CHAPTER 5

Preventive Maintenance

This chapter delves into the essential aspects of keeping your assets in top-notch condition while harnessing the power of SAP S/4HANA. We explore a range of functionalities that cover everything you need to know.

The following are some of the key topics covered in this chapter.

- Preventive maintenance
- Master data
- Single-cycle maintenance plan
- Planning regular external service procurement
- Maintenance planning with a time-based strategy
- Maintenance planning with a performance-based strategy
- Maintenance planning with cycles of different dimensions
- User interfaces

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5.1. What Is Preventive Maintenance?

Preventive maintenance, or proactive maintenance, is a way of taking care of things before they break or stop working. It involves doing regular checks and minor repairs to keep things running smoothly and avoid bigger problems later on. Just like getting regular check-ups at the doctor helps keep you healthy, preventive maintenance helps keep machines, equipment, and facilities in good shape and prevents unexpected breakdowns.

All planned maintenance (preventive / proactive maintenance) can be grouped into the four types shown in Figure 5-1.

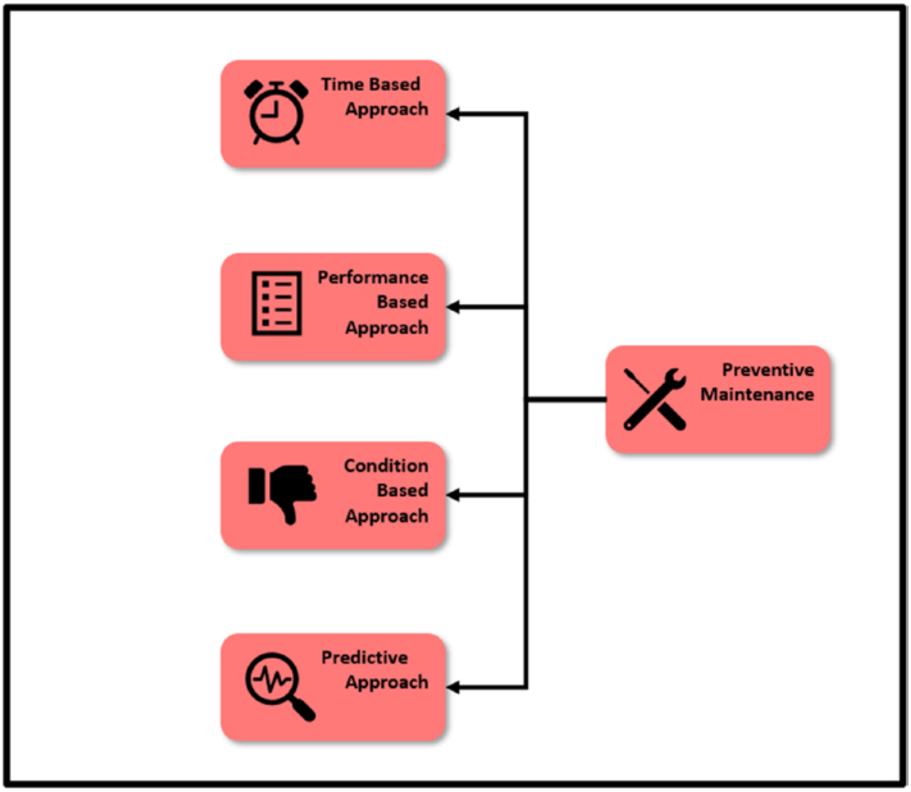


Figure 5-1. *Different ways to schedule preventive maintenance*

- **Time-based maintenance**: Maintenance tasks are scheduled at specific time intervals; for example, the air filter is replaced every three months.
- **Performance-based maintenance**: Maintenance tasks are scheduled when a specific number of operating hours or a certain reading is reached; for example, the oil should be replaced after 500 hours of engine running.
- **Condition-based maintenance**: Maintenance tasks are scheduled when the asset's or its parts' condition is outside the acceptable value range; for example, replacing a vehicle's battery is performed when the power level is below 25%.
- **Predictive maintenance**: Maintenance tasks are scheduled when real-time condition data of the asset or its parts signals a possibility of part failure; for example, if a machine's oil flow pressure sensor reading is very high, it indicates that the oil filter is clogged.

S/4HANA Asset Management includes detailed preventive maintenance functionalities that help companies care for their machines, equipment, and facilities. The functionalities help them schedule regular inspections, servicing, cleanings, and minor repairs. This way, they can avoid unexpected breakdowns that could disrupt their work and cost a lot to fix.

5.2. Master Data

Master data is akin to the foundation of a software application. It constitutes the fundamental information that a software application, such as SAP S/4HANA, employs to interact with business process data. Envision it as the crucial details regarding entities such as equipment, materials, customers, vendors, and more. For instance, if you're utilizing S/4HANA to oversee a manufacturing factory, the master data would encompass information about all the machines, their specifications, their locations, a list of tasks to be performed, and other indispensable particulars.

5.2.1. Maintenance Task List

The maintenance task list is among the most crucial master data sets for conducting planned maintenance and repair activities, including preventive maintenance, periodic maintenance, regular checks, and inspections. For example, as preventive maintenance, a specific maintenance job must be performed for all piston pumps at a regular frequency. This job consists of operations and replacement parts from wear and tear if needed (e.g., disconnection from the electrical power supply, closing incoming fluid to the pump, visual inspection for leakage, seal replacement, etc.).

This section delves into intricate details about the various types of maintenance task lists, their utilization in maintenance orders, the planning of routine inspections, and important customization settings.

Types of Task Lists

In S/4HANA Asset Management, there are three types of maintenance task lists.

- An **equipment task list (E)** is created for a specific piece of technical object. This task list is assigned to a particular equipment master, such as the task list for half-yearly servicing of an equipment master number 200000235.

- A **functional location task list (T)** is also created for a specific piece of technical object. This task list is assigned to a particular functional location master, such as the task list for a yearly overhaul of the engine assembly line represented as functional location master number 1000-EA-AL01.
- A **general maintenance task list (A)** is not linked to any specific technical object, such as an equipment master or functional location. It is created to be used for a group of technical objects which have similar technical characteristics. For example, a task list for quarterly preventive maintenance of a particular make of piston pumps with the same technical specifications.

Any of the task list types can be used for planned maintenance (e.g., preventive maintenance, routine inspection) and unplanned maintenance (corrective maintenance, breakdown maintenance).

Maintenance task lists are organized into clusters known as task list groups. Each task list group comprises maintenance task lists sharing identical or akin maintenance steps. The task lists in a task list group are recognized by the group counter, which sequentially labels the task lists within that specific group (see Figure 5-2).

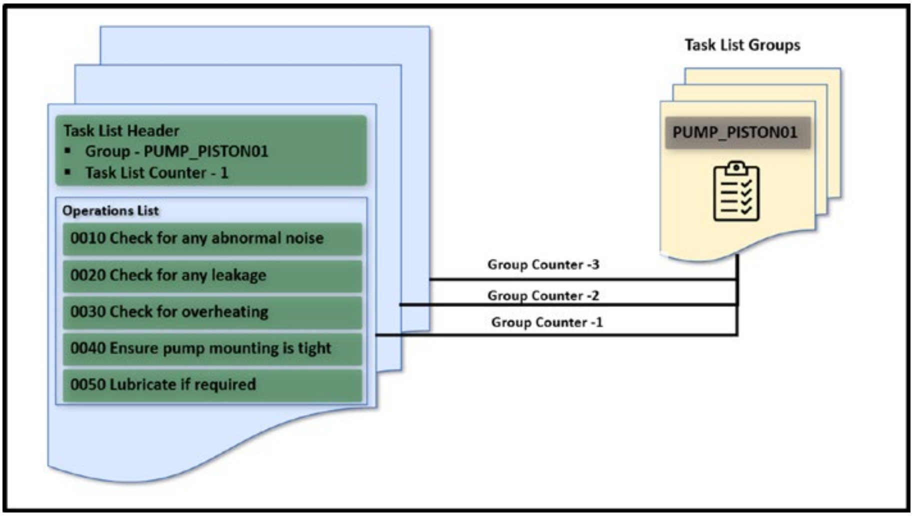


Figure 5-2. *Organization of maintenance task list in group counter*

Based on task list type, task list groups are either technical object-based (see Table 5-1) (functional location and equipment master task lists) or object-independent (see Table 5-2) (general maintenance task lists).

Table 5-1. *Equipment Task List Group*

Task List Group	Technical Object	Task List Counter	Description
3003	Equipment–200000235	1	3-month general service
3003	Equipment–200000235	2	6-month air filter replacement

Table 5-2. *General Maintenance Task List Group*

Task List Group	Task List Counter	Description
PUMP_PISTON01	1	Task list for pump general service
PUMP_PISTON01	2	Task list for pump piston replacement
PUMP_PISTON01	3	Task list for pump replacement

All the maintenance task lists within a group are managed as a single unit. Therefore, SAP suggests dividing your maintenance task lists into several smaller groups to streamline processing. This reduces the data volume that the system needs to handle when accessing a task list group, leading to shorter system response times.

Structure of Maintenance Task List

In general, data within a maintenance task list is divided into two sections called task list general data (referred to as header data in the SAP GUI user interface) and task list operation data. The header section data applies to the entire task list, whereas operation data is specific to each operation in the task list (see Figure 5-3).

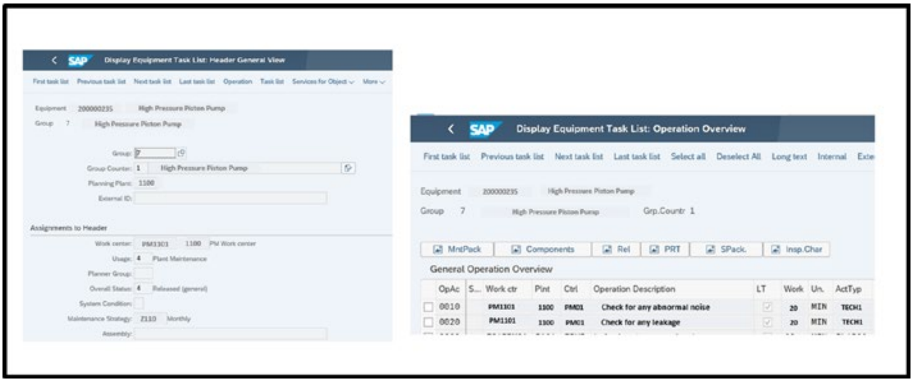


Figure 5-3. *Important data in header level and operation level of a task list*

The following are important pieces of information maintained at general data level.

- Plant
- Maintenance work center
- Planner group
- Maintenance strategy
- Assembly
- Quality management data
- Status

The following are some important data maintained at the operational level.

- Operation number
- Operation short description
- Maintenance work center

- Components required
- Production resource tool (PRT)
- Service packages
- Maintenance packages

Profile for Managing Task List

Specific fields in different maintenance task lists such as operation number and unit of duration typically contain the same data or information. To facilitate the user, this data can be defaulted during the creation of maintenance task lists using profile functionality. A profile holds standardized information needed in identical or similar combinations while processing maintenance task lists. Profile is defined in customization.

At the time of maintenance task list creation, you can select the previously defined profile, which contains the required data, on the initial screen. This data is automatically populated in the new maintenance task list. Users can overwrite the populated data at any time. Users can even default a particular profile ID (in case there are more than one profiles created) by using the User Parameter ID–PIN and the specific profile ID in the SAP user master data.

Operation Control Key

The control key functionality defines if an operation is processed internally (using a maintenance work center) or externally (using an external vendor) (see Figure 5-4). The control key also defines a few other processing behaviors of an operation, such as if the operation should be scheduled, relevant for costing, operation required to be confirmed, and printing allowed. Control keys are defined in customization.

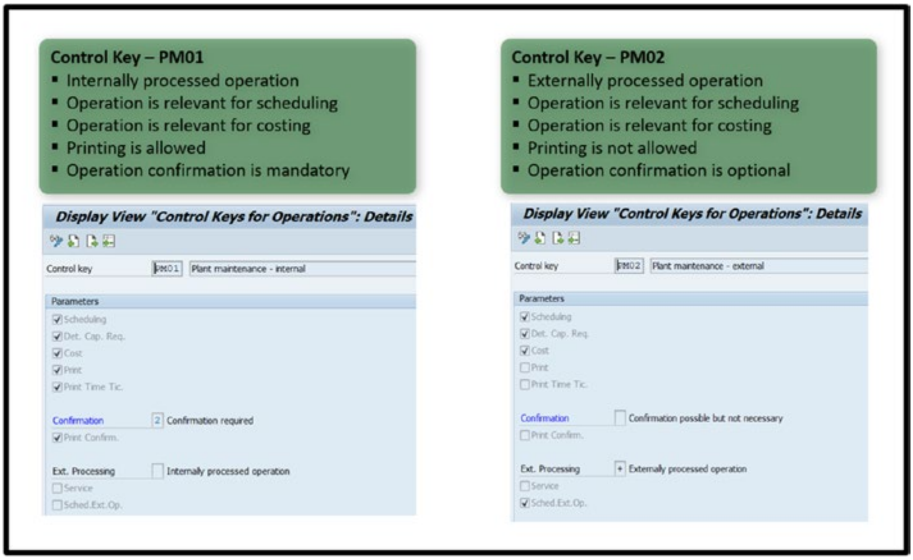


Figure 5-4. *Task list operation's control keys*

Adding Component in Maintenance Task List

In maintenance task lists, you can allocate material components to operations. These materials can be located and obtained from the bill of materials (BOM) associated with the technical object (equipment, functional location, or assembly) assigned to the task list. In this scenario, the BOM directly matches the content of the structure list.

Additionally, you can allocate stock materials, even if they aren't included in the technical object's BOM, directly to the operations within the maintenance task list. This is referred to as a "free material assignment." To accomplish this, you use the material number for the assignment. To perform a free material assignment, you need to define a BOM usage (typically in Asset Management) within the Customizing settings. When you opt for a free assignment, the system generates an internal BOM, which cannot be manipulated through the application. The material components that are assigned to the operations of the task list are copied into the maintenance order when the maintenance task list is transferred into the maintenance order.

Adding Component in General Maintenance Task List

To include material components in a general maintenance task list, you must begin by assigning an assembly (material master number of the assembly) in the header section of the general maintenance task list. It is possible to append components from the assembly's BOM to the operations within the general maintenance task list (see Figure 5-5). Additionally, you can incorporate material components from the common list of materials.

If you intend to modify or remove the assembly from the header section of the general maintenance task list, you can only do so after you have deleted component assignment from the operations.

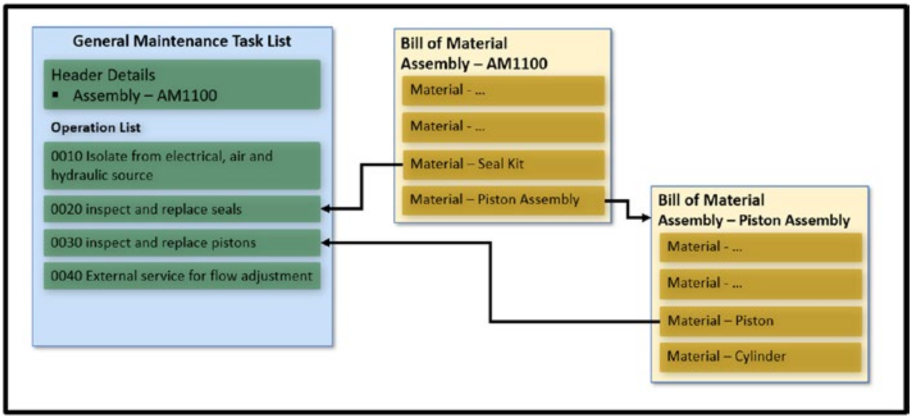


Figure 5-5. *Adding components in general maintenance task list*

Adding Component in Equipment Task List and Functional Location Task List

You can add material components in the equipment task list from the BOM for the equipment master and in the functional location task list from the BOM for the functional location. The material components you wish to allocate to a task list for equipment or functional location do not necessarily need to be present in the relevant BOM at the time of assignment. It is also possible to assign stock materials without restrictions. The system does not automatically include the freely assigned material in the BOM. The original form of the initial BOM is maintained, allowing you to access it whenever needed.

For the unrestricted allocation of materials in maintenance task lists, the system administrator needs to define a BOM usage for maintenance related BOMs (e.g., usage 4 in the SAP standard system) in the customizing configuration for maintenance task lists. After material has been freely assigned, avoid altering the designated usage, as modifying it could result in the potential loss of existing free material assignments.

Adding External Service Package to Maintenance Task List

For externally processed operations in task list, service packages (service master) can be assigned to the operation in the maintenance task list. A service package can be assigned to those operations as well which need to be processed internally in intercompany process. Service masters are created and maintained in Materials Management application. You have the option to assign service packages to the operation by either inputting a specific service number or choosing one or multiple services from the standard or model service specifications.

Apart from employing service packages, services can also be manually added within the service specifications for the operation. Nonetheless, all particulars, including price, unit of measure, and description, must be input manually.

5.2.2. Creating Maintenance Order with a Task List

General maintenance task lists are utilized in maintenance plans to facilitate the automatic copying of task lists into preventive maintenance orders and regular inspection orders. This copying occurs when orders are generated from these maintenance plans. Nevertheless, task lists can also be manually chosen during the manual creation of a maintenance order. For instance, if a user intends to execute ad hoc preventive maintenance for equipment lacking a maintenance plan, and a general maintenance task list applicable to comparable equipment types exists, it can be selected (see Figure 5-6).

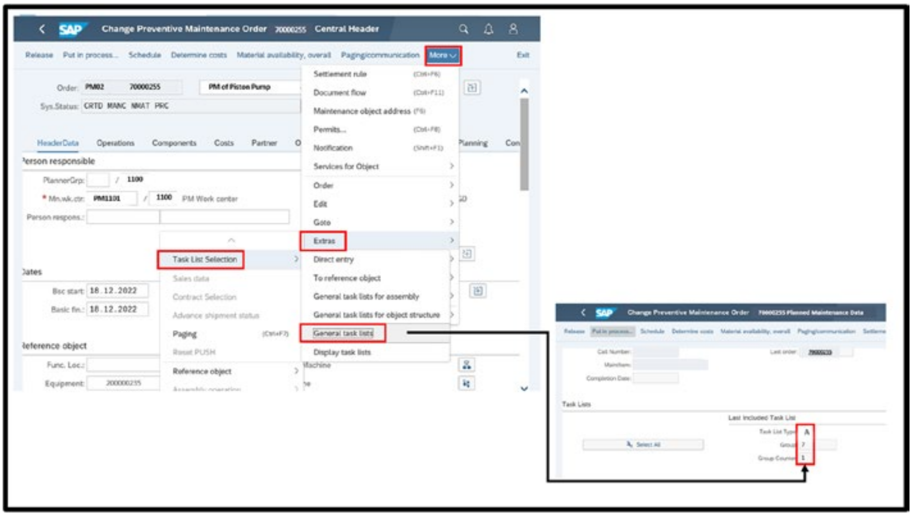


Figure 5-6. Selecting the maintenance task list manually during the creation of a maintenance order

5.2.3. Task List for Inspection Rounds

Inspection planning comprises similar repetitive inspections and tasks for many different technical objects. Users refer to their shop papers to perform inspection activities for specific technical objects. After completing the inspection activity, the maintenance technician confirms the manhours utilized and creates measurement documents in the system (see Figure 5-7). To set up inspection rounds, PRTs are required to be assigned as measuring points in the task list.

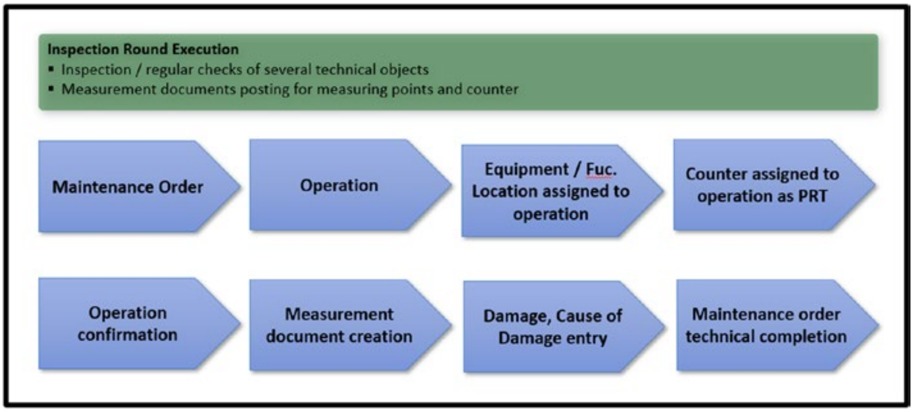


Figure 5-7. *Inspection round process flow*

The enhancement has been applied to the procedure for confirming overall completion. When conducting an overall completion confirmation at the conclusion of an inspection round, it is now possible to directly generate a notification from a technical object linked to an operation. Additionally, modifications can be made to an existing notification associated with a technical object.

You must activate the LOG_EAM_CI_3 and LOG_EAM_CI_4 business functions to have the full functionality of inspection rounds.

5.2.4. SAP GUI-Based (User Interface) Functions

This section details few of the important functionalities available from SAP GUI user interface.

Where-Used Lists

For the efficient planning of resources such as work centers, materials, and PRTs, for maintenance and repair work, the maintenance planner can utilize the "Where-Used Lists" report. This report allows the viewing of all maintenance task lists containing specific resources. For instance, if a material component becomes unavailable from a supplier and a replacement with an alternative component from task list operations where the discontinued material was assigned is needed, this report facilitates the process. Through this report, it becomes possible to substitute existing work centers and PRTs with alternative ones that are assigned to task lists.

Object Overview

Using the object overview report, you can display different objects that can be assigned to a maintenance task list. You can customize the list of objects to be displayed in the report. The report displays the following objects.

- Material
- Service package
- Object dependency
- Maintenance package
- Inspection characteristics

Action Log for Task Lists

Action log functionality records changes to maintenance task lists. The change log captures information such as who has made change, which field, old and new data and when the change happened.

5.2.5. Customizing Maintenance Task Lists

The following lists important objects that can be customized.

- Maintenance planner group
- Number ranges
- Profile for defaulting values in a task list
- Control key for operation
- Presetting for free assignment of material
- Presetting for multi-level list display
- Order type presetting for task lists

From the SAP Easy Access menu, navigate to Tools → Customizing. Double-click IMG → SPRO–Execute Project. Click the SAP Reference IMG button.

Table 5-3 lists important configuration paths related to plant.

Table 5-3. *Customizing Maintenance Task Lists*

Configuration Step	Configuration Path
Configure Planner Group	Plant Maintenance and Customer Service → Maintenance Plans, Work Centers, Task Lists and PRTs → Task Lists → General Data → Configure Planner Group
Define Number Ranges	Plant Maintenance and Customer Service → Maintenance Plans, Work Centers, Task Lists and PRTs → Task Lists → Control Data → Define Number Ranges for General Maintenance Task Lists
Define Profile with Default Values	Plant Maintenance and Customer Service → Maintenance Plans, Work Centers, Task Lists and PRTs → Task Lists → Control Data → Define Profiles with Default Values
Maintain Control Keys	Plant Maintenance and Customer Service → Maintenance Plans, Work Centers, Task Lists and PRTs → Task Lists → Operation Data → Maintain Control Keys
Presetting for free assignment of Material	Plant Maintenance and Customer Service → Maintenance Plans, Work Centers, Task Lists and PRTs → Task Lists → Control Data → Define Presetting for Free Assignment of Material
Presetting for multi-level list display (object overview)	Plant Maintenance and Customer Service → Maintenance Plans, Work Centers, Task Lists and PRTs → Task Lists → Presetting for List Display of Multi-Level Task Lists
Order Type Presettings for Task Lists	Plant Maintenance and Customer Service → Maintenance and Service Processing → Maintenance and Service Orders → Functions and Settings for Order Types → Default Values for Task List Data and Profile Assignments

5.3. Single-Cycle Maintenance Plan

S/4HANA Asset Management comes with detailed preventive maintenance functionalities, which help companies take care of their machines, equipment, and facilities. It helps them schedule regular inspections, servicing, cleanings, and minor repairs.

5.3.1. Maintenance Plan

The maintenance plan serves the purpose of planning, scheduling, and creating call objects for technical objects, such as equipment and functional locations, for designated dates. These call objects encompass maintenance notifications, orders, and service entry sheets (see Figure 5-8). Additionally, the option exists to generate maintenance notifications and orders simultaneously from the maintenance plan.

For example, for a three-month general servicing of air-conditioning, a job order must be created automatically regularly.

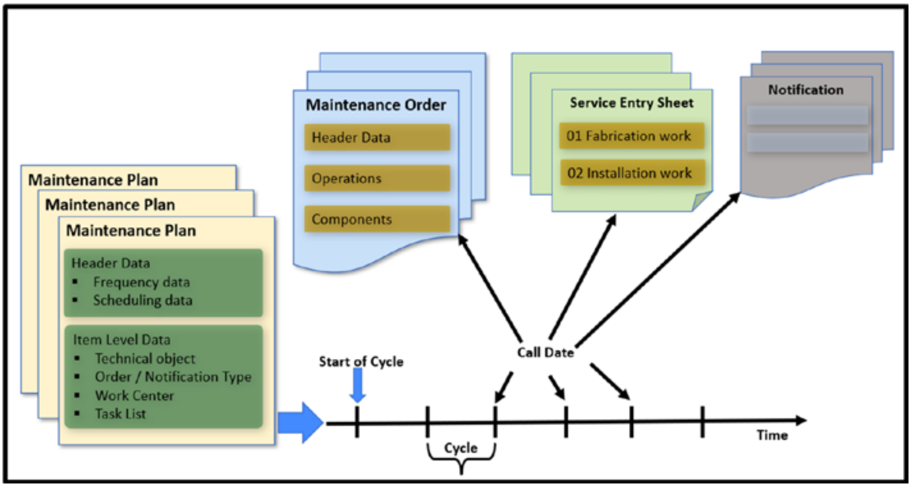


Figure 5-8. Maintenance plan and types of call objects

A maintenance plan can be scheduled according to duration or performance value. For instance, an air conditioner might require servicing every three months, while a car may need maintenance every 5000 kilometers. To meet these needs, users must generate two maintenance plans: one based on time and another based on performance.

Further, a maintenance plan can be scheduled based on a single cycle, multiple cycles (strategy based) or cycles of different dimensions (the multiple counter plan).

Single-Cycle Plan

In a single cycle maintenance plan, one schedule (one frequency) is adhered to for producing call objects like maintenance orders. Each time, identical operations and components are entered within the maintenance order.

Strategy Based

A strategy-based maintenance plan follows more than one schedule (multiple frequencies) to generate call objects such as maintenance orders. Maintenance orders generated for different schedules may contain varying operations and components. For example, servicing an air conditioner every three months requires inspection and cleaning, whereas servicing it every twelve months may necessitate the replacement of filters or gas refilling.

Multiple Counter Plan

A plan with multiple counters is scheduled using cycles of various dimensions (see Figure 5-9). This plan generates call objects, such as maintenance orders, when any single cycle reaches the designated limit or all cycles simultaneously hit the limit. For instance, a car needs servicing every six months or after covering 9000 kilometers, whichever occurs first. Conversely, a bus requires servicing when it accumulates 15,000 kilometers, and has been six months since its last maintenance.

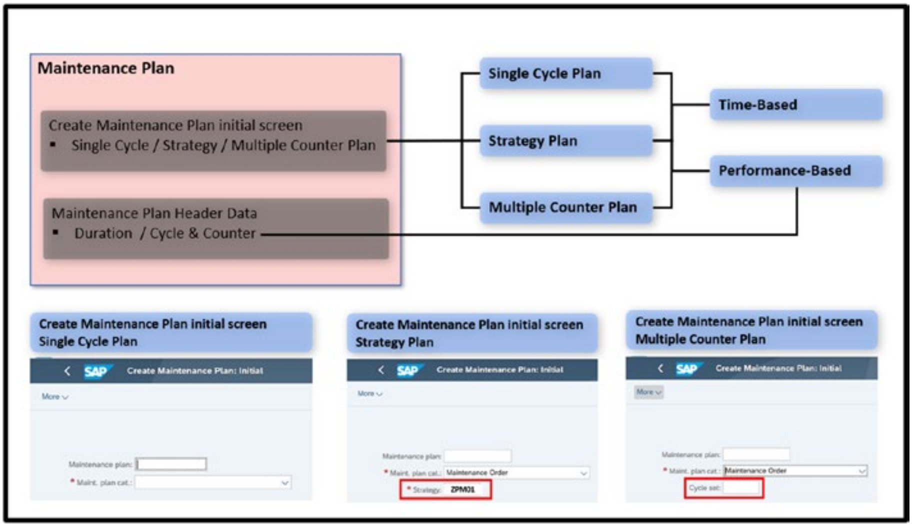


Figure 5-9. *Time-based and performance-based scheduling options for maintenance plan*

Structure of a Maintenance Plan

A maintenance plan consists of mainly two sections of data: maintenance plan header data and item data.

Information in the header data area applies to the entire maintenance plan. The following lists various data maintained at the header level.

- Maintenance plan number
- Maintenance plan text
- Cycle data: cycles, measurement units

- Scheduling parameters: call horizons, scheduling periods, tolerance
- Additional data: category, key date

Information in the item data area applies to a specific item (such as particular equipment or functional location) (see Figure 5-10). The following are various data maintained at the item level.

- Maintenance item number
- Technical object: equipment or functional location
- Planning data: Planning plant, call object type, planner group, task list

A maintenance plan can consist of several items (such as multiple equipment or functional locations). A separate call object (order, notification, or service entry sheet) is created for each item.

As an example, within a maintenance plan, diverse components of a water pump need to be managed. You can establish a maintenance item for the pump unit, a separate item for the electric motor, and a third one for the pump gears. Each maintenance item is linked to its individual task list. All these items fall under the umbrella of a single maintenance plan and share identical timings (scheduling data).

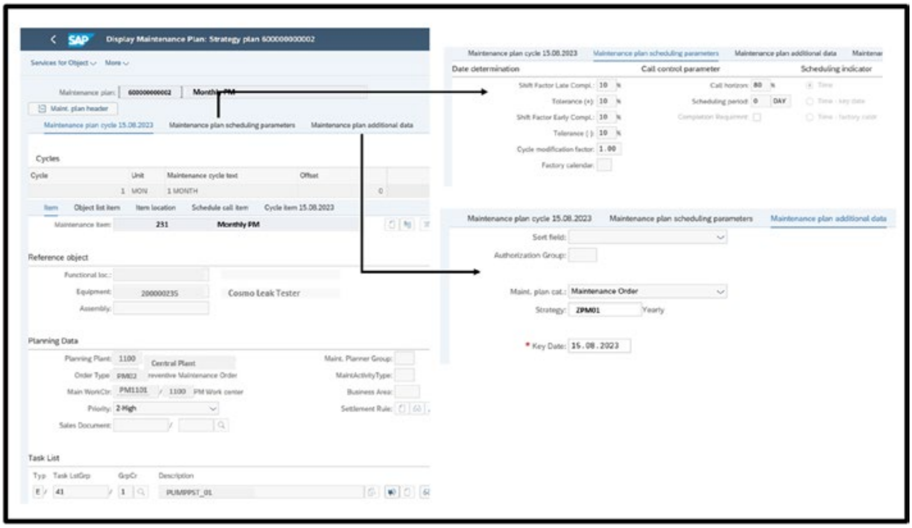


Figure 5-10. *Structure of a maintenance plan*

5.3.2. Maintenance Plan Setup for Generating a Maintenance Order

For internal planned maintenance (including preventive maintenance and routine inspections) of a technical object, maintenance orders are produced from the maintenance plan based on the frequency recommended by the manufacturer or the organization's maintenance procedure. The maintenance plan automatically generates these orders (see Figure 5-11).

Within the item data section of the maintenance plan, users can input the technical object (equipment or functional location) and the maintenance order type under which the order is generated. By selecting the Do Not Release Immediately checkbox, the maintenance order is not immediately released upon creation from the maintenance plan, even if the Release Immediately checkbox is set in customization for the order type.

Within the item data section of the maintenance plan, the task list is allocated. This task list encompasses the operations to be carried out and components to be replaced for the technical object. If there is no appropriate task list accessible for the technical objects, users have the option to directly create a new task list (general maintenance/equipment/functional location task list) from the maintenance plan. When no task list has been assigned in the maintenance item section of the maintenance plan, the system duplicates the maintenance plan text and uses it as the description for the first operation in the generated maintenance order.

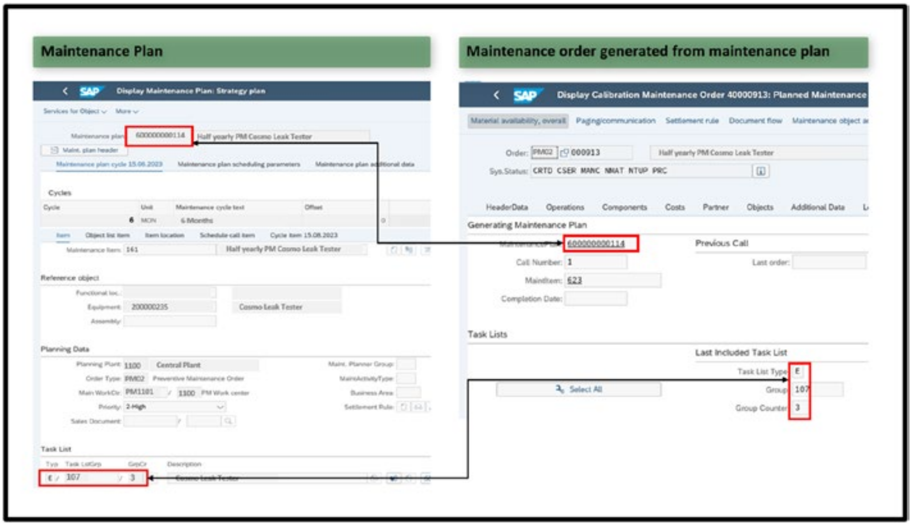


Figure 5-11. Maintenance plan and autogenerated maintenance order

5.3.3. Scheduling a Single-Cycle Plan

Once a maintenance plan is created, it is activated through the scheduling features of preventive maintenance. Maintenance plan scheduling is employed to produce call objects (maintenance orders/notifications) punctually.

The existing transaction code, IP30, has been employed to manage the scheduling of maintenance plans. Since processing all maintenance plans in IP30 can be time-consuming, different selection parameters are utilized to reduce the volume of maintenance plans during the scheduling process. However, as time progresses, new safety and legal regulations recommend timely creation of all call objects. Introducing the new transaction code, IP30H, now enables scheduling of all maintenance plans within a specified timeframe at once. When using transaction code IP30H, there is no need to input selection parameter values, as the system internally carries out preselection based on factors like maintenance strategies, dates, and counter readings. This ensures that the system incorporates only the due maintenance plans, eliminating the possibility of missing any call objects. With IP30H, the system selects a significantly smaller number of maintenance plans, leading to improved response times.

Scheduling Options

The following describes the scheduling options.

- **Start**: The Start option is for the first-time scheduling of a maintenance plan (see Figure 5-12). If during creation of the maintenance plan, start date was entered in the scheduling parameters section of the maintenance plan then the date is proposed during starting the scheduling else, user is required to enter start date.

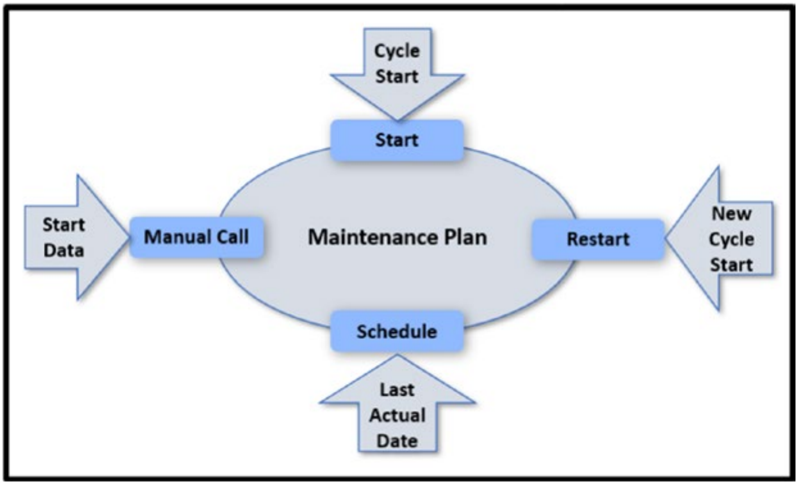


Figure 5-12. *Scheduling options in single-cycle plan*

- **Restart**: If the incorrect start date is mistakenly chosen or there have been alterations to the framework conditions, it's possible to schedule the maintenance plan anew. Any existing scheduled plan dates that are pending can be deleted. Deleting these pending plan dates does not impact calls that have already been executed.
- **Schedule**: It computes fresh planned dates and call dates, and (when relevant) triggers the subsequent maintenance order. Scheduling can be carried out on an individual plan basis manually, or collectively through online deadline monitoring or a system job. The method of collective scheduling is the most frequently employed.

- **Manual Call**: If you wish to schedule a maintenance plan, call for a specific date, you have the option to do so manually. You can use a manual call to include extra dates without disrupting the regular scheduling. To achieve this, indicate a new call date. For example, you want to perform ad hoc servicing on your car during the rainy season.
- **Deactivate**: This feature allows you to temporarily restrict maintenance plans for a specific duration. Subsequently, the system assigns the status INAK to the maintenance plan. This status prevents scheduling, and any pending planned scheduled dates are marked as blocked. Initiating maintenance calls is not feasible in this state. You can deactivate a maintenance plan in both the Change and Scheduling modes. The reactivation of blocked maintenance plans is possible whenever needed. For example, equipment has been sent to an external vendor for a major overhaul. During the period when the equipment is unavailable, the maintenance plan needs to be deactivated to cease the generation of maintenance orders.

Planned Date and Cycle Start Date

In the single-cycle plan, a value for the cycle (such as three months or one year) is assigned. The cycle value is intended for defining the frequency (interval period) for the planned dates. Call objects (orders/notifications) are generated based on the planned dates and the call horizon maintained in the scheduling parameters area of the maintenance plan. The call date (the order creation date) is typically set before the planned date, allowing enough buffer time for maintenance work planning, such as arranging external services or procuring non-stock materials.

The cycle start specifies the date at which the calculation of the planned dates should commence (see Figure 5-13).

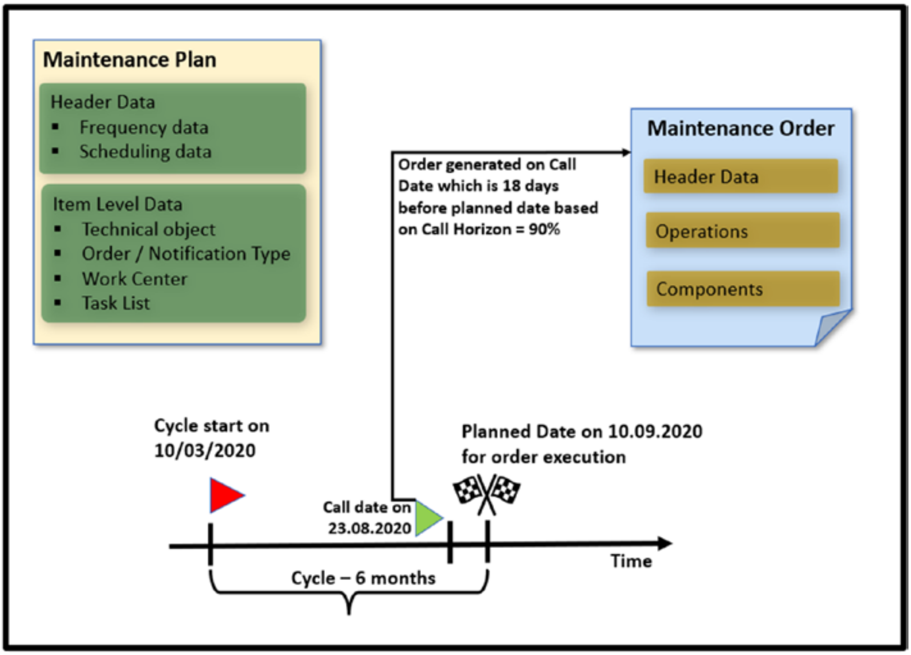


Figure 5-13. *Cycle start date, call date, and planned date*

Call Horizon

The call horizon is an important scheduling parameter used to calculate the call date, which is when a maintenance order, notification, or service entry sheet is created before the planned or actual execution date. The precise management of order generation allows you to plan the order ahead of the order execution date. Consequently, tasks that must be executed and finished on time can be achieved on the intended date. In a performance-based maintenance plan, it is recommended to always use the call horizon.

Call horizon is maintained as a percentage of the total cycle value. A 100% call horizon means that the call object is created on the planned date. 0% call horizon means that the call object is created on the date when the maintenance plan is started (see Table 5-4).

Table 5-4. *Call Horizon Calculation Example*

Cycle Length	Call Horizon	Call Date (order generation date)	Planned Date (execution date)
6 months (180 days)	Blank	Immediate (0% of 180 days)	after 180 days
6 months (180 days)	90%	after 162 days (90% of 180 days)	after 180 days
6 months (180 days)	100%	after 180 days (100% of 180 days)	after 180 days

You can maintain the call horizon in various objects of the preventive maintenance application, such as in a single-cycle plan, maintenance strategy, and strategy plan. Changes in the call horizon maintained within the maintenance strategy does not have a retrospective impact on existing maintenance plans using the maintenance strategy. The changed value is proposed in all maintenance plans created after the call horizon change.

When the LOG_EAM_CI_6 business function is activated, the call horizon value can be entered as days. You can maintain call horizon in percentage, number of calendar days or number of working days. The call horizon determines the timing for generating a maintenance call object, such as a maintenance order. It indicates the duration required between the order creation date and the upcoming planned maintenance date Should you indicate a percentage, the system compute the timing for the maintenance call using this specified percentage of the maintenance cycle.

If you opt for days (DAY), the system produces the maintenance call objects a specific count of days prior to the planned date. During the scheduling of the maintenance call, the system does not consider weekends, holidays, or any vacation shutdowns your company might have.

If a factory calendar is entered in the header section of the maintenance plan, the system uses the calendar for calculating dates during scheduling. In the case where a factory calendar is not maintained at the header level, the system retrieve the factory calendar of the planning plant that is maintained at the item level of the maintenance plan. For each item in the plan, the system calculates the earliest available working day as the planned maintenance day.

The call horizon functionality is not applicable for a multiple counter plan. In the scheduling parameters section of a multiple counter plan, you can enter a preliminary buffer in the number of days, which indicates how many days before the planned maintenance date the order should be created.

Scheduling Period

The scheduling period is one of the control values for the scheduling process maintained in the maintenance plan. It indicates the future time period (such as one year or 18 months) for which planned dates should be calculated in advance during the scheduling of a maintenance plan. It can be used for both time-based and performance-based maintenance plans.

Shift Factors and Completion Requirement

The shift factor provides the option to advance or delay the next planned maintenance date. If the last planned maintenance work has been completed earlier or with some delay compared to the actual planned date, you can use a shift factor value of 100% to move the next planned date by an equal number of days based on the early or late completion.

If the checkbox for completion requirement is marked in the scheduling parameters section of the maintenance plan, then the next call object (notification or maintenance order or service entry sheet) is only generated after the last call object has been completed.

With the activation of the completion requirement, the subsequent order is generated only after the technical completion of the preceding order (see Figure 5-14). The creation of the next notification is dependent on the completion of the preceding one, in the case of a call object being a notification. The subsequent service entry sheet is generated only after the acceptance of the preceding service entry sheet, in the scenario where the call object is a service entry sheet.

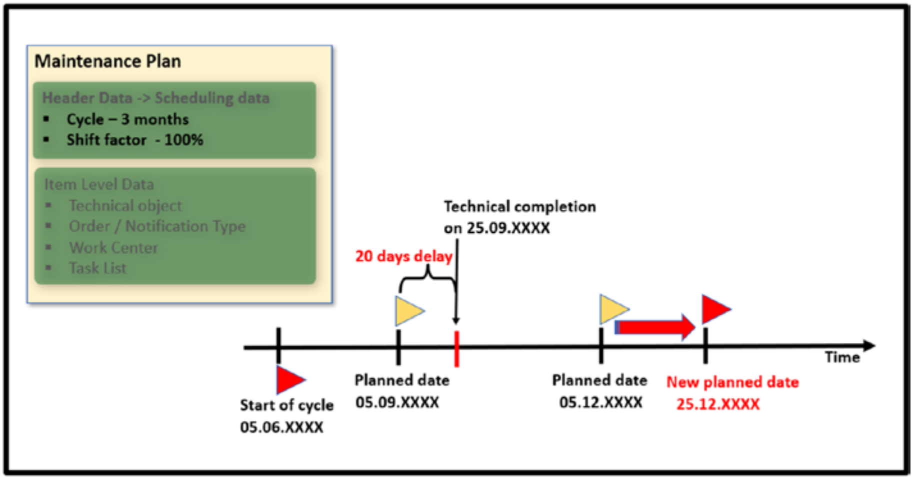


Figure 5-14. *effect of shift factor and completion requirement*

5.3.4. Creating and Scheduling a Single-Cycle Plan with Notification

Similar to generating maintenance orders, a maintenance plan can be set up to create maintenance notifications on a regular basis, based on the frequency recommended by the manufacturer or the organization's maintenance procedure (see Figure 5-15). These notifications are automatically generated from the maintenance plan. For example, sometimes regular maintenance involves only routine inspection of equipment and doesn't require considerable manpower or component changes. Therefore, for such routine inspections, maintenance notifications can be used instead of maintenance orders. If any damage or malfunction is noticed during inspection, the user can create a maintenance order with reference to the notification.

When a maintenance plan is created, the user needs to select the call object as a Notification for the Maintenance Plan category.

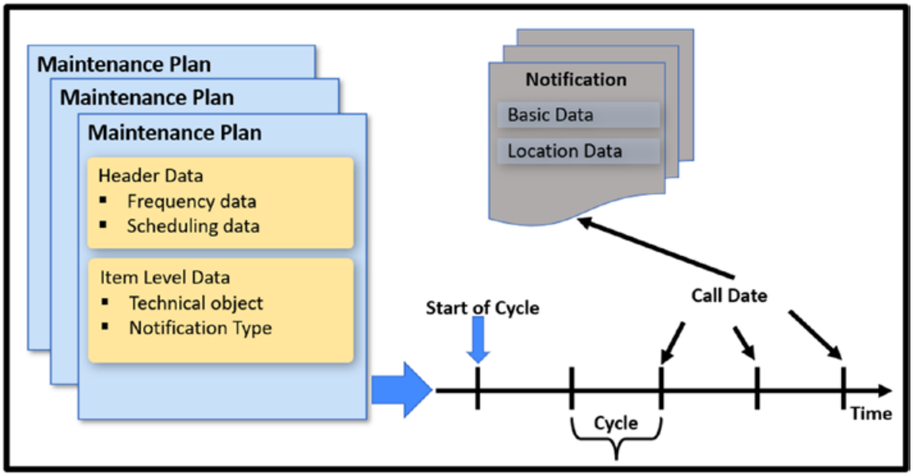


Figure 5-15. *Maintenance planning for notification generation*

5.3.5. SAP GUI-Based (User Interface) Functions for Single-cycle Plans

This section details a few of the important functionalities available in the SAP GUI user interface for a single-cycle plan.

Various transaction codes are available to create maintenance plan in SAP GUI user interface.

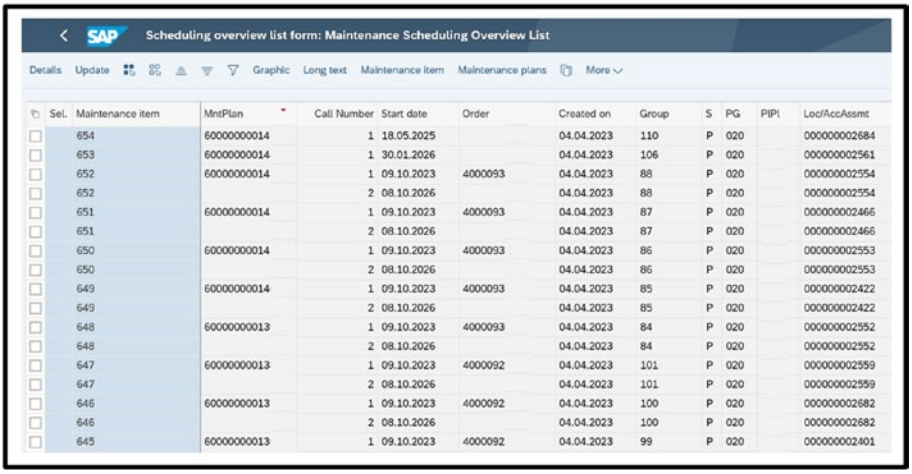
- IP41: Create a single-cycle plan
- IP42: Create a strategy plan
- IP43: Create a multiple counter plan

Transaction code IP30 (deadline monitoring) schedules maintenance plans (see Figure 5-16). Multiple maintenance plans can be scheduled together by creating a selection variant and assigning it to each of the maintenance plans. You can define a time period in the Interval for Call Objects field to control the planned waiting dates converted to call objects during execution. Normally, IP30 is executed in the background using a scheduled job that utilizes the IP30 (RISTRA20) ABAP program. The following are scheduling functionalities available in IP30.

- Immediate start for all
- Rescheduling
- Creating call objects

Transaction code IP30H, successor of IP30, is HANA-based. The new transaction code now enables scheduling of all maintenance plans within a specified timeframe at once. When using transaction code IP30H, there is no need to input selection parameter values, as the system internally carries out preselection based on factors like maintenance strategies, dates, and counter readings. This ensures that the system incorporates only the due maintenance plans, eliminating the possibility of missing any call objects. With IP30H, the system selects a significantly smaller number of maintenance plans, leading to improved response times.

The prerequisite to using IP30H is to activate the LOG_EAM_MPSI business function, maintenance plan scheduling, using preselection 1. Reversal of the business function is also possible.



Sel.	Maintenance item	MntPlan	Call Number	Start date	Order	Created on	Group	S	PG	PIPI	Loc/AccAssmt
	654	60000000014	1	18.05.2025		04.04.2023	110	P	020		000000002684
	653	60000000014	1	30.01.2026		04.04.2023	106	P	020		000000002561
	652	60000000014	1	09.10.2023	4000093	04.04.2023	88	P	020		000000002554
	652		2	08.10.2026		04.04.2023	88	P	020		000000002554
	651	60000000014	1	09.10.2023	4000093	04.04.2023	87	P	020		000000002466
	651		2	08.10.2026		04.04.2023	87	P	020		000000002466
	650	60000000014	1	09.10.2023	4000093	04.04.2023	86	P	020		000000002553
	650		2	08.10.2026		04.04.2023	86	P	020		000000002553
	649	60000000014	1	09.10.2023	4000093	04.04.2023	85	P	020		000000002422
	649		2	08.10.2026		04.04.2023	85	P	020		000000002422
	648	60000000013	1	09.10.2023	4000093	04.04.2023	84	P	020		000000002552
	648		2	08.10.2026		04.04.2023	84	P	020		000000002552
	647	60000000013	1	09.10.2023	4000092	04.04.2023	101	P	020		000000002559
	647		2	08.10.2026		04.04.2023	101	P	020		000000002559
	646	60000000013	1	09.10.2023	4000092	04.04.2023	100	P	020		000000002682
	646		2	08.10.2026		04.04.2023	100	P	020		000000002682
	645	60000000013	1	09.10.2023	4000092	04.04.2023	99	P	020		000000002401

***Figure 5-16.** Maintenance plan scheduling overview report*

- **Maintenance plan costing**: You can utilize the cost estimate to calculate the maintenance expenses within a designated timeframe.
- **General costing**: With general costing, you can compute the maintenance expenses for either a single maintenance plan or multiple plans.
- **Object-related cost estimate**: You have the option to derive the maintenance expenses for a technical object over a defined duration. In both maintenance plan general costing scenarios, the cost estimation takes into account active maintenance dates within the specified period, excluding waiting planned dates and skipped call dates. If the specified period extends beyond the last active date, the system simulates the relevant dates.

Work time and material are allocated values based on the rates and prices that are applicable at the time of creating the cost estimate. Varied rates, such as those for future posting periods (e.g., internal service rates), are not taken into account.

- **Change document for maintenance plan scheduling**: Change records can be generated when alterations are made to fields within the maintenance plan or its items, or when adjustments are made to maintenance calls. To enable the creation of change documents, you must activate this feature within the maintenance plan category's customization settings.
- **Work list for notification call object**: When maintenance activities for a technical system are carried out through an order, encompassing system components with varying maintenance cycles, a work list of requests (notifications) can be employed. The distinct maintenance plans generate requests for each corresponding part of the system. At a specified time, all requests pertaining to the technical system are consolidated and transformed into an order. Subsequently, the task lists from the relevant maintenance item are duplicated into the order.

  The task's target entity is evident for each operation outlined in the order. Typically, the order's reference object is the higher-level technical system (e.g., the functional location), against which the order expenses are allocated.

5.3.6. Customizing Maintenance Plan

The following describes important customizable objects in a maintenance plan.

- **Maintenance plan category**: This category is used to determine the type of call objects for the maintenance plan.
- **Set pop-up with completion date**: To provide an option to enter two dates while completing a maintenance order: one for entering the completion date and another for entering the reference date.
- **Number ranges**: Number ranges for maintenance items and plans.
- **Sort field**: The sort field is used for grouping multiple maintenance plans so that all plans can be scheduled in one attempt.
- **Default order type for maintenance item**: This allows you to get a default order type during maintenance plan creation.
- **Adjust order type for immediate release**: Provide the option to release the maintenance order immediately at the time of creation from the maintenance plan.

From the SAP Easy Access menu, navigate to Tools → Customizing. Double-click IMG → SPRO–Execute Project. Click the SAP Reference IMG button.

Table 5-5 lists important configuration paths related to plant.

Table 5-5. *Customizing Maintenance Plan*

Configuration Step	Configuration Path
Maintenance plan category.	Plant Maintenance and Customer Service → Maintenance Plans, Work Centers, Task Lists, and PRTs → Maintenance Plans → Set Maintenance Plan Categories
Set the completion date in the pop-up.	Plant Maintenance and Customer Service → Maintenance Plans, Work Centers, Task Lists and PRTs → Maintenance Plans → Set Maintenance Plan Categories.Mark Completion Date checkbox
Assign number ranges for maintenance plans and maintenance items.	Plant Maintenance and Customer Service → Maintenance Plans, Work Centers, Task Lists and PRTs → Maintenance Plans →1. Define Number Ranges for Maintenance Plans2. Define Number Ranges for Maintenance Items
Define the Sort field.	Plant Maintenance and Customer Service → Maintenance Plans, Work Centers, Task Lists and PRTs → Maintenance Plans → Define Sort Fields for Maintenance Plan
Assign a default order type for the maintenance item.	Plant Maintenance and Customer Service → Maintenance and Service Processing → Maintenance and Service Orders → Functions and Settings for Order Types → Define Default Order Types for Maintenance Items
Adjust the order type (Release Immediately).	Plant Maintenance and Customer Service → Maintenance and Service Processing → Maintenance and Service Orders → Functions and Settings for Order Types → Configure Order Types. In the order type definition screen, mark the Release Immediately checkbox.

5.4. Planning Regular External Service Procurement

For the routine maintenance of a technical object carried out by an external vendor, the preventive maintenance aspect of S/4HANA Asset Management provides the ability to create a service entry sheet according to the necessary frequency. These service entry sheets act as notifications to remind about the upcoming regular servicing of a technical object. After the technical object's servicing is completed, the user needs to process the service entry sheet so that the service cost is allocated to the linked maintenance order.

For example, a two-year service package has been procured from the car manufacturer for a car. According to this service contract, the car needs to be sent for servicing every three months. A maintenance plan has been setup and scheduled to generate a service entry sheet every three months throughout the two-year duration.

The following is the process flow for maintenance plan–based service procurement (also see Figure 5-17).

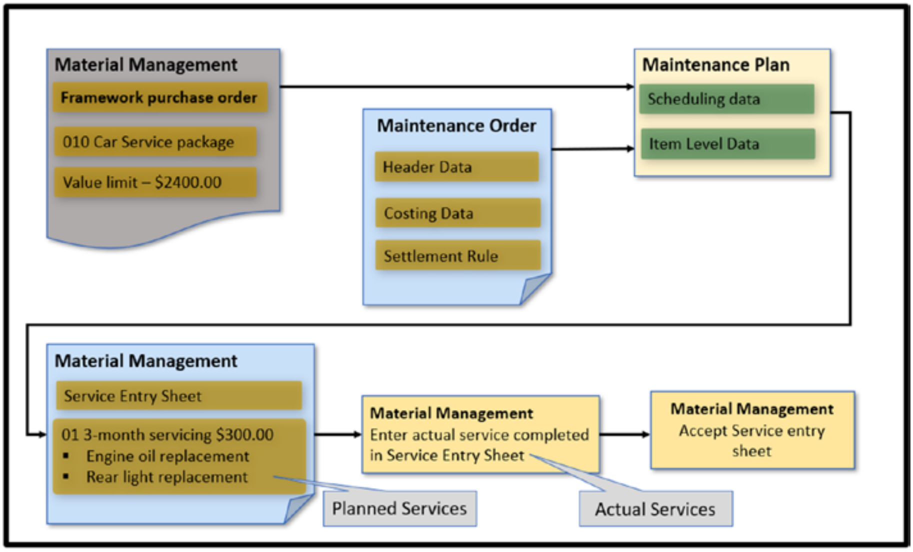


***Figure 5-17.** Process flow for maintenance plan-based service procurement*

1. **Create a framework order.** Like any other procurement process, a framework purchase order (category–FO) needs to be created for service procurement in The Materials Management application of S/4HANA. Vendor and value limits need to be maintained. Service specifications are not required.

2. **Create a maintenance order for settlement.** For absorbing the cost of regular service from external vendor, a maintenance order needs to be created which is used for cost collection and cost settlement.

3. **Create a maintenance plan.** Setting up a maintenance plan to have service entry sheets generated regularly based on the necessary frequency. The maintenance plan with category

MM is created with a reference to the framework purchase order and maintenance order for settlement (see Figure 5-18).

A G/L account must be maintained in the plan, which is used for posting the cost of services for financial accounting. In controlling, the cost is updated using the settlement order. Entering service specifications is optional for the performed service. Services from various purchasing documents (such as quotations, purchase requisitions, normal purchase orders, and contracts) can also be entered manually, or a service master record can be maintained.

Pricing is calculated using condition records maintained at various levels: service master record, vendor and service master record, or plant, as well as vendor and service master record.

4. **Scheduling the maintenance plan for service entry sheet generation.** The maintenance plan is scheduled to calculate a planned date when the service is due. When the planned date is reached, a service entry sheet is automatically created for the framework purchase order.

5. **Enter services.** Process the service entry sheet after the completion of regular service. The service entry sheet is updated for the framework order in the event of any discrepancies between the planned and actual services provided, as well as the pricing. The actual values is compared with the value limit specified in the framework order.

6. **Accept the service entry sheet.** After updating the service entry sheet, it is accepted. The cost of the service is updated in both the maintenance settlement order and the G/L account maintained in the maintenance plan.

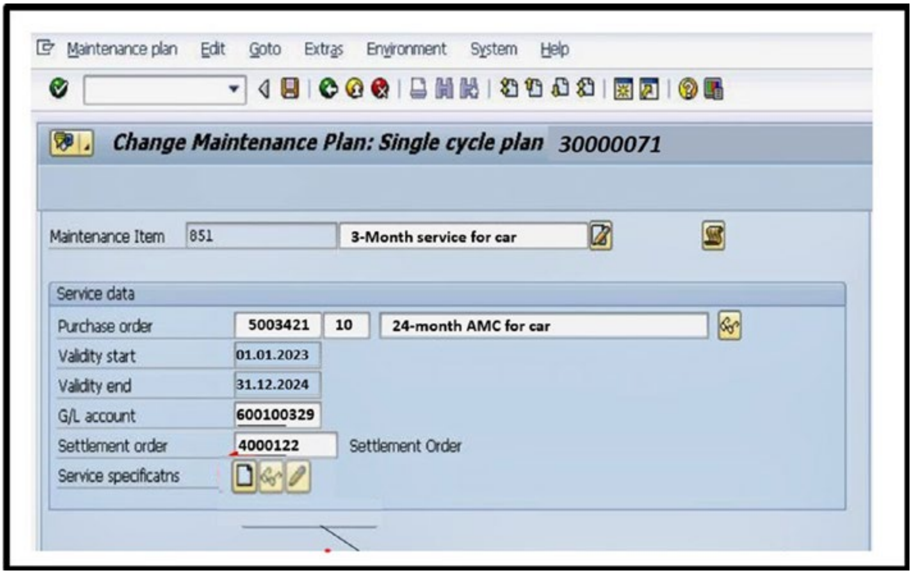


Figure 5-18. *Maintenance plan for service entry sheet generation*

5.5. Maintenance Planning with Time-Based Strategy

Maintenance planning with a time-based strategy deals with planning and generating regular call objects (notifications, maintenance orders) for a technical object consisting of multiple subassemblies and components that require maintenance at different intervals (e.g., monthly or yearly).

A time-based strategy is employed to create and schedule a maintenance plan to generate regular maintenance orders for a technical object with varying frequencies for its different components.

For example, a preventive maintenance plan for an air conditioner may encompass routine cleaning and visual inspections every three months, while tasks such as filter replacement and chemical cleaning occur every six months, with a gas top-up scheduled annually (see Figure 5-19).

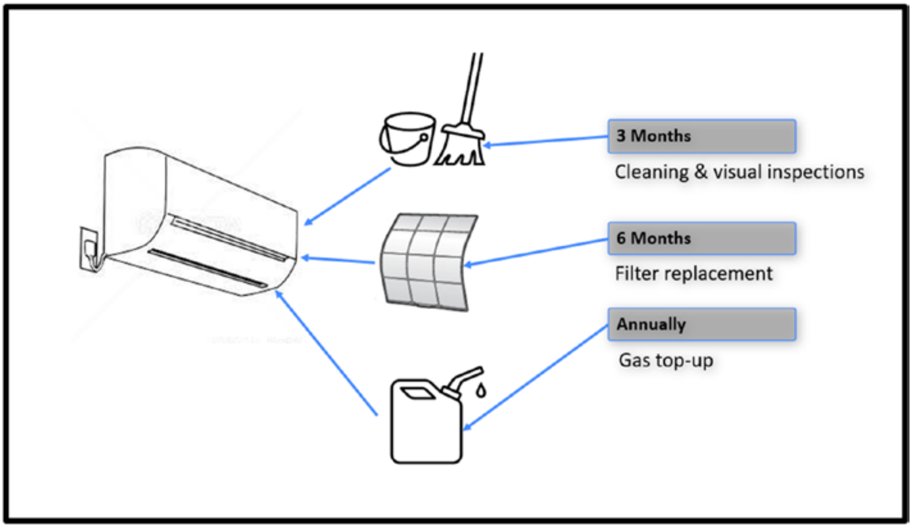


Figure 5-19. *Maintenance planning with time-based strategy*

5.5.1. Maintenance Strategy

A maintenance strategy groups multiple maintenance packages and scheduling parameters for maintenance planning. A maintenance strategy can comprise any number of maintenance packages. All the packages assigned to a maintenance strategy must share the same cycle duration unit (such as months for all packages). For instance, a maintenance strategy consisting of two packages—one with a cycle duration of one month and another with a cycle duration of one year—must be defined as one month and twelve months, respectively.

The following maintenance strategies are assigned to maintenance task lists. The important elements of a time-based maintenance strategy (see Figure 5-20).

- Scheduling indicator
- Call horizon
- Shift factor and tolerances
- Time: factory calendar
- Package sequence and where-used list

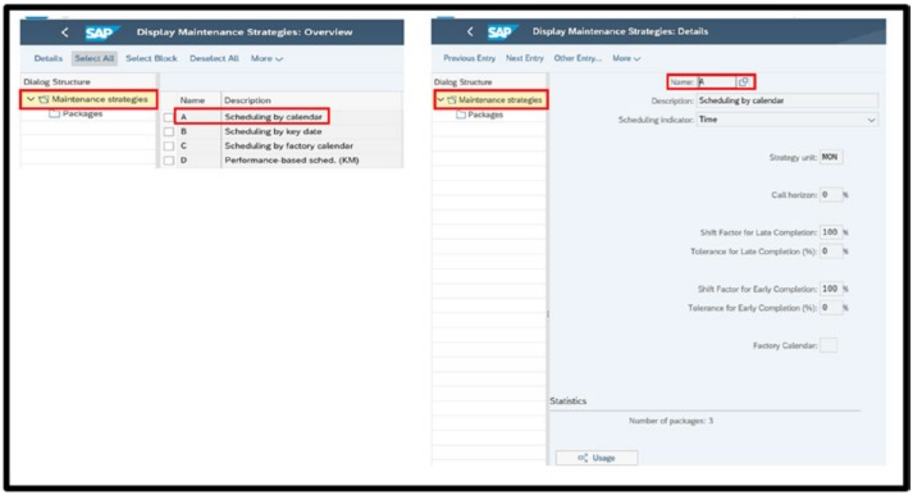


Figure 5-20. *Maintenance strategy and scheduling parameters*

Maintenance Package

Maintenance packages are elements of a maintenance strategy, and they are assigned to the operations of a maintenance task list. Each maintenance package defines a duration frequency at which the operation is to be performed. For example, consider a maintenance task list with two operations: the first operation involves cleaning and visual inspections and is assigned maintenance package-1 (every three months), while the second operation, which includes filter replacement and chemical cleaning, is assigned maintenance package-2 (every six months).

The following lists important parameters for a maintenance package.

- Maintenance package number
- Description
- Cycle length
- Unit of measurement
- Hierarchy
- Offset
- Initial and subsequent buffers

The *offset* of a maintenance package determines the timing for the initial due date of a maintenance package. You must set an offset if the first maintenance should occur at a different time than the regular cycle.

Specified in days relative to the planned date, the *initial and subsequent buffers* establish the start and end dates for a maintenance order.

The *hierarchy* of the maintenance package determines which package to call if multiple packages are due simultaneously. It is assigned to a maintenance package. Depending on the hierarchy, all packages can be called, or some packages can be ignored.

A maintenance package with a higher hierarchy level is selected when multiple packages are due simultaneously. Maintenance packages with the same hierarchy level are called together if all packages are due at the same time (see Figure 5-21).

For example, preventive maintenance for an air conditioner may involve two operations: the first operation involves cleaning the filter, while the second operation includes filter replacement. At six months, both operations are due. To ensure that filter cleaning is not performed before replacement, the second operation is assigned a higher hierarchy level compared to the first operation. As a result, the first operation is not executed when both operations are due.

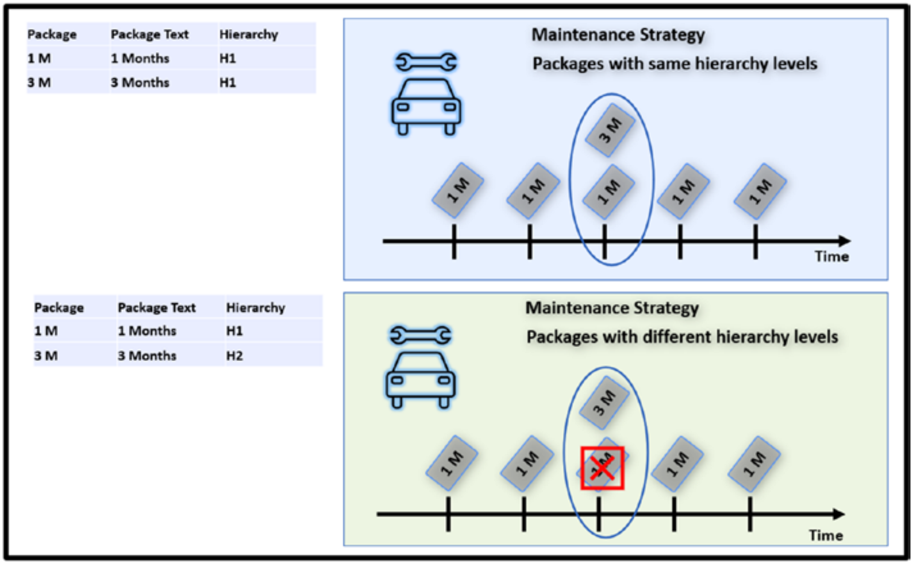


Figure 5-21. *Maintenance packages and the effect of hierarchy levels*

5.5.2. Assigning a Maintenance Strategy to a Task List

In a strategy-based maintenance plan, the user needs to assign the maintenance strategy to a task list that is used to create the strategy-based maintenance plan. The following explains the steps to assign a maintenance strategy to a task list.

During the creation of a task list, the user needs to assign a maintenance strategy to the header section of the task list.

In the next step, the packages in the maintenance strategy are assigned to each operation of the task list (see Figure 5-22). These packages define the frequency of the operations.

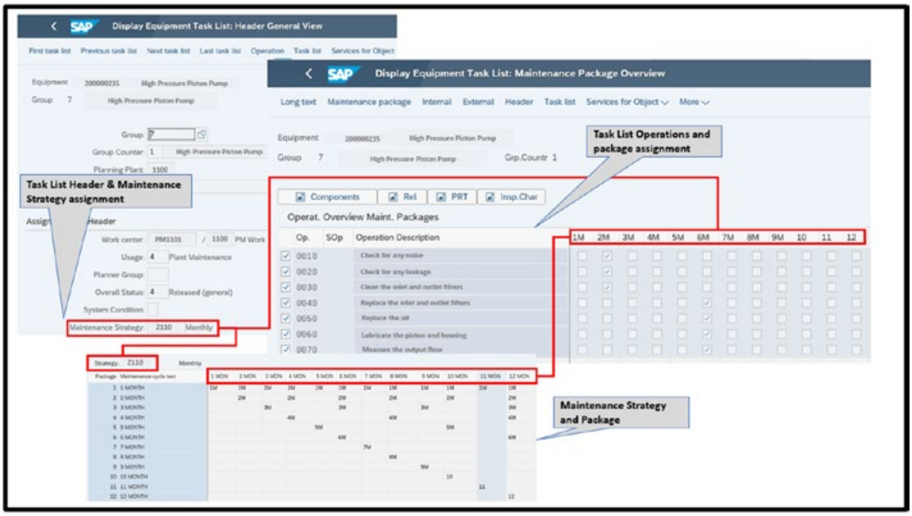


Figure 5-22. *Maintenance package assignment to operations of a task list*

5.5.3. Creating a Time-Based Strategy Plan

A time-based strategy plan follows more than one schedule to generate call objects such as maintenance orders. Maintenance orders generated for different schedules may contain varying operations and components. For example, servicing an air conditioner every three months requires inspection and cleaning, whereas servicing it every twelve months may necessitate the replacement of filters or gas refilling.

A time-based strategy plan is created with a specific maintenance strategy assigned to it. Users can input the task list group and counter directly into the respective fields, or these can be chosen using the search help functionality. In the search help input screen, the maintenance strategy of the plan gets copied automatically as a selection criterion, ensuring that only task lists with the same strategy are selected. The maintenance packages used in the assigned task list are checked and displayed in the cycles for the maintenance plan. The packages of the maintenance strategy that are not used in the task list are not displayed.

5.5.4. Scheduling a Time-Based Strategy Plan

Once a maintenance plan is created, it is activated through the scheduling features of preventive maintenance. Maintenance plan scheduling produces call objects (maintenance orders/notifications) punctually.

The scheduling options for the strategy plan is same as the one for single-cycle plan except one option. In strategy plan, the Start in Cycle scheduling option allows you to start scheduling the strategy plan from the middle of the cycle (see Figure 5-23).

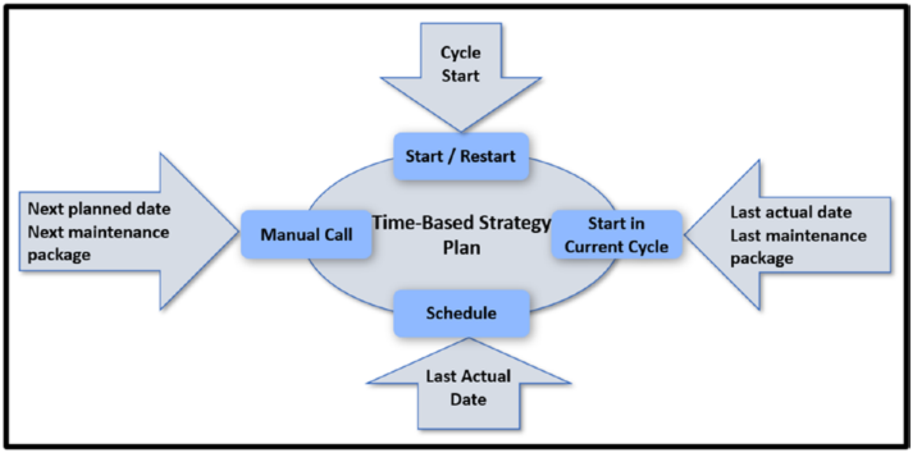


Figure 5-23. *Scheduling options in a time-based strategy plan*

For example, a maintenance strategy comprises two-month, six-month, and 24-month packages. At the time of maintenance plan creation, preventive maintenance was already in progress in the organization. Four weeks ago, the eighth two-month package was executed. The scheduling option "start in the cycle" enables the maintenance plan to begin not with the first two-month package but with the ninth two-month package due and the third six-month package.

The following describes the scheduling parameters.

- **Factory calendar**: The factory calendar from the maintenance strategy gets copied to the strategy plan as a default. The default factory calendar can be changed in the strategy plan, if required.
- **Cycle start**: Planned and call dates calculation start date.
- **Call horizon**: Call horizon is used to calculate call date, the date when maintenance order, notification or service entry sheet is created before the planned date (actual execution date of the maintenance order, notification or service entry sheet).
- **Scheduling period**: Scheduling period indicates the future time period (such as 1 year or 18 months) for which planned dates should be calculated in advance during the scheduling of a maintenance plan.
- **Completion requirement**: With the activation of the completion requirement, the subsequent order is generated only after the technical completion of the preceding order.

- **Shift factors**: The shift factor provides the option to either advance or delay the next planned maintenance date. If the last planned maintenance work has been completed earlier or with some delay compared to the actual planned date, you can use a shift factor value of 100% to move the next planned date by an equal number of days based on the early or late completion.
- **Tolerance for shift factors**: The tolerance for the shift factor function defines the time duration for which early or delayed completion of a call object compared to the planned date does not affect future plan dates.
- **Cycle modification factor**: One of the scheduling parameters for the maintenance plan is the cycle modification factor. The cycle modification factor allows you to adjust the cycle times for a maintenance strategy on a per-plan basis. If the factor is greater than 1, it extends the strategy's cycle times (see Figure 5-24), while a factor less than 1 reduces them. This factor allows you to lengthen or shorten the maintenance cycle, such as adapting to temporary extra needs while keeping the maintenance strategy unchanged. Importantly, the cycle modification factor is applicable solely to the specific maintenance plan where it has been set.

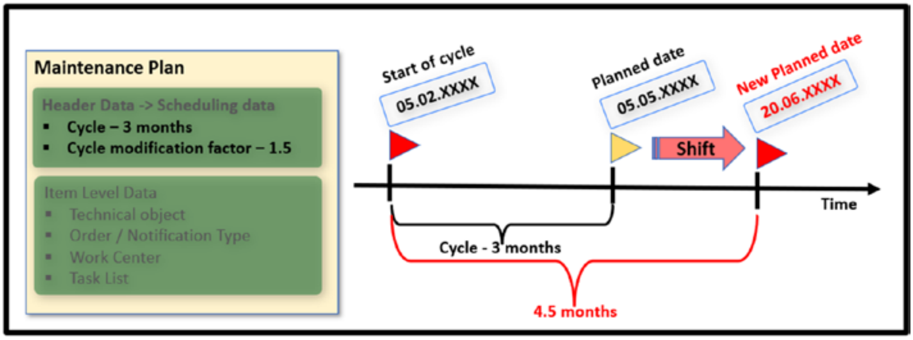


Figure 5-24. *Cycle modification factor*

- **Scheduling indicator**: The scheduling indicator defines the type of time-based scheduling assigned. The following are three types of time-based scheduling.
    - **Time (based on calendar)**: Calendar days are considered for calculation of dates.
    - **Time-Key-Date based**: From the cycle start, the dates are always calculated for the specific key date.
    - **Time (using factory calendar)**: Working days are considered for calculation of dates.

5.5.5. SAP GUI-Based (User Interface) Functions for Strategy Plans

Engineering change management functionality can be used for maintenance and service task lists. Different task list versions can be saved with various change masters. Change masters prove to be particularly advantageous when specific combinations of maintenance packages remain valid for only a limited duration. In such instances, the change master maintains a task list version with a specific validity date. When a task list associated with a change master is utilized in a maintenance plan, the validity date of the change master is cross-referenced during plan scheduling. If a maintenance package no longer holds validity (or is not yet valid) concerning a given plan date, it is deactivated for that specific plan date.

5.6. Maintenance Planning with Performance-Based Strategy

Maintenance planning with a performance-based strategy deals with the planning and generation of regular call objects (notifications, maintenance orders) for a technical object consisting of multiple subassemblies and components that require maintenance at their different running performance (such as 1000 hours, 25000 hours). For example, a preventive maintenance plan for diesel generator may encompass routine cleaning and visual inspections every 1000 hours and tasks such as filter replacement and oil replacement occur after every 25000 hours (see Figure 5-25).

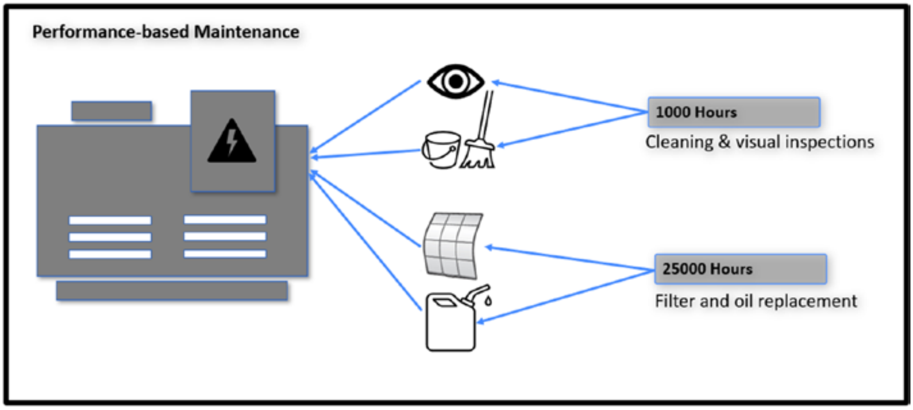


Figure 5-25. *Maintenance planning with a performance-based strategy*

Preventive maintenance can be scheduled and executed through a performance-based approach, utilizing regularly input counter readings. The calculated maintenance dates are automatically adapted according to the entered counter readings. Master data element measurement counter is required to create for the technical object (equipment, functional location master).

5.6.1. Counters and Measurement Documents

Master data counters are used to consistently record incremental values associated with the operation of a technical object. They are always established with reference to a technical object. For instance, a counter is utilized to log the total operating hours of equipment on a daily basis.

A counter is linked to a characteristic (such as operating hours, flow, or volume) from the classification system. This characteristic is always associated with the corresponding characteristic unit (e.g., hours or liters). To create a counter, you must maintain a fixed estimated annual aggregated reading value. This value serves as a reference for calculating intervals for maintenance plan dates.

The first measurement document entered for a newly added counter is known as the initial measurement document. It indicates the current counter reading at that particular moment. In the absence of an initial measurement document for the new counter, a maintenance plan that relies on this counter cannot be started. Performance-based maintenance planning relies on measurement documents. To reflect the maintenance scheduling process with maximum accuracy, input the measurement documents consistently (see Figure 5-26) and as frequently as feasible.

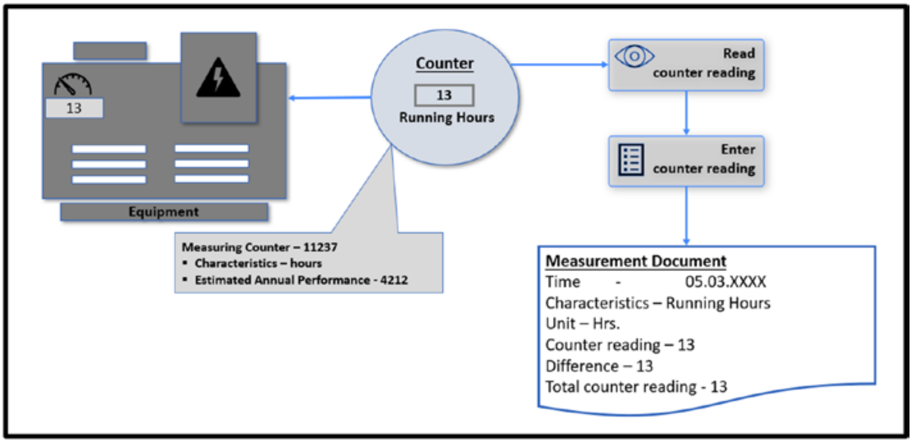


Figure 5-26. *Measuring counter and creating initial measurement document*

A performance-based maintenance strategy is created using the Performance Scheduling Indicator (activity). The performance value unit is assigned in the strategy. A maintenance strategy can comprise any number of maintenance packages. The packages are comprising of same parameters as in time-based strategy and packages such as maintenance package number, cycle length, unit of measurement and others.

5.6.2. Creating a Performance-Based Maintenance Strategy Plan

A performance-based strategy plan follows more than one schedule to generate call objects such as maintenance orders. Maintenance orders generated for different schedules may contain varying operations and components. For example, servicing a diesel generator every 1000 hours of running requires inspection and cleaning, whereas servicing it every 25000 hours of running may necessitate the replacement of filters and oil.

Performance-based strategy plans are of two types: the single-cycle plan and the strategy plan.

A measuring counter is required in the technical object for maintenance planning using a performance-based maintenance plan. Like a time-based maintenance plan, the maintenance plan category and maintenance strategy need to be assigned in a performance-based maintenance plan. Upon entering the reference object, the counter is automatically suggested, determined by the unit aligned with the maintenance strategy (e.g., hours). In the case of a performance-based single-cycle plan, the counter is automatically suggested once the maintenance cycle and reference object are provided.

Users can input the task list group and counter directly into the respective fields, or these can be chosen using the search help functionality. In the search help input screen, the maintenance strategy of the plan gets copied automatically as a selection criterion, ensuring that only task lists with the same strategy are selected. The maintenance packages used in the assigned task list are checked and displayed in the cycles for the maintenance plan (see Figure 5-27). The packages of the maintenance strategy that are not used in the task list are not displayed.

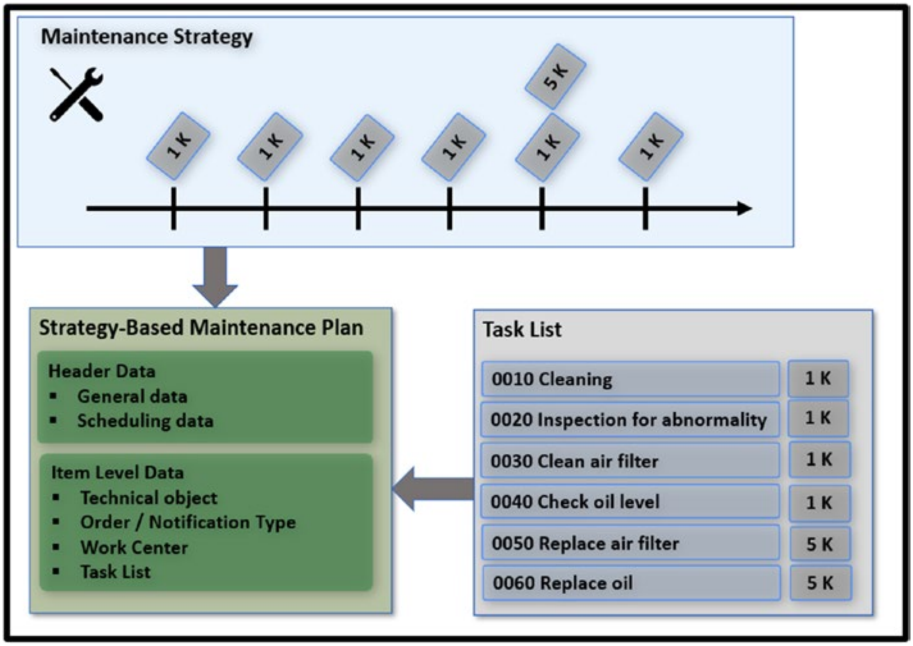


Figure 5-27. *Creating a performance-based maintenance strategy plan*

5.6.3. Scheduling a Performance-Based Maintenance Strategy Plan

The scheduling options for the performance-based strategy plan are the same as the ones for the single-cycle plan except for one option. In the performance-based strategy plan, the Start in Cycle scheduling option allows you to start scheduling the strategy plan from the middle of the cycle (see Figure 5-28).

Entering a counter reading greater than the one in the latest measurement document is not permissible, as maintenance planning relies on the current data recorded in the system through measurement documents.

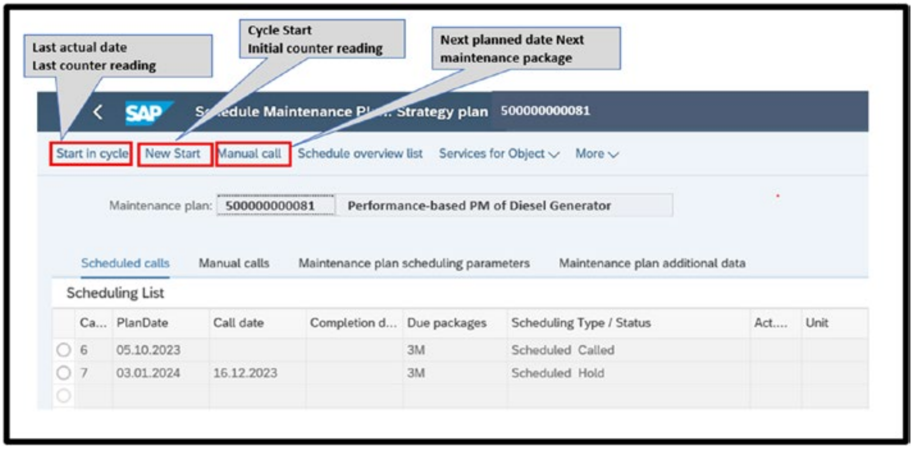


Figure 5-28. *Scheduling options in a performance-based strategy plan*

The following describes the scheduling parameters.

- Call horizon
- Scheduling period
- Initial counter reading
- Completion requirement
- Shift factors
- Tolerance for shift factors
- Cycle modification factor

Basic Scheduling Functions

Performance-based maintenance plans are scheduled according to the projected yearly performance input in the reference technical object counter (see Figure 5-29). Based on the projected annual performance, the daily performance is calculated. Using the calculated daily performance and maintenance cycle, the time period is calculated and then added to the maintenance plan's start date to obtain the estimated plan date based on the current daily performance.

For example, as shown in Table 5-6, by adding the cycle value to the current counter reading, beginning from the cycle start, the first planned date is set after 50 days.

Table 5-6. *Counter Reading and Cycle Value*

Projected annual performance	7300 hours
Daily performance based on annual performance	7300 hours/365 days = 20 hours per day
Planned date for a cycle of 1000 hours	1000/20 = 50 days

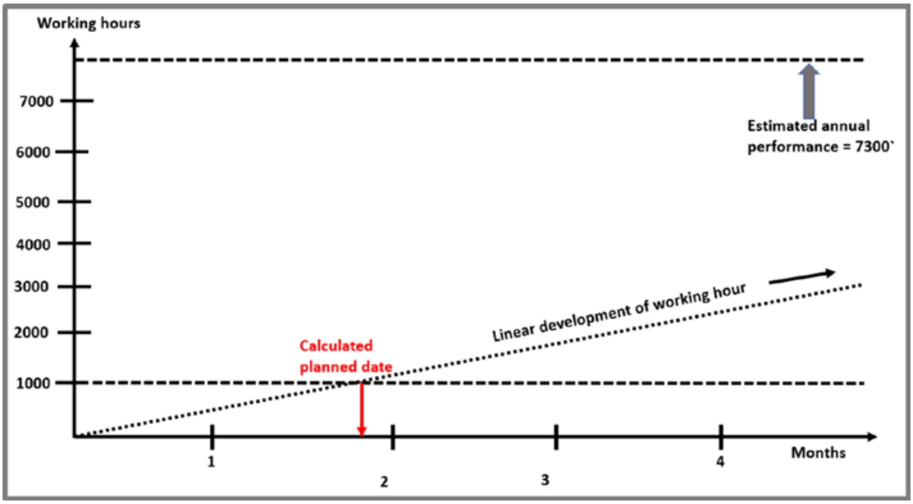


Figure 5-29. *Projected planned date based on estimated annual performance*

A plan date is calculated depending on the cycle and projected annual performance. If a measurement document is created, it leads to the recalculation of the planned date. In simpler terms, the planned dates are influenced directly by the entered measurement documents (see Figure 5-30). This implies that the regular input of measurement documents is necessary to achieve a planned date that accurately mirrors the performance value.

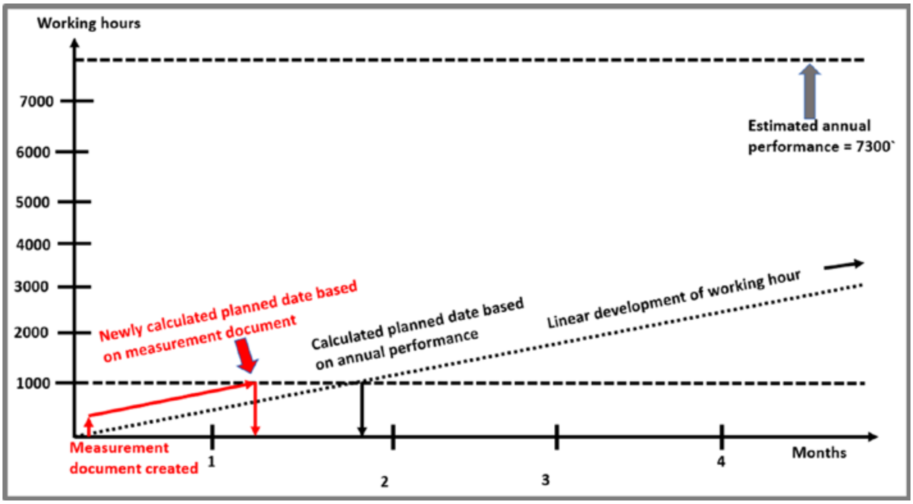


Figure 5-30. *Planned date adjustment based on regular entry of counter reading*

Call Horizon

A call horizon calculates call date, the date when maintenance order, notification or service entry sheet is created before the planned date (actual execution date of the maintenance order, notification or service entry sheet). It is specified in percentage and refers to the duration of the maintenance cycle.

Let's look at the following data as an example.

- The estimated annual performance of a diesel generator is 7300 hours.
- The daily performance based on annual performance is 20 hours (7300 hours/365 days = 20 hours).
- The preventive maintenance is 1000 hours of running.
- The planned date for a cycle of 1000 hours is 50 days (1000/20 = 50)
- The maintenance plan's cycle starts at a counter reading of 0 hours on 05.03.XXXX.
- The project's planned date for maintenance is 24.04.XXXX
- The call horizon entered is 90%
- The call date for creating the call object (maintenance order) is 19.04.XXXX (90% of 50 days = 45 days; therefore, 50 – 45 days = 5 days before the plan date).

For illustrative purposes, let's assume that regularly created measurement documents contain an average of 20 hours per day. When running hours vary daily, the planned date and the call date are recalculated accordingly.

If the call horizon is left unspecified during the scheduling of the maintenance plan, the system takes it to be 0%. Consequently, a call is initiated right away (meaning an order is generated) as soon as the maintenance plan kicks off, regardless of the counter reading. If you intend to maintain the cycle duration, it's recommended to establish a call horizon of 100%.

5.7. Maintenance Planning with Cycles of Different Dimensions

A multiple counter maintenance plan consists of functionalities to plan and schedule regular maintenance for a technical object that needs to be maintained based on cycles of different dimensions, such as total running hours and output generated in liters (see Figure 5-31). For example, in a filtration plant, the water pump's regular maintenance is scheduled for every 2160 hours of running or 500,000 liters of suction.

To plan and schedule regular maintenance for water pumps in a clarification plant, a multiple counter plan can be used, where maintenance orders is generated based on cycles of different dimensions, such as after 2160 hours of running or 500,000 liters of suction.

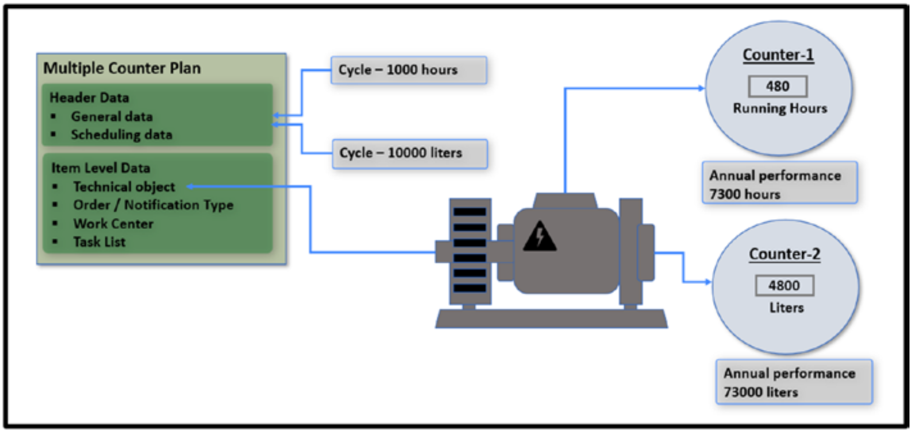


Figure 5-31. *Multiple counter plans*

5.7.1. Creating and Scheduling a Multiple Counter Plan

In a multiple counter plan, cycles are used to maintain the required performance value. The maintenance strategy is not employed in this plan. Cycles can be assigned freely to a multiple counter plan. If a strategy is assigned to the entered task list in a multiple counter plan, the strategy holds no relevance during the operation selection from the task list.

The starting of the multiple counter plan relies on the present counter readings, with the date of the measurement document containing the latest counter value being the determining factor. The scheduling is consistently adjusted according to the current counter readings.

Restarting a multiple counter plan is possible. The "Start in current cycle" function is appliable only in multiple counter plans featuring sequences of cycle sets. The manual call option does not applies to the multiple counter plan (see Figure 5-32).

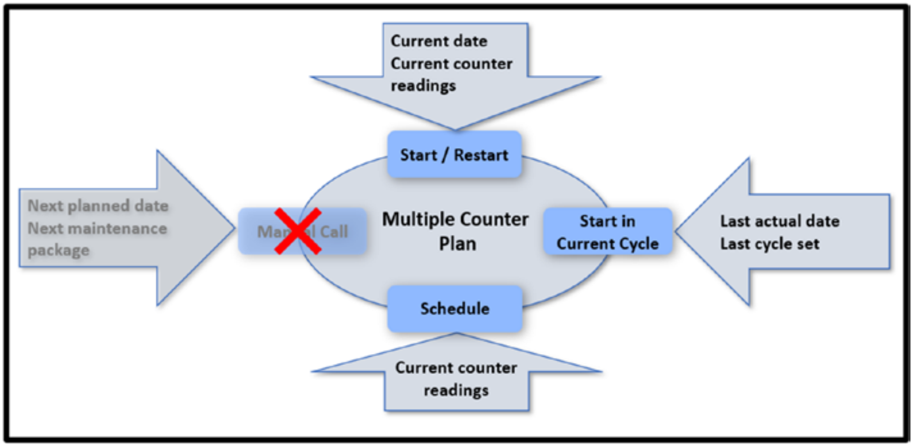


Figure 5-32. *Scheduling function in multiple counter plan*

The following describes the scheduling parameters of a multiple counter plan.

- **Cycle modification factors**: The cycle modification factor allows you to adjust the cycle times for a maintenance plan. If the cycle modification factor is greater than 1, it extends the cycle times. If it's less than 1, it reduces them. This factor enables you to either lengthen or shorten the maintenance cycle.
- **Preliminary buffer**: In a multiple counter plan, you can input a preliminary buffer in terms of the number of days. This buffer indicates the lead time before the planned maintenance date when the order should be generated.
- **Operation type**: Operation type defines the link type for maintenance cycles. Choosing an AND link results in the order being generated only when all cycles reach the required performance value. On the other hand, with an OR link, the order is generated as soon as any of the cycles reach the required performance value.
- **Start date and time**: Through deadline monitoring, a maintenance plan started based on the designated start date and time.
- **Scheduling period**: The scheduling period indicates the future time period (such as 1 year or 18 months) for which planned dates should be calculated in advance during the scheduling of a maintenance plan.
- **Completion requirement**: By activating the completion requirement, the subsequent order is generated only after the technical completion of the preceding order.

- **Shift factors**: The shift factor offers the choice to either advance or postpone the next planned maintenance date. If the last scheduled maintenance task has been carried out before or after the actual planned date, you can employ a shift factor value of 100% to adjust the next planned date by the same number of days, contingent on the early or delayed completion.
- **Tolerance for shift factors**: The shift factor tolerance function establishes the time duration during which the early or delayed completion of a call object compared to the planned date does not impact the future planned dates.

The multiple counter plan is triggered based on the current counter reading. The initial projected plan date is determined using the reading from the relevant measurement document (see Figure 5-33). In the case of an AND link type, the projected plan date is calculated based on the largest interval originating from the cycle and performance per day.

In a multiple counter plan, to achieve precise scheduling in accordance with the cycle sets, the following list of process flow steps should be followed.

1. Create the maintenance order.
2. Complete the maintenance order.
3. Record the measurement document upon order completion or consistently enter measurement documents at regular intervals.
4. Reschedule the multiple counter plan.

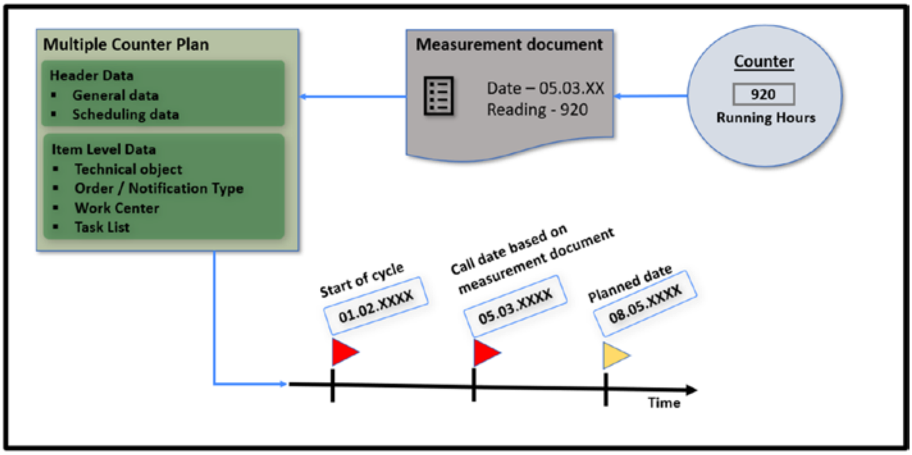


Figure 5-33. *Posting measurement document*

Unlike the performance-based strategic plan, the scheduling of the multiple counter plan doesn't involve high numbers of cycle counts for establishing the new planned date. Instead, scheduling is consistently computed based on the current counter readings.

The actual call date is ascertained from the entered measurement documents, which increase in the counter reading. If the maintenance cycle becomes due as a result of these measurement documents, the call is promptly initiated. When the cycle isn't due as per the measurement document, the call is initiated on the calculated planned date.

5.7.2. Using Cycle Set Sequence

The cycle set is used as a template to generate a multi-counter plan. Cycle set comprises of successive maintenance cycles (see Figure 5-34). Unlike the maintenance strategy, the cycle set lacks a reference function. Consequently, once the maintenance plan is created, there is no longer a connection with the cycle set. When the cycle set becomes part of the maintenance plan, changes or removals can be made to individual cycles.

Also, multiple cycle sets can be used in a multi-counter plan. Each cycle set is then allocated a sequence number (cycle set sequence), which aids in associating the cycle set with a maintenance item. This allows the inclusion of various maintenance items with distinct cycles. It's important to note that only one time-based cycle can be utilized within a multi-counter plan.

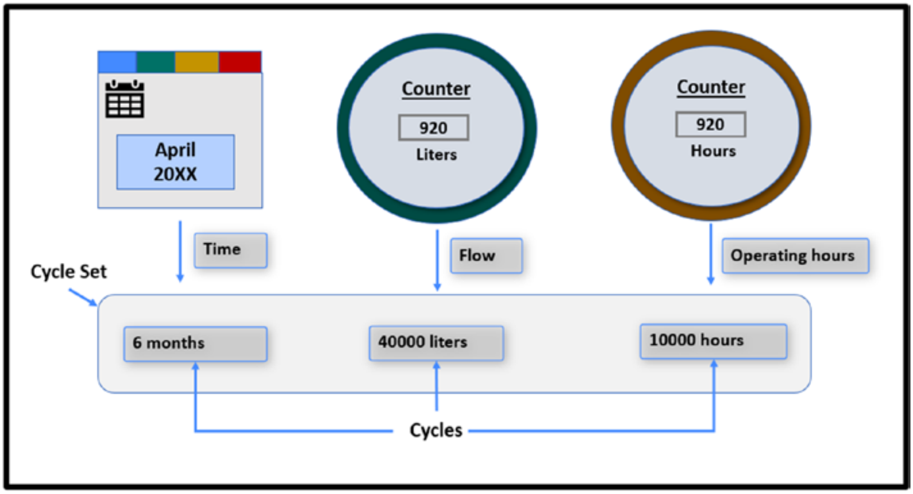


Figure 5-34. *Cycle sets and cycles*

For example, a diesel generator set is scheduled for regular maintenance after 1800 hours of running and/or three months. Regular maintenance includes tasks such as cleaning and visual inspection. After another 1800 hours of running and/or three months, a detailed maintenance will be carried out. The detailed maintenance includes tasks such as replacing the air filter and oil.

In a multiple counter plan, using two cycle sets with two cycles in each cycle set, you can plan regular maintenance for the diesel generator in the example. Each of the cycle sets needs to be assigned to an item in the plan, one for regular maintenance and the other for detailed maintenance.

Common multiple counter plans typically operate with individual cycles connected by an operation type (OR or AND). These cycles usually involve the same maintenance item, which means the set of operations is always the same. However, multiple counter plans are not designed to accommodate different maintenance strategies. Thus, unlike the functionality of maintenance packages within a maintenance strategy, they cannot execute a different set of operations.

To address this constraint, *cycle set sequences* were developed. These sequences combine multiple cycles into a set that can be allocated to a maintenance item. The concept revolves around integrating multiple cycle set sequences within a single multiple counter plan, enabling a scheduling pattern akin to 1–2–1–2. By assigning specific maintenance items to either "1" or "2," it becomes possible to generate varying tasks.

The following describes the scheduling process.

1. When calculating the first plan date, scheduling takes into account cycle set 1 and generates a maintenance order (call object) only for this date, corresponding to the maintenance item linked with cycle set 1.

2. Using this date as a reference, scheduling evaluates the cycles within cycle set 2 to calculate the subsequent plan date. Once again, it generates a call object only for the pertinent maintenance item.

3. The scheduling process revisits the first cycle set after scheduling the second and, consequently, the highest cycle set.

5.8. User Interface

S/4HANA Asset Management comes with several Fiori apps to help user perform preventive maintenance planning and execution. The following are important Fiori apps.

- Fiori Apps–Process Task List (Planner), Fiori App ID–W0021: Three apps are available for Create Task List, Change Task List, and Display Task List.
- Fiori Apps–Find Maintenance Task List, Fiori App ID–F2660: This app lets you find and display the Equipment task list, Functional location task list, and General maintenance task list.
- Fiori Apps–Manage Maintenance Items, Fiori App ID–F5356: This app helps a maintenance planner manage maintenance items, including create maintenance items, assign maintenance item to a maintenance plan, view details of a maintenance item.
- Fiori Apps–Find Maintenance Items, Fiori App ID–F3621: This app lets you find and display maintenance items.
- Fiori Apps–Find Maintenance Plans, Fiori App ID–F3622: This app lets you find and view maintenance plans, its assigned maintenance items, its properties, and its scheduled and manual maintenance calls.
- Fiori Apps–Manage Maintenance Plans, Fiori App ID–F5325: With this app, you can manage maintenance plans.

- Fiori Apps–Mass Schedule Maintenance Plans, Fiori App ID–F2774: As a maintenance planner, you can use this app to schedule all maintenance plans due within a specific time frame.

5.9. Summary

This chapter explored various aspects of maintenance planning and execution.

Master data includes maintenance task lists and their applications, user interfaces, and essential customizations. The single-cycle maintenance plan, creation, and scheduling of single-cycle maintenance plans, along with insights into customizing these plans to suit specific needs. The planning of regular external service procurement focuses on generating a service entry sheet through a maintenance plan, streamlining the process of external service procurement.

Maintenance planning with a time-based strategy explains the concept of a maintenance strategy and guides crafting and scheduling time-based strategy plans. Furthermore, maintenance planning with a performance-based strategy and the creation and scheduling of performance-based maintenance strategy plans were outlined, offering insights into optimizing maintenance activities.

The chapter delved into maintenance planning with cycles of different dimensions, detailing the intricacies of developing and scheduling multiple counter plans accommodating various maintenance cycle dimensions. Finally, the user interface was explored, highlighting SAP Fiori apps designed for working with task lists and maintenance plans.