Surviving Assemble-To-Order with Outside Processing

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Introduction

This white paper is intended to explain how Opnext used Assemble-To-Order (ATO) Make functionality to facilitate the outside processing of consigned components in direct response to customer sales orders. The booking of customer sales orders in Order Mgmt. triggered the creation of discrete WIP jobs with an outside processing step. Outside processing allowed the Assemble-To-Order process to transmit configuration instructions to the 3rd party contract manufacturer in the form of an Outside Processing standard purchase order and transact the consumption of a key component, held on consignment, when completing the final assembly.

The scope of this white paper is to present E-Business Suite functionality via examples from a release 11.5.10.2 (CU2) instance. All functionality presented should be applicable to E-Business Suite Release 12. The set-ups required for Assemble-To-Order or Outside Processing are outside the scope of this white paper. Various E-Business Suite user guides and numerous OAUG presentations at the national level already address such set-ups. Also out of scope are ATO Buy scenarios, referred to as Procure-To-Order or back-to-back orders. Finally, Configure-To-Order using Oracle Configurator is not addressed.

Background – Original Process

Opnext had an existing product line that was made by an offshore contract manufacturer (CM) via a Finished Goods Buy turnkey solution. Under the turnkey solution, Opnext placed purchase orders (POs) to the CM for finished goods (FGs) two to six weeks in advance of the need-by date. The finished goods in this product line had a manufacturing lead time of 16 weeks due to long-lead items. A process flow for this turnkey solution is shown in Figure 1.

Opnext provided the CM with six-month forecasts outside of Opnext's E-Business Suite (EBS) system so the CM could procure long-lead items in advance. Opnext also gave the CM short-term forecasts of FG products. The CM often used the short-term forecasts to start WIP jobs in its own system. Opnext's customer sales orders (SOs) for this product line were often booked only two to three weeks before the customer's request date. Occasionally, products built from short-term forecasts were not consumed by any sales orders.

Several issues arose from the original turnkey process. Even if the six-month forecasts were fairly accurate, the existing process did not always provide the CM with enough lead time to meet customer demand. The product built from short-term forecast was sometimes slightly different from the ordered item on the subsequent customer sales order. Undesired rework costs were incurred to transform the assembled product into the ordered item. Lastly, the CM expressed concerns about purchasing long-lead items based on forecasts. The CM preferred that Opnext have a more formal obligation (for example, a standard PO) to buy and pay for the long-lead items whether or not consumed.
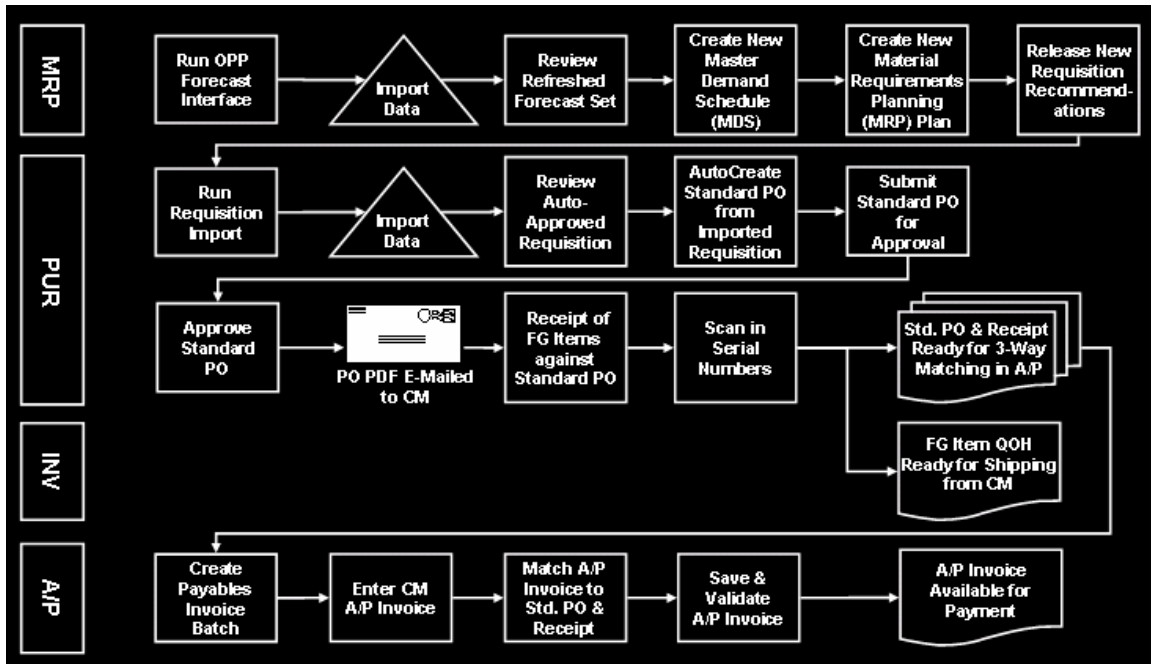
Figure 1 – Original Process: Finished Goods Buy Turnkey Solution

Business Case

Opnext initiated a redesign of the business process to manufacture this product line in order to facilitate the final configuration of FGs using common subassembly (SA) components. The existing CM would tweak its processes so that one common subassembly could be used in any FG item within a product group. A product group typically consisted of five or six unique FG item numbers. The final configuration lead time under the redesigned business process would be two to three weeks. The common subassembly included the long-lead items and represented 90% of the total manufacturing time and cost of the finished good.

Opnext's users envisioned a 2-PO model under the redesigned business process:

1. Issue a standard PO for the advance purchase of subassemblies.

2. Issue a standard PO for assembly services to configure the subassemblies into specific FG items.

The first POs for subassemblies would be placed twelve weeks in advance. The ordering of subassemblies had nothing to do with ATO functionality. The creation of the subassembly POs would be driven by MRP planning. The Opnext planner would upload a three-month forecast of subassemblies, based on product group forecasts, into the master demand schedule. This eliminated the need to provide precise six-month forecasts of specific products (unique item numbers). The CM would build the ordered subassemblies, bill Opnext, and hold the SAs on consignment until consumed. The SAs would be added to Opnext's Oracle EBS Inventory when built via receipts against the SA POs.

The second POs would be issued to the same CM for the assembly of a FG item once a firm customer sales order for that item number was booked. These second POs represented an outside processing (OSP) PO for services to assemble the finished good. The idea was that these second POs for OSP services should be triggered, directly or indirectly, by the booking of a customer SO just like the concept behind Assemble-To-Order functionality. In this case, the completion of FG assembly services needed to consume the subassembly (previously ordered and built) from our Oracle Inventory.

System Solution

The system solution for this new business process was the combination of ATO Make functionality with Outside Processing functionality. A key requirement was to automate as many steps in the process as possible to minimize the need for manual user entry or interfaces with the CM.

Under the solution, the FG items in this product line would be set up as ATO Make items. Their OM Assembly-to-Order flag would be checked on, their General Planning Make or Buy flag would be set to "Make", and their Build in WIP flag would be checked on.

The booking of a sales order for these ATO Make items would trigger the creation of a discrete WIP job. The routing on the WIP job would have only one step – an outside processing step. The OSP step would create the second PO for the FG assembly services and cause the WIP job to consume the subassembly upon completion. The completion of the WIP job would also create a reservation against the finished good inventory for the SO line that had spawned the WIP job.

The process flow for this system solution is shown in Figure 2. A walkthrough of the steps in the flow is presented in a later section of this white paper.
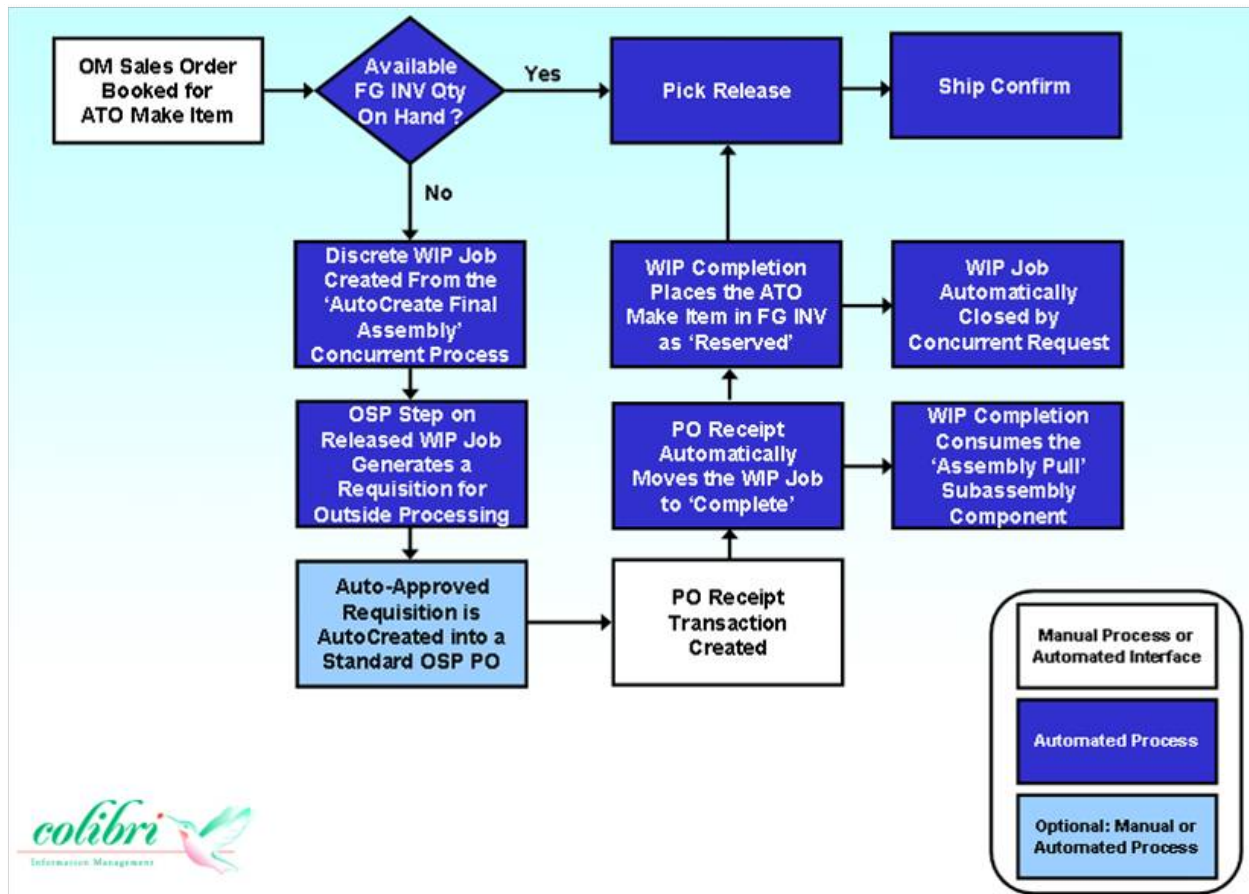
Figure 2 – Process Flow of System Solution: ATO Make with Outside Processing

The relationship between sales orders, discrete WIP jobs, OSP requisitions, and OSP POs can be seen through a Sales Backlog custom Discoverer worksheet in Figure 3. When the sales order line has a status of **PRODUCTION_OPEN**, it indicates that the ATO Make process has spawned the creation of a WIP job. If

the SO line has a status of **SUPPLY_ELIGIBLE**, the line is eligible to create a WIP job but other factors have prevented the job's creation up to this point; for instance, a necessary concurrent request has not yet run.


Figure 3 – Discoverer Worksheet for Sales Order Backlog of ATO Make Items

The creation of discrete WIP jobs is controlled by the sales order line workflow (WF). When the workflow spawns a discrete WIP job, it links the SO line to the WIP job. Figure 4 displays how Opnext added the seeded ATO workflow process, "Line Flow - ATO Item", to a line workflow assignment.

Figure 4 – SO Line Workflow Assignments

Figure 5 shows the seeded ATO WF process "Create Supply Order - Line, Manual" as a sub-process in Opnext's custom SO line workflow.
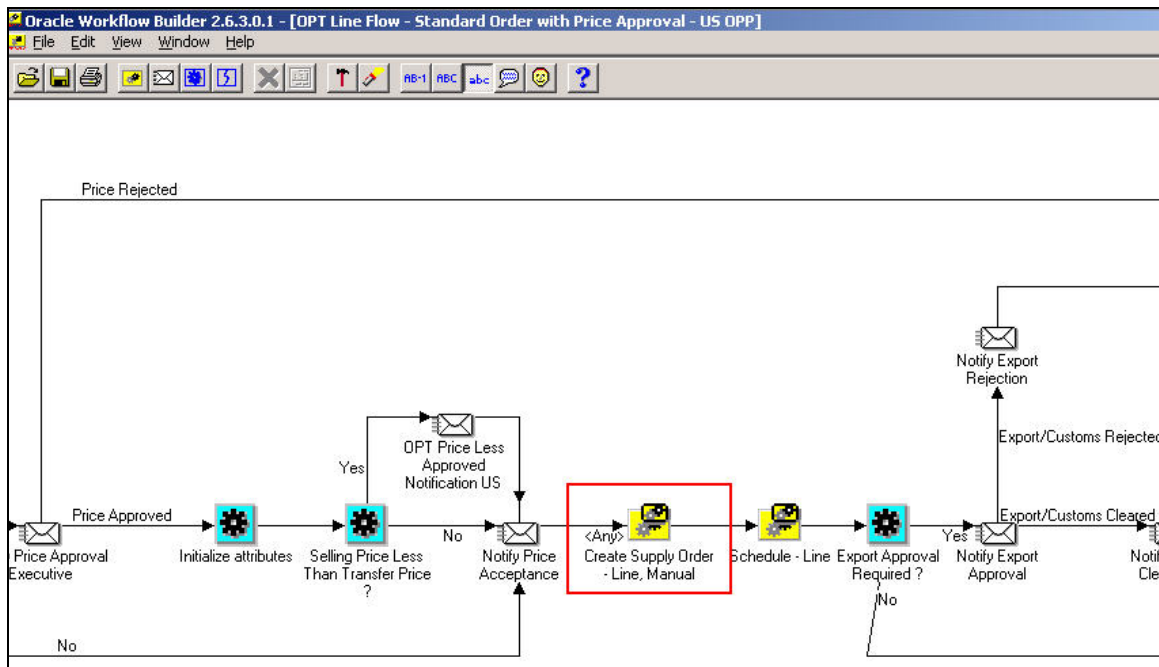
Figure 5 – ATO Sub-Process Added to SO Workflow

Outside processing is seeded EBS functionality whereby components are typically shipped out ("outbound consignment") to a third-party supplier for OSP services. The functionality assumes that the assembled items would be physically received and an OSP resource charge would be incurred. Outside processing functionality creates Purchase Requisitions that generate OSP POs to the supplier of services and ultimately consumes the consigned components that had been shipped out.

In Opnext's case under this system solution, the consigned components – the common subassemblies – would not be shipped out, because the CM who built the SAs would just hold them on consignment.

The PO unit price on the OSP PO is the price for the assembly services, not the full value of the assembled item to be received back. The PO unit price is usually set in EBS to the same value as the standard cost of the OSP resource charge.

The standard cost of an ATO Make item under Opnext's system solution is the material cost of the subassembly plus the OSP resource charge. For example, the rolled-up standard cost of ATO Make item LASER123 would be calculated as follows based on the costs of its common subassembly, SA999, and OSP resource charge:

Material Cost of Subassembly SA999		$900
+ OSP Resource Charge	+	$100
Rolled-up Std Cost of ATO Make Item LASER123		$1,000

Transaction Walkthrough

This section presents a walkthrough of the steps in the ATO Make with OSP process flow. Figure 6 below is the same flow shown in Figure 2 with the addition of step numbers for reference.

Figure 6 – Process Flow of System Solution: ATO Make with Outside Processing

Step 1: OM Sales Order Booked

A customer sales order for ATO Make item LASER123 has been entered. The ATO flag on the SO line is automatically checked on based on the item's attributes. The ordered quantity is 30 units. The line is sourced from the **PCM** org. After the SO is booked, the SO line workflow will change the line status from "Booked" to "Supply Eligible" as shown in Figure 7.

Figure 7 – Step 1: ATO Make SO Line Booked with Status of 'Supply Eligible'

Step 2: Discrete WIP Job Created

Once the status has changed to "Supply Eligible", the line is eligible to be auto-created into a discrete WIP job. The next time the "AutoCreate Final Assembly Orders" WIP request is run for the ship-from org **PCM** [refer to Figure 8 below], the request will assess whether a discrete WIP job should be created based on the item's fixed lead time and the request's Offset Days parameter.

Figure 8 – Step 2: AutoCreate Request to Spawn the WIP Job

When the "AutoCreate Final Assembly Orders" spawns discrete WIP job 366248, as shown in Figure 9, the job is created in a "Released" status. The SO line WF will change the line's status to "Production Open".

Figure 9 – Step 2: Discrete WIP Job Created

The WIP job is created with a sales order reservation against the SO line. By clicking the Sales Orders button on the Discrete Jobs form [Figure 9], the WIP module user can see the form displayed in Figure 10. This Sales Orders form reveals that order # 71003203 has reserved 30 units against this job.

Figure 10 – Sales Order Reservation via the WIP Job

This sales order reservation is also viewable in the Order Management module via the Actions button on the SO line. The action "Supply To Order Workbench" will open an HTML page like the page in Figure 11.

Figure 11 – Sales Order Reservation via SO Line Actions

Note: Once the WIP job completes in subsequent Step 6, the SO line reservation is no longer visible through the methods shown in Figures 10 and 11. The reason is that the SO line reservation is replaced by a finished goods Inventory reservation.

Step 3: Outside Processing Step Generates Requisition

The outside processing step on WIP job 366248 uses a resource, OSP_LSR123, as shown on the View Resource Requirements form in Figure 12.

Figure 12 – Step 3: OSP Resource on WIP Job

Using seeded EBS OSP functionality, the resource spawns a purchase requisition that is imported into the Purchasing module in an "Approved" status. Figure 13 indicates that Requisition 53201 line 1 was imported from WIP job 366248.

Figure 13 – Step 3: Requisition Line Imported from WIP

Step 4: AutoCreated OSP Purchase Order

A purchase order for outside processing services can be auto-created from the imported requisition line either manually or automatically via contract agreements. The automatic creation of POs is beyond the scope of this white paper. The manually auto-created standard purchase order, # 11294, is shown in Figure 14. The PO line type is "Outside processing". The PO unit price of $100 is the same as the OSP resource charge's standard cost.

Figure 14 – Step 4: AutoCreated OSP Purchase Order

Figure 15 reveals the link between PO 11294 line 1 and discrete WIP job 366248 as captured on the Distributions form of the PO line shipment. The PO line distribution has a destination type of "Shop Floor" with a quantity of 30. The Distributions form includes an Outside Services button which, when clicked, displays an Outside Processing form. The Outside Processing form references the WIP job, 366248, and the OSP resource, OSP_LSR123. The form also shows a resource and assembly quantity of 30.

Figure 15 – Distribution on AutoCreated OSP PO

Step 5: Outside Processing PO Receipt Transaction

When the outside processing has finished, the next step is to record a receipt against the OSP purchase order. The receipt can be performed manually as displayed in Figure 16 or via an interface. The destination type of the selected PO line is "Shop Floor", which is indicative of an outside processing PO line.

Figure 16 – Step 5: OSP PO Receipt Transaction

Step 6: WIP Job Automatically Completed

The receipt transaction in Step 5 will automatically move the received quantity to the next step in the WIP job. Since the OSP step is the last (and only) step on the routing under Opnext's solution, the receipt actually completes the WIP job. Figure 17 shows job 366248 with a new status of "Complete".

Figure 17 – Step 6: WIP Job Automatically Completed

Step 7a: ATO Make FG Item Added to Inventory as Reserved

The completion of the job in Step 6 creates two separate Inventory material transactions. One transaction is the WIP assembly completion that adds the ATO Make item to Inventory at standard cost as reserved. The other transaction is the consumption of the "Assembly Pull" component. The WIP job completion also changes the SO line status to "Awaiting Shipping", ready for picking and shipping.

The first transaction listed in Figure 18 is the addition of 30 units of LASER123 to the SAE_SUB_FG subinventory under the **PCM** Inventory org. This transaction was costed at the $1,000 rolled-up standard cost for LASER123.

Figure 18 – Step 7: ATO Item Added to Inventory / Subassembly Consumed

When the WIP assembly completion quantities are added to Inventory, an Inventory reservation for the quantities is created automatically against the ATO Make SO line. The completion process essentially replaces the SO reservation against the WIP job (created in Step 2) with a SO reservation against Inventory. Figure 19 shows the Inventory reservation of sales order 71003203 against 30 completed units of LASER123.

Figure 19 – SO Reservation against Inventory

Step 7b: "Assembly Pull" Subassembly Component Consumed

The second transaction in Figure 18 is the consumption of 30 units of subassembly SA999 from the SAE_CCSA subinventory at a standard cost of $900 per unit. Component SA999 was set up on the bill of material with a material control Supply Type of "Assembly Pull" to allow a WIP user to manually substitute the component on the job. While substitutions are outside the scope of this paper, it is worth noting that component consumption could be transacted at an earlier step if Opnext never had a need to substitute.

Step 8: WIP Job Closed via Concurrent Request

Completed WIP jobs can be closed automatically through the WIP concurrent request "Close Discrete Jobs" shown in Figure 20.
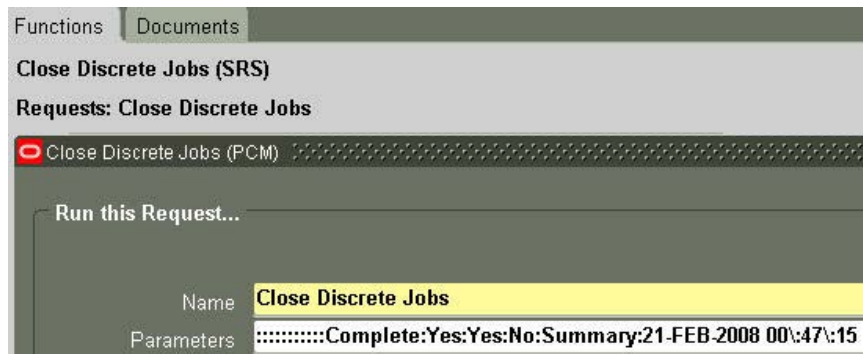
Figure 20 – Step 8: Run the WIP Concurrent Request to Close Discrete Jobs

After the "Close Discrete Jobs" request was run, discrete WIP job 366248 has a status of "Closed" in Figure 21. The closing of the WIP job creates resource accounting distributions valued at $100 per unit.
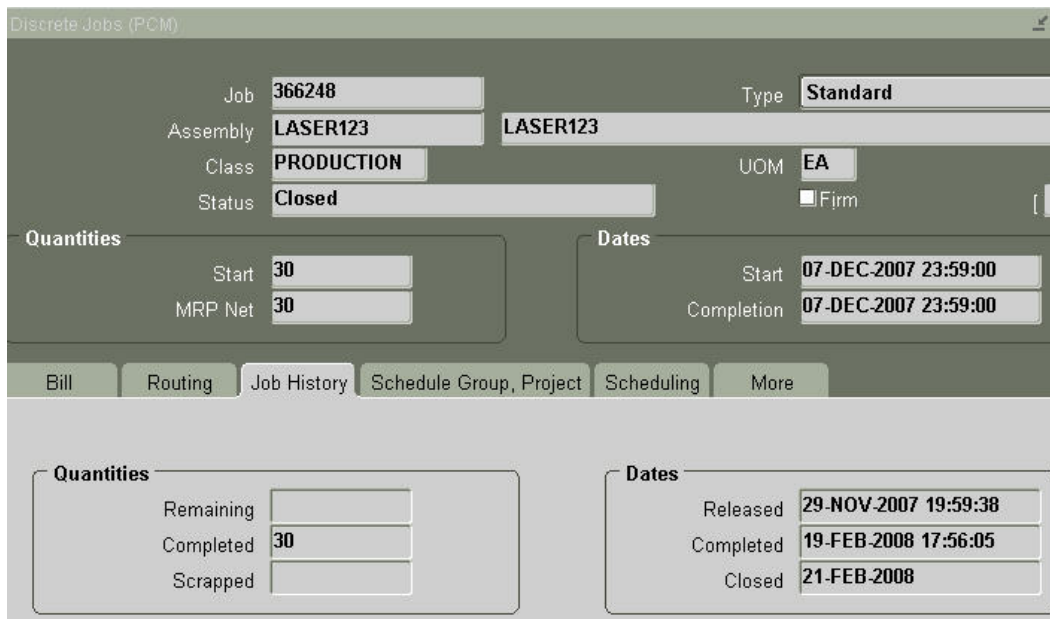
Figure 21 – Step 8: WIP Job Closed via Concurrent Request

Issues

Issue 1: Confusion with Seeded OSP Functionality

The outside processing requisition and PO under the standard EBS OSP model uses a "fake", or non-physical, OSP services item as the ordered item. The non-physical OSP item is defined in the item master but has no standard cost or quantity on-hand (QOH). The OSP PO, for example, might show an ordered item number of OSP_SERVICES for services to build item LASER123. The OSP PO would not show item LASER123 as the ordered item under the standard EBS offering.

How would the CM receiving the OSP PO know which FG item to assemble based on an ordered item of OSP_SERVICES?

Likewise, receipts against an OSP PO under the standard EBS OSP model are recorded against the non-physical OSP PO item on the PO even though the receiver physically receives the assembled item.

How would a person at the receiving dock know to match the physical receipt of assembled item LASER123 to a PO with ordered item OSP_SERVICES?

Opnext's solution was to deviate from the standard EBS OSP offering and set up the ATO Make FG item also as the outside processing item. This alternative was suggested by Opnext's consultant for this implementation from Colibri, Ltd. It eliminated the need to create any non-physical OSP items in the item master. No Oracle documentation was found that addressed this alternative.

The impact of this solution was twofold:

- It allowed the OSP PO to show the assembled item, for instance, LASER123, as the ordered item on the PO line.

- It enabled receipts for the OSP PO to be made against the physically-received item, LASER123.

Figure 22 shows the necessary Purchasing attributes for ATO Make item LASER123. The Outside Processing flag for this physical item is checked on and the OSP unit type is set to "Assembly". The List Price shown is $100, which is the per-unit charge for assembly services that will appear on OSP POs.

Figure 22 – Setting the ATO Make Item as an OSP Item

Under Opnext's solution, the ATO Make item is then linked to the OSP resource in the Outside Processing region of the Resources form. Resource OSP_LSR123 in Figure 23 was created for this example. A unique resource must be created for every ATO Make item under Opnext's solution, because each resource has a specific ATO Make item as its selected Outside Processing item in lieu of a non-physical OSP item under the standard EBS model. The non-physical OSP item under the standard EBS model could theoretically be shared across different assemblies via a common resource.

Figure 23 – Linking the OSP Item to the Resource

Figure 23 also shows that the Costed flag for resource OSP_LSR123 is checked on and the resource has a Frozen standard cost of $100 per unit. The Frozen cost of the resource was manually set to the same value as the List Price of the ATO Make item. The Resource Costs form becomes visible by clicking the Rates button.

As noted in a previous section, the routing on the WIP job only has one step – an outside processing step. The routing for LASER123 is displayed in Figure 24 with only one step, sequence 10 for department OPP_CM. What makes this an outside processing step is the resource assigned to the department on the routing. Figure 24 shows the selected operation resource, OSP_LSR123, which has been defined as a costed outside processing resource in Figure 23 above.
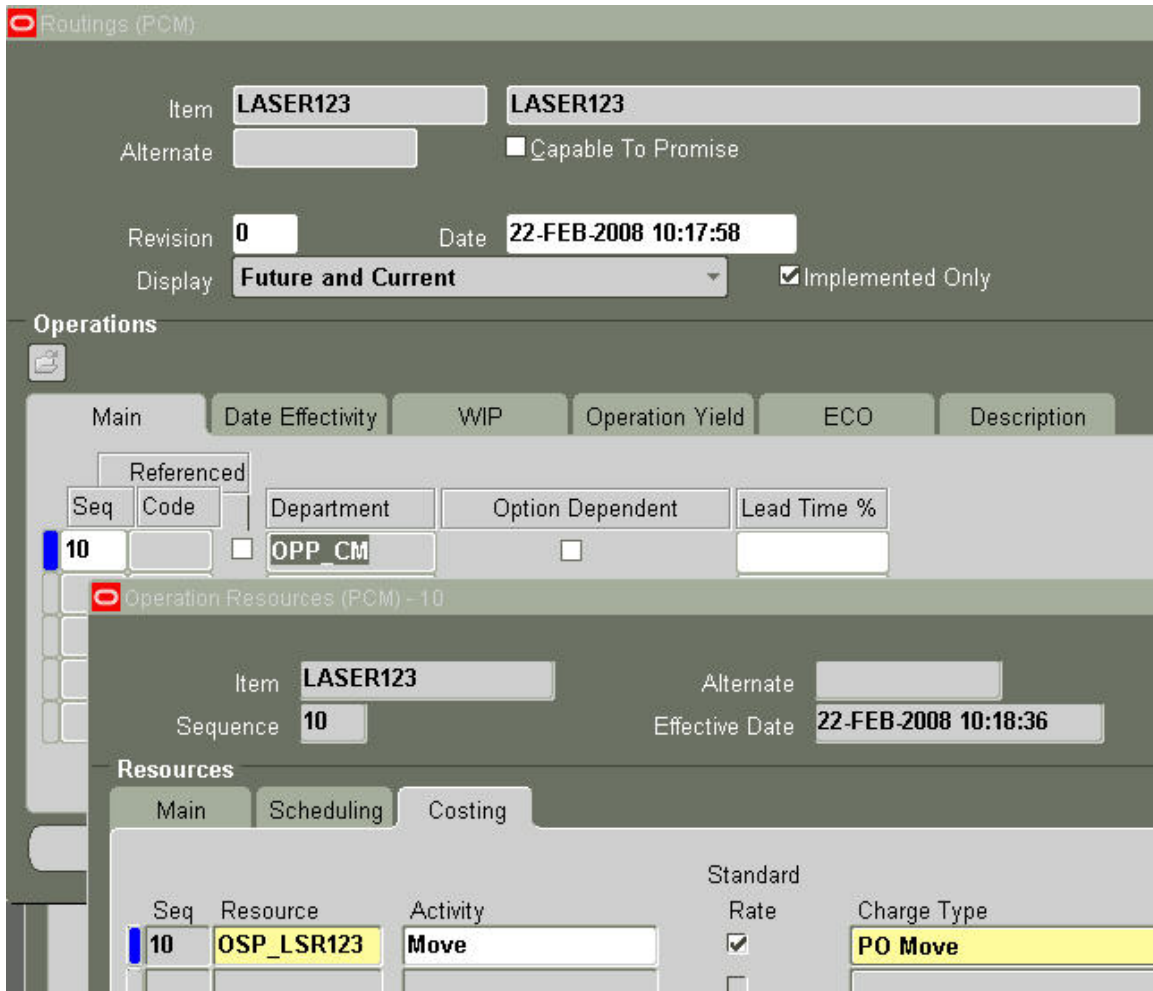
Figure 24 – Linking the Resource to the Routing

Issue 2: Concern over Purchase Price Variance

When Opnext first considered the alternative of setting up the ATO Make item as the outside processing item, concerns were raised over its impact on the purchase price variance (PPV) calculated at the time of the OSP PO receipt.

Would this alternative setup produce an unexpected PPV calculation for every OSP PO receipt even when the OPS PO unit price equaled the actual charge for the outside services?

Generally, the calculation for purchase price variance is:

> PPV = (PO Price – Std. Cost) * Quantity Received

*Since the rolled up standard cost of finished good LASER123 is $1,000, would every receipt of LASER123 on an OSP PO create an undesired PPV of ($100 - $1000) * Quantity Received?*

Fortunately, these concerns were unfounded. The PPV for an OSP PO is actually calculated as follows:

> PPV = (PO Price – Std. Cost of Resource) * Quantity Received

The standard cost of resource OPS_LSR123 is $100 [from Figure 23]. The PPV for the OSP PO receipt of LASER123 was therefore calculated as ($100 - $100) * Quantity Received, or zero PPV, as desired.

Once Opnext implemented this alternative, accountants verified that the OSP PO receipts were recorded as expected on EBS receiving transaction reports, PPV reports, and the Accrual Reconciliation Report.

Issue 3: Insufficient Component Quantity On-Hand

Post-implementation, one issue surfaced around WIP job completions when the supply subinventory had insufficient component quantity on-hand. The OSP PO receipt could be recorded even when this condition existed. The receipt would be recorded with no warning to the user and attempt to trigger the automatic completion of the WIP job (Walkthrough Step 6). Since the completion process could not find enough component quantities on-hand, however, the WIP job never completed.

The impact from this issue was:

- No user received any notification of the error.

- The WIP job remained in a "Released" status.

- The ATO Make item quantities were never added to Inventory.

- A "Move processing" record for the failed WIP completion became stuck on the **WIP_MOVE_TXN_INTERFACE** table with a process status set to 3 for "Error".

- The OSP PO line misleadingly reflected the receipt in its Quantity Received even though the physically-received ATO Make item quantities were not added to Inventory.

- If the OSP PO line had been fully received, the line was closed for receiving.

Opnext created a Forms Personalization in the Receipts form to perform an error check for insufficient component quantity in the supply subinventory. The personalization applied only to receipts for outside processing PO lines (destination type = "Shop Floor"). If the error condition were met, the personalization prevented the recording of the OSP PO receipt. An example of the personalization error message appears in Figure 25. The user would have to re-attempt the receipt transaction after sufficient QOH had been added to the supply subinventory.
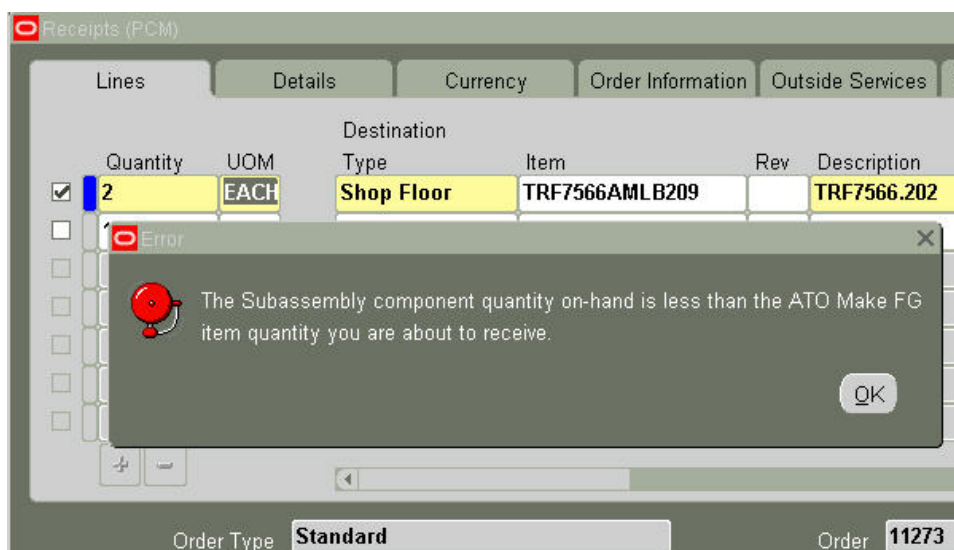
Figure 25 – Personalization to Prevent an OSP PO Receipt When Insufficient Component QOH

Issue 4: Synching Up Sales Order Line Changes

If the quantity or date on an ATO Make sales order line changed, or the line was cancelled, the change was not automatically made to the discrete WIP job or the OSP PO. EBS provided no functionality to propagate ATO Make SO line changes to the spawned WIP job. EBS also provided no functionality to propagate WIP job changes to its outside processing PO except, possibly, for the WIP concurrent request, "Discrete Update OSP Need-by Dates".

It became very apparent to Opnext that quantities and dates on the WIP job and OSP PO could become out of synch with the SO line when changes were made to the sales order. If the quantity on the SO line decreased significantly, for instance, from 900 to 300, no mechanism would notify the CM that the original OSP PO to assemble 900 units was no longer valid. The risk was the unnecessary assembly of 600 units [900 – 300].

The issue was addressed by permanently delegating a user to manually synch up the WIP job and OSP PO to the modified ATO Make SO line. To detect the potential need for manual intervention, a standard EBS workflow notification was enabled to trigger a notification whenever an ATO Make SO line changed or had been cancelled. Oracle designed this seeded WF notification to notify the planner. To enable the notification, the ATO Make finished good item had to be assigned a Planner code in the ship-from org (warehouse). Also, the assigned Planner code needed to be linked to an employee record.

The Organization Item form in Figure 26 indicates that planner code CONFIG_FG has been selected for item LASER123 in the **PCM** org. The smaller Planners form in Figure 26 shows the employee who has been assigned in **PCM** to the CONFIG_FG planner code.

Figure 26 – Planners Setup Required for WF Notification

An example of the seeded workflow notification for the planner is presented in Figure 27. The quantity on sales order 71003145 line 1.1 has changed from 5 to 30. The notification makes a point to tell the recipient to ". . . review the impact of these changes . . . and take appropriate action."

```
From: Oracle Workflow Mailer
Sent: Tuesday, February 19, 2008 8:30 PM
To:   Guether, Eric

Subject: FYI: Work Flow Notification : Order Number 71003145, line # 1.1 for
customer Flash Gordon Electronics Inc. has been modified.

Oracle Workflow Notification (FYI)
_____

Changes have been made to the configured Order #71003145, Line Number #1.1.
Details of the changes are provided below. Please ignore non-applicable (N/A) items.

1. Request Date is changed ------------------------------------- N/A
2. Scheduled Date is changed ---------------------------------- N/A
3. Scheduled Arrival Date is changed -------------------------- N/A
4. Quantity is changed ---------------------------------------- 5 TO 30
5. The order Line has been cancelled -------------------------- N/A
6. Configuration has been changed ----------------------------- N/A
7. Configuration item has been de-linked from the order line --- N/A
8. Ship From Org has been changed ----------------------------- N/A


Please review the impact of these changes on the manufacturing / shipping / procurement
process and take appropriate action.

If the configuration item was de-linked, you may need to review the supply (if any)
associated to the order line prior to de-link.

Please note that the order may involve multiple configuration and/or sourcing of configuration
from different organizations.

This is an FYI notification and you are not required to respond to this notification.
```

Figure 27 – Seeded Workflow Notification

Issue 5: Return to Supplier

Months after Opnext implemented this ATO Make with OSP solution, another issue surfaced. The issue occurred specifically when a Return to Supplier (RTS) transaction was recorded against the OSP PO receipt <u>before</u> the completed items were ever shipped out. The user appeared to successfully record the Return to Supplier transaction without knowing that the ATO Make item quantities in Inventory were still reserved by the original ATO sales order. The quantities to be returned were not really available and thus were not processed when the RTS transaction was entered.

The impact from this issue was:

- The user received no notification of the reserved quantities or the failed RTS transaction.

- The ATO Make item quantities were not relieved from Inventory via the RTS transaction.

- A "Move validation" record for the failed return got stuck on the **WIP_MOVE_TXN_INTERFACE** table with a process status set to 1 for "Pending".

To prevent this issue, Opnext created a Forms Personalization in the Receiving Returns form to perform an error check for unavailable quantity on-hand. The personalization applied only to returns of receipts for

outside processing PO lines (destination type = "Shop Floor"). When the error condition occurred, the personalization prevented the recording of the return to supplier transaction. An example of the personalization error message appears in Figure 28.
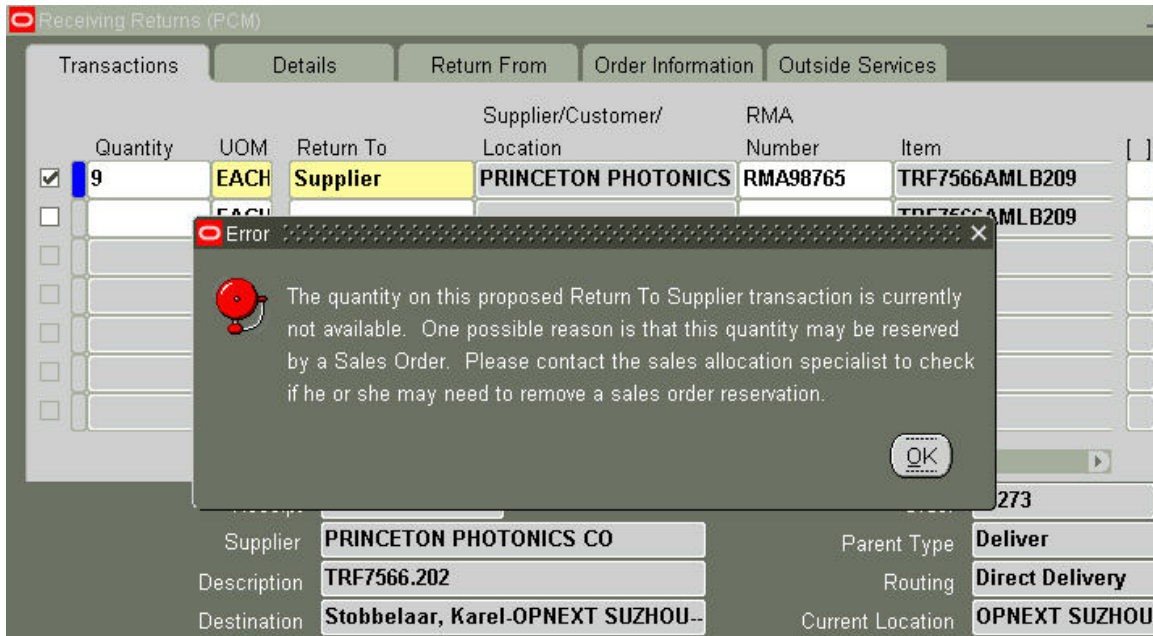
Figure 28 – Personalization to Prevent a Return When Insufficient ATO Item Available Quantity

Conclusion

Opnext found ATO Make with Outside Processing to be a cost-effective solution to counter the business issues which arose from its original Finished Goods Buy turnkey solution. The solution presented in this white paper can be implemented in an existing Oracle EBS 11i or Release 12 instance most likely without outside resources such as functional consultants.

ATO Make functionality and Outside Processing functionality each span several EBS modules and can be confusing for an end-user to comprehend fully. The purpose for this white paper is to help other organizations with an EBS system understand the combination of ATO Make and Outside Processing.

When combined, both functional processes can facilitate the outside processing of consigned components as initiated by customer sales orders. While Opnext tried to automate as many steps as possible, the need arose for Forms Personalizations, workflow notifications, and custom Discoverer queries to allow Opnext users to survive the post-implementation of this cross-module solution.