand planning for the next month can't be respected. To counter this, SAP has enhanced its demand planning process to not just predict with historical data but also to add other inputs using driver-based planning that considers risks and opportunities. However, daily changes still must be considered, and forecast updates are required within a week. So, SAP IBP offers demand sensing as a solution for better forecasting accuracy in the short-term horizon due to accurate and larger number of input factors. Demand sensing isn't a separate solution, but a part of the demand planning process, which considers the classic demand planning outcome as the primary input for the demand sensing process. Figure 6.1 illustrates SAP IBP time series planning, which consists of operational, tactical, and strategic planning. Demand sensing is planning in daily granularity, and supply priorities and order confirmation are part of order-based planning via SAP IBP for response and supply.

In this chapter, we'll start by introducing demand sensing and explaining how it compares to regular demand planning. We'll then walk through how to set up forecast models for demand sensing and explore the different options that are available. Finally, we'll review the lag-based planning functionality.

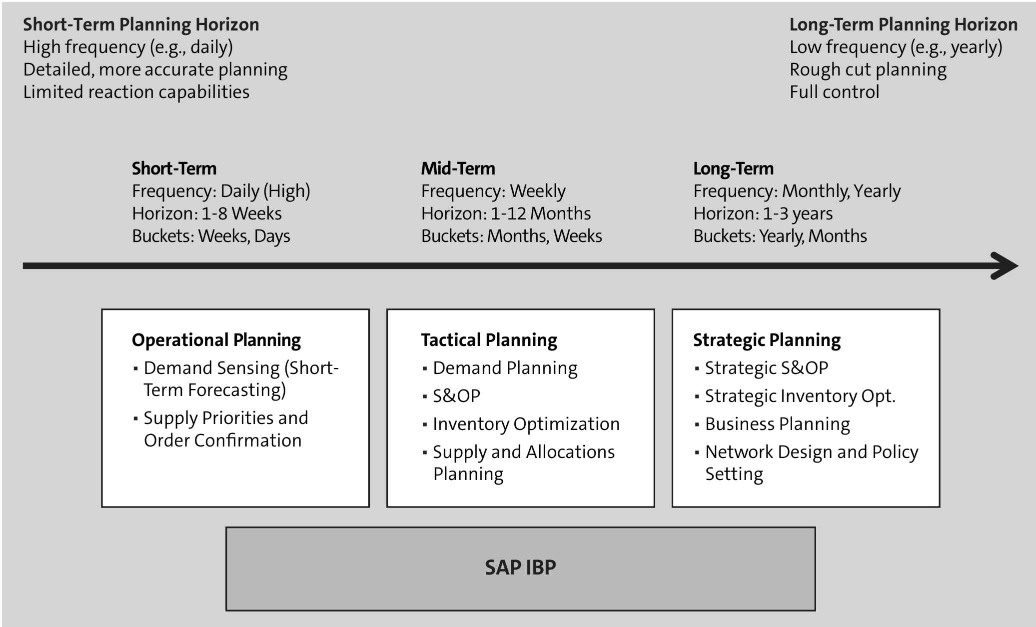


Figure 6.1 Operational Planning

6.1 Demand Sensing

Demand sensing is an extension of the classical forecasting technique, which generates optimized forecasts daily. Generally, demand planning is used for tactical and operational planning. Demand sensing supports short-term operational supply planning such as deployment. Automated demand sensing in the short-term forecast helps to lower safety stock due to higher forecast accuracy when you run it together with SAP IBP for inventory.

As shown in Figure 6.2, demand sensing provides a short-term forecast by giving consensus demand as input with other additional demand signals such as promotions, historical sale orders, shipments, and lag-based snapshots, which will be combined to give sensed demand as the output for supply deployments.

In this section, we'll introduce the demand sensing process, explain how to configure demand sensing forecast models, and then walk through the forecast models that are available.

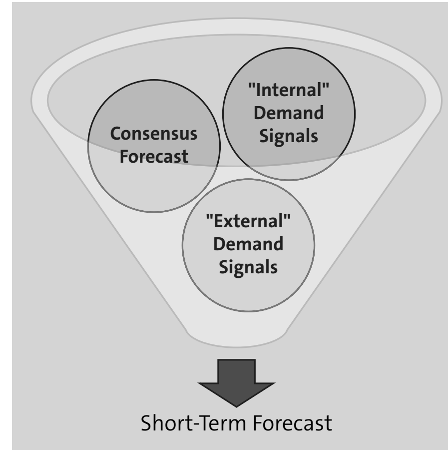


Figure 6.2 Demand Sensing: 4 to 8 Weeks

6.1.1 Introduction to Demand Sensing

Demand planning is forecasted in the mid-term to long-term based on the historical data in the past, whereas *demand sensing* uses the output of demand planning to accommodate the variability in demand. In today's volatile, uncertain, complex, and ambiguous world, a product's customer tolerance time is shorter than the cumulative lead time. Demand sensing works based on the following questions:

- What caused the change?
- Where is the change?
- When is the change required?
- How large of a quantity is required now?

All these short-term changes are due to internal and external factors causing the change. Internal factors include point of sales (POS) changes, cannibalization, collaborative planning, transport capacity and distance, new product introduction, promotions, and events. External factors include weather, customer behavior due to economic conditions, social media, and competitor activity.

Demand sensing models are advanced SAP models most suitable for products with short-term forecasting to meet short-term customer demand with optimal inventory. A demand sensing model works based on advanced algorithms and analyzes the results based on the pattern identified by the machine learning-based regression analysis. This model type is most suitable for fast-moving consumer goods and consumer-packaged goods industries.

Statistical forecasting is the first and foremost step in SAP IBP for demand. SAP IBP has many functionalities within demand planning. Any company can implement a project without these functionalities, but none of the demand planning projects can be implemented without statistical forecasting.

Demand sensing contains three forecasting algorithms, which we'll discuss in detail in Section 6.1.3:

- Demand sensing (full)
- Demand sensing (update)
- Demand sensing with gradient boosting (full)

Note

Demand sensing with gradient boosting (full) is a new feature from SAP IBP version 2108.

Consensus demand planning is the starting point in the demand sensing process and illustrates how the system arrives at the weekly and daily demand sensing output. The demand sensing process consists of the following steps, as shown in Figure 6.3:

❶ **Inputs**
The system considers the following inputs:
- Consensus demand plan
- Lag-based snapshots of the consensus demand plan
- Internal sources such as deliveries, sale orders, promotions, and open orders
- External sources such as POS and inventory data from retailers, competitor sales data, market conditions, climate changes and social media changes, and other signals

❷ **Preprocessing**
Preprocessing steps for the forecast input data include the following:
- Considers product lifecycle information for new products from the reference product history
- Eliminates promotion-related sales lifts in the sales history
- Detects statistical outliers in the sales history and excludes them from the learning phase

❸ **Machine learning/pattern recognition**
The demand sensing algorithm uses machine learning and pattern detection methods based on the following:
- Forecast bias
- Open order patterns
- Extra signals

The demand sensing algorithm calculates these adjustment factors using machine learning technologies and computes the weekly optimized sensed demand.

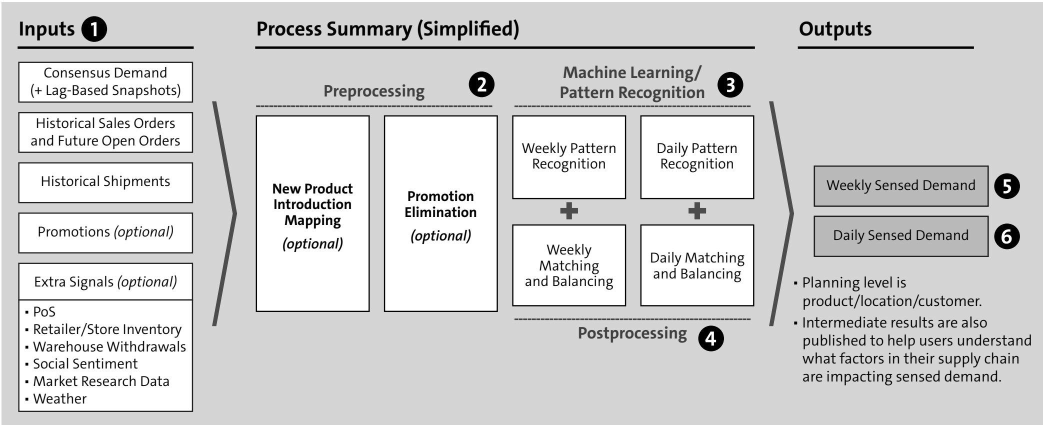


Figure 6.3 Demand Sensing Process Flow

❹ **Postprocessing**
Postprocessing steps on the weekly optimized sensed demand include the following:
- In the forecast model, sensed demand can only increase and decrease up to a certain maximum compared to input forecasts.
- Promotion uplifts are balanced according to the fact that sales spikes can happen before or after a planned promotion, rather than exactly when it's planned.
- Forward-backward forecast consumption is performed to make sure that the demand expectation doesn't fall below the volume of open orders.

Note

Forecast is consumed by sales orders in the forward (e.g., 7 days) and backward (e.g., 7 days) time periods within the defined time horizon (e.g., 14 days).

❺ **Weekly sensed demand**
According to the forecast model, the algorithm disaggregates the weekly sensed demand according to the selected method. Disaggregation is performed based on profiles, daily demand splits for each profile, and weight calculations based on each profile.

❻ **Daily sensed demand**
The algorithm performs the following postprocessing steps on the daily sensed demand:
- Uplift plans are balanced to account for the fact that sales spikes often don't take place when a promotion is planned, but before and after.

6

– The model performs a forward-backward consumption forecast to balance the baseline demand and make sure that demand expectations don't fall below what is available in open orders.

The final output process is daily sensed demand.

Figure 6.4 illustrates the difference between demand planning static output for a week compared to dynamic demand sensing output based on the demand variability on a day-to-day basis. Demand planning runs with a set periodicity that determines the statistical forecast for the future, whereas within the periodicity, demand planning won't react to variations in the demand due to changing market needs.

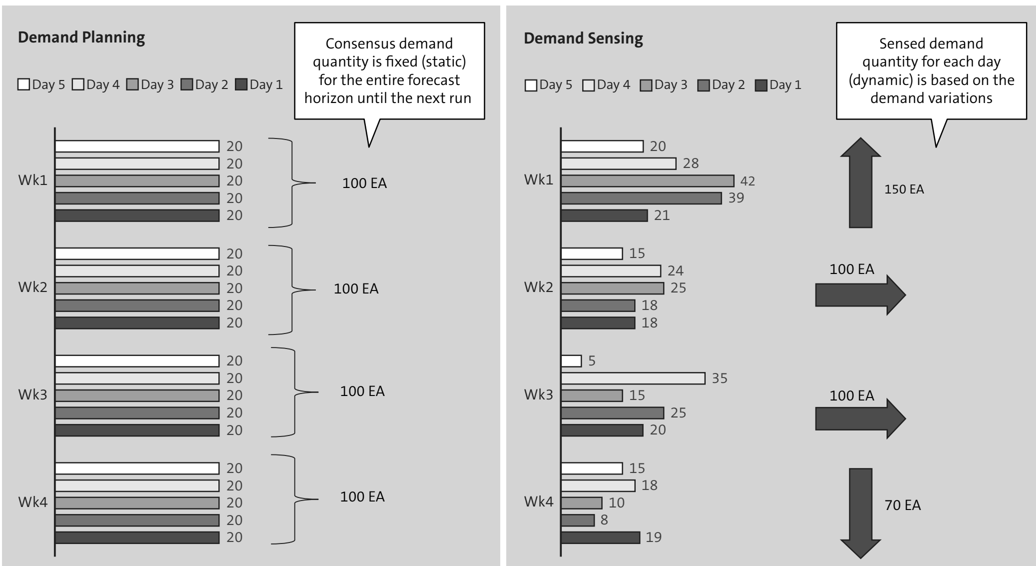


Figure 6.4 Demand Planning versus Demand Sensing

Demand planning statistical forecast models are developed based on the classical statistical forecast models and can be seen in the calculations in the Predictive Analysis Library (PAL); however, SAP IBP's demand sensing algorithm is developed by SmartOps, which is now part of SAP. The SmartOps team also developed the inventory optimization algorithm. The differences between statistical forecasting and demand sensing are explained in Table 6.1.

Topic	Statistical Forecasting	Demand Sensing
Basic principle	Forecasting	Pattern recognition by machine learning
Planning horizon	Mid-term to long-term horizon (1–2 years)	Short-term horizon (8–12 weeks)

Table 6.1 Classical Statistical Forecasting versus Demand Sensing

Topic	Statistical Forecasting	Demand Sensing
Planning cycles	Monthly or weekly	Weekly and daily
Historical data usage	Seasonality and trends	Short-term patterns with past 52 weeks of data; seasonality and trends taken from consensus forecast
Input	Sales history, statistical forecast, internal and external drivers (driver-based planning)	Consensus forecast, promotions, multiple other input signals (refer to Figure 6.3)
Models	19 (as of SAP IBP 2202) excluding manual forecasts	3 (enriching further the input from demand planning)
Future	Fully autonomous and any external models are possible	Outlier enhancement (XGBoost), leverage additional inputs

Table 6.1 Classical Statistical Forecasting versus Demand Sensing (Cont.)

6.1.2 Configure Demand Sensing Forecast Models

Demand sensing (full), demand sensing (update), and demand sensing with gradient boosting (full) are all required to run in SAP IBP, add-in for Microsoft Excel. To run these models the following prerequisites are required:

- In the Planning Areas app, the following mandatory master data types are required:
  - Product (root attribute is `PRDID`)
  - Location (root attribute is `LOCID`)
  - Customer (root attribute is `CUSTID`)
  - Lag (root attribute is lag)
  - `UOMTO` (root attribute target unit of measure [UoM])
  - `UOMConversion` factor (root attributes product ID, target UoM)
- In the Planning Areas app, the following mandatory planning levels are required:
  - Product/location/customer/weeks and a key figure for the consensus demand plan (transferred from SAP IBP for demand to demand sensing)
  - Product/location/customer/days and a key figure for the result of demand sensing (transferred to SAP IBP for sales and operations)
  - Product/location/customer/demand sensing fulfillment/days and a key figure to store requested and confirmed quantity
- In the Time Profiles app, the following mandatory time levels are required for demand sensing:
  - Daily: Level 1

  - Weekly (technical): Level 2
  - Other levels (level 3 weeks to 6 years) to use them with SAP IBP for demand
- In the Manage Forecast Model app, you select a planning area where the time profile contains weeks not months.

> **Note**
>
> In addition, the following restrictions apply to forecast models using the demand sensing algorithm:
>
> - They can only use preprocessing step promotion sales lift elimination (optional).
> - They can only contain one forecasting step.
> - They can't calculate forecast error measures.
> - They aren't ex-forecast calculations.
> - They can only be created at the lowest time level granularity (days).
> - They can only take input signals from key figures with granularity (days, weeks).
> - They can be used in the forecast calculations in SAP IBP, add-in for Microsoft Excel with the planning level attributes of product, location, customer selected in the planning view.
> - They can only run on the baseline version of the planning area.

- In terms of demand sensing algorithm usage, the demand sensing (full) or the demand sensing with gradient boosting (full) can run on a weekly basis, and the demand sensing (update) can run daily to consider the delta demand changes.

The Manage Forecast Model app is essential in demand planning. It's used to create and edit preprocessing information, forecasting models, and postprocessing details. Demand sensing algorithms are used to predict the future demand based on the consensus demand and other input signals through key steps in the **GENERAL**, **PREPROCESSING STEPS**, and **FORECASTING STEPS** tabs, which we'll describe in the following sections.

> **Note**
>
> The **POSTPROCESSING STEPS** settings aren't applicable because you can't calculate any error measures with the demand sensing algorithm.

General Settings

In the **GENERAL** settings shown in Figure 6.5, you have to maintain the forecast model ID, description, and time settings. It's mandatory to set the **Periodicity** to **Daily** for the demand sensing algorithm.

The **Historical Periods** must be greater than the result of the following calculation, in which *X* is the number of forecast periods, and *Y* is the quantity ratio calculation horizon:

Historical period > [2 (X/7 – 1) + Y] × 7

But the best practice is using a historical period that is greater than or equal to 52 weeks for best demand sensing results. For example, consider the following formula:

Historical entry value = Historical periods + Number of weeks of quantity ration calculation + (2 × (forecast periods – 1))

In our example shown in Figure 6.5, this formula would look like the following:

Historical entry value = 52 + 8 + (2 × (6 – 1)) = 70 weeks × 7 = 490 days

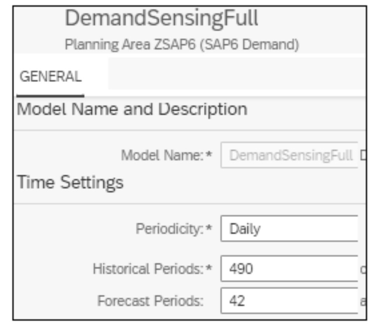


Figure 6.5 General Settings

The minimum entry value for the **Historical Periods** setting is automatically calculated.

> **Note**
>
> You should make sure that the historical data for the consensus demand and the corresponding snapshot is loaded at least for this time frame (e.g., 490 days). Otherwise, demand sensing will consider 0 for the missing periods during calculation.

Preprocessing and Data Cleansing

PREPROCESSING STEPS settings are optional in the demand sensing process to remove the outliers due to uplifts in the promotion sales of the forecast history. These settings help to feed the data without any promotion spikes to the demand sensing (full) algorithm. If some values are missing from the historical data, they can be substituted by adding the substitute missing values algorithm or maintaining value 1 for the `FORECAST_ESCAPENULL` parameter in the Global Configuration app (see Chapter 2, Section 2.8). This is a prerequisite to use the promotion sales lift elimination preprocessing algorithm.

Promotion sales lift elimination is a preprocessing method only compatible with demand sensing forecast models. This algorithm is used to cleanse promotional spikes in the short-term sales history. This helps the demand sensing algorithm run with cleansed data so that it can predict the forecast without any spikes. The planning area used for the promotion sales lift elimination must use the daily level in its time profile, irrespective of the forecast run, which can run at the weekly level as well. If it runs at the daily level, then the forecast is aggregated to the weekly level before it cleanses the data. It's mandatory to use the key figure at the product/location/customer level.

Note

Promotion sales lift elimination is only possible if the time profile defined for the planning area includes **Daily** as the time profile level. This is mandatory even if the promotion elimination runs at the weekly or monthly level.

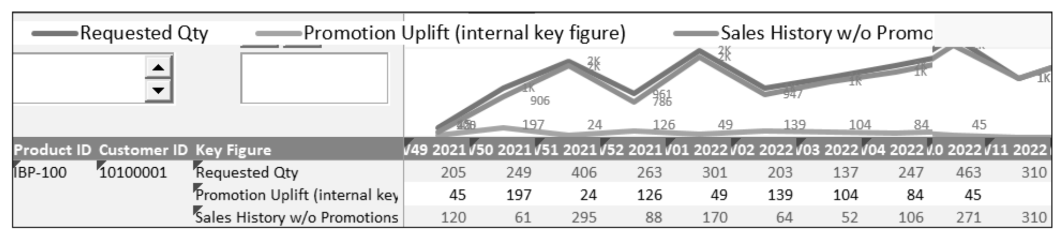
The promotion sales lift elimination preprocessing method is shown in Figure 6.6, and it must be used only with the demand sensing algorithm. It involves the following key fields:

- **Outlier Multiplier**
  A number used to multiply the values during the test. Normally, the decimal number range is between 1.5 and 3.
- **Sales History**
  A key figure storing the sales history for which you want to eliminate the outliers associated with promotion sales lifts. Normally, in demand sensing, it's the confirmed quantity or requested quantity uses for this purpose with the SAP6 planning area. This input is mandatory for the promotion sales lift elimination process.
- **Planned Sales Lifts**
  A key figure with planned promotion increases or decreases in the past and future forecasts due to promotion sales lifts from the external promotional data retrieved from the trade promotion management system using SAP Cloud Integration for data services. The SAP6 sample planning area uses **Promotion Uplift (internal key figure)** for this purpose.
- **Consensus Forecast**
  A key figure that contains a consensus forecast excluding the sales lift from promotions. In the promotion sales lift elimination process, it's used as baseline when the promotion uplifts are subtracted from the sales history. Key figure **Consensus Demand without Promotions** is used for this purpose with SAP6 sample planning area.
- **Save Results In**
  This is the output key figure in which preprocessing results will be saved. It provides the sales history, excluding promotions, from the historical data set. The SAP6 sample planning area contains the **PROMOBASELINE** (**Sales History w/o Promotions**) key figure for this purpose.

Figure 6.6 Preprocessing Model: Promotion Sales Lift Elimination

Now, let's consider the results of this configuration. The promotion source is loaded from the external system and disaggregated using the copy operator to the promotion uplift key figure, as shown in Figure 6.7. In the elimination process, the algorithm performs the following steps:

1. Identify the outliers in the sales history (**Requested Qty**) key figure. The outlier multiplier is maintained as **2**. The outlier logic is the same as the outlier correction algorithm.
2. Check the sales lifts caused by promotions in the sales history key figure input.
3. Search for and eliminate the values from the historical periods in which the correlations between the outlier and promotion were identified. In addition, the algorithm looks for and adjusts the closest values proportionally whenever there is no exact correlation between the promotion sales lifts and the outliers.
4. Store the cleansed values of the sales history into the **Sales History w/o Promotions** output key figure. You can observe that the output is zero wherever the promotion uplift exists from week 10 2022 to week 17 2022.



Product ID	Customer ID	Key Figure	V49 2021	V50 2021	V51 2021	V52 2021	V01 2022	V02 2022	V03 2022	V04 2022	V.0 2022	V11 2022
IBP-100	10100001	Requested Qty	205	249	406	263	301	203	137	247	463	310
		Promotion Uplift (internal key	45	197	24	126	49	139	104	84	45	
		Sales History w/o Promotions	120	61	295	88	170	64	52	106	271	310

Figure 6.7 Promotion Sales Lift Elimination

Forecast Steps

In the **FORECASTING STEPS** settings, you have to configure the forecasting itself and also define the **Overall Parameters** for the forecast models, as shown in Figure 6.8, and choose the demand sensing algorithm to calculate the forecast. The key fields are as follows:

- **Main Input for Forecast Steps**
  The key figure used as the input for the demand sensing forecasting calculations in the current model. The key figure **Requested Qty** as input key figure is used for this purpose with SAP6 sample planning area.

> **Note**
> Don't use the output key figures of the preprocessing steps as the main input for the forecasting step. The output key figures are only for storing the results at the end of the process. If you give preprocessing output as the input for the forecasting step, the system will give you a warning.

- **Target Key Figure for Forecast**
  This is the key figure for which you want to save the final forecast. As it's maintained as an overall parameter, it's not impacted by individual key figures maintained in the demand sensing algorithm.
- **Target Key Figure for Ex-Post Forecast**
  You can't choose ex-post forecast with demand sensing (full) and demand sensing (update) algorithm.

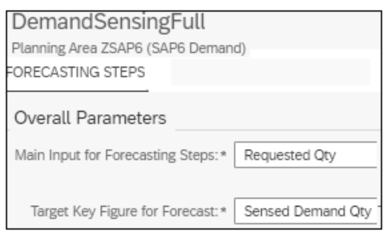


Figure 6.8 Forecasting Step Overall Parameters

6.1.3 Forecasting Models

As mentioned earlier, demand sensing in SAP has three models: demand sensing (full), demand sensing (update), and the new demand sensing with gradient boosting (full) algorithm, which was introduced from SAP IBP version 2111. Similar to the demand planning gradient boosting of decision trees algorithm, demand sensing with gradient boosting (full) is an ensemble machine learning algorithm that considers the information gained from each independent variable when the sensed demand is calculated.

In the following sections, we'll discuss how demand sensing models work and the differences between them. For information on selecting your model, see Chapter 4.

Demand Sensing (Full)

Demand sensing (full) computes a short-term demand plan generally between six and eight weeks. This method helps achieve targeted customer service levels and optimized inventory policies, transportation, and production.

Consensus demand output from demand planning and lag-based historical snapshots are mandatory inputs to run demand sensing (full). Lag-based historical snapshot values are loaded the first time, and weekly jobs are scheduled manually for the subsequent load. The demand sensing (full) algorithm must be configured in the Manage Forecast Model app per the instructions in Section 6.1.2, with a mandatory **Periodicity** of **Daily**.

An error measure calculation horizon isn't applicable with demand sensing. You can only use the demand sensing (full) algorithm in the statistical forecast model. You can't use demand sensing (full) and demand sensing (update) or any other model together. Preprocessing is optional with this method, and it's only allowable to use the promotion sales lift elimination method with demand sensing (full).

The demand sensing (full) algorithm requires the following settings to run:

- **Use Custom Key Figure Calculations for Regression Outputs**
  If you select this option, as shown in Figure 6.9, the algorithm applies user-defined calculations for certain key figures to store internal machine learning regression results. The results can then be used in the postprocessing steps of demand sensing.

> **Warning!**
> Only advanced users should use this flag and edit the corresponding user-defined key figure calculations.

  You can define calculations for the following key figures:
  - **Forecast adjustment factors for different demand signals**
    The minimum/maximum custom conditions can be adjusted for the key figures `FORECASTBIAS` `FUTUREORDEREDQTYFCTADJUSTMENT` and `<extrasignal>FCTADJUSTMENT` to tell how much consensus demand can be adjusted by demand sensing.
  - **Daily profiles for demand signals**
    The key figures `FUTUREORDEREDQTYPROFILE0` – `FUTUREORDEREDQTYPROFILE6` can be adjusted to override the **Daily Demand Profiles** tab of the **Configuration Expert Overview** that represent percentages of the weekly demand per day of the week for daily demand disaggregation.

- **Run Time Series Analysis for Demand Sensing**
  If you choose this option, as shown in Figure 6.9, the demand sensing algorithm will automatically analyze the sales history statistically to identify the trends, other characteristics, and output. Through the time series analysis functionality, the demand sensing algorithm automatically caps the weekly sensed demand and avoids extreme outputs such as high or low compared to sales history characteristics. It also handles the trending situations better, so you don't need to run the time series analysis separately.

Figure 6.9 Regression Output and Time Series Analysis

> **Note**
> Here, time series analysis is managed by the demand sensing algorithm, which is different logic than the time series analysis originally run with the Forecast Automation app job in regular demand planning. We explained time series analysis further in Chapter 4.
>
> This option is only available with the demand sensing (full) algorithm. The option isn't applicable for the demand sensing (update) algorithm because it runs based on the latest update of sensed demand data. This time series analysis step will be used only for any new product that is mapped to a reference product after its phase-in end date. It won't be analyzed for data from the reference products.

- **Consensus Forecast**
  This is a mandatory and prominent input key figure for demand sensing from demand planning, with a weekly granularity at the location-product-customer level. In the SAP6 planning area, this is the **Consensus Demand without Promotions** key figure, as shown in Figure 6.10.
- **Signal Horizon**
  The time period in which the system considers demand signals during the demand sensing algorithm. The time period is either past or future. For example, the consensus demand key figure refers to quantities forecasted for the future, so the time horizon of the key figure assigned is the **Future**, as shown in Figure 6.10.
- **Bias Horizon**
  This calculates the bias optimization input during the demand sensing calculation based on past historical bias in weeks. The value should be in ascending order, and four periods are mandatory out of six. SAP default values are **1**, **2**, **4**, **6**, **8**, and **9**, with **Periodicity** set to **Week**, as shown in Figure 6.10. The maximum value you can enter in this field is **10**.

- **Snapshot Key Figure**
  This optional input key figure, as shown in Figure 6.10, helps the demand sensing algorithm analyze input forecasts based on the different lags during demand sensing, which is the preferred approach. If you don't maintain this input, then the demand sensing algorithm will use **Consensus Demand without Promotions** key figure for every lag.

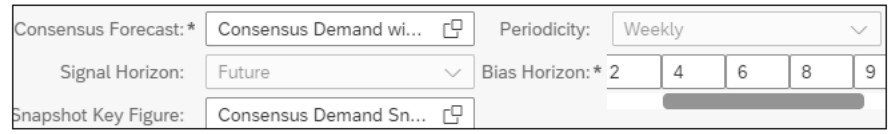


Figure 6.10 Input Key Figure and Bias Horizon

> **Note**
> You should have historical data for all the periods without null values for the snapshots. If the snapshot key figure isn't fully filled, then the demand sensing algorithm defaults to the **Consensus Demand** key figure during its weekly calculation outputs.

- **Daily Disaggregation Method**
  This setting allows the algorithm to calculate the daily disaggregation of the sensed demand statically or dynamically. There is one static method and two dynamic disaggregation methods available, as shown in Figure 6.11:
  - **Static, Based On Best Fit**
    This default option is based on three different demand profiles: consensus demand, sales orders, and shipments or delivered quantities; rolling averages are calculated using the **Daily Average Calculation Horizon** setting. The goal of using machine learning to estimate daily demand is to minimize the error of the daily forecast. For each of the three profiles, the daily profiles represent a percentage of the demand within a day of the week. However, machine learning calculates the daily sensed demand by weighing the profiles differently during different weeks.
  - **Dynamic, Based On Sales Order**
    As a result of the machine learning algorithm, dynamic daily profiles are generated for each week of planning by detecting the time-varying patterns of past daily sales orders.
  - **Dynamic, Based On Delivered Quantities**
    As a result of the machine learning algorithm, dynamic daily profiles are generated for each week of planning by detecting the time-varying patterns of past daily shipments and delivered quantities.

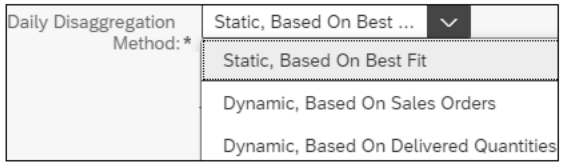


Figure 6.11 Daily Disaggregation Method

- **Ordered Quantity**
  Overall sale orders and stock transport orders that are due to be delivered soon. The ordered quantity is the same input key figure as that from the main input for the forecasting steps in the **Overall Parameters** section. This is a noneditable key figure. In the SAP6 planning area, the **Requested Qty** key figure, as shown in Figure 6.12, or **Confirmed Qty**, is used for this purpose. The **Periodicity** of this input key figure is **Daily**.
- **Quantity Ratio Calculation Horizon**
  This algorithm helps identify the trend based on the open orders in the short term and based on the past historical data (rolling). This horizon should be between 8 and 12 weeks, and this is also considered one of the inputs to set historical periodicity.
- **Delivered Quantity**
  A pivotal figure to identify the quantity historically delivered in the past to customers. In the SAP6 planning area, it's **Delivered Qty Adjusted** (`ADJDELIVQTY`), as shown in Figure 6.12.
- **Daily Average Calculation Horizon**
  Requested and delivered quantities of the past will be averaged for every day of the week in the past. For example, the Thursday average will be calculated for the last *X* weeks, and then the Friday average will be calculated for the same period. The number of days in the week will be calculated based on the workday selection. Daily shipment profiles are used as inputs for disaggregating weekly forecasts during the demand sensing run. The period must be between four and eight weeks and can't be greater than the bias horizon's highest value. The number must be between **4** and **8**, as shown in Figure 6.12.

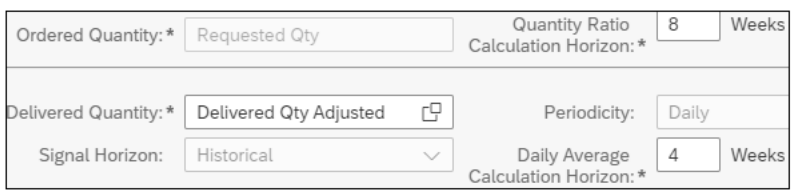


Figure 6.12 Ordered Quantity and Delivered Qty

- **Maximum Forecast Increase/Maximum Forecast Decrease**
  This setting is used as a reference for sensed demand, as shown in Figure 6.13. It can be more or less than the consensus demand. Both the absolute value and percentage are maximums, so the higher value will be considered. Let's consider an example:
  - Maximum decrease quantity = 50 EA
  - Maximum decrease percentage = 30%
  - Consensus demand = 100
  - Max (100 – 50, 100 × 0.7) = max (50, 70) = 70

  Here, the sensed demand quantity can't be less than 70 EA. Similarly, if you calculate the max increase, it will be 150 EA. So, the demand sensing threshold is between 70 and 150.

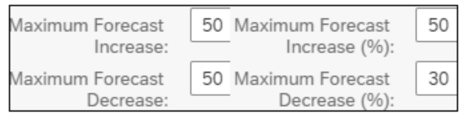


Figure 6.13 Minimum/Maximum Threshold

- **Minimum Data Points**
  This field, as shown in Figure 6.14, is to indicate that a minimum number of historical periods is required to run a demand sensing algorithm. The default value for this setting is 15. The maximum allowed values are based on the historical periods. For example, if you maintain historical periods **420 days** in the **GENERAL** tab, you can't maintain more than minimum data points 71 because 420 days = 70 weeks.
- **Extra Signals**
  To get an accurate forecast output, you can add up to eight critical figures as different signals. These signals are added to the algorithm until it reaches the desired weighted mean average percentage error (WMAPE) threshold. The default WMAPE threshold percentage is 37.5%.
- **Calendar Key Figure**
  The key figure that stores holiday information in the calendar (e.g., New Year's Day, Easter day). If a day is marked as a holiday in this key figure, the algorithm will move any demand to the next day except open orders (requested quantities).

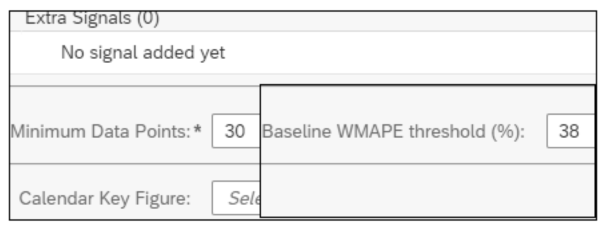


Figure 6.14 Extra Signals

- **Select Workdays**
  When you select **Daily** for the **Periodicity** in the Microsoft Excel planning view, the weekly forecast quantities are disaggregated daily based on the workdays selected with this algorithm. At least one workday is mandatory, from Monday to Sunday, as shown in Figure 6.15, so you must select at least one workday.

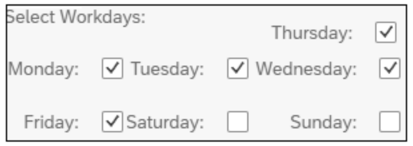


Figure 6.15 Workdays

- **Balancing and Open Order Matching**
  Balancing and open order matching settings are used when the demand sensing algorithms have taken into account the daily sensed demand value for the past days of the current week, and they determine the daily sensed demand for the remainder of the week. This setting is applicable for demand sensing (full) and demand sensing (update) algorithms. The settings for demand sensing (full) algorithm are shown in Figure 6.16.

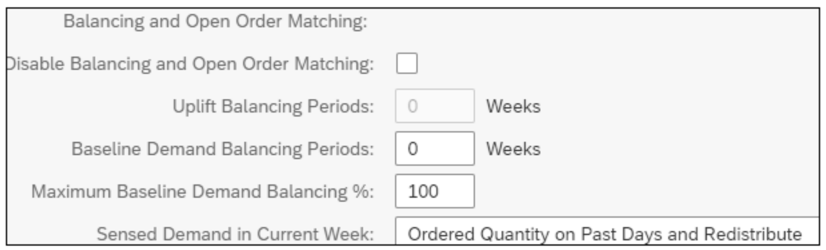


Figure 6.16 Balancing and Open Order Matching

- **Disable Balancing and Open Order Matching**
  If this checkbox is selected, demand sensing won't run the balancing and open order matching steps that are part of its logic. By following this approach, you can balance short-term consumption expectations around the latest open orders and forecasts.
- **Uplift Balancing Periods**
  The number of weeks before and after a week in which high sales signals should be associated with planned promotions. This setting allows the algorithm to balance the impact of promotions across the periods where they may impact sales. The setting is only displayed on the **FORECASTING STEPS** tab but can't be edited there. You can only edit it on the preprocessing steps after adding the promotion sales lift

elimination algorithm to your forecast model. If the preprocessing algorithm is added to a forecast model, the uplift balancing periods settings isn't displayed on the **FORECASTING STEPS** tab.

> **Note**
> This setting isn't available if the promotion sales lift elimination algorithm is run at the monthly level. You can only enter an integer between 0 and 6.

- **Baseline Demand Balancing Periods**
  Based on the oversell and undersell patterns, the algorithm should consider how many weeks are before and after every week in the planning horizon. If orders are placed before or after the planned consensus demand, balancing can prevent double counting of the baseline demand. You can enter an integer between 0 and 6.
- **Maximum Baseline Demand Balancing %**
  The consensus forecast percentage that baseline demand balancing is allowed to consume during the weeks on the outer ends of the baseline demand balancing periods. You can enter a percentage between 0 and 100.
- **Sensed Demand in Current Week**
  You can use this setting to specify how the algorithm should balance the sensed demand on the past days of the current week. The algorithm calculates the daily sensed demand for the remainder of the week after it balances the daily sensed demand from the past days of the current week. There are three ways to accomplish these steps:
  - **Ordered Quantity on Past Days and Redistribute**
    The sensed demand is set equal to the ordered quantity for the past days, and the difference from the total weekly sensed demand is redistributed to the remaining days. This is the default setting.
  - **No Redistribution and Consume Forward from Current Day**
    The daily sensed demand for the past days is equal to the daily sensed demand for the same week from a past run. The net difference between the total quantity ordered in the past days is consumed forward from the current day.
  - **No Redistribution and Consume Backward from End of Week**
    The daily sensed demand for the past days is equal to the daily sensed demand for the same week from a past run. The net difference between the total ordered quantity in the past days is then consumed backward from the end of the week.

  Use the default options unless demand sensing influences production and isn't necessary to change the past demand.

Warning!

If you want to use any of the last two options in the preceding list, the system uses the SENSEDDEMANDQTY key figure as an additional input. In that case, the SENSEDDEMANDQTY key figure is enabled for UOM conversion, and the HCONVSENSEDDEMANDQTY key figure must also to be added to the planning area that you're using or the demand sensing application job will fail.

Note

If demand sensing runs on the first day of the week and then reruns on a different day of the same week, the selected balancing method is applied only for that week. You can only specify a balancing method for the past days if the **Disable Balancing and Open Order Matching** option isn't selected in your forecast model.

- **Configuration Expert View**
  If this option is **ON**, a new section opens where you can select an aggregation level for demand sensing, which is helpful if you want to run the demand sensing algorithm in multiple aggregation levels. You can create multiple forecast models separately with different aggregation levels and define the key figures based on the aggregation level that you selected.

  The default aggregation level is base planning level of the target key figure; for example, **Location|Product|Customer|Daily** is selected, as shown in Figure 6.17. The key figure fields are populated automatically based on the business meanings of the technical key figures in the SAP6 or SAPIBP1 sample planning areas, but the key figures can be changed based on your business requirements. But you have to consider the following when making changes from the default:

  – It's recommended to change the default settings if you're an advanced demand planning user.

  – The root attribute of the master data types containing the attributes that you select for the aggregation level should also be included in the base planning level of the target key figure for the forecast. Attributes such as lag or UOMTO (target UoM) can't be used.

  – You should not change the default setting if either the global configuration parameter DS_AT_ANY_LEVEL_ALGORITHM is set to OFF, or if you're using a planning area created after SAP IBP version 2108 and copied from the SAP6 sample planning area with default value **AUTO** and attribute DSFULFILLMENTDAYS not configured in the planning area.

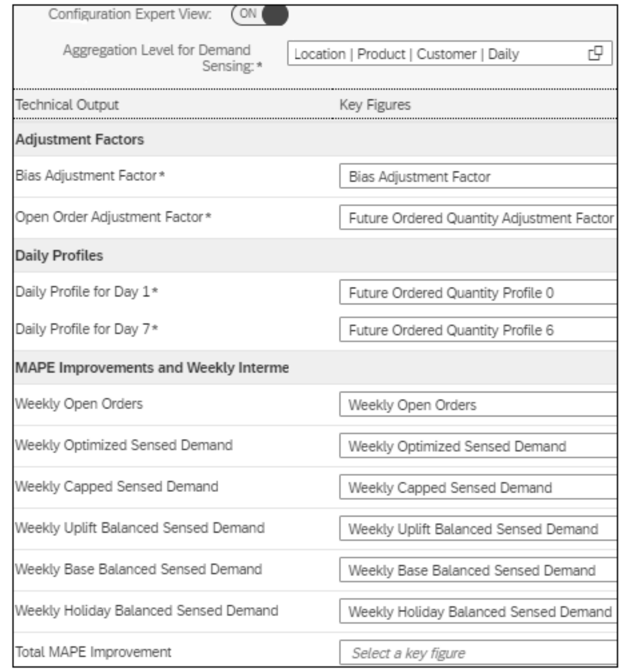


Figure 6.17 Configuration Expert View

The demand sensing output will appear once the job completes successfully with demand sensing (full) run from SAP IBP, add-in for Microsoft Excel or the application job. You'll see the sensed demand is generated for the next 42 days (6 weeks) in the future after eliminating the promotion and considering the weekly open orders and requested quantity, as shown in Figure 6.18.

Location ID	Product ID	Customer ID	Key Figure	04/12/2022	04/16/2022	04/17/2022	W15 2022	W16 2022	W20 2022
3710	FG126	37100001	Requested Qty	240	240	240	1,680	1,680	1,680
			Delivered Qty	200	200	200	1,400	1,400	1,400
			Delivered Qty Adjusted	200	200	200	1,400	1,400	1,400
			Sensed Demand Qty	240	240	240	1,680	1,400	1,400
			Weekly Open Orders				1,680	480	

Figure 6.18 Demand Sensing (Full) Result

You can analyze the results from the application log in SAP IBP, add-in for Microsoft Excel after the algorithm executes the results, as shown in Figure 6.19. The application log can be viewed for the job executed from the Microsoft Excel planning view or scheduled from the application job in the background.

Step	Severity	Message
	Information	Current period initialized with time stamp 2022-04-16T20:45:08 and time zone UTC
	Information	Step 1 of 1 preprocessing steps
	Information	Planning area: NORMALIZED
	Information	Promotion elimination executed using variance test on key figure CONSENSUSDEMAND
	Information	Promotion elimination executed using variance test on key figure REQQTY .
	Information	Promotion elimination executed using variance test on key figure PROMOSPLITALL .
	Information	Step 1 of 1 forecasting steps
	Information	Planning area: NORMALIZED
Demand Sensing (Full)	Information	Forecast model offset is 0.
Demand Sensing (Full)	Information	Starting forecast date is 2022-04-16.
Demand Sensing (Full)	Information	Outlier algorithm: Variance test executed on key figure REQQTY.
Demand Sensing (Full)	Information	Outlier algorithm: Outlier multiplier used is 2.
Demand Sensing (Full)	Information	Promotion elimination executed on key figure REQQTY.
Demand Sensing (Full)	Information	Promotion elimination executed using key figure CONSENSUSDEMAND.
Demand Sensing (Full)	Information	Promotion elimination executed using key figure PROMOSPLITALL.
Demand Sensing (Full)	Information	Default uplift bucket length is 0.
Demand Sensing (Full)	Information	PROMOSPLITALL Key figure is at weekly time profile level.
Demand Sensing (Full)	Information	Inputs to Demand Sensing:
Demand Sensing (Full)	Information	Historical horizon: 34. Sensing horizon: 6.
Demand Sensing (Full)	Information	Minimum data points: 30. Baseline WMAPE threshold: 0.38.
Demand Sensing (Full)	Information	Maximum promotion uplift bucket size is 0.
Demand Sensing (Full)	Information	Maximum base consumption bucket size is 0.
Demand Sensing (Full)	Information	Maximum bucket size used is 0.
	Information	Finished successfully

Figure 6.19 Demand Sensing (Full) Log

Demand Sensing (Update)

Demand sensing (update) is used for daily delta changes runs. So, to run this algorithm, demand sensing (full) is a prerequisite. If you run demand sensing (full) once a week, then demand sensing (update) will run daily to consider the new orders and shipments. The previous results generated from demand sensing (full) will be adjusted with this update run. You can't run demand sensing (full) and demand sensing (update) at the same time.

Demand sensing (update) runs for changes in the current week orders or shipments into account, and sensed demand calculations are based on the regression weights obtained from the demand sensing (full) algorithm in the beginning of the week. The demand sensing (update) run recalculates the entire sensing horizon not just the current week. So, the demand sensing (update) run will impact the changes in the results generated by the demand sensing (full) run.

Because the demand sensing (update) is only updating delta changes in the demand during the week, the changes in the results of the demand sensing (full) algorithm won't require all the settings similar to demand sensing (full), as shown in Figure 6.20.

The current open order was updated/modified in the middle of the week. In this example, for material **FG126** on location **3710**, new orders came in during the middle of the week, and the weekly open order quantity increased from **1,680** to **1,710** pcs. This is updated by the daily run using demand sensing (update) of the current week, as shown in Figure 6.21.

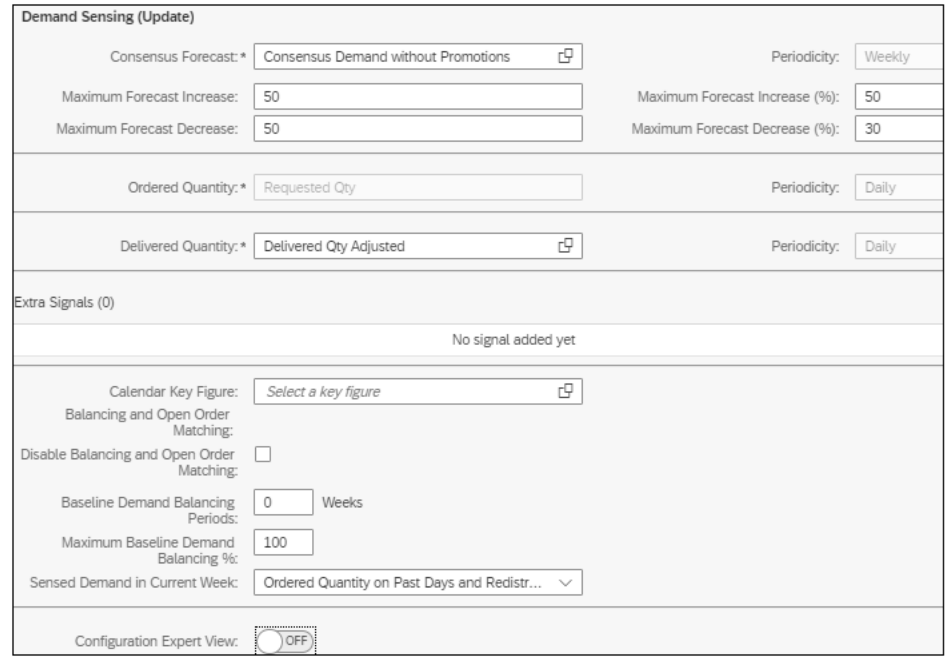


Figure 6.20 Demand Sensing (Update) Settings

Location ID	Product ID	Customer ID	Key Figure	04/11/2022	/14/2022	04/15/2022	04/16/2022	W15 2022	W16 2022
3710	FG126	37100001	Requested Qty	240	240	300	250	1,710	1,680
			Delivered Qty	200	200	200	200	1,400	1,400
			Delivered Qty Adjusted	200	200	200	200	1,400	1,400
			Sensed Demand Qty	240	240	300	250	1,710	1,400
			Weekly Open Orders					1,710	480

Figure 6.21 Demand Sensing (Update) Result

Demand Sensing with Gradient Boosting (Full)

The new forecasting algorithm, demand sensing with gradient boosting (full), is similar to the gradient boosting of decision trees in demand planning introduced in SAP IBP version 2111. This is a machine learning algorithm that considers the values of independent variables when sensed demand is calculated.

The algorithm performs repeated optimizations on several decision trees, each of which represents a tree-like model of possible outcomes. In the resulting ensemble model, additional signals at different levels of the tree are taken into account depending on what threshold is used in calculating the sensed demand. With this method, accuracy is better than with the linear method used in the demand sensing (full) algorithm, which considers the extra signals in the order that were added to the forecast model.

> **Note**
> Demand sensing with gradient boosting (full) is only available with new forecast models, and it's used for demand sensing (full) runs, not for updates.

Consider the following points to use demand sensing with the gradient boosting (full) algorithm:

- It's recommended to run demand sensing on total demand not promotion eliminated demand.
- If you want to consider the promotions in demand sensing, add uplift as an extra signal.
- Extra signal is added to the model by importance level, not by your own order.
- It's good to look at the forecast accuracy at the total level not individual demand streams.
- This forecast algorithm doesn't performed well on intermittent demand.

Demand sensing with gradient boosting (full) requires the following parameters to run:

- **Minimum Data Points**
  The minimum number of historical data points that are required to run the demand sensing algorithm. The default value for this setting is **30** weeks, as shown in Figure 6.22. If the planning level location/product/customer has fewer historical weeks than this setting, it will get the default from demand sensing.
- **Outlier Multiplier**
  The number, as shown in Figure 6.22, is used by the algorithm to calculate the boundaries for the boxplots for the interquartile range (IQR) method, which are graphical representations of how historical values are distributed compared to the median (see Chapter 4). Historical values outside boundaries are considered outliers and adjusted during the learning phase of demand sensing. The SAP-recommended range for the multiplier is between 1.5 and 3.
- **Machine Learning Parameters**
  It can be **Automatic** (default), as shown in Figure 6.22, or **Manual**. If the parameter is set to **Automatic**, gradient boosting will use the default parameter settings. If you set this parameter as **Manual**, it will allow changing the minimum number of trees, maximum tree depth, and learning rate.
- **Aggregation Level for Demand Sensing**
  This is the aggregation level for demand sensing to run on. You can run the demand sensing at different aggregation levels with different models. The aggregation level needs to be at **Daily** periodicity, as shown in Figure 6.22, **Location|Product|Customer|Daily**.

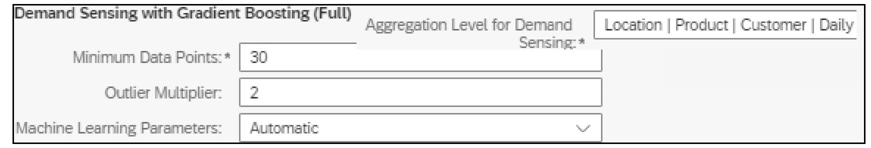


Figure 6.22 Minimum Data Points

- **Maximum Number of Trees**
  The maximum number of trees to make the ensemble model. The higher the number of trees, the more computation time will be needed, which requires the runtime of the algorithm. You can choose an integer between 1 and 50. The default value is **10**, as shown in Figure 6.23.
- **Learning Rate**
  Each decision tree output is weighted when added together. When the tree is added to the model, you can specify a learning rate to decrease each tree's contribution. If you decrease the learning rate, prevent overfitting, and thus obtain more reliable predictions, you should increase the maximum number of trees. There are, however, more computations and thus runtime associated with a large number of trees. The default is **0.75**, as shown in Figure 6.23, but the number can be between 0 and 1 inclusive.
- **Maximum Tree Depth**
  The maximum number of levels in a tree. Each additional level increases the number of terminal nodes in the tree by a factor of 2. This means adding a level will increase two nodes in the tree. Because the algorithm builds many trees, the individual trees should not be very deep. This parameter can be used to avoid overfitting as a higher tree depth allows the forecasting model to learn the relations that are specific to a time series. The default setting is **1**, as shown in Figure 6.23. You can choose an integer between 1 and 5.

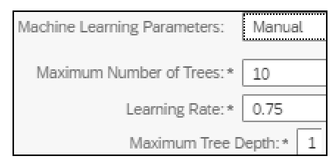


Figure 6.23 Machine Learning Parameters: Manual

- **Signals**
  They are the main data sources used by the algorithm. Gradient boosting has four named signals in the setup process, and two of these signals have to be configured. You can define the following signals, as shown in Figure 6.24:
  - **Ordered Quantity**
    The key figure representing confirmed and unconfirmed quantities of sales

orders and stock transport orders that are due to be delivered this week. This is a noneditable key figure and is identical to the key figure maintained in the **Overall Parameters** section. The periodicity of the input key figure must be set to **Daily**.

– **Delivered Quantity**
This the key figure representing the historical quantities delivered to customers. The periodicity of the input key figure must be set to **Daily**.

– **Forecast**
The key figure representing the forecast from the mid- to long-term demand planning process before any demand sensing intervention. Demand sensing makes adjustment to this forecast and optimizes it for the short-term forecast. The periodicity of the key figure should be set to **Weekly**.

– **Forecast Snapshots**
This optional input key figure analyzes demand sensing forecasts at different lags during its machine learning algorithm. Weekly snapshots are used of the **Forecast** key figure. Over the time demand sensing is run on an ongoing basis, additional snapshots are taken each week by the lag-based snapshot operator. For the first time, forecast snapshots must be uploaded as a prerequisite to run the demand sensing algorithm. In the SAP6 sample planning area, the **Consensus Demand Snapshot** key figure will be used for this purpose.

You can keep this field empty. In this case, demand sensing uses the **Consensus Forecast** key figure for every lag. For example, you can leave it empty in the following cases:

- There aren't many changes in the consensus forecast over time.
- You want to use demand sensing, but you don't have enough historical lag-based snapshots.

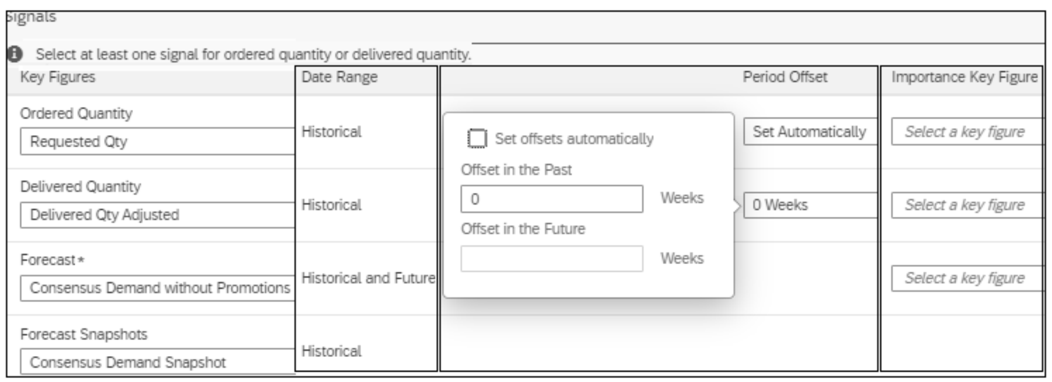


Figure 6.24 Signals

> **Warning!**
> If you're not certain that you have enough historical data for the snapshots, you should leave the **Snapshot Key Figure** field empty. A key figure that is entered here will be used as is without being auto-filled with missing data. During its weekly optimization steps, demand sensing may default to the input consensus forecast, or there may be problems with demand sensing outputs.

- **Date Range**
  The date range configures the algorithm to consider past and future values of the key figure in addition to the historical values. Any key figure derived from the main input will be set as a historical key figure.
- **Period Offset**
  For each independent variable, you can choose an offset in the past and an offset in the future to mimic the impact of these variables on the periods before and after each period for which the variable contains values. The system will then clone and temporarily shift the values of the independent variables to the offset periods. This can be used, for example, to mimic that an important sporting event also impacted the periods before and after the event, not just the time when it happened. Such information may help the algorithm calculate a better forecast for those periods.

  By checking **Set offsets automatically**, it will default to the sensing horizon without offsets. It has to be an integer between 0 and 9 inclusive.
- **Importance Key Figure**
  This key figure will store information on how important that specific input is in calculations during the training phase. The stored values are between 0 and 1, and the sum of the importance key figure is 1, so this is a form of percentage measurement.

  You can choose different importance key figures for each input or aggregate the importance of the multiple values by choosing the same importance key figure for them. For example, you can choose a calendar key figure to store all calendrical inputs. This will help to reduce the data volume in the training phase. This is an optional key figure. If you don't choose an **Importance Key Figure** for some inputs, the algorithm still calculates the values, but it won't store them. However, the percentage might not add up to 100%.
- **System-Generated Signals**
  Signals are generated automatically during forecasting. You can select either of the following, as shown in Figure 6.25:

  – **Consider System Calendar Signal**
  If you enable this option, calendar-related features are added to the forecast model. Some of these system-generated features are the day of the week, day of the month, and so on.

– **Consider Open Orders**
  If you enable this option, the system generates an open orders signal for gradient boosting. Open orders are sales orders with a creation date prior to the current week.

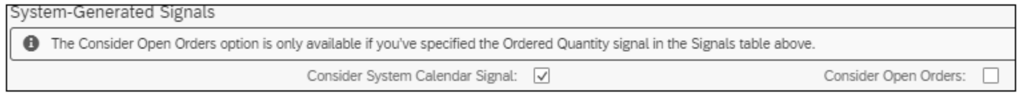


Figure 6.25 System-Generated Signals

> **Note**
> The importance value of the system calendar signal can't be aggregated with other signals.

- **Maximum Forecast Increase/Increase %**
  The absolute value and percentage by which the sensed demand can be more than the consensus forecast, as shown in Figure 6.26. Both are maximum values, and the higher one is considered as the actual threshold.

> **Note**
> The absolute increase value is expressed in terms of base UoM of the planning area.

- **Maximum Forecast Decrease/Decrease %**
  The absolute value and percentage by which the sensed demand can be less than the consensus forecast. Both are maximum values, and the higher one is considered as the actual threshold.

> **Note**
> The absolute increase value is expressed in terms of base UoM of the planning area.

- **Baseline WMAPE Threshold**
  The baseline threshold used by the system to check the forecast accuracy before the demand sensing run if the calculated WMAPE is smaller than the baseline threshold. The default value for this setting is 38%, as shown in Figure 6.26.

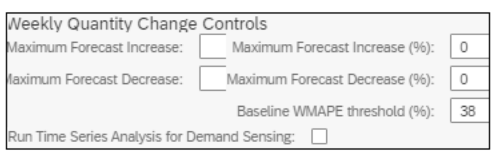


Figure 6.26 Weekly Quantity Changeover

- **Run Time Series Analysis in Demand Sensing**
  If you choose this option, you don't need to run time series analysis separately before executing demand sensing. Instead, the demand sensing algorithm itself will statistically analyze the sales history to identify trends and characteristics, and the outputs of this analysis will help machine learning steps further refine weekly optimized sensed demand.
- **Daily Disaggregation Signal**
  Machine learning supports the disaggregation of the sensed demand by producing daily profiles based on time-varying patterns detected in the historical values of the selected signal. Select a disaggregation signal for the algorithm to learn from (see Figure 6.27). Note that daily profiles are dynamic in nature because the historical values of selected signals may be different in each week of the planning horizon.
- **Daily Disaggregation Profile Override**
  The key figure stores the daily disaggregation profiles after you overwrite them manually in SAP IBP, add-in for Microsoft Excel. You can use this option if you think that the system-generated optimization isn't accurate. The algorithm uses the updated profiles to adjust daily sensed demand.

> **Note**
> There are a few points to keep in mind when setting up daily disaggregation:
> - Depend on the profiles you enter; the daily sensed demand value sums up to a weekly sensed demand that is lower or higher than the original demand calculated by the algorithm.
> - If you overwrite the daily disaggregation profile for certain days, the system considers 0 weight for the remaining days, which means the sensed demand is 0 for all other day of the week.
> - The system considers calendar signals only after the disaggregation step, so they can still influence the final results.
> - The algorithm will use a new override key figure when creating the daily sensed demand, but it will save generated daily profiles automatically in the `DAILYDSPROFILE` key figure.

- **Daily Average Calculation Horizon**
  The number of weeks in the past for which the disaggregation signal is averaged for each day of the week. For example, a Thursday average is calculated for the quantity requested in the last 4 weeks, then the Friday average is calculated for the same period, and so on. The daily shipment profiles are used as inputs for disaggregating the weekly forecasts during the demand sensing run. Rolling averages based on the parameter are taken for different weeks in the historical horizon, and daily demand pattern expectations are calculated by machine learning. The number must be between 4 and 12 inclusively (see Figure 6.27).

- **Select Workdays**
  Based on the selection here, the system is allowed to fill the demand. The system uses machine learning to disaggregate the weekly sensed demand. You must select at least one workday for this setting.

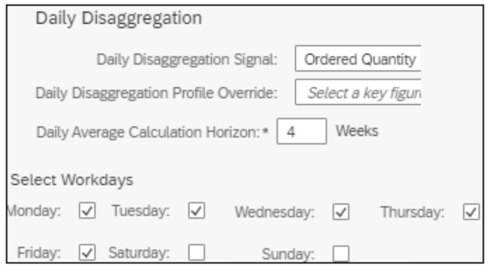


Figure 6.27 Daily Disaggregation and Select Workdays

- Additional Outputs
  In this section, you have two additional outputs: training model outputs and weekly diagnostic outputs. These can be broken down into the following key figures as shown in Figure 6.28:
  - **Daily Disaggregation Profile (`DAILYDISAGGPROFILE`)**
    Sensed demand disaggregation profile from weekly forecast to daily forecast.
  - **Weekly Optimized Sensed Demand (`WEEKLYOPTIMIZEDSD`)**
    Optimized sensed demand results from the machine learning algorithm before any postprocessing.
  - **Weekly Open Orders (`WEEKLYOPENORDER`)**
    Current open orders where the order creation date ≤ the base period.
  - **Weekly Capped Sensed Demand (`WEEKLYCAPPEDSD`)**
    Capped sensed demand according to maximum increase/decrease settings in the forecast model, which are applied to optimized sensed demand.
  - **Weekly Uplift Balanced Sensed Demand (`WEEKLYUPLIFTBALANCEDSD`)**
    Sensed demand results after planned promotion uplifts are balanced and added back to the capped sensed demand.
  - **Weekly Base Balanced Sensed Demand (`WEEKLYBASEBALANCEDSD`)**
    Sensed demand results after baseline demand balancing and open order matching steps are executed on the uplift balanced sensed demand.
  - **Weekly Holiday Balanced Sensed Demand (`WEEKLYCALBALANCEDSD`)**
    Sensed demand results after daily calendars are taken into account and demand is potentially moved from one week to a previous week (due to holidays at the beginning of the week).

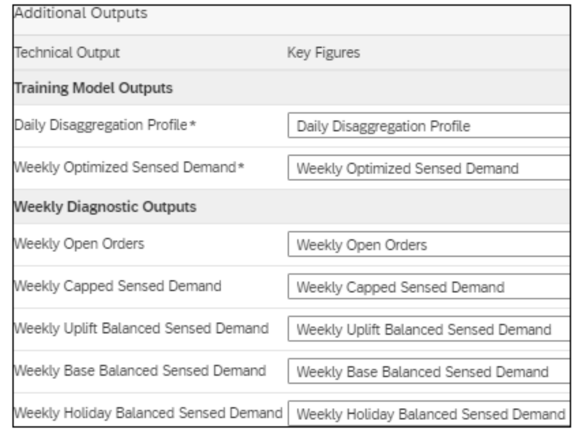


Figure 6.28 Additional Outputs

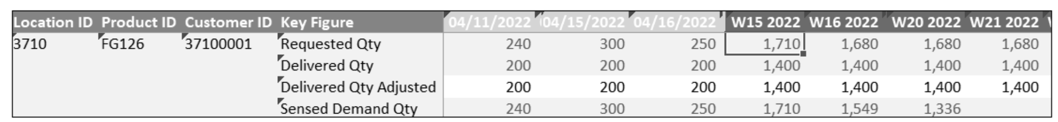
Demand sensing with gradient boosting (full) method has the following advantages:

- It calculates with extra signals for more accurate results than the demand sensing (full) algorithm.
- You can choose historical or both historical and future extra signals.
- It has greater forecast accuracy throughout the short-term forecast horizon.
- It's not dependent on open orders as a signal for accuracy improvement.

However, the following disadvantages should also be kept in mind:

- In cases where independent variables have varying future values, the algorithm can't make good predictions because the tree structure depends on the training data.
- This algorithm requires more time to complete due to a lot of computing required.

Demand sensing output will show up once the job completes successfully with the demand sensing full run with gradient boosting from SAP IBP, add-in for Microsoft Excel or the application job. You'll see the sensed demand is generated for the next 42 days (6 weeks) considering the independent variables, as shown in Figure 6.29.



Location ID	Product ID	Customer ID	Key Figure	04/11/2022	04/15/2022	04/16/2022	W15 2022	W16 2022	W20 2022	W21 2022
3710	FG126	37100001	Requested Qty	240	300	250	1,710	1,680	1,680	1,680
			Delivered Qty	200	200	200	1,400	1,400	1,400	1,400
			Delivered Qty Adjusted	200	200	200	1,400	1,400	1,400	1,400
			Sensed Demand Qty	240	300	250	1,710	1,549	1,336	

Figure 6.29 Demand Sensing (Full) Gradient Boosting

6.2 Lag-Based Planning

Lag-based forecasting is used in demand planning, including demand sensing and inventory optimization. Lag function delays an input from one row by a certain number of periods and returns the result in another row. Lag-based forecasting is used to calculate forecast accuracy and bias calculation. There are several possible levels and lags in which forecast errors can be calculated. Lag-based snapshot input is a prerequisite to run the demand sensing algorithm. Lag is used in demand planning to calculate forecast accuracy of statistical forecasts, consensus demand plan quantity, consensus demand final, and combined final demand. Lag can be used with and without snapshot operators.

In the example shown in Figure 6.30, you can see the illustration of lag working in the **CONSENSUSDEMAND** key figure and lag-based snapshot key figure **CONSENSUSDEMANDSNAPSHOT**.

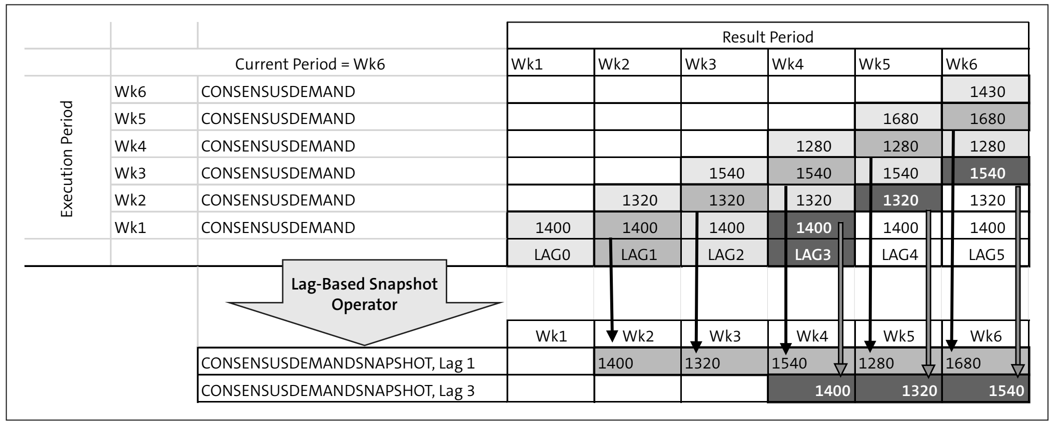


Figure 6.30 Lag

Lag-based planning requires attributes and master data types, planning levels, key figures, and planning operators. We discussed this general configuration in detail in Chapter 2. Let's go through the specifics for lag-based planning now:

- **Attributes and master data types**
  The **LAG** attribute is the **INTEGER** type assigned to master data type **LAG** as the key attribute and delivered with the SAP6 sample planning area as standard (see Figure 6.31).

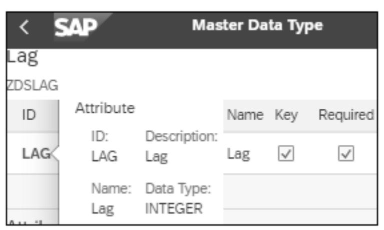
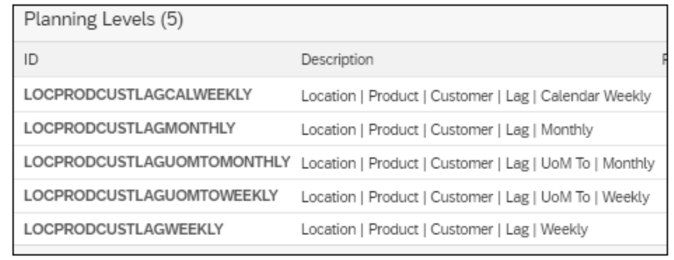


Figure 6.31 Lag Master Data Type

- **Planning level**
  For lag-based key figures base the planning level with lag as a key attribute to aggregate, disaggregate, and display the key figure at the LAG level. Lag-based planning levels, as shown in Figure 6.32, are delivered with the SAP6 planning area. You can extend the planning level to your own based on your requirements.



Planning Levels (5)

ID	Description
LOCPRODCUSTLAGCALWEEKLY	Location | Product | Customer | Lag | Calendar Weekly
LOCPRODCUSTLAGMONTHLY	Location | Product | Customer | Lag | Monthly
LOCPRODCUSTLAGUOMTOMONTHLY	Location | Product | Customer | Lag | UoM To | Monthly
LOCPRODCUSTLAGUOMTOWEEKLY	Location | Product | Customer | Lag | UoM To | Weekly
LOCPRODCUSTLAGWEEKLY	Location | Product | Customer | Lag | Weekly

Figure 6.32 Lag Planning Level

- **Key figure**
  SAP delivers standard operators and key figures with SAP IBP1 and SAP6 sample planning areas. If your business has different requirements, you can create them differently. For example, the **Consensus Demand Snapshot** key figure is created with planning level product/location/customer/lag/weekly, as shown in Figure 6.33, which is the mandatory input for demand sensing.

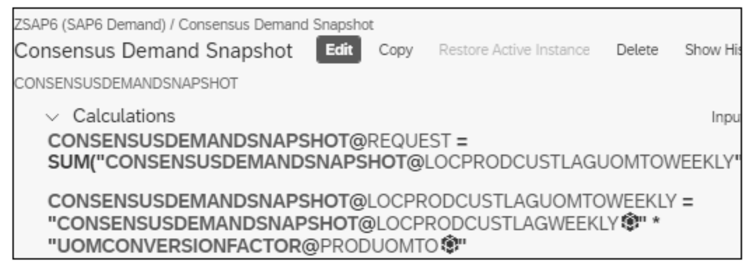


Figure 6.33 Lag Key Figure

Other lag-based key figures are related to forecast error calculation on statistical forecast, consensus demand plan, and consensus demand final key figures. Each forecast's three key figures for lag, error, and bias are required for forecast accuracy calculations. In the example, statistical forecast quantity lag-based key figures are shown in Table 6.2.

Key Figure	Description
STATISTICALFORECASTQTYLAG	Lag-specific key figure, which means LAG is used as root. Used to store the snapshots of key figure STATISTICAL-FORECASTQTY for all relevant monthly lags (in our example, 1-month lag + 3-month lag).
STATISTICALFORECASTQTYERROR	Contains the calculated statistical forecast quantity errors per month and by lag (in our example, 1-month lag + 3-month lag).
STATISTICALFORECASTQTYBIAS	Contains the calculated statistical forecast bias per month and by lag (in our example, 1-month lag + 3-month lag).

Table 6.2 Lag-Based Key Figure

Snapshots contain a static copy of the values for a particular key figure within a specific time frame. In a lag-based snapshot, lags are set up as root attributes in the base planning level of a key figure. To analyze how the forecast is calculated in the past, demand sensing needs lag-based snapshots of the consensus demand as various lags compare and correlate to actual sales at different lags. As a result, future forecasts can be optimized. For more information on configuring snapshots, see Chapter 2, Section 2.7.3.

6.3 Summary

You've now seen an operational demand planning overview. You've learned about preprocessing algorithm promotion sales lift elimination, as well as three demand sensing forecast models: demand sensing (full), demand sensing (update), and demand sensing full with gradient boosting and its settings and outcomes. Next you saw the comparison between demand planning and demand sensing, including the difference between their forecast models. Finally, you learned about lag-based forecasting.

In the next chapter, we'll discuss data segmentation and realignment with SAP IBP for demand.

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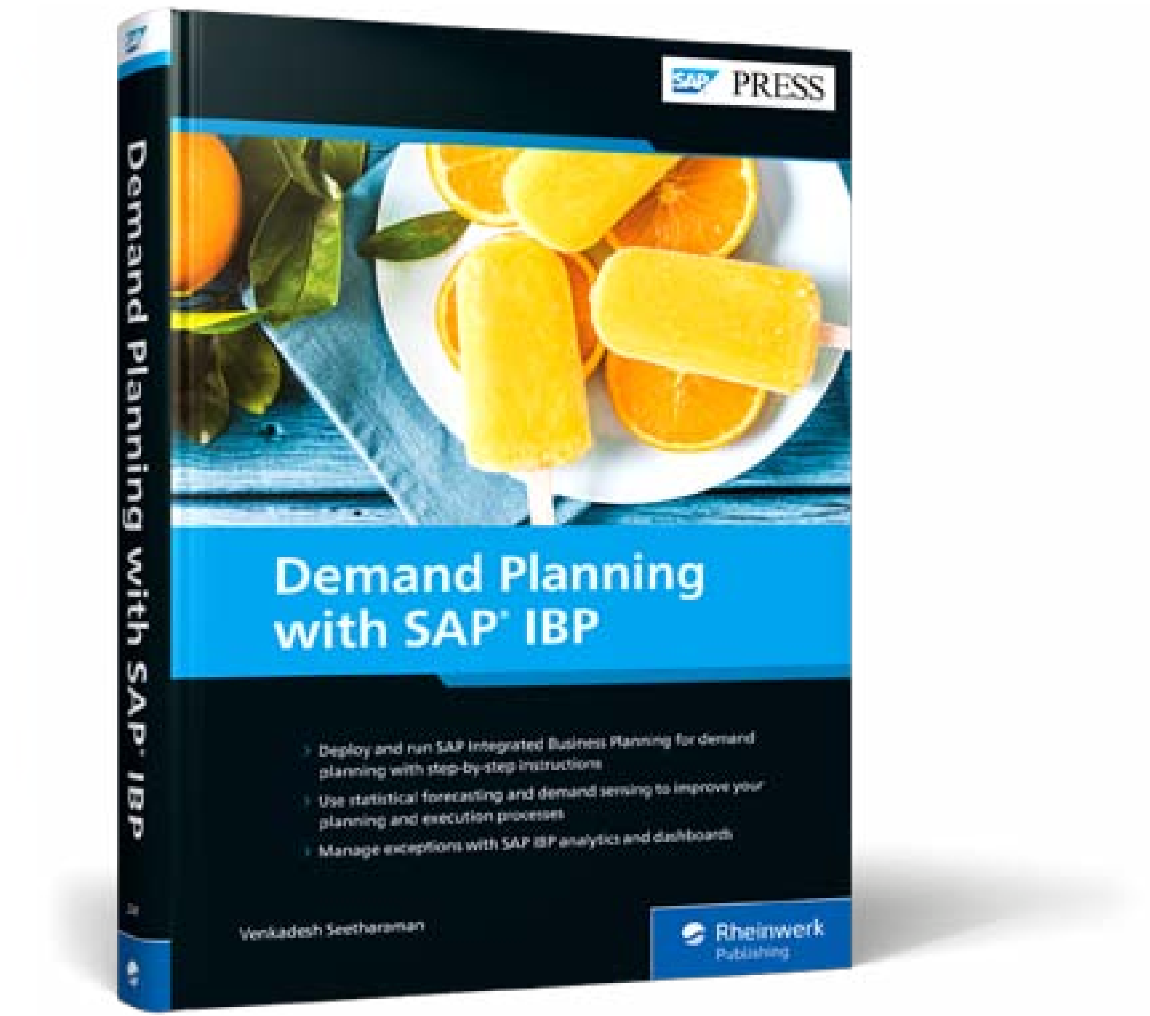

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Venkadesh Seetharaman is a highly motivated digital supply chain expert currently working at Bolders Consulting Group as a digital supply chain architect. He has more than 20 years of diverse experience in supply chain consulting that includes process and technology consulting. He has worked on large-scale SAP IBP, SAP S/4HANA, and other supply chain transformation projects for global customers, resolving complex supply chain problems through process correction, technology implementation, and continuous improvements in various industries, including life sciences, high-tech, automotive, utilities, communication, and fast-moving consumer goods. Venkadesh believes that cultivating structured supply chain education helps in solving most critical supply chain problems, which motivates him to be an avid blogger and content developer across SAP Community.