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# Integrated Campaign Planning, Scheduling and Order Confirmation in the Specialty Chemicals Industry

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The purpose of this chapter is to document the implementation of an integrated order allocation/production planning design using OMP Plus. After a description of the case and the challenges, we will describe the architecture of the planning system, putting emphasis on the interaction between OMP Plus and SAP ERP. Finally, we will describe the order confirmation and production planning workflow and highlight the benefits of the project.

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## 26.1 Case Description

The company is one of the world's biggest manufacturers of films used in the manufacturing of safety laminated glass. Safety laminated glass is used in the Automotive, Architectural as well as in the Photovoltaic industry. Next to strengthening glass, the film also improves sound insulation and/or provides color to the window. The films are adhesives sold in rolls, these need to be stored refrigerated. The company also produces intermediate products, i.e. the resins and plasticizers required for the extrusion of films. The company operates plants in North America, Europe and Asia for both intermediates and films manufacturing (see Lebreton et al. 2010).

### 26.1.1 Procurement

The company purchases bulk chemical commodities globally using long-term contracts. These provide price stability in exchange of a minimum order volume. Nevertheless, due to the volatility of the oil and gas markets, prices can be index-based. Most of the other raw materials are purchased locally by the plants.

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### 26.1.2 Production

The company's production chain consists of three stages: intermediates manufacturing, film extrusion and finishing operations. Intermediates are manufactured on four sites worldwide, each plant producing generic materials as well as specialty materials that can be single-sourced. Film extrusion takes place in four plants worldwide, each of them operating between one or several extrusion lines. Each extrusion line has specific capabilities in terms of products or widths that can be processed. Films, like intermediates, are produced in campaigns. The films can be cut to an alternative width or be interleaved during finishing operations. Interleaving consists of unwinding the rolled film and inserting an interlayer that will allow for unrefrigerated storage.

The bill of material is divergent. The company purchases less than ten key raw materials and produces a dozen of intermediate materials which are used to extrude more than 100 different film formulations (film types). To minimize cutting losses at the customer, the company sells rolls of film in cm width increments. Hence, in a year, the company will sell and/or store up to 10,000 different finished goods combinations.

### 26.1.3 Distribution and Sales

The rolls are dispatched to a global network of distribution centers, located in the vicinity of key customers. Each distribution center has its own product offering, depending on what the customers frequently order. In case an SKU would not be available, the company might send another SKU instead. The company has a standard product offering which indicates what sizes are make-to-stock and which ones are make-to-order. Customers should expect longer lead times for make-to-order SKUs and can decide to either wait or order a make-to-stock SKU. Due to the wide number of finished goods combinations, the forecast accuracy at SKU level is low, making forecasts at this level impractical. The fact that customers have multiple suppliers of film does contribute to the randomness of demand. A summary of the supply chain attributes is provided in Table 26.1.

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## 26.2 Objectives of the Project

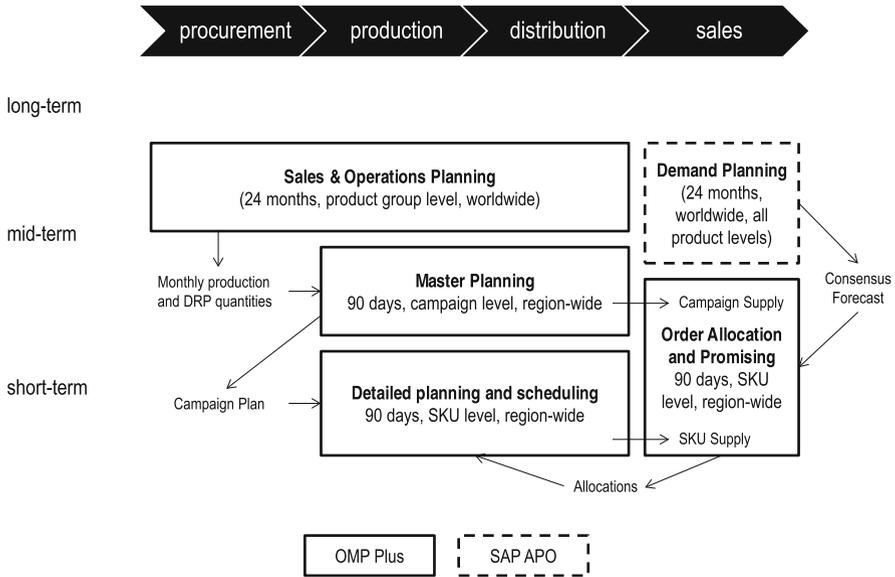
A production planner/scheduler has thousands of order lines to manage in parallel. Hence, manual planning has never been an option. Prior to the introduction of the OMP planning suite, it was also clear that SAP MRP and the PP module (i.e. planning tables) did not provide enough functionality to handle the business' requirements in terms of visibility, flexibility and user-friendliness.

A drastic reduction of working capital could only be achieved with an improved way of dynamically tying supply with demand, taking into account the business rules. Hence, the objectives of the projects were:

**Table 26.1** Functional supply chain attributes—films

Functional attributes	
Attributes	Contents
Number and type of products procured	Few raw materials (commodities)
Sourcing type	Multiple suppliers
Supplier lead time and reliability	Short, high reliability
Materials' life cycle	Long
Organization of the production process	Continuous
Repetition of operations	Batch production
Changeover characteristics	Sequence dependent
Bottlenecks in production	Known
Distribution structure	Two stages
Pattern of delivery	Weekly to monthly
Deployment of transportation means	Individual links
Loading restrictions	Full-truck load, less than truckload depending on destination
Availability of future demand	Forecasted
Shape of demand	Constant, lows in August/December
Products life cycle	Several years
Number of product types	More than 50
Degree of customization	High
Products' structure	Divergent
Bill of materials	Divergent
Structural attributes	
Attributes	Contents
Network structure	General
Degree of globalization	Worldwide
Location of decoupling point(s)	Make to stock/make to order
Major constraints	Manufacturing capacity
Legal position	Intra-organizational
Balance of power	Customers
Direction of coordination	Mixture
Type of information exchanged	Forecasts and orders

- Transfer the manually created allocation plan (including business rules) to a planning software, thus creating real-time transparency on available supply world-wide
- Assess/simulate the impact of scheduling changes on inventory replenishments & order fulfillment
- Better coordinate resin/sheet production to minimize inventories of raw materials, resin and sheets
- Provide a planning application allowing users to make decisions rapidly and reflect them immediately in SAP R/3, taking into account customer service policies and Master Planning's targets (commonly named S&OP targets).



**Fig. 26.1** Architecture of the planning system

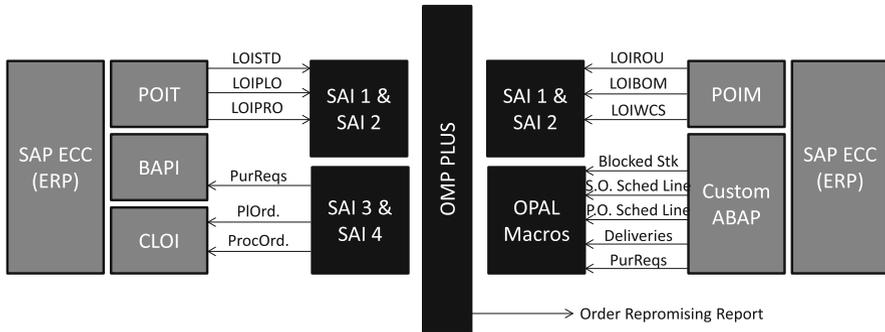
## 26.3 Architecture of the Planning System

The OMP Planning suite takes over the production and distribution planning tasks and is connected with SAP ERP for the transactional data as well as SAP APO Demand Planning for the forecast. The Sales and Operations Planning (S&OP) module has been introduced as a stand-alone application back in 2006, together with SAP’s APO Demand Planning Module. Until 2010, the campaign planning, detailed scheduling and available to promise (ATP) were performed using SAP ERP (MM and SD modules). By November 2010, the business went live with OMP Plus which provides an integrated solution to manage campaigns, run the daily scheduling and confirm orders.

The S&OP module, which runs the planning for 24 months, provides monthly production quantities for each production asset and distribution quantities between plants and distribution centers (see Fig. 26.1). As mentioned earlier, the supply chain is global so in-transit inventory is extremely critical and needs to be taken into account.

Every month, the OMP Plus module imports the target monthly production quantities and works as follows:

1. Split monthly production quantities into a daily campaign plan for the next 90 days, by machine.
2. Assess all order allocations previously performed since the supply has been modified.



**Fig. 26.2** SAP/OMP interfaces

3. Adjust planning or adjust the order allocations.
4. Send the updated order allocations to the customer service group so that the orders can be re-promised if needed.

On a daily basis, new orders are coming in and steps 2 to 4 are repeated. We will go in more detail about the process in the next section.

OMP Plus imports SAP's transactional data using two standard interfaces: POIM for master data and POIT for transactional data. The data is exported several times per day using standardized messages called iDocs:

- LOISTD: stock requirements list (POIT) including all supply and demand elements
- LOIPLO: planned orders (POIT) containing the details of the un(con)firmed supply elements
- LOIPRO: process orders (POIT) containing the details of the (con)firmed supply elements (manufacturing orders)
- LOIROU: routings/recipes (POIM) including operations, sequences and production rates
- LOIBOM: bill of materials (POIM)
- LOIWCS: work centers (POIM), i.e. machines and resources.

The centerpiece of OMP Plus is its ability to tie up supply and demand using allocation cycles. Both supply and demand elements in SAP are dynamic, e.g. a forecast becomes a sales order and then a delivery. On the supply side, a planned order becomes a process order and is finally posted to inventory. Thus, an MRP element will change its type and unique identifier (ID) during the MRP life cycle. In each step of the life cycle, it is critical to track the identifier because it is tied up to the allocation. Such information was not available in the standard SAP interface and had to be made available by means of flat files using custom ABAP code. The import of SAP data takes place within OMP's SAI 1 (fetching of iDocs and flat files) and SAI 2 modules (updating the OMP Plus model), as depicted in Fig. 26.2. Custom macros written in OPAL (OMP's scripting language) were developed to import the flat files.

The planning results consist of an order allocation and supply elements (planned orders and process orders) that are sent to SAP's standard interface called CLOI (Class Logistics Optimization Interface). For intercompany replenishments, Purchase Requisitions are created using BAPIs because CLOI tables do not cover this functionality. OMP's SAI 3 module prepares the input data for CLOI tables while SAI 4 fills in the CLOI tables and sends back the reference of the newly created MRP elements.

OMP Plus' order allocation also indicates when an order can be shipped. After each allocation cycle and once the supply elements have been created in SAP, the production planner sends an allocation report to the customer service representatives (CSRs) in a spreadsheet format indicating what action needs to be undertaken for each order item. Potential actions can be:

- Do nothing, order can be shipped on time (or earlier) with the SKUs requested
- Re-promise for a later date with the initially requested SKUs
- Substitute requested SKU A with SKU B to meet the customer requested date.

In theory, the reallocation could be translated automatically in SAP. However, from a service standpoint, the supply chain department prefers to double check with customers whether the changes (re-promising or substitution) are acceptable before reflecting the order change in SAP.

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## 26.4 Integrated Order Confirmation and Supply Planning with OMP Plus

The ability to perform order allocations in an interactive manner (and batch mode) was a main driver for choosing OMP Plus against other APS alternatives such as APO's gATP. As Meyr (2009) points out, grouping orders helps improve the allocation's cost effectiveness as it gives more freedom to combine demand with supply elements (see Chap. 9 for more details on ATP). In the following, we will explain how the order allocation works and how it is used to trigger the supply plan.

### 26.4.1 Supply vs. Demand Elements

OMP Plus' core functionality consists of matching supply with demand elements. Both are downloaded from SAP ERP using the logic described previously. Table 26.2 lists all MRP element types retrieved and used within the allocation cycles. A certainty factor is assigned to the MRP element type. Demand elements with the highest certainty will be allocated first. Demand and supply elements with the lowest ranking might be excluded from the allocation cycles or be treated in the last possible cycle. The rationale behind is that you do not want to miss an order on the books because supply was allocated to a "less certain" demand (forecast or safety stock).

**Table 26.2** MRP elements by descending order of certainty

Demand elements in scope	Supply elements in scope
Delivery	Stock on hand
Dependent requirement of process order	In transit inventory
Sales orders	Purchase orders
Stock transfer orders	Process order
Quote	Firmed planned order
Dependent requirement of planned order	Purchase requisition
Transfer reservation (reqt of purchase req)	Planned order
Forecast	
Safety stock	

Within a plant, a Process Order is a supply but also triggers internal demand for components. This internal demand is taken into account when allocating orders to a supply that might require a planned order to execute the allocation.

### 26.4.2 Definition and Weighting of the Allocation Cost Matrix

The allocation cycles can be expressed as a transportation planning problem (TPP). Given  $S$  the set of supply MRP elements and  $D$  the set of demand elements, the objective is to minimize the allocation costs (26.1) subject to three constraints.

$$\text{minimize } \sum_{\substack{s \in S \\ d \in D}} cost_{s,d} \cdot Alloc_{s,d} \tag{26.1}$$

Constraint (26.2) ensures that the previous allocation is taken over before allocating new orders.

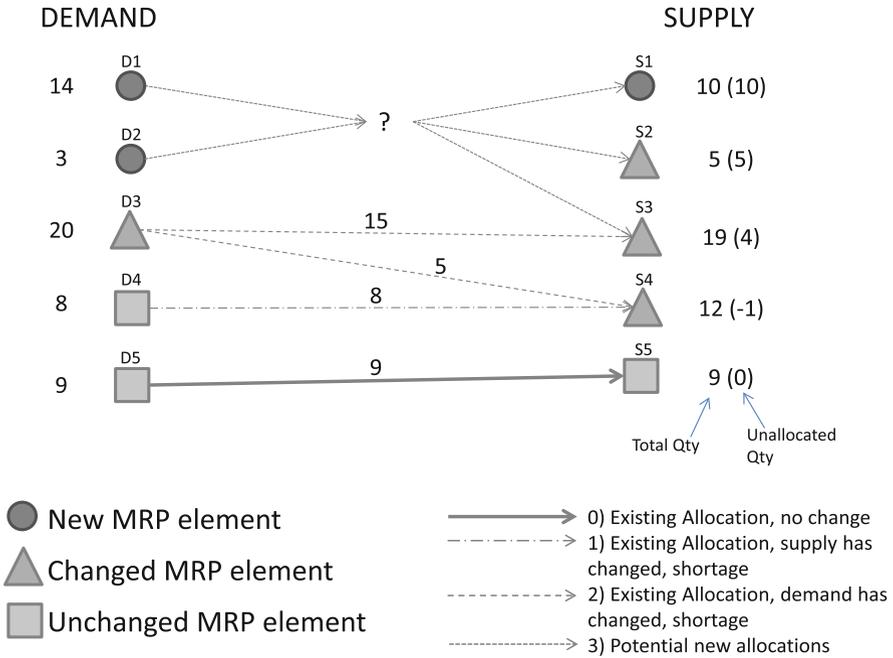
$$alloc_{s,d}^{ini} = Alloc_{s,d} \quad \forall s \in S, d \in D \text{ where } alloc_{s,d}^{ini} \text{ exists} \tag{26.2}$$

Constraint (26.3) states that the whole demand needs to be supplied while constraint (26.4) guarantees that supply is not over-allocated.

$$\sum_{s \in S} Alloc_{s,d} = demand_d \quad \forall d \in D \tag{26.3}$$

$$\sum_{d \in D} Alloc_{s,d} \leq supply_s \quad \forall s \in S \tag{26.4}$$

Additional logic has been built in to take into account the fact that supply elements might change between allocation cycles. For instance, a fully allocated supply of 10 might be reduced to 8, leading to a shortage of 2. Equation (26.2)



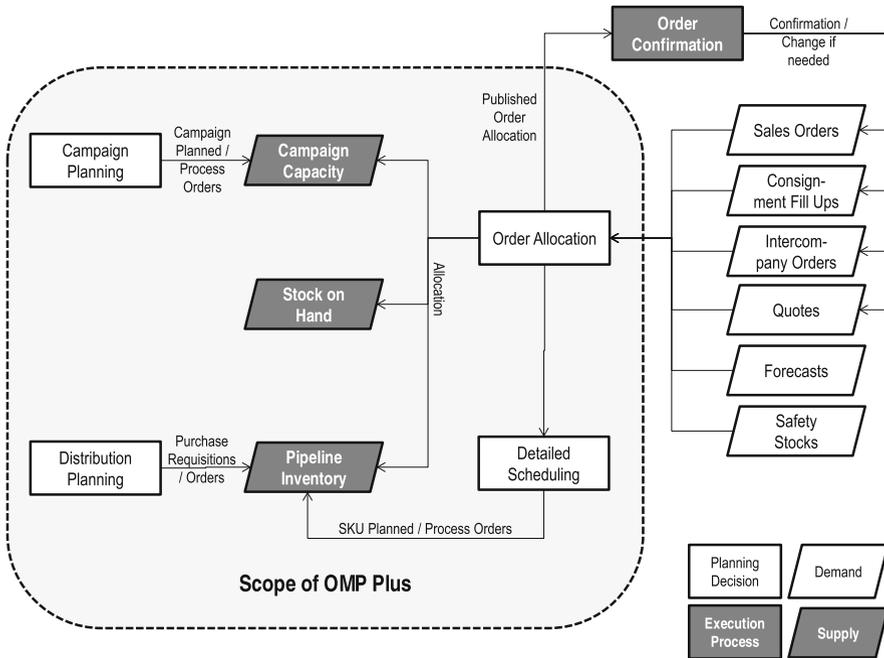
**Fig. 26.3** Order allocation with dynamic MRP elements

needs to be relaxed for the problem to be solvable. Furthermore, the allocation of the matrix takes place in several cycles, by descending certainty.

Figure 26.3 provides a graphical overview of the allocation logic. After the incremental download, the MRP elements are updated. OMP Plus differentiates between new, changed and unchanged orders.

In the case above, the allocation D5 and S5 remains unchanged. Elements D3 and D4 were fully allocated to S3 and S4 previously, however, supply element S4 now only allows 12 instead of 13 units to allocate. As a result, there is a shortage of 1 unit. The previously confirmed allocation will be treated in priority because orders were promised against this allocation. D4 will be treated before D3 in the allocation because D4 has not been altered while D3 has been changed between the two SAP downloads (change in quantity or customer requested date). New demand elements D1 and D2 can be assigned to supply elements S1 to S3 because these have unallocated quantities.

An accurate definition of the cost matrix is crucial for the automation of allocation cycles. Planners will trust the allocation “optimizer” provided it delivers explainable results. The allocation should therefore reflect what a scheduler might do in practice using common sense and standard business rules.



**Fig. 26.4** Order confirmation cycle with OMP Plus

The cost matrix is built using different characteristics such as:

- Due date of supply and demand elements (hence, will the allocation induce a delay?)
- Certainty of the order (if a demand element has high certainty, e.g. Delivery, and a due date in a very near future (tomorrow), you want to allocate stock on hand against it)
- Material specifications (among others: product dimensions, minimum lot size, packaging, product origin. . .).

Planners and schedulers maintain cost matrix tables in OMP Plus which define the compatibility between the material specifications of the supply and demand elements.

### 26.4.3 Creation of Supply for Pegging Purposes

Figure 26.4 provides a summary of the complete order confirmation and production planning cycle. Orders are entered in SAP throughout the day. SAP’s Available to Promise logic at Sales Order entry is set up in such a way that the order always confirms at the end of the total replenishment lead time. The total replenishment lead time reflects the service commitment of the product offering (next day to 10 days). At this moment, the sales order has been created in SAP but has not been

through the OMP allocation cycle. The Sales Order is thus flagged in such a way that the transport planner knows that he/she needs to wait prior to create the Delivery Note. A Delivery Note can only be created once the Sales Order has been “confirmed by OMP”.

Once the SAP MRP elements are exported to OMP, the planner gets a notification that new data is available for allocation. The automatic allocation is triggered once the planner acknowledges the new data and its import. The demand can be allocated to stock on hand, to pipeline inventory (in-transit) as well as to campaign capacity.

The allocation might require the creation of supply elements in SAP ERP (Planned Orders, Process Orders, Purchase Requisitions). These supply elements are created after order allocation using a functionality called “Publishing”.

Once the publishing is done, an Excel report is sent to the customer service team with the status of each order item. An action might be required and would be highlighted in the report. The most frequent actions imply either substituting an SKU by another or changing the material availability date. If the order confirmation is acceptable for the customer, the customer service representative will then flag the order as being “confirmed by OMP”. Every subsequent change to the order will set the “confirmed” flag back to zero.

The allocation only creates Planned Orders. Another step linked to the order confirmation cycle is the detailed scheduling, i.e. the finite scheduling of the supply elements. On a daily basis, the planner/scheduler transforms the Planned Orders into Process Orders. Since the available capacity is an integral part of the allocation cycles, the Process Orders seldom face capacity issues.

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## 26.5 Results and Lessons Learned

The roll out of the OMP Plus suite has brought drastic improvements for scheduling and re-promising. As of now, planners and customer service representatives have a full visibility on order pegging and capacity loading. Every change in the production schedule can be assessed real time on its impact on customers, despite thousands of active order lines at a given moment of time.

Thanks to the business rules, expressed in the form of a cost allocation matrix, more than 95 % of the order lines are allocated automatically by OMP Plus and do not require any manual intervention from the planner. Nevertheless, we observed that allocation rules may strongly vary between supply planners and world regions. Business rules needed to be adjusted regionally to match local preferences or priorities but could build on a standardized data structure. The application has been rolled out worldwide by a team of two during the past two years. Interestingly, the main efforts were put in tweaking the local allocation rules and getting the planners to feel comfortable with the application.

Due to the increase in automation, the quality of MRP data had to be improved, next to the ability of the planner to deal with advanced planning tools and concepts. Any flaw in master data has to be spotted by the planner and solved accordingly

because no supply can be sent to SAP otherwise. Before the implementation of OMP Plus, master data errors were tackled “outside the system”.

The main challenge for the project was and remains the management of the payload between SAP and OMP. On a daily basis, more than 50,000 stock requirement lists are exported from SAP to OMP, next to the related master data. Exporting such an amount of data takes time and planners have to work around this constraint. Thanks to an intensive collaboration with OMP, solutions were found to split the data download into smaller subsets that can be updated fast, hence providing almost real time data to the planner.

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