

Supply Chain Management with SAP APO™

Jörg Thomas Dickersbach

Supply Chain Management with SAP APO™

Structures, Modelling Approaches
and Implementation of SAP SCM™ 2008

3rd edition



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Preface

This book rather addresses the question ‘how to implement SAP APO™’ than ‘why to implement SAP APO™’ and is written for people who are involved in SAP APO™ implementations. It is based on the SAP APO™ release SAP SCM™ 2008. The aim of this book is to provide the reader with the necessary background to start with first own steps in the system in the right direction by explaining the architecture and some basic structures of SAP APO™ and introducing common modelling approaches.

Although there are already several books published about SAP APO™ and there is a detailed documentation of the functions in the system, we have experienced a distinct need for explanations regarding the structure and the interaction of systems, modules and entities. The understanding of the possibilities and necessities on entity level is the basis for the modelling and the implementation of the business processes. This book mentions additionally many issues which have a great relevance in implementations, but are not mentioned in the literature.

In our experience with SAP APO™ projects we noticed an ever greater need (which remains more often than not unaware for much too long) to clarify the implications of the SCM approach for the implementation projects. Since SCM projects with SAP APO™ differ significantly from SAP ERP™ projects, there are some typical traps in which even experienced SAP ERP™ project managers are apt to fall which cause severe problems up to project failure. Especially in the first chapter common mistakes in SCM projects are pointed out.

The book does not claim to describe all SAP APO™ functionalities and modelling possibilities – since the modelling approaches are nearly unlimited and the product is still evolving, this would be impossible. Instead the focus is set on explaining common approaches especially for the high tech, the consumer goods and the chemical industries. Not included into the scope of this book are the scenarios and functionalities especially for automotive industry, repetitive manufacturing and aerospace and defence, and some other functionalities as VMI to third party customers, container resources and campaign planning.

Since the focus of the book lies on the practical use of SAP APO™, SCM theory in general as well as in connection with SAP APO™ is not within the

scope of this book. Therefore instead of the SCM literature the SAP notes of the online service system (OSS) are quoted. Working with the OSS is anyhow inevitable for any implementation project and an important source for information.

Compared to the first edition this book contains additional topics (as transportation planning, interchangeability, bucket-oriented CTP and scheduling of complex job chains) and many updates in the functionality – representing two years' development.

Finally I would like to thank Jens Drewer and Claus Bosch, who helped me a lot during the whole project (the chapter about transportation and shipment scheduling was contributed by Jens Drewer), Bernd Dittrich for his help and comments on transportation planning, and Dr. Stephan Kreipl, Anita Leitz, Bernhard Lokowandt, Armin Neff, Stefan Siebert, Uli Mast and Christoph Jerger for their corrections and comments.

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Jörg Thomas Dickersbach

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Part I – Overview

1 SCM Projects with SAP APO™

1.1 The Supply Chain Management Approach

For a long time the focus in logistics projects has been on the optimisation of certain logistic functions – e.g. the optimisation of the transportation and distribution structure – usually with small concern to the adjacent processes and to the complete product portfolio. The supply chain management approach differs from this by grouping products with similar properties (from a logistics point of view) to a supply chain and taking all the processes – in SCOR terminology: plan, source, make, deliver – per supply chain into account. Figure 1.1 visualises the different approaches to structure the logistics processes within a company.

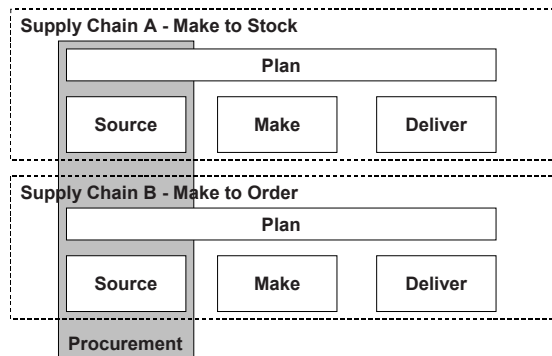


Fig. 1.1. The supply chain approach

The main differentiator for supply chains is the production strategy, that is if a product is created according to a specific customer demand (make to order) or anonymously (make to stock). Other criteria for separate supply chains might be different customer groups or product properties as the shelf life or the value.

The advantage of the supply chain approach is that the processes are examined from the point of view how they contribute to the targets of the supply chain management (e.g. low operating costs, flexibility and responsiveness or delivery performance). Therefore the integration between different logistical functions, for instance sales planning and production planning, is stronger within the focus of the supply chain management approach. In many cases the transparency between different logistical functions and between planning and execution offers already a significant potential for optimisation. The next step is to extend the supply chain approach beyond the limits of a single company and regard the entire value chain from the raw material to the finished product for the consumer. In this area the collaborative processes gain increasing importance.

• *Beer Game*

The beer game illustrates the importance of the transparency within the supply chain in a playful way. The supply chain for the beer game consists of a retailer, a wholesaler, a distributor and a factory. Each round a customer order is placed at the retailer, the retailer places his order at the wholesaler and so on unto the factory. The factory finally creates production orders. The goods flow is modelled by deliveries from the factory to the distributor, from the distributor to the wholesaler and so on to the customer. Each delivery requires goods movements across two fields and takes therefore two rounds. The production – the time between the creation of the production order and the goods receipt at the factory – requires three rounds. Figure 1.2 shows the structure for the order flow and for the goods flow.

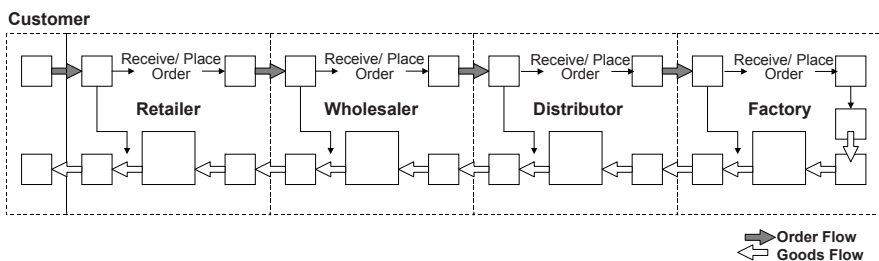


Fig. 1.2. The beer game

The customer orders are given and represent a steady demand with one increase of the level, as shown in figure 1.3. The game starts at a steady state with initial stock, orders at all levels and deliveries. The time lag between placing the order and receiving the supply, the insecurity about the future

orders of the partner on the demand side and the insecurity regarding the stock outs at the partner on the supply side usually cause overreactions for the own orders, which destabilise the supply chain. This behaviour is known as the ‘bullwhip effect’. Figure 1.3 shows the result of a game which was played with experienced sales and logistics managers. The orders of each team – retailer, wholesaler, distributor and factory – are displayed, and the amplitude of the changes in the order quantity increases with the distance to the customer.

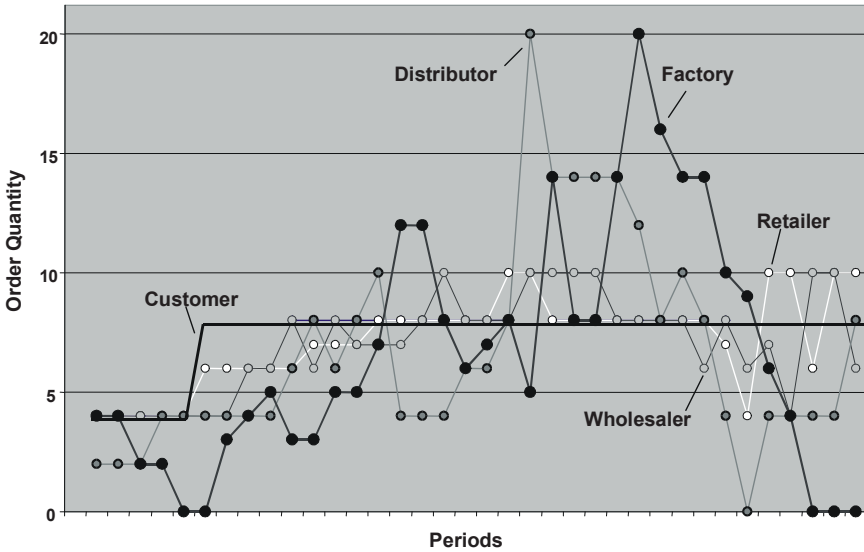


Fig. 1.3. The bullwhip effect

The impression at the factory site is that the customer demand is completely arbitrary. It is evident that a visibility of the customer demand across the supply chain helps to prevent this kind of destabilisation of the supply chain. To improve the transparency both a change of the processes and a system which enables the data transparency is necessary.

1.2 Supply Chain Management Projects with SAP APO™

A successful supply chain management project requires more than the implementation of a planning tool. The belief that the implementation of SAP APO™ solves all problems is in fact one of the major causes for the failure of SCM projects.

SAP APO™ is able to support SCM processes by visualising and processing data with a set of algorithms, but the adaptation to the particular business requirements has to be done in the particular implementation project. The prerequisite for this is that the requirements are clearly defined. No planning tool is able to provide the results you always wanted to have but never really thought of how to get them. Even if detailed requirements regarding the use of a planning tool exist, exaggerated expectations are a major risk for any SAP APO™ implementation. We strongly recommend keeping the solution as simple as possible – at least for the first step. To our experience all projects which aimed too high – by modelling too many constraints, avoiding manual planning steps at any price and including too many business areas, countries or plants – were significantly prolonged and had to reduce their scope in the end nevertheless.

Ideally a SCM project starts with a business case to define the targets and quantify the benefits of the project and is followed by a high level process design. The high level process design defines which processes are in the scope, whether they are local or a global and is used to define the according roles and responsibilities. Depending on the impact of the organisational changes, change management gains increasing importance to support the acceptance of the new processes and thus indirectly of the new planning system.

Another case is the implementation of SAP APO™ as a replacement of the existing planning systems due to support problems and/or strategic IT decisions. To our experience these cases are less apt to compromise regarding their expectations.

Since the supply chain management projects can significantly affect and change the company, a strong commitment by the sponsor in a sufficiently high position is necessary.

1.3 SAP APO™ Project Management and Peculiarities

SAP APO™ projects differ significantly from SAP ERP™ implementation projects, because the planning processes are usually more complex and less standardised and the integration aspects have an increased importance. The possibilities to model processes across modules and systems are quite numerous and the technical aspects of the system and the data integration do play an important part. The challenges for the project management in SAP APO™ implementations are mainly to define an appropriate project scope, avoid dead ends in the modelling approaches, ensure the integration of the processes and plan the necessary tests with sufficient buffers for changes (e.g. after the stress test).

Since SAP APO™ offers many functions and possibilities, it is very tempting to stretch the scope by including too many functions, constraints and business areas, countries and plants, so that the project becomes too complex to be successful. Therefore both in the definition of the scope as well as in the functional requirements a clear prioritisation is necessary. Generally we recommend a roll-out approach instead of a ‘big bang’ scenario, that is to divide the scope of a big implementation into several smaller implementations. The roll-out approach has the advantage of increased acceptance by a faster success and decreases the risk of running into a dead end (because of organisational incompatibilities, inappropriate modelling, insufficient master data quality ...).

We strongly recommend starting any SAP APO™ implementation project with a more or less extensive feasibility study. The benefits of the feasibility study is an increased security regarding the modelling approach and a basis for the definition of the scopes for the pilot and the following roll-out projects as well as for the project planning. The result of the feasibility study has to be a prioritisation of the functions and the business areas and an agreement about the scope and the modelling approach. To avoid misunderstandings due to working on a high level of abstraction and to ensure the feasibility of tricky modelling approaches, we recommend creating an integrated prototype in the systems already at this stage.

In general the benefits of advanced planning systems like SAP APO™ are the data transparency to support SCM decisions and the possibility to apply complex planning algorithms and optimisation techniques to improve the plan. Though optimisation techniques are often placed in the foreground, in most cases the main benefit is derived from the data transparency, and the application of processes which require a consistent global data basis – e.g. a coordinated sales and operations planning, demand visibility

and forecast collaboration, global inventory management – is usually already a big challenge for a company. Often however a master data harmonisation is required before these benefits might apply – the quality of the master data is a severe threat for any SCM project and has therefore to be carefully examined during the feasibility study. Another issue regarding the use of optimisation techniques which should not be underestimated is whether the result is understandable and hence accepted by the planner. Though there are processes where optimisation tools provide a clear advantage, awareness for the implications is necessary – especially in the first implementation steps.

One main advantage of SAP APO™ to its competitors is its property regarding the integration to SAP ERP™. Nevertheless both the importance and the difficulties of the integration to the execution system(s) are usually underestimated. The integration is not just a simple exchange of data but an alignment of planning and execution processes, the more the scope of the planning moves towards execution.

SCM processes are often modelled across modules and across systems. To avoid the risk of unfeasible interfaces (both from a process as from a data point of view), the project organisation has to be according to the processes and not according to the systems and modules (especially if the implementation project contains both SAP ERP™ and SAP APO™).

Typically an implementation project contains the phases project preparation, blueprint, realisation, test, go live preparation and support after go live. For the blueprint phase of a SAP APO™ implementation it is absolutely necessary to perform a prototyping in parallel, because the processes are too complex to design without system feedback. During the entire project the basis support has an increased importance due to the more complex system landscape and additional, new technologies as the live cache and SAP BI™, which require administration.

A challenge for the project management is to plan sufficient buffers for adjustments and corrections after the integration test and the stress resp. the performance test. Especially the performance test has to be as early as possible, since the result might cause the procurement of additional hardware or even a redesign of some processes. Another important issue which is often neglected is the system management concept, which defines the requirements and procedures for the system administration, e.g. for backup and recovery, for downtimes and for upgrades.

SAP offers a set of services to check and review the implementation projects at different stages both from a technical and a process modelling point of view. Using these services might help recognising problems earlier.

2 SCM Processes and SAP APO™ Modules

The focus of this book is the SCM processes within a company. Though the possibilities of collaboration with customers and suppliers and the according processes are mentioned as well, the focus is on the SCM within a company, because to our experience in this area there is still the biggest potential for most companies. From a company's point of view a supply chain usually consists of

- customers,
- distribution centres (DCs),
- plants and
- suppliers.

There might be several levels for distribution (e.g. regional and local DCs) or several levels of production, if one plant produces the input material for another plant. Another characteristic of a supply chain is whether sourcing alternatives exist. Multiple sourcing is common for suppliers, and in many cases alternatives exist for production and distribution as well. Common variants in the distribution are direct shipments from the plant to the customer (instead from the local DC) depending on the order size. The most common supply chain processes cover the areas

- demand planning,
- order fulfilment (sales, transportation planning),
- distribution (distribution planning, replenishment, VMI),
- production (production planning, detailed scheduling, production execution) and
- external procurement (purchasing, subcontracting).

In cases of multiple sources for internal procurement an integrated approach for distribution and production planning may be favourable as described in chapter 10. The difference between distribution planning and replenishment is that the purpose of distribution planning is to propagate the demand in the network to the producing (or procuring) locations. Therefore distribution takes place from short- to medium-term or even long-term and requires subsequent processes, whereas replenishment is concerned in the more operative task how to fulfil the demands within the network with

a given supply quantity (which might be often a shortage). Figure 2.1 shows the processes in relation to the part of the supply chain.

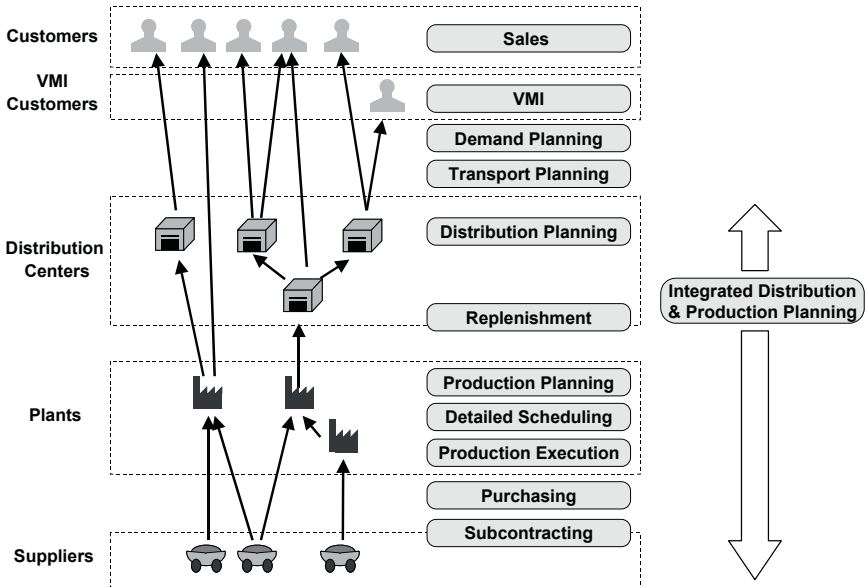


Fig. 2.1. Common supply chain processes

These processes differ both regarding their time horizon and their level of detail. A demand plan is usually established for 12 month to 5 years, whereas replenishment is carried out for some days to few weeks into the future. Regarding the level of detail, medium-term capacity planning is performed to get an overview of the monthly or weekly load on some bottleneck resources in contrast to a production schedule that contains the allocation of single operations with their exact duration to the resources. For additional information regarding the SCM processes Knolmayer et al. 2009 provides a good overview.

Figure 2.2 gives an indication about common time horizons of the respective processes.

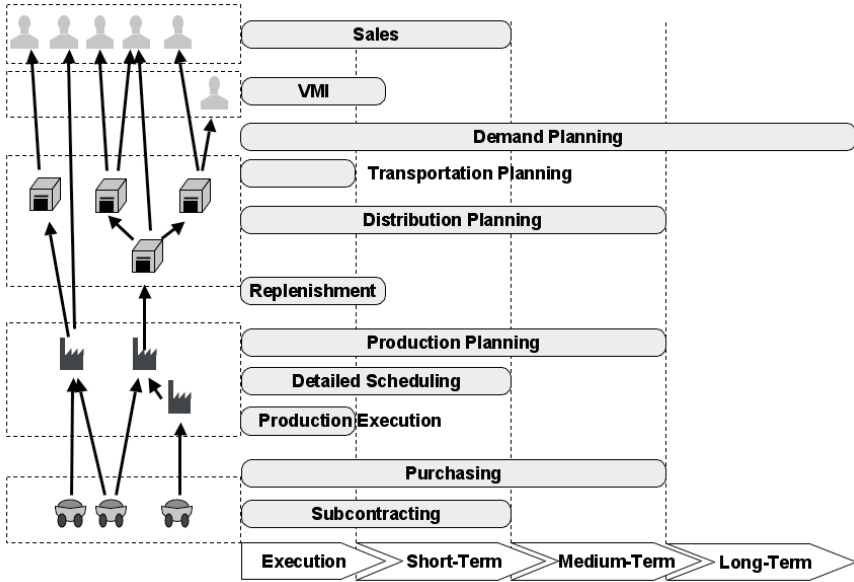


Fig. 2.2. Common time horizons for SCM processes

According to the different levels of the supply chain partners, time horizons and processes, SAP APO™ consists of different modules with different levels of detail. These modules are:

- Demand Planning (DP),
- Supply Network Planning (SNP) including deployment functionality,
- Production Planning & Detailed Scheduling (PP/DS),
- Available-to-Promise (ATP) and
- Transportation Planning & Vehicle Scheduling (TP/VS).

Figure 2.3 shows the positioning of these modules regarding the covered time horizon and the level of detail.

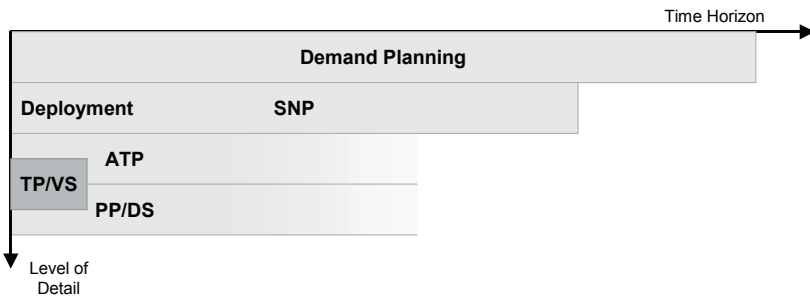


Fig. 2.3. Level of detail and time horizon for the SAP APO™ modules

Depending on the implementation, especially the time horizons for ATP and PP/DS might vary strongly. DP, SNP and ATP use time buckets:

- in DP usually months or weeks,
- in SNP usually months, weeks or days and
- in ATP days or parts of days.

PP/DS and TP/VS apply a time continuous calculation, so all orders are scheduled to hour, minute and second.

The supply chain processes identified above are generally modelled in the SAP APO™ modules as shown in figure 2.4. SNP provides three different methods for distribution planning resp. integrated distribution and production planning: the SNP heuristic which is not constrained by capacity restrictions, the SNP optimisation based on linear programming and the capable-to-match (CTM) heuristic which considers capacity constraints. Production planning and procurement – to a certain extent even distribution planning – are modelled either in both SNP and PP/DS, in SNP only or in PP/DS only, depending on the requirements for the process.

APO-DP	APO-ATP	APO-TP/VS	APO-SNP	APO-PP/DS
Demand Planning	Sales	Transportation Planning	VMI	
			Integrated Distribution & Prod. Planning	
			Distribution Planning	
			Replenishment	
			Production Planning	
				Detailed Scheduling
				Production Execution
			Purchasing	
			Subcontracting	

Fig. 2.4. SCM processes in SAP APO™ modules

From a supply chain project point of view figure 2.3 represents an implementation with the full scope of SAP APO™. There are some companies that apply SAP APO™ this way and even implement the complete scope at once. More often only a part of this scope is implemented – either as a first step or because this part is sufficient to satisfy the current needs. The

advantage of keeping the scope of the implementation small lies in getting early results and having a shorter project duration.

Many implementations have only DP in scope since it is both technically and organisationally the part with the least complications. Especially in cases when the SAP APO™ implementation is done together with a change in the processes – e.g. from a (internal) customer – (internal) supplier relationship towards a supply chain planning in global or regional companies – the organisational aspects become most critical to the success of the project. Other common architectures are

- ATP for availability check across several plants,
- PP/DS for scheduling and sequence optimisation,
- PP/DS for finite production planning,
- DP & ATP for demand planning and availability check of allocations,
- DP & SNP for demand planning, distribution planning and replenishment,
- DP, PP/DS & ATP if there is no focus on distribution in the supply chain and sourcing decisions are either irrelevant or made using rules based ATP.

These are only some of the possible or even of the realised architectures. Dickersbach 2008 gives an indication about the incidence in implementations. Because of the multiple possibilities to model processes in SAP APO™ an experienced consultant should be involved at the definition of the architecture and the scope of an implementation.

Collaboration between companies has in some cases doubtlessly advantages, but for the vision of competing supply chains this is only one part. The other part is to establish SCM within a company – which is usually the more difficult part because it affects the organisation to a much higher degree. The change towards collaboration might be a bigger one looking from a change in the process but it affects only a small part of the organisation.

3 SAP APO™ Architecture

3.1 Technical Building Blocks of SAP APO™

SAP APO™ consists technically of three parts: the database, the SAP BI™ data mart and the live cache. The SAP BI™ data mart consists of info cubes. The live cache is basically a huge main memory where the planning and the scheduling relevant data are kept to increase the performance for complex calculations. Though there is technically only one live cache per installation, the data is stored in three different ways depending on the application:

- as a number per time period (month, week, day) and key figure (time series),
- as an order with a category, date and exact time (hour: minute: second) and
- as a quantity with a category and a date in the ATP time series.

We will refer to the according parts of the live cache as time series live cache, order live cache and ATP time series live cache.

Demand planning uses much of the SAP BI™ functionality and relies on the info cubes as data interface to any other system – SAP ERP™, SAP SEM™ or flat file. Therefore the historical data is always persistent in an info cube. For processing the data is written into the time series live cache. SNP and PP/DS use mainly the order live cache, though SNP is able to access the time series live cache as well, since there are many structural similarities between DP and SNP. ATP at last relies only on the ATP time series live cache. This way of data storage implies a certain redundancy, because orders are stored both in the order live cache and in the ATP time series live cache. The data model is however quite different, and the redundant data storage enables better performance for the applications. TP/VS finally uses the order live cache to reference other orders. Figure 3.1 shows how the SAP APO™ modules use the live cache and the data integration for transactional data from SAP ERP™ to SAP APO™.

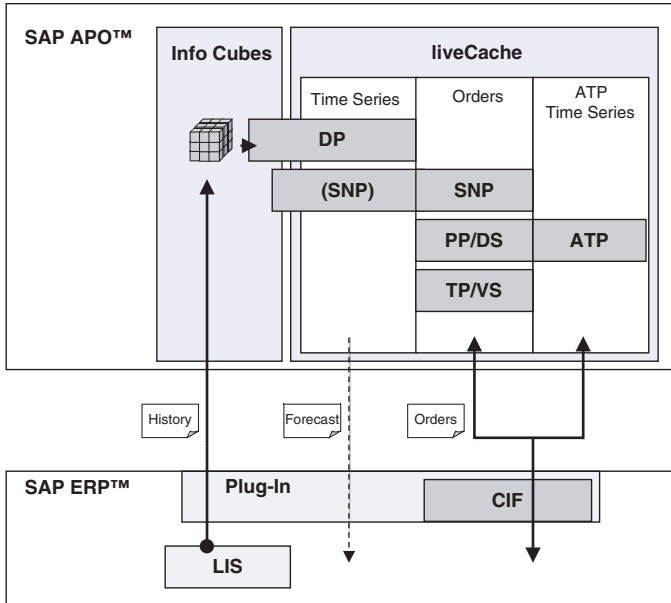


Fig. 3.1. SAP APO™ system structure and integration with SAP ERP™

The transactional data for planning purposes (e.g. planned orders and purchase requirements) are created in SAP APO™ and should preferably remain in SAP APO™ only to reduce the data load for the interface. In any case SAP APO™ should be the master for planning. For data with a close link to the execution (e.g. sales orders and purchase orders) SAP ERP™ is the master. Historical data finally is stored in SAP ERP™. For the integration of the transactional data and the data history with the plug-in SAP provides an interface from SAP ERP™ to SAP APO™. One part of the plug-in is the core interface (CIF), the other provides the interface to the SAP BI™ structures. The integration of SAP ERP™ to the SAP BI™ structures relies on the info structures of the logistics information system (LIS) in SAP ERP™, where transactional data is stored for reporting purposes according to the defined selection criteria. These data are uploaded into an info cube with periodic jobs.

In contrast to the periodic data upload to the SAP BI™ part the CIF provides an event triggered online integration. For example with the update of the goods receipt an event is created which triggers the transfer of the updated stock situation to SAP APO™. This information creates two entries in SAP APO™: one as an order in the order live cache and one as an element in the ATP time series live cache.

The release SAP SCM 2008 does not only contain SAP APO™ but other systems as well: the Supply Network Collaboration Hub (SAP SNC™), the Event Manager (SAP EM™), Forecasting and Replenishment (SAP F&R™), and the Extended Warehouse Management (SAP EWM™).

3.2 Master Data Overview

Like in SAP ERP™, master data plays an important role in SAP APO™ and controls many processes. Organisational entities like company codes or sales organisations on the other hand have no significance in SAP APO™. Some master data objects in SAP APO™ have analogies in SAP ERP™ like the product, and most of these are transferred from SAP ERP™. Others have to be maintained in SAP APO™.

• *Master Data and Applications*

Figure 3.2 provides an overview of the most important master data objects in SAP APO™ and in which application they are more or less mandatory (displayed in white) or only required for certain processes (displayed in grey).

Demand DP	Sales ATP	Transport TP/VS	Distribution SNP	Production SNP & PP/DS	Procurement SNP & PP/DS
Characteristic Value Comb.					
Location					
Product	Product				
	Rule				
	Resource				
		Transportation Lane			Transp. Lane
			Quota Arrangement		Quota Arr.
				PPM / PDS	
				Set Up Group & Matrix	
					Procurement Relationship
Interchangeability Group			Interchangeability Group		

Fig. 3.2. Overview master data and applications

Most of these master data have correspondencies to the SAP ERP™ master data. Table 3.1 shows these correspondencies for those master data that are transferred from SAP ERP™ via CIF.

Table 3.1. Corresponding master data objects in SAP APO™ and SAP ERP™

SAP APO™ Master Data	SAP ERP™ Master Data
Location	Plant
Product	Material
Resource	Work Centre (PP) or Resource (PP-PI)
Transportation Lane	Info Record
Production Data Structure (PDS)	Production Version
Production Process Model (PPM)	(Combination of BOM and Routing/Recipe)
Procurement Relationship	Info Record, Scheduling Agreement, Contract

The characteristic value combinations (CVCs) can be generated from historical data that is transferred from SAP ERP™. If no historical data is available, e.g. for the demand planning of new products, the characteristic value combinations can be maintained in SAP APO™ as well.

The characteristics for planning in DP are chosen freely – the sales organisation for example will often be used for demand planning, but does not have any other correspondence. Only for the product and the location the characteristics 9AMATNR and 9ALOCNO are used per default as a link to the product master resp. the location master for the data integration between the time series live cache and the order live cache. Figure 3.3 visualises the master data integration from SAP ERP™ to SAP APO™. This is a one directional process, no master data information is transferred from SAP APO™ to SAP ERP™.

The integration of the characteristic value combinations (CVCs) is performed using the historical data that is transferred to the info cube. The CVCs are generated from the info cube.