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In the last decade Advanced Planning Systems became a relatively mature software technology. Many major software vendors—especially the providers of ERP systems like SAP (Dickersbach 2009) and Oracle (Siddiqui 2010)—invested in APS technology and provide now a broad spectrum of APS modules and functionality.

One of the first Advanced Planning Systems was OPT that was implemented end of the 1980s (Schrageheim and Ronen 1990; Silver et al. 1998). OPT is based on the *Theory of Constraints* (Goldratt 1990), stipulating that the constraints of a production system have to be represented in detail in a planning system in order to exploit and to control its performance. The software vendor of OPT—STG Holdings Inc.—was acquired by Manugistics in 2001, which was acquired by JDA in 2006. Since 2005, more than 20 acquisitions of APS vendors could be counted. Twelve of these took place between 2010 and 2013. There is a continuous consolidation of the APS market on-going. Figure 16.1 gives an overview of the acquisitions of major APS providers of the last 15 years. The APS vendors included in Fig. 16.1 were selected according to a high degree of coverage of the APS functionality as defined by the supply chain planning matrix (see Fig. 4.3 on p. 77).

The major players in the SCM software arena are SAP, Oracle, JDA, Ariba, and Manhattan Associates. In 2012, these five software vendors together had a share of 49 % of worldwide SCM software revenues. In 2012, SAP took over Ariba, increasing the gap in SCM related revenue between Oracle and SAP. In 2012 SAP had a market share of 21 %, being followed by Oracle with a market share of 17 %.

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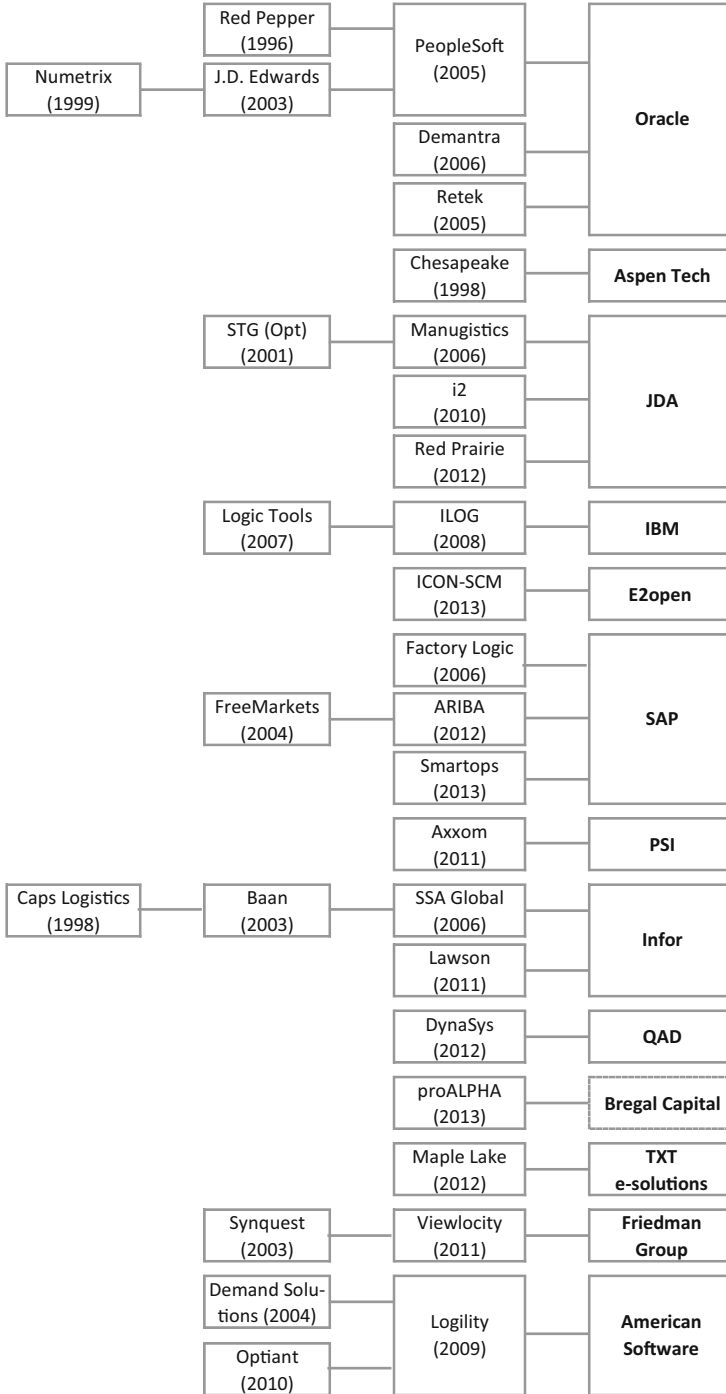
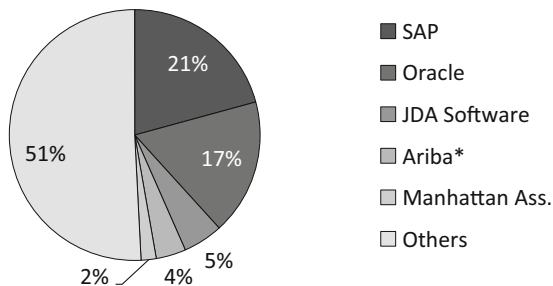


Fig. 16.1 Overview of acquisitions of APS vendors since 1996



Company	2012		2011		2011-2012	
	Revenue	Market Share (%)	Revenue	Market Share (%)	Growth (%)	
SAP	1.721	20,8	1543	19,9	11,6	
Oracle	1.453	17,5	1297	16,7	12,1	
JDA Software	426	5,1	430	5,6	-	1,0
Ariba*	319	3,8	367	4,7	-	13,0
Manhattan Ass.	160	1,9	142	1,8	13,2	
Others	4.216	50,9	3115	51,3	20,4	
Total	8.296	100,0	6893	100,0	7,1	

* Ariba's estimates represent nine months of business operations before its acquisition by SAP.

Fig. 16.2 Top five SCM software vendors by total software revenue, worldwide 2012 (millions of dollars) (Gartner 2013)

JDA is number three with a market share of 5%, being the largest supply chain focused software vendor. Figure 16.2 shows the market volume and market share 2011 and 2012 of the top five SCM software vendors as published by Gartner (2013).

Besides the top five (after the acquisition of Ariba by SAP: top four) software vendors, there are still many small to mid-sized software vendors on the market; mainly in specific market niches. The potential user has a large variety of systems to choose from, and in many cases, a clear indication which system to buy and implement is not at hand. Thus, a systematic approach for the selection of an APS is required. The following four steps provide a guideline and a proven methodology for the selection of an APS:

1. Create a *short list of APS* based on parameters such as supported planning processes, industry specifics, information on the APS vendor companies, license fees and typical implementation time and effort for the APS (Sect. 16.1).
2. Assess the APS on the short list based on the *requirements* that have been collected in the definition phase of the APS project (see Chap. 15). Remove APS from the short list that do not fulfill the major requirements (Sect. 16.2).
3. Setup a detailed implementation plan including a refined estimate of the effort and the timelines for the *implementation and integration* of the APS (Sect. 16.3).
4. Compare the APS vendors based on their *post implementation effort and support model* (availability and costs for user support, service fees, release migration, etc.; Sect. 16.4).

The results from the requirements analysis, implementation and integration planning and the support model are consolidated, resulting in a ranking of the APS vendors. In the following sections we detail the selection methodology for the selection of an APS.

16.1 Creation of a Short List

In the early phase of the selection process the “strategic fit” of the APS with the targeted planning processes, the industry within which the supply chain is operating (as far as industry solutions are concerned), the budget targeted for the APS implementation project and the planned implementation time may be equally important as the features and functions. The assessment of the APS by these criteria cuts down the number of APS that have to be considered in the subsequent detailed analysis. By that, time and effort for the selection process can be reduced.

16.1.1 Planning Processes

Table 16.1 lists a range of APS vendors. The information about the selected APS as shown in Table 16.1 (and in the other tables of this chapter) is based on three APS market surveys:

1. The first study is a market survey of Supply Chain Management software conducted 2003 by the Supply Chain Management Competence & Transfer Center (Laakmann et al. 2003). Laakmann et al. compare 23 APS vendors and give detailed information about the individual modules of the 23 APS, grouped by vendor.
2. The second study is a market survey focusing on SCM solutions for the medium-sized businesses conducted by the Business Application Research Center (BARC), a spin-off from the Chair for Information Science at University of Würzburg (Albert et al. 2006). Albert et al. compare 14 APS vendors regarding planning philosophy and concept, functionalities and user friendliness.
3. As not all APS covering modules from the supply chain planning matrix were contained in these two studies, J & M Management Consulting conducted additional market surveys in 2007 and in 2013. These studies are based on information from a questionnaire that was filled in by the APS vendors directly and on internet research by the authors.

Note, that some of the APS vendors included in the first two studies were not included in this chapter, as the intersection of their functionality with the supply chain planning is too small, because the information that was available about the products of these vendors was not sufficiently detailed or because the APS vendors were acquired by other software vendors as shown in Fig. 16.1. The planning tasks that may be supported by an APS are summarized by the Supply Chain Planning Matrix. The columns in Table 16.1 represent APS software modules according to the SCP matrix (refer also to Fig. 5.1 on p. 100). In addition to the modules

Table 16.1 Planning processes covered by APS modules

	Strategic Network Design		Demand Planning		Master Planning		Demand Fulfilment/ATP		Production Planning & Scheduling		Distribution & Transport Planning		Collaborative Planning		Alert Management	
Adexa		●	●	●	●	●		●	●	●	●	●	●	●	●	J&M 2013
American Software		●	●	○	○	●	●	●	●	●	●	●	●	●	●	J&M 2013
Aspen Tech		●	●	○	●	●	●	●	●	●	●	●	●	●	●	J&M 2013
Friedman Group	○		●	○	●	●	●	●	●	●	●	●	●	●	●	J&M 2013
IBM	●	○	●	●	○	●	○	●	○	●	○	●	●	●	●	J&M 2013
Infor		●	●		●	●	○	●	○	●	○	●	●	●	●	J&M 2013
Inform	○	●	●	●	●	●	●	○	●	○	●	○	●	●	●	J&M 2013
JDA	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	J&M 2013
Manhattan Assoc.	○	●	○					○	●	●	●	●	●	●	●	J&M 2013
OM Partners	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	J&M 2013
Oracle	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	J&M 2013
ORsoft	○	○	●	●	●	●			○	○	○	○	○	○	○	J&M 2013
proAlpha		○	●	●	●	●			○	○	○	○	○	○	○	Albert et al. (2006)
PSI	●	●	●	●	○	○	○	○	○	○	○	○	○	○	○	J&M 2013
QAD		●	●	○	○	●	●	●	●	●	●	●	●	○	○	J&M 2013
Quintiq	○		●	●	●	●	●	●	●	●	●	●	●	●	●	J&M 2013
SAP		●	●	●	●	●	●	●	●	●	●	●	●	●	●	J&M 2013
TXT e-solutions		●	●	●	●	○	○	○	●	●	●	●	●	●	●	Albert et al. (2006)
Wassermann	○	●	○	●	●	●	●	●	●	●	●	●	●	●	●	J&M 2013

- Core functionality of software vendor
- Additional functionality of software vendor

shown in Fig. 5.1 we included two further processes: Alert Management (Chap. 13) and Collaborative Planning (Chap. 14). For each software vendor, information is provided how the functionalities of the APS software modules are included in the product offering of that vendor, e.g. whether an APS software module is considered to be core functionality (indicated by a “●”) or additional functionality of the respective software suite (indicated by a “○”). An empty field means either that no information was provided by the vendor, or that this functionality is not covered by the APS.

16.1.2 Industry Focus and Experience

The supported industry sectors are important selection criteria for APS, as some vendors have specific expertise in certain industries, supporting the planning processes of these industries better than other vendors. The manufacturing processes, the used

terminology, the business rules, the planning processes, the optimization procedures and the reporting requirements strongly differ across industries (Felser et al. 1999). Although the main APS vendors have substantial credentials in almost all industry sectors, for a number of reasons APS vendors often have a focus on one or two specific industry sectors, for example:

- The engineers that are responsible for the design and the implementation of the system already had experience in these industries.
- The first successful implementations were installed in these industries.
- For strategic reasons the APS vendor is focusing on these industries.
- Specific planning features are a prerequisite for specific industries. Unless there are potential clients no effort is spent to include these features in the APS.

Some of the APS vendors launch implementation initiatives for specific industries, trying to extend the scope of their expertise to a new area.

The main improvement areas of an APS implementation strongly depend on the type of industry and the type of the supply chain according to the supply chain typology, respectively (refer to Chap. 3). See Chap. 4 for a description of the dependency between industry specific planning tasks and the supporting planning concepts and methods. In distribution intensive industries, the main potentials are in the optimization of the distribution and transportation operations, including the deployment of supply and the reduction of inventory. In asset intensive industries, major improvements are possible by the optimization of the throughput, the detailed scheduling of the capacity bottlenecks and the reduction of change over time. In material intensive industries forecasting and procurement decisions influence business performance and should be optimized by the APS. Table 16.2 gives an overview of the industries supported by the APS vendors.

A remark has to be made related to a metric, that is often used by software vendors to indicate experience in certain industries: the number of installations. The procedure to measure the number of installations strongly depends on the APS vendor. Some vendors take only the number of sites that are supported by their APS, others count all installations of individual APS modules separately, leading to a larger number of installations. Furthermore, some vendors consider any installation, whether productive or in an early implementation stage, whereas others consider only installations where the customer has announced that the system is being used productively. Thus, it should be defined precisely by the vendor how the number of installations is being measured.

16.1.3 Information on the APS Vendor Companies

Besides the supported planning processes and the industry focus, information on the APS vendor companies are important for the selection process to be able to identify a reliable business partner. Table 16.3 lists the following information:

- The year the company entered the APS market
- Number of employees

Table 16.2 Industry focus and experiences of APS vendors

	Aerospace & defense		Automotive		Clothing/apparel		Consumer packaged goods		Electronics/high tech		Food & beverage		Logistics service providers		Pharma/chemicals/petroChem		Semiconductor		Machinery		Retail		Paper & metals		
Adexa	○	○	●	●	●	○							●	●											
American Software			○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Aspen Tech				●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Friedman Group	●	●		●	●	○	●	●	●	●	●	●	●	●	○	●	●	●	●	●	●	●	●	●	●
IBM	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Infor	○	●	●	●	●	●	●	●	●	●	●	●	○	●	●	●	●	●	●	●	●	●	●	●	●
Inform	●	●	○	●	○	●	○	●	○	●	○	●	○	●	○	●	○	●	○	●	○	●	○	●	○
JDA	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Manhattan Assoc.				○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
OM Partners		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Oracle	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
ORsoft	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
proAlpha				●	●	○																			
PSI	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
QAD		○		●	●	○																			
Quintiq	○		●			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
SAP	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
TXT e-solutions			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Wassermann	○	●	○	●	●	○																			○

- Numerous references available for this industry sector
- Limited number of references available for this industry sector

- Revenue of the year 2012
- Link of the vendor’s website.

Note that, as mentioned before, many APS vendor companies went through a series of mergers and acquisitions, making the historic information difficult to interpret and compare.

16.1.4 License Fees

Typically, the size of the customers of an APS vendor also relates to the license fees. Whereas APS vendors with larger customers tend to be in the upper price

Table 16.3 Information on APS vendor companies

	Year of APS market entry	Number of employees	Revenue 2012	Website
Adexa	1994 ¹	150 ¹	274 m \$ ¹	www.adexa.com
American Software	1996	na	102 m \$	www.amsoftware.com
Aspen Tech	1984	1,325	243 m \$	www.aspentech.com
Friedman Group	2011	na	na	www.friedman-group.com
IBM	na	430,000	104 bn \$	www.ibm.com
Infor	na	12,400	2.8 bn \$	www.infor.com
Inform	1980s	450	50 m euro	www.inform-software.de
JDA	1978	4,600	> 1 bn \$	www.jda.com
Manhattan Assoc.	1989	2,400	376 m \$	www.manh.com
OM Partners	1985	250	> 31 m \$	www.ompartners.com
Oracle	1990	120,000	37 bn \$	www.oracle.com
ORsoft	1990	67	8 m €	www.orsoft.net
proAlpha	1995	528	58.8 m €	www.proalpha.de
PSI	2011	1,590	181 m €	www.psi.de
QAD	2012	na	252 m \$	www.qad.com
Quintiq	1997	750	60 m €	www.quintiq.com
SAP	1998	65,000	16 bn €	www.sap.com
TXT e-solutions	1989	580	47 m €	www.txtgroup.com
Wassermann	2004	na	na	www.wassermann.de

¹ For Adexa, no up-to-date information was available. Therefore, we used the last information available from 4th edition

segment, the APS vendors with small and medium sized customers are more often found in the lower price segment. In many cases, the license fees are determined based on the number of users and the expected business benefits created by the implementation of the APS—measured by KPI improvements as described in Chap. 15. The license fees should match the expectations and the targeted budget of the APS implementation project. However, it is often difficult to get information about the pricing model applied by the APS vendors without entering actual contract negotiations.

16.1.5 Implementation Time and Costs

Besides the supported planning processes, the industry focus and the general vendor information and license fees, the typical implementation time and costs should be considered. From this, an estimate of the required use of internal resources as well as external consultants and experts from the APS vendor may be derived. The best information source to estimate the time and effort are reference projects in the same industry—or in related industries, as direct competitors most probably will not talk about their experiences. The APS vendors should provide a list with references

where projects with a similar scope had been completed and set productive. A visit at one or several reference sites is strongly recommended at an early stage of the selection process in order to learn from the experiences that have been made with the APS vendor and its systems.

16.2 APS Requirements

The main result of the definition phase of the APS project has been the detailed requirements list (see Chap. 15). The list can contain more than 100 individual requirements; in order to be able to handle large numbers of requirements, these should be grouped according to the planning processes that are in the scope of the APS implementation project.

The SCP Matrix shown in Fig. 4.3 (p. 77) can be used to identify the planning processes that are to be supported by the APS, e.g. Demand Planning, Master Planning, Demand Fulfillment and Production Planning and Scheduling. All requirements should be assigned to one or multiple of the selected planning processes.

Although APS are a relatively mature software technology, covering all main functional areas, most systems are only partially developed with respect to the full functional scope announced by the APS vendors, especially as far as requirements of specific industries on a very detailed level are concerned. In some areas, the APS therefore have to be further developed, either by adding additional functionality, resolving issues within existing functionality or better integrating the functional modules. The latter issue—lack of integration—is especially a problem for APS vendors that have acquired another APS vendor in order to include the systems of that vendor into their own product suite. To reflect the coverage of the functional requirements and the plans of the APS vendors to further develop their systems, the following assessment scheme has been developed, consisting of five levels:

- *Level 1:* The functionality is not available; there is no plan to develop this functionality.
- *Level 2:* The functionality is not available; it is planned to develop this functionality in the future.
- *Level 3:* The functionality is partially available; there is no plan to develop this functionality further.
- *Level 4:* The functionality is partially available; it is planned to further develop this functionality in the future.
- *Level 5:* The functionality is currently fully available.

There are three options to evaluate the functional requirements according to these five levels. The easiest and fastest way to get an assessment is to hand over the detailed requirements list grouped by the planning processes to the APS vendors and ask them to provide a self-assessment of their respective systems. For requirements being evaluated to be at levels 2 and 4, a date for the availability of the future development must be provided by the APS vendor; for requirements being evaluated to be at levels 3 and 4, details about the degree to which the functionality is currently available must be provided by the APS vendor.

The second option is to ask the APS vendors to demonstrate the required functionality in a live demo. As this takes more time and effort than the first option—on both sides, the potential customer and the APS vendor—only key functionality should be selected for demonstration. Typically, the second option is combined with the first option: Based on the self-assessment of the APS vendor, critical functional requirements are selected to be shown in a live demo. In order to prepare this, the APS vendor can be asked to state for each functional requirement his ability to demonstrate that functionality, according to the following scheme:

Level A The functionality can be demonstrated with an existing demonstration set with less than 24 h lead-time.

Level B The functionality can be demonstrated, but requires changes to the standard demonstration models (no changes to the software).

Level C The functionality can be demonstrated at another customer's site.

Level D The functionality cannot be demonstrated easily.

The third option is to implement a prototype to assess in detail to what degree a specific functional requirement can be fulfilled by an APS. This of course creates additional effort and must be carefully planned. The following issues should be clarified before starting a prototype implementation:

- The scope and the target of the prototype must be clearly defined. Only critical functional requirements and interface issues should be prototyped. For example, the integration of the APS into an existing order entry system can be evaluated by implementing a prototype system.
- A data set for the prototype implementation may be generated or may be extracted from the operational systems, e.g. ERP-systems.
- A detailed project plan for the prototype implementation and a budget (cost and time) must be set up. This includes the decision of what portion of the effort is taken over by the APS vendor.
- In relation to this it must be decided which APS shall be included into the prototype implementation effort. Normally, the number of systems that are prototyped is restricted to one or two. Otherwise, too much effort is invested into development work that cannot be reused in the real implementation project after the selection process.

Based on the prototype implementation(s) it must be possible to answer all open questions that have been included in the scope of the prototype.

The results of the self-assessment by the APS vendors, the results of the system demonstrations and the results of the prototype implementation are summarized in a report on which the selection decision will be based.

16.3 Implementation and Integration

The estimated effort for the implementation of the system and the integration of the APS into the existing IT landscape has to be considered upon the selection of an APS, in order to match budget restrictions.

16.3.1 Implementation of the APS Functionality

The implementation tasks can be grouped into

- The modeling of the supply chain, including the definition of the locations, sites, material flows, operations, buffers, resources etc.
- The customization of the planning procedures and the optimization algorithms (e.g. the parameters of a scheduling heuristic)
- The setup of internal data structures and databases
- The realization of organizational changes
- The training and project management activities.

Typically, APS use specific modeling techniques and representations of the supply chain and employ system specific planning and optimization techniques. Thus, the implementation approach and the implementation effort strongly depend on the selected APS.

Based on the initial estimate of the implementation effort for each of the APS modules that are in the scope of the project, a rough-cut project plan is created. This is done for those APS that are on the top of the short list; in order to keep the planning effort low, the creation of rough-cut implementation schedules should be restricted to the top two or three systems. The plans have to account for the availability of the required APS functionality. If one of the vendors has announced that a specific functionality is available at a certain point in time, all related implementation tasks have to be moved out accordingly. In the next step, the functional implementation plan is extended by the required integration tasks.

16.3.2 Integration Technology

The integration approaches for APS range from vendor specific integration techniques to standard middleware systems (see Fig. 16.3 for an overview; a detailed description of integration and communication approaches for supply chain planning is given in Chap. 13).

There are three approaches to integration: Internal integration technology of the APS, special integration technology provided by the APS vendor, integration technology provided by third-party vendors. As an example for the first approach, SAP provides a tight integration of their Advanced Planning System APO into SAP's ERP system R/3 via the Core Interface (CIF), taking care of the exchange of master data, transactional data, and planning data between SAP R/3 and SAP APO.

As an example for the second approach, JDA provides its own middleware product *JDA Platform* that is open to a large variety of other systems including SAP, Oracle/PeopleSoft/JD Edwards, Microsoft Dynamics GP (Great Plains) and AX (Axapta) and Infor/SSA Global and provides a wide range of integration mechanisms, formats and protocols including flat file, table-to-table, tRFC, XML parsing, message queue processing, transactional exchange and web services. SAP

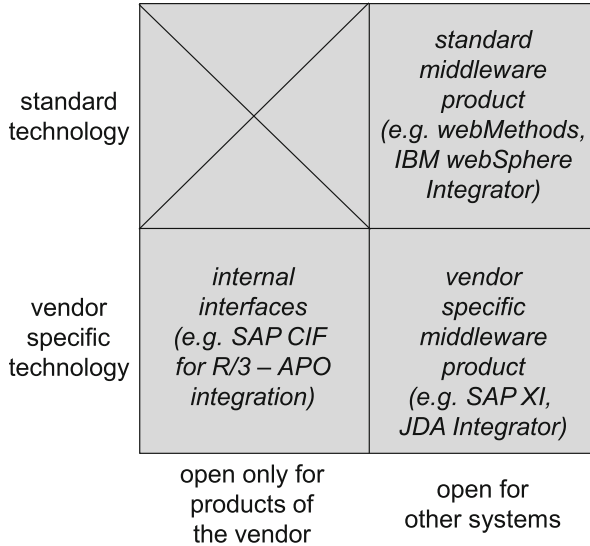


Fig. 16.3 Classification of APS integration technology

also provides an open integration tool SAP eXchange Infrastructure (XI) that is open for other systems.

Examples for the third approach, integration technology provided by third-party vendors, are Enterprise Application Integration (EAI) systems like webMethods or IBM webSphere Integrator (formerly CrossWorlds).

There are advantages and disadvantages for each of the three integration approaches. Internal interfaces like those between SAP R/3 and SAP APO are the easiest to implement. Base data and dynamic data are transferred between R/3 and APO via the internal interface without the need of further interface implementation. However, this holds true only for data *that is already maintained by the ERP system*. Data that is provided by external systems, for example a shop floor control system, requires extra interface programming. Furthermore, the aggregation of data required to map operational data from the ERP system to a master planning model is only partially supported (see also Chap. 8).

APS vendor specific middleware products are open to external systems. Interfaces between the APS and external systems are customized; programming is normally not required to setup the data transfer. Many integration systems use *mapping structures*, mapping the fields of a data source to the fields of a data target. For example, the source could be the master plan as maintained by the APS, the target could be a table in the ERP system. SAP provides a full EAI system called XI that is open to SAP and non-SAP systems. Standard middleware products and EAI systems provide a similar functionality as APS vendor specific middleware products, with the additional advantage that the system is not proprietary technology of the APS vendor, but is supported by a wider range of applications.

incremental planning procedure	<i>netchange required for incremental plan adjustment</i>	<i>high performance data netchange required</i>
initial planning procedure	<i>upload of full data set appropriate</i>	<i>netchange data upload may be required for performance reasons</i>
	performance of data upload not critical	performance of data upload critical

Fig. 16.4 Integration modes dependent on performance and planning process requirements

Both APS vendor specific and standard middleware products support the creation of *data interfaces* between a source and a target system very well. Aggregation and filtering rules can easily be implemented on top of these middleware products. But note that data integration is only the first step. In order to fully integrate an APS with other systems, the integration must be extended to the *functional level*. Consider as an example the transfer of the master plan from the APS to some ERP system. The transfer of the master plan into some table of the ERP system is just the first step. The full integration requires that appropriate transactions in the ERP system are invoked to further process the data. For example, demand data could be created in order to drive purchasing decisions within the MRP module based on the master plan (see also Chap. 11).

16.3.3 Integration Mode, Performance and Availability

Besides the integration technology, the integration mode has to be assessed. In general, a *full data upload* into the APS is distinguished from a *netchange of the data* (refer to Chap. 13). The decision whether upload of the full data set is acceptable or whether a netchange interface is required, depends on the planning processes that will be supported and on the performance of the data load (see Fig. 16.4).

If an initial plan is created and the performance of the data upload is not critical, a full data upload is appropriate. If performance is critical or if the planning process incrementally maintains a plan, only the changes of the data have to be uploaded into the APS. Some APS like SAP APO even provide an online interface between

the APS and the ERP system. For example, new production orders and changes to existing production orders are continuously transferred to the production planning and scheduling module of APO, and the netchange to the plan is computed by APO. This enables the continuous update of the production plan and quick responses from the APS to the shop floor.

For some planning processes, e.g. order confirmation, not only the performance, but also the availability of the interface and the integrated system must be considered. It may be crucial for the business performance that *every order* gets a quote in nearly real-time, i.e. within milliseconds, even in case of system failure. In order to guarantee a high availability of the order promising system, some APS vendors employ highly available transaction systems like the TIBCO data bus that has been developed for use in highly available, online transaction environments as for example the finance sector (Tibco 2014). The mean time between failures can be used as a measurement for the availability of the integrated system.

16.4 Post-implementation Effort and Support Model

The fourth step in the selection process is the assessment of the expected post-implementation effort and the support model of the APS vendor. The efforts—and costs—that are created after the completion of the implementation can be classified into

- The yearly maintenance and support fees requested by the APS vendor
- The costs for a release update and the typical frequency of release updates
- The costs for the system administration
- The costs for the user support.

Most APS vendors charge a specific percentage of the license fees per year for the continuous support services they provide to their customers. Typically, the yearly support fees are in the range of 15–25% of the license fees. However, the availability of the support centers, the languages in which support can be given and the range of the support services differ. Some APS vendors offer the full range of their services online via the Internet, while others rely more on telephone support. It is especially useful if the APS vendor is able to login remotely to the APS in order to detect and resolve issues.

As APS are still evolving very rapidly, APS vendors offer several updated and extended releases per year. According to the guiding rule *Never change a running system*, one should not follow every release change immediately. However, some APS vendors offer support services only for the latest release. Thus, the APS of these vendors should be upgraded on a regular basis to the latest release (e.g. every second release). In order to get a rough idea about the effort for an upgrade of the system to a new release, other customers of the APS vendor should be interviewed about their experience related to release changes. Especially, the question whether external support in addition to the support of the APS vendor is required or not

has to be answered, as external support would require a higher budget for release changes.

Besides release changes, general administration tasks have to be assessed. Examples of these tasks are

- Administration of databases used by the APS
- Rollover of a rolling monthly or weekly plan to the next planning cycle
- Administration of the APS servers on operating system level (in most cases, Unix or Windows servers are used)
- Extension and/or adaption of the APS, e.g. creation of new reports, installation of new clients, modification of models, user administration etc.

For each of these administration tasks it must be decided whether it will be managed internally or whether the task will be outsourced. In both cases, the skills required and the effort generated have to be assessed for all APS considered.

The fourth post-implementation task that should be evaluated in order to compare APS is user support. In practice, a three level support structure is often setup: First level support is given by so-called *super-users*. A super-user is an especially skilled and trained end user, who is able to receive descriptions of issues from other end users, explain and resolve simple issues and transmit a complete description of a complex issue to second level support. Typically, the super-users have already been members of the implementation team and have supported the APS implementation project in a leading role. Second level support is normally embedded into the standard IT support organization. Some issues, especially those related to system administration, will be resolved there. Internal issues of the APS will be forwarded to third level support, i.e. the support of the APS vendor. APS differ in the tools for issue detection and resolution they provide. Again, it might be useful to ask other customers of the APS vendors about their experience with costs and effort related to the end user support for the product of the APS vendors.

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