

# SAP®/R3™ as Part of a Federated ERP System Environment

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## ABSTRACT

Enterprise resource planning (ERP) systems are complex software systems and consist of many software components which provide specific functionality. Such ERP systems depend on very large-scale infrastructures like servers and networking technology, which are very expensive to install and to maintain. Particularly small and medium-sized enterprises cannot afford such systems because of the high costs that are connected to the purchase, installation, customizing and maintenance of large ERP systems like SAP®/R3™. This proposal describes a model which allows the provision of SAP/R3 internal functionality to various ERP-Clients. The new idea is that a number of enterprises can share their future IT-costs by applying the proposed model which includes an SAP/R3 system in a Federated ERP (FERP) system environment. In this context SAP/R3 is taken as an example for large ERP systems.

## 1 INTRODUCTION

### Definition 1:

An *ERP system* is a standard software system which provides functionality to integrate and automate the business practices associated with the operations or production aspects of a company. The integration is based on a common data model for all system components and extends to more than one enterprise sectors [1, 2].

Modern ERP systems consist of many software components which are related to each other. Currently these components are administered on a central application server. In connection to the ERP system complexity several problems appear:

- Not all installed components are needed.
- High-end computer hardware is required.
- Customizing is expensive.

Due to the expensive proceedings of installation and maintenance only large enterprises can afford such complex ERP systems. One solution to face these problems is to develop a distributed ERP system where the system components are reachable over a network (e.g. internet). This component ensemble (federated system) still appears as single ERP system to the user, however it consists of different independent

elements which exist on different computers. Based on this construction it is possible for an enterprise to access on-demand functionality (components) as services of other network members over a P2P network. This approach solves the mentioned problems as follows:

- Due to the separation of local and remote functions, no local resources are wasted for unnecessary components.
- Single components are executable on small computers.
- Due to decreasing complexity of the local system also installation and maintenance costs subside.

### Definition 2:

A federated ERP system (FERP system) is an ERP system which consists of system components that are distributed within a computer network. The overall functionality is provided by an ensemble of allied network nodes that all together appear as a single ERP system to the user. Different ERP system components can be developed by different vendors.

### Definition 3:

- An *ERP system component* in this case is a reusable, closed and marketable software module which provides services over a well-defined interface. These components can be combined with other components in a not foreseeable manner [3, p. 19].

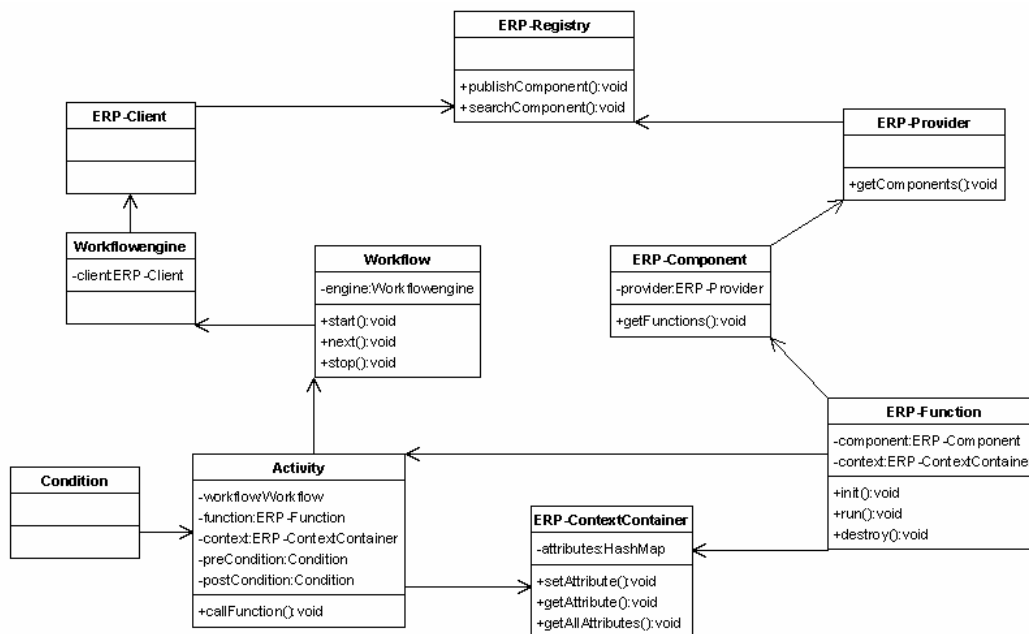
An IDC [4] study from December 2004 shows that SAP is the market leader in the range of ERP systems for large enterprises in Western European countries. The following list gives a survey of the different enterprise sectors where functions and processes of ERP systems can be assigned to. This is an incomplete list which shows grouping categories for business objects in SAP/R3:

- Finance
- Treasury
- Controlling
- Investment management
- Enterprise controlling
- Real estate management
- Logistics
- Sales
- Logistics Execution
- Quality management
- Maintenance
- Customer service
- Project management
- Environmental management
- Human resource management
- Payroll accounting
- Event management
- Production planning and controlling
- Materials management
- ...

Figure 1. Communication between non-SAP systems and SAP/R3 Systems on the basis of Web Services



Figure 2. UML Class diagram of a federated ERP system



The new idea is to make SAP/R3 functions available for external non-SAP ERP systems, which offer only basic functions. Figure 1 shows this scenario, where a Wrapper Service enables an ERP-Client which is a non-SAP system to use SAP/R3 components.

One business model for this scenario is that various SMBs share the costs that are related to the installation, maintenance and (cross-client) customizing of SAP/R3. Especially industry branch solutions like automotive supplier industry, electronic industry, metal and plastic industry, financial services, healthcare and education provide a lot of important standard functionality which are not part of competing ERP solutions. The integration of SAP/R3 systems in a federated ERP system environment enables SMBs to make use of special SAP/R3 processes.

## 2 FEDERATED ERP SYSTEM MODEL

The main characteristic of a federated ERP system is that its components are distributed over a network. All components of the FERP network are accessible by all participants of the federation. Furthermore there is a differentiation between client nodes and providers whereas providers offer ERP components and clients utilize those. Figure 2 shows this a federated ERP system as UML class diagram.

The most important classes of the FERP system in this model are the following:

- An *ERP-Registry* stores a list of all *ERP-Providers* and a reference to the list of the provided *ERP-Components*.
- An *ERP-Provider* offers *ERP-Components* to *ERP-Clients*.
- An *ERP-Client* uses *ERP-Components* during the processing of *Workflows*.
- A *Workflowengine* is responsible for the processing of workflows and is assigned to an *ERP-Client*.
- A *Workflow* in this context is a plan of sequentially or in parallel chained functions as working steps in the meaning of activities which lead to the creation or utilization of business benefits.
- An *Activity* encapsulates an *ERP-Function*. There are *Conditions* which control the invocation time of these functions.
- An *ERP-Function* encapsulates any functionality in the context of enterprise resource planning.
- An *ERP-Component* encapsulates various *ERP-Functions* belonging to the same main business sector.

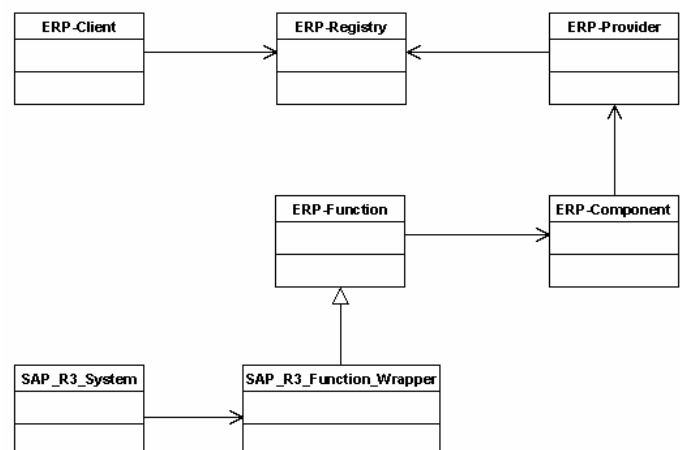
## 3 SAP/R3 AS ERP COMPONENT PROVIDER

Figure 3 shows the integration of an SAP/R3 system as part of an extended FERP model. SAP/R3 functions are wrapped by a special *ERP-Function* which is connected to the SAP system. By this all function calls can be forwarded to the SAP system whereas the return values can be reformatted to the FERP model-conform representation.

Prerequisite for the applicability of this model is that there is a standardized data model for all participating *ERP-Clients*. Based on this it will be possible for the *SAP\_R3\_Function-Wrapper* to execute a mapping between SAP/R3 and FERP parameters and return values. An implementation of the proposed model can use the following technologies:

- UDDI<sup>1</sup> registry as *ERP-Registry*
- WSDL<sup>2</sup> as a standard XML format for the formal description of *ERP-Components* and *ERP-Functions*

Figure 3. FERP model cut-out with the introduction of an SAP/R3 system



- SOAP<sup>3</sup> as communication protocol between client and provider as to invoke ERP-Function calls
- BAPI<sup>4</sup> to make SAP/R3 functions available over a network and accessible for SAP\_R3\_Function-Wrappers

#### 4 CONCLUSIONS AND OUTLOOK

Comparing distributed ERP systems and ERP systems running on only one computer, the distributed systems offer a lot of advantages. Particularly small- and medium sized Enterprises (SMB) benefit from using shared resources. However, the design and development of a system architecture is subject to a number of problems and risks. Because the implementation of SAP/R3 functions is closely abutted to the SAP/R3-own data model, it is often very difficult to encapsulate SAP/R3 functions as standalone services. Therefore a lot of expertise about the SAP/R3 data model is necessary. Besides this, SAP/R3 is a highly integrated software system whereby a lot of dependencies exist between available functions. This leads to the conclusion that SAP developers must be integrated into the design and implementation processes of our proposal. Furthermore security considerations play an important role when an open network (e.g. the internet) is used, because ERP systems process confidential enterprise data. If a single SAP/R3 system is going to be shared by various ERP-Clients there must be a trustworthy model for the separated data management of all participating ERP-Clients which temporarily send confidential data on the same ERP-Provider. Finally, this proposal is not restricted to SAP/R3 as ERP implementation to be integrated. Other products like *Oracle®E-Business Suite* or *SSA®Baan ERP 5* have to be examined in the future research works.

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#### ENDNOTES

- <sup>1</sup> Universal Description, Discovery and Integration (UDDI) [5]
- <sup>2</sup> Web Service Description Language [6]
- <sup>3</sup> Simple Object Access Protocol [7]
- <sup>4</sup> Business Application Programming Interface [8]

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