Integration of Manufacturing Execution Systems

The Integration of Manufacturing Execution Systems (IMES) ES bundle offers a way to synchronize manufacturing-related master data and transactional data between SAP ERP 6.0 and shop floor systems. This gives the enterprise a real-time view of production processes occurring at manufacturing locations that may be spread across the globe.

Leveraging the ANSI/ISA-95 standards model, the Integration of Manufacturing Execution Systems (IMES) ES bundle provides all required enterprise services to integrate and synchronize manufacturing-relevant data in real time between SAP ERP and shop floor systems as well as the ability to monitor and record information and manage any exceptions at the enterprise level.

By implementing this ES bundle, an organization gains the ability to monitor and control exceptions at the enterprise level. It increases visibility at both the line and shift level. For every factory shift, an enterprise can monitor:

- Material availability and consumption
- Capacity availability and utilization
- Schedule changes
- Product genealogy and quality management

On each production line the enterprise can monitor:

- Cycle times and operating efficiencies
- Machine breakdowns and unplanned downtime
- Quality index
- Future maintenance requirements

These capabilities lead to more accurate order entry, reduced man hours, better delivery performance, increased project engineering productivity, and reduced maintenance costs. It also allows a factory to dynamically respond to unpredictable changes or exceptions on the fly. This is known as adaptive manufacturing.

IMES shares several enterprise services with the Manufacturing Work Instructions (ES) bundle. But these same services achieve an entirely different outcome when deployed in this bundle. This is a powerful example of how enterprise services are both flexible and reusable.

Audience

Any industry doing production planning and quality management in an existing SAP environment with manufacturing execution systems on the plant floor will find this ES bundle useful. IMES enables manufacturers to synchronize manufacturing-related master data and transactional data in near real-time. This ES bundle also standardizes most integration touch points based on the ISA-95 enterprise-control model. This ES bundle is equally useful for discrete, process, and repetitive manufacturing industries.

For details on Service Operations, Business Objects and Process Components, please check the ES Workplace.

How To Use This ES Bundle

Global competition is placing tremendous pressure on cost, quality, and responsiveness in manufacturing industries. As a result, manufacturing nodes are being pushed out to distant locations. This leads to a loss of visibility and control. And as a result, the business and financial impact of production exceptions cannot be monitored or controlled at the enterprise level. Plants are using copies of master data, creating compliance and quality issues. Production personnel lack the decision-support information to meet their targets and act as informed knowledge workers.

A single manufacturing plant typically has between 10 and 50 shop floor automation systems at work. For a global business operating multiple sites, this could translate into anywhere from 40 to 700 different plant information systems working at the same time. The majority of these systems were designed to run a plant, and connectivity to any other system or application was an afterthought.

Until the last five to seven years, few manufacturers even mentioned that they needed the automation layer, the manufacturing execution system
MES layer, and the ERP layer to be able to talk to each other. Some organizations have cobbled together a distributed manufacturing network based on point-to-point integrations. These costly workarounds feature brittle interfaces. The resulting system is complex, inflexible, and ultimately a roadblock to improved performance.

IMES offers a solution to integrate shop floor systems with SAP ERP 6.0 and enables the manufacturer to synchronize manufacturing-relevant data in near real time. This ensures that one single version of the truth exists across all manufacturing systems. It also enables the enterprise to adapt to new business processes on demand and without investing in a full-scale IT integration project. This ES bundle supplies the ability to add or replace components and processes as they change - a software version of plug-and-play components. The IMES ES bundle can usually be implemented in between 90 and 120 days.

Much of the work of IMES takes place in the backend and is invisible to the end user. This ES bundle offers standardized integration touch points to synchronize manufacturing-relevant master and transactional data between SAP ERP 6.0 and shop floor systems.

Since this ES bundle provides all required services leveraging the ANSI/ISA-95 standard model, it contains all the enterprise services required to connect ERP with any shop floor system. Customers who wish to improve or extend their shop floor user interfaces may want to consider implementing the Manufacturing Work Instructions ES bundle as well.

In the past, the enterprise services in this ES bundle have performed production confirmations with backflush. As of Enhancement Package 4, a new parameter is added to the Create Repetitive Manufacturing Confirmation enterprise service operation to perform confirmations without backflush when desired.

This section explores specific use cases that show how the IMES enterprise services might be used by an organization to synchronize disparate plant floor operations. There is no one right way to deploy this bundle of enterprise services. The goal is to give you a greater understanding of the inner-workings of the business objects and enterprise services underlying the bundle so that you can implement them in the way that fits your particular environment. Note that these examples may refer to users directly invoking enterprise services. This technique illustrates the process flow of the service operations; in fact, service operations are invoked by an application, by an application's user interface, or by another service operation. This wiki is also a space for you to share knowledge and collaborate with others who are implementing the IMES bundle.

**Use Case 1: Production Planner / Supervisor**

For the Production Planner or Supervisor, the manufacturing process begins with the receipt of a production order defining what is to be produced, at which location, and how much capacity is required. The *Production Order* business object is employed by the service operations that are used to gather and deliver this data. The *Find Production Order by Elements* service operation can be used to pull a list of production orders for a specific work center, material, date range or any combination of the three.

The *Read Production Order* service operation includes all the specific details about the order, such as:

- What is to be produced
- When production is to take place
- How much capacity is required to process the order
- How much production will cost

The contents of the production orders that come from the *Read Production Order* service operation are translated into an ISA-95 Production Schedule Message that is consumed by an application such as SAP MII and sent to a shop floor system.

The following table summarizes these steps and the associated enterprise services:

<table>
<thead>
<tr>
<th>Step</th>
<th>Enterprise Service Invoked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1: A production planner/supervisor looks for new production orders by work center, material, date range, or any combination of these</td>
<td>Find Production Order by Elements</td>
</tr>
<tr>
<td>Step 2: A list of production orders matching the search criteria is propagated and the user selects one, which displays the relevant information</td>
<td>Read Production Order</td>
</tr>
<tr>
<td>Step 3: The contents of the production order are translated into an ISA-95 Production Schedule Message and sent to a shop floor system</td>
<td>(No enterprise service is invoked during this step)</td>
</tr>
</tbody>
</table>

**Batch**

The likely starting point for a batch production environment might be the batch feature, which uses the *Identified Stock* business object. A batch is the quantity or partial quantity of a certain material or product that has been produced according to the same recipe, and represents one homogeneous, non-reproducible unit with unique specifications.

The *Identified Stock* (or batch) business object carries all of the data about the technical, physical, and/or chemical properties of a certain material or product that has been made according to a recipe. The paints used on cars, for example, are classified by color value, viscosity, and expiration date (among other characteristics). Each of these characteristics may have its own batch number, and every mix of these different batches can be assigned a separate batch number.

This opens the door to many different service operations.
The service operation might be used to identify every batch that has a color value of 3.2.

The Read Batch service operation can then be used to pull out the rest of the data about that batch, such as the viscosity and expiration date.

If it turns out that the plant does not have a batch with the just the right mix of elements, the Create Batch service operation would be used to define a new batch that includes paint with the color value of 3.2 along with the correct viscosity and a new expiration date.

Since a new batch is being created almost from scratch, it can now be made at one of the many manufacturing plants available. In that case, the planner could choose to move the production via the Change Batch Plant Assignment service operation or simply assign it to a new location through Create Batch Plant Assignment.

The following table summarizes these steps and the associated enterprise services:

<table>
<thead>
<tr>
<th>Step</th>
<th>Enterprise Service Invoked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1: The planner/supervisor needs to select a batch by specific characteristics for the production order or to create a batch to match the required characteristics</td>
<td>(No enterprise service is invoked at this point)</td>
</tr>
<tr>
<td>Step 2: The user will perform a search based on specific characteristics</td>
<td>Find Batch by Elements</td>
</tr>
<tr>
<td>Step 3: The search propagates a list of batches. The user can select one in order to see specific information.</td>
<td>Read Batch</td>
</tr>
<tr>
<td>Step 4: If a batch with the correct characteristics cannot be found, the user can select the create option to define a new batch to the correct specifications of the production order</td>
<td>Create Batch</td>
</tr>
<tr>
<td>Step 5: If a new batch is being created, it can be made at one of a number of plants. The user may move production to one of these plants.</td>
<td>Change Batch Plant Assignment</td>
</tr>
<tr>
<td>Step 6: The user can select from a list of possible sites to assign the new location</td>
<td>Create Batch Plant Assignment</td>
</tr>
</tbody>
</table>

**Bill of Operations**

The Production Bill of Operations business object specifies the sequences (routing) and work steps to be followed during production.

This business object finds and details the specific process steps that need to be carried out by a machine operator to produce a material. It includes the order in which the operations should be carried out as well as the required resources and tools that may be necessary, such as the positioning of jigs and fixtures. The materials and work centers to be used, as well as any quality checks that are to be carried out during the production process, are also defined in this operation.

In some cases, a plant floor or machine operator may request a change in the production bill of operations. This change could be achieved through the Find Production Bill of Operations Simple by Identifying Elements and Material service operation. The required information can be obtained by querying based on the production bill of operations key and material. The information is then automatically added into the production order.

Additionally, the Find Production Bill of Operations Simple by Identifying Elements and Material service operation might be used to gather data about the planned costs for completing the order. This service operation can then be used to generate purchase requisition orders for nonstock items as well as any items that will be processed externally.

The following table summarizes these steps and the associated enterprise services:

<table>
<thead>
<tr>
<th>Step</th>
<th>Enterprise service Invoked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1: The sequence (routing) and work steps to be followed during production by a machine operator must be added to the production order</td>
<td>(No enterprise service is invoked during this step)</td>
</tr>
<tr>
<td>Step 2: The planner/supervisor must find a production bill of operations to support the production order</td>
<td>Find Production Bill of Operations Simple by Identifying Elements and Material</td>
</tr>
</tbody>
</table>

**Production Bill of Material**

The production order also incorporates the Production Bill of Material business object. The bill of material is a list of all the parts required to produce a product, and is the result of testing carried out by the design department to ensure that the product can be manufactured.

This business object uses service operations to find and transfer specific items from the bill of material list into the production order. Reservations for bill of materials items held in stock are also generated if necessary.

The production planner could use the Production Bill of Material business object in many different ways. Fundamentally, it helps the planner determine where to gather the correct batches of material from (via the Find
Production Bill of Material Variant Basic Data by Material and Plant service operation) as well as to plan the provision of materials and to calculate the cost of materials required to make a specific product (via the Find Variant Item by Variant Identifying Elements service operation). The Bill Of Materials is also used in operation planning to assign the sequence of operations and items required for production. For example, the car paint may need to be mixed and heated before another pigment is added, mixed again, and so on. Production control can also use this service to calculate cost-effective order quantities based on previous production runs.

This graphic shows the components of a bicycle as they would appear in a Bill Of Material (click to enlarge)

The Bill of Material content from the Find Variant Item by Variant Identifying Elements service operation is translated into an ISA-95 Product Definition Message and sent to the shop floor system.

<table>
<thead>
<tr>
<th>Step</th>
<th>Enterprise Service Invoked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1: The planner/supervisor must add the parts required to fulfill the production order</td>
<td>(No enterprise service is invoked during this step)</td>
</tr>
<tr>
<td>Step 2: The user will need to find specific items from a bill of materials list</td>
<td>Find Production Bill of Material Variant Basic Data by Material and Plant</td>
</tr>
<tr>
<td>Step 3: This will propagate a list from which the user can move selected items to the production order</td>
<td>(No enterprise service is invoked during this step)</td>
</tr>
<tr>
<td>Step 4: The user will also need to plan the provisioning of materials and calculate the related cost of materials</td>
<td>Find Variant Item by Variant Identifying Elements</td>
</tr>
<tr>
<td>Step 5: The content derived from the above step is then translated into an ISA-95 Product Definition Message and sent to the shop floor system</td>
<td>(No enterprise service is invoked during this step)</td>
</tr>
</tbody>
</table>

Work Centre

Operations are carried out at a work center, which is a physical location on the shop floor. In the SAP lexicon, the Work Centre business object can represent any of the following physical work centers:

- Machines, machine groups
- Production lines
- Assembly work centers
- Employees, groups of employees

Together with Production Bill of Material and routings, work centers are among the most important blocks of master data in the production planning and control system. Work center data is used for:

- Scheduling: Operating times and formulas are entered in the work center so that the duration of an operation can be calculated.
- Costing: Formulas are entered in the work center so that the costs of an operation can be calculated. A work center is also assigned to a cost center.
- Capacity planning: The available capacity and formulas for calculating capacity requirements are entered in the work center.
- Simplifying operation maintenance: Various default values for operations can be entered in the work center.

The Work Centre business object is also of great help to the production planner. Perhaps the planner needs a mixing machine to complete the car paint order. The Find Work Centre by Plant service operation enables the planner to access a list of available work centers on a manufacturing line or shop floor by plant. Now imagine that the planner finds only one mixing machine in operation at the plant with the correct set of materials for the batch, but many other orders need to use the same machine. The Read Work Centre service operation gives the planner the following information:

- Scheduling: Duration of an operation
- Costing: Cost of an operation
- Capacity: Total and available capacity

The planner now has an idea about when the car paint order can be completed and how much it will cost.

The data content from the Read Work Centre service operation is translated into an ISA-95 Equipment Message and sent to a shop floor system.

The following table summarizes these steps and the associated enterprise services:
Step 1: The planner/supervisor will need to assign some processes to specific locations on the shop floor (i.e. machine, production line, employees, and etc.)

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>Step 1: The planner/supervisor will need to assign some processes to specific locations on the shop floor (i.e. machine, production line, employees, and etc.)</td>
<td>(No enterprise service is invoked during this step)</td>
</tr>
</tbody>
</table>

Step 2: The user will search for a list of available work centers by plant

<table>
<thead>
<tr>
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<th>Enterprise Service Invoked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 2: The user will search for a list of available work centers by plant</td>
<td>Find Work Centre by Plant</td>
</tr>
</tbody>
</table>

Step 3: A list will be propagated from which the user can select a work center and see its details

<table>
<thead>
<tr>
<th>Step</th>
<th>Enterprise Service Invoked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 3: A list will be propagated from which the user can select a work center and see its details</td>
<td>Read Work Centre</td>
</tr>
</tbody>
</table>

Step 4: The planner can select the proper work center. The work center data is translated into an ISA-95 Equipment Message and sent to the shop floor system

<table>
<thead>
<tr>
<th>Step</th>
<th>Enterprise Service Invoked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 4: The planner can select the proper work center. The work center data is translated into an ISA-95 Equipment Message and sent to the shop floor system</td>
<td>(No enterprise service is invoked during this step)</td>
</tr>
</tbody>
</table>

The IMES bundle ensures that all of this data is in sync with the ERP system. The production planner may be located in one country even though the production operations are taking place in a different country.

Having produced the necessary pieces of data for completing an order, the production planner can deliver it to the shop floor in any number of ways. Adobe Interactive Forms might be used or, through SAP MII interfaces, instructions can be delivered to existing shop floor automation systems. The order instructions may also be printed out if necessary.

**Use Case 2: Line Operator**

The Production Bill of Operations and its related enterprise services are made available to a line operator on the plant floor. The process steps to the line operator will be available from the production order. This can be delivered to the line operator's work center using existing ANSI/ISA-95 standard interfaces in use at most manufacturing operations today. The machine operator now has instructions on mixing, freezing, and packaging the material, for example.

The machine operator signals that he has started the mixing operation and when it is complete. The amount of material used to finish the operation is also noted. The Production Confirmation business object, and its related service operation Create Production Confirmation, is utilized here. Along with confirming the execution of a production process, it carries data about the quantities of produced goods (yield and/or scrap), the time consumed, and the performed work quantities during the execution of a production order.

Create Production Confirmation records all of the following:

- Inventory changes
- Plan adjustments
- Resource utilizations
- Service product consumptions
- Work in-process quantity changes
- Progress status changes

All of this information is captured in the plant floor system, which sends the data to SAP MII in ISA-95 Production Confirmation message format. Once SAP MII receives this message, it will call the relevant service operation within the Production Confirmation business object and post the data to the ERP system.

This can be achieved in different ways. The data can be updated in real time or as a batch operation. It can be sent first to an ERP system at the plant and then synchronized with the primary ERP system in a distant location, or it can be sent directly from the plant floor to the distant backend system. The IMES bundle allows you to choose the best method based on the existing setup at the manufacturing plant.

Production Confirmation then updates the Inventory, Financial Accounting, and Supply Chain Control systems in the backend system. Inventory updates will be handled by the Create Production Confirmation service operation and will happen in the background. This service can be used by a Quality Manager, as well as to trigger goods movement postings for consumed goods (from stock to production) as well as for produced goods (from production to stock). This procedure is automated in the backend by the service operation.

The following table summarizes these steps and the associated enterprise services:

<table>
<thead>
<tr>
<th>Step</th>
<th>Enterprise Service Invoked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1: As part of a line operator's normal workflow, s/he accesses a production bill of operations related to a specific production order</td>
<td>Read Production Bill of Operations</td>
</tr>
<tr>
<td>Step 2: The line operator will signal when s/he has begin the work</td>
<td>(No enterprise service is invoked during this step)</td>
</tr>
<tr>
<td>Step 3: Upon completion, the line operator will input relevant information to update other systems and processes</td>
<td>Create Production Confirmation</td>
</tr>
</tbody>
</table>
Step 4: When the line operator saves this information into the system the data is sent to SP xMII in an ISA-95 Production Confirmation message format

Step 5: Once SAP xMII receives the data, it is sent to the backend ERP system

Step 6: The ERP system sends a confirmation that it has received the data

Step 7: Upon receipt of the data in ERP the inventory system(s) are updated

Step 8: The financial accounting and supply chain control systems in ERP are also updated

Use Case 3: Plant Manager

The Identified Stock business object is most often used by a production supervisor to identify, create, or change a subset of materials to be used in a manufacturing process. But it can also perform a crucial function for a plant manager who is overseeing multiple manufacturing operations in disparate locations.

Let's revisit that order for car paints. In the end, several different plants were used to fulfill the order. Reports are coming in that some of the paint has the wrong epoxy count. The plant manager must determine how much of the paint needs to be recalled. Using the Find Batch by Elements service operation, the plant manager could query to find every batch that was created using that specific recipe and which plants produced those batches. By using the Read Batch service operation, the manager could further confirm specific details about the materials used in each batch, such as the epoxy count, and determine that the plant in Singapore experienced a quality variation, but the one in Ireland did not. A fully integrated enterprise could even determine which car paint shops received the faulty batches of paint and thus recall just the batches that need to be replaced rather than recalling all of the yellow paint produced. (For more information about batch traceability, see the Batch Traceability and Analytics ES bundle.)

The following table summarizes these steps and the associated enterprise services:

<table>
<thead>
<tr>
<th>Step</th>
<th>Enterprise Service Invoked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1: The plant manager for several different plants identifies a quality issue with a specific batch of product made at two or more plants</td>
<td>(No enterprise service is invoked during this step)</td>
</tr>
<tr>
<td>Step 2: The user searches for every batch created using a specific process, materials, or recipe</td>
<td>Find Batch by Elements</td>
</tr>
<tr>
<td>Step 3: The user can review each of the search results to confirm specific details by calling up each batch</td>
<td>Read Batch</td>
</tr>
<tr>
<td>Step 4: The user is able to identify an anomaly at a specific plant</td>
<td>(No enterprise service is invoked during this step)</td>
</tr>
<tr>
<td>Step 5: The user can then track the batch to specific customers and issue a recall notice</td>
<td>(No enterprise service is invoked during this step)</td>
</tr>
</tbody>
</table>

Use Case 4: Maintenance Inspector / Supervisor

The IMES ES bundle also provides services that enable line operators and plant inspectors to address equipment malfunctions and failures by creating requests for maintenance support. In addition, the bundle allows maintenance supervisors to create orders that specify the scope and nature of the repairs to be conducted. As a result, less time and money are wasted on breakdowns that disrupt production and delay schedules.

Use case 2 describes the process by which a machine operator fills an order for the creation of a batch of paint. Under ordinary circumstances, he is responsible for starting the mixing operation, as well as for noting when the operation is complete. Here, however, no sooner has the operator started mixing the new batch than he receives a notice that one of the pumps is not injecting the proper quantity of paint into the mix. After shutting down the equipment, he summons a maintenance inspector to determine the type of symptom the machinery is exhibiting, along with the symptom's probable cause.

After filling in the details for a maintenance request, the inspector invokes the Create Maintenance Request service operation, which uses the Maintenance Request business object. Next, the inspector sends the request for the pump's repair to the maintenance supervisor.

Depending on the extent to which a business relies on its ability to quickly and accurately monitor, plan, and carry out equipment and property maintenance, it can integrate the IMES ES bundle with the Maintenance Processing ES bundle. The Maintenance Processing ES bundle provides a comprehensive set of enterprise services that can be used to streamline repair and preventative maintenance and automate many procedures.
that currently have to be performed manually. For example, if necessary, the supervisor in the current use case could use services in the Maintain
cance Processing ES bundle to view analytics such as charts and graphs that document the maintenance history, budget availability, life of a part,
and warranty information, all of which would help her decide whether to repair or replace the respective pump.

The maintenance inspector submits the maintenance request to SAP ERP. Thereafter, the request is available in the supervisor's personal order
work list, where all of the other maintenance requests she has received are listed.

Once the maintenance supervisor opens her personal object work list, she uses the Read Maintenance Request service operation to view details
about the maintenance request. She can add damage codes, cost codes, or other important information to the maintenance request by using the
Change Maintenance Request service operation. She can also add information such as how many hours of work it will take to replace the pump
and what materials will be needed. Finally, she decides whether to approve or reject the request. If the supervisor accepts the maintenance
request, she uses the Create Maintenance Order service operation, which uses the Maintenance Order business object. The request is then
converted to an order and forwarded to a service technician. Using the Find Maintenance Order by Basic Data service operation, the technician
can access the maintenance order at will. Later, as he administers the maintenance, the technician can invoke the Change Maintenance Order en-
terprise service to update SAP ERP with any status changes to the maintenance order.

The following table summarizes these steps and the associated enterprise services:

<table>
<thead>
<tr>
<th>Step</th>
<th>Enterprise Service Invoked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1: The machine operator receives a notice that there is a malfunction and summons a maintenance inspector</td>
<td>(No enterprise service is invoked during this step)</td>
</tr>
<tr>
<td>Step 2: The maintenance inspector provides the necessary information to create a maintenance request in the local system then submits it to the ERP system</td>
<td>Create Maintenance Request</td>
</tr>
<tr>
<td>Step 3: The request is available to the maintenance supervisor's work list</td>
<td>(No enterprise service is invoked during this step)</td>
</tr>
<tr>
<td>Step 4: The maintenance supervisor opens the work list and calls up a specific request to work on</td>
<td>Read Maintenance Request</td>
</tr>
<tr>
<td>Step 5: The supervisor adds information to the maintenance request</td>
<td>Change Maintenance Request</td>
</tr>
<tr>
<td>Step 6: The supervisor approves the request and submits it as a maintenance order to a service technician</td>
<td>Create Maintenance Order</td>
</tr>
<tr>
<td>Step 7: The service technician can access the order at will</td>
<td>Find Maintenance order by Basic Data</td>
</tr>
<tr>
<td>Step 8: As the maintenance is being performed the technician can update changes to the maintenance order in the ERP system</td>
<td>Change Maintenance Order</td>
</tr>
</tbody>
</table>

Use Case 5: Updating SAP ERP with Production Order or BOM Changes from MES

Typically production orders move from the planning system (SAP ERP) to the execution system (MES). But there are cases where production
orders may be created or changed on the MES side. These updates should be automatically sent to SAP ERP to keep the systems in synch.

Let's say that a last minute call to change an order is received. For efficiency's sake, the production manager might enter it into the MES system,
which then invokes the [Change Production Order* enterprise service operation.

Similarly, a last-minute call might be issued to create a production order. Again, for efficiency's sake, this order is entered in the MES system,
which then calls [Create Production Order* to invoke the creation of the order in SAP ERP and synchronize the system.

Cancelling a production order can also take place at an unexpected point in time. Time may be of the essence in cancelling a production order
about to be executed, in which case the production manager cancels the order at the MES system, which then invokes Cancel Production Order
to update SAP ERP about the cancellation of the order.

The bill of material for a product is similarly volatile. Particularly in electronics, updated parts may be required on a regular basis. Production staff
can change the bill of material in the MES system and then invoke the Change Production Bill of Material enterprise service operation, which
updates SAP ERP with the latest bill of material for the product in question.

The following table summarizes these events and the associated enterprise services. Note that unlike in most use cases, the following events can
happen at any time rather than in sequence.

<table>
<thead>
<tr>
<th>Event</th>
<th>Enterprise Service Invoked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event: The production manager enters a change in a production order in the MES system</td>
<td>Change Production Order</td>
</tr>
</tbody>
</table>
Use Case 6: Flexibility in Handling Backflush for Repetitive Manufacturing

In repetitive manufacturing, production confirmation is often simplified. Though a product may be very complex, at the end, you confirm the product as a whole rather than issuing a production confirmation for each step in the process. The production confirmation relates to two separate issues: first, the consumption of materials used in the product, and second, confirmation that the product itself was created.

This type of production confirmation, where all at once after the product is finished, you confirm that the product has been created and that all these parts have been consumed is referred to as confirmation with backflush.

The second possibility is confirmation without backflush. In this case, you confirm at the end that the product was created, but you do not automatically have the consumption of the materials used in the product logged in the system. This is confirmation without backflush.

It may be that the inventory needs to be verified by another person, that the components are expensive, but for whatever reason, when companies choose to do production confirmation without backflush, the backflush operations are put in someone's work queue to perform at a later time.

In the past, the enterprise services in this ES bundle have performed production confirmations with backflush. As of Enhancement Package 4, a new parameter is added to the Create Repetitive Manufacturing Confirmation enterprise service operation to perform confirmations without backflush when desired.

The following table summarizes these steps and the associated enterprise services:

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<tbody>
<tr>
<td>Step 1: The plant manager wants to perform a production confirmation without backflush</td>
<td>Create Repetitive Manufacturing Confirmation with parameter that specifies no backflush</td>
</tr>
</tbody>
</table>

Use Case 7: Reading Documents Associated with a Production Order

Production orders often come with schematics, instructions, documentation, and blueprints. By reusing a service from the Document Builder ES bundle in conjunction with the Read Production Order enterprise service operation, production personnel can seamlessly access such documents.

First, the production manager invokes Read Production Order, which provides information about any linked documents. Selecting a particular document invokes the Read Document enterprise service operation, displaying the document in question so that it can be viewed in the context of the production order.

In this way, if there are questions about a production order, access to linked documents is always available to those who need the information.

<table>
<thead>
<tr>
<th>Step</th>
<th>Enterprise Service Invoked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1: The production manager wants to review a production order</td>
<td>Read Production Order</td>
</tr>
<tr>
<td>Step 2: The production manager sees information about a linked document and selects the document</td>
<td>Read Document</td>
</tr>
</tbody>
</table>

Use Case 8: Reading Documents Associated with a Production Order

A plant manager typically manages multiple locations in a company that has heterogeneous system landscape with one or more ERP systems, Manufacturing Execution Systems (MES), Asset Maintenance systems, and so on. In such an environment, it becomes a challenge to monitor and manage production and quality performance.

Much vital information related to manufacturing can be exposed using enterprise services that make the right information available at the right time to the right person. Manufacturing enterprise services make access to ERP-related manufacturing information very easy. For example:
Plant manager wants to monitor the production queue and status

| Find Production Order by Elements, Read Production Order, and Read Production Confirmation |

Plant manager wants to locate sales order information for a make-to-order scenario.

| Read Sales Order |

Plant manager wants to monitor expected characteristics from production versus order characteristics.

| Find Variant Item by Variant Identifying Elements Read Production Confirmation |

Plant manager wants to monitor production plan Vs. actual yield

| Read Production Order Read Production Confirmation |

Plant manager wants to keep track of maintenance activities by reading the maintenance status.

| Read Maintenance Confirmation Read Maintenance Request |

With such information readily available, a plant manager can take pertinent and timely actions.

**Using This ES Bundle with Partner Applications**

- Invensys-Wonderware
- Tata Consultancy Services

**Future Directions**

Enhancement and creation of additional enterprise services is tentatively planned for future enhancement packages, particularly services related to Product Data Maintenance, Production, and Production Model Management process components. Extensions to support variant configurations and JIT/JIS are being considered for a future enhancement package.

**Connectivity**

IMES achieves connectivity between ERP and the shop floor through SAP MII. Thousands of shop floor systems, including logistics inventory management systems, plant data historians, plant maintenance systems, control systems, quality management, and manufacturing execution systems, can be connected with the backend in this way. SAP MII communicates with ERP using services.

SAP MII is a powerful composite application (xApp) that is capable of extracting data, transforming it, and visualizing it. This gives SAP MII the ability to consume manufacturing services as well as enterprise services. It can be used to fetch trend data or tag value, for instance. Another advantage to SAP MII is that it does not require constant connectivity to ERP. SAP MII can buffer data - from a day to a week's worth of orders - and retain those values until a connection is established again. This opens the possibility of round-the-clock operation, which is a critical advantage in today's competitive manufacturing businesses.

**System Requirements**

- SAP MII (Recommended)
- SAP ERP 6.0
- SAP enhancement package 1 for SAP ERP 6.0
- SAP enhancement package 2 for SAP ERP 6.0
- SAP enhancement package 3 for SAP ERP 6.0
- SAP enhancement package 4 for SAP ERP 6.0

**Related ES Bundles**

- Manufacturing Work Instructions
- Integration of Quality Management Systems
- Batch Traceability and Analytics

**End-to-end Processes Where This ES Bundle Is Used**

- Efficient Manufacturing Operations
Links

SDN and SAP Links

- SOA Homepage on SDN