

Integrating PC Application Programs in SAP R/3 4.0



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Written by Technology Marketing, SAP AG

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Integrating PC Application Programs in SAP R/3 4.0

The SAP R/3 System encompasses the entire business structure of a company, and provides a way to model all business processes within a company and to external partners. Similar to the organizational division of a company into several areas, the R/3 System has a modular structure consists of several modules, such as Human Resources Management (HR), Financial Accounting (FI), and Controlling (CO). R/3 is based on a client/server architecture, consisting of the database tier, the application tier, and the presentation tier. The presentation tier implements the user interface, and consists mainly of the SAPGUI (SAP Graphical User Interface), which is supported on many different operating systems.

Overview

R/3 users in a company work under the SAPGUI in R/3, and – in parallel – use a variety of PC applications, such as word processing, spreadsheet, local databases, or graphics programs. These applications are installed on the workplace computers – usually MS Windows PCs – provide a wide range of functions for their respective purposes, and the users are generally familiar with their operation. Therefore, integrating these programs with R/3 makes a great deal of sense in many areas of a company. For example, the analysis and preparation of company data in controlling, or the processing of letters and faxes to customers, employees, or applicants in the areas of marketing, sales, or personnel is most easily achieved with a spreadsheet or word processing program, while the data itself reside in the R/3 System.

With R/3 Release 4.0, SAP offers standardized options for integrating any OLE-capable desktop applications in the R/3 System, both enhancing the functionality of R/3 and improving ease of use. This new technology – desktop integration through ABAP objects – replaces the previous implementation for integrating desktop applications in SAP R/3. This White Paper will introduce the range of functionality represented by this new integration technology, the resulting benefits, and the underlying technological architecture.

Introduction

As far as communicating with PC applications, such as word processing and spreadsheet programs, through well-defined standard interfaces is concerned, R/3 has always been an open system. When examining desktop integration with SAP R/3, we can generally differentiate between the outside-in approach and the inside-out approach.

Outside-In Approach

In the **outside-in approach**, a desktop application initiates communication with the R/3 System via existing programming languages (such as Microsoft Excel 97 and Visual Basic for Applications) and SAP OLE Automation in order to retrieve R/3 data, process it, and return it to the R/3 System if necessary. Thanks to the OLE programming in the macro language of the desktop application and the transparent use of BAPIs (Business Application Programming Interfaces) as the standardized interfaces, this technology forms an outstanding foundation for customer-specific integration projects. SAP OLE Automation has been available since R/3 Release 3.0. SAP itself uses this approach to implement the Microsoft Excel-based Business Explorer for the SAP Business Information Warehouse and the Employee Self Services in HR for R/3 4.0.

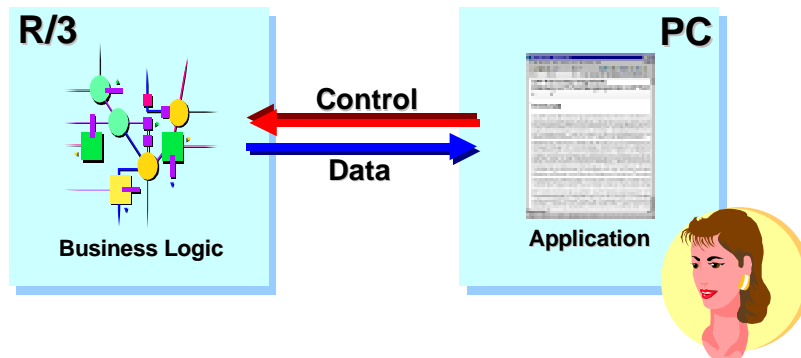


Figure 1: The Outside-In Approach for R/3 Desktop Integration

Inside-Out Approach

In contrast to the above method, the **inside-out approach** involves calling desktop applications from within the R/3 System and controlling them from there. Generating a letter in a word processing program from within an R/3 transaction and then saving that letter in the R/3 System is one example of this approach that is already used in various places in the R/3 3.x system.

The inside-out approach is utilized to implement the following technology in R/3 3.x:

- ❑ Uploading and downloading files in specific formats (binary file formats from desktop applications, RTF, ASCII, etc.) and even batch processing of data in SAP R/3 after upload (travel expense recording, project planning in R/3 3.x)

- ❑ Direct control of Microsoft Word from within R/3, using the RFC-based and DDE-based WSWINSRV technology (correspondence in applicant data management, memos in customizing and in the Project System in R/3 3.x)
- ❑ Direct control of Microsoft Word and Excel using specific ABAP/4 OLE language elements (ABAP/4 OLE Automation Controller) through OLE Automation (display and format R/3 data lists using the Excel-based XXL List Viewer, entering form letters in Human Resources Accounting using Microsoft Word in R/3 3.x)

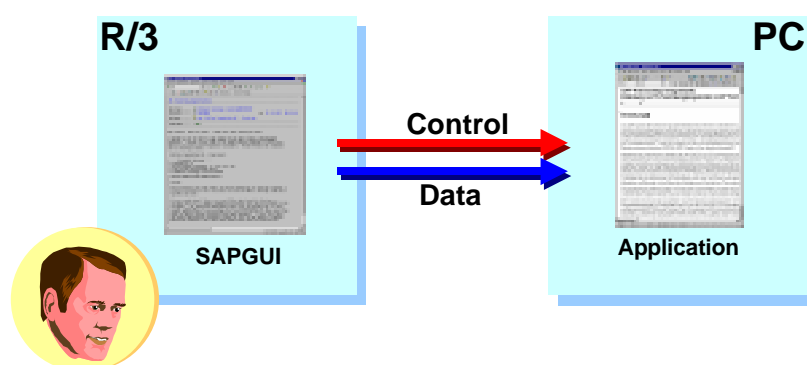


Figure 2: The Inside-Out Approach for R/3 Desktop Integration

As we can see, different technologies are used to implement the different aspects of the inside-out approach under R/3 3.x. In order to provide a uniform technology for integrating desktop applications, optimizing functionality, stability, and programming options, and minimizing the required maintenance effort, SAP has developed a new Basis technology in R/3 Release 4.0: the **integration of desktop applications through ABAP objects**. At the same time, this technology represents the first standardized integration technique for integrating any OLE-capable desktop applications with R/3 in a uniform manner.

Integrating Desktop Applications Through ABAP Objects

Range of Functions and Benefits

The R/3 4.0 integration technology through ABAP Objects enables the generic integration of any OLE-compatible desktop applications, such as Microsoft Office, Lotus SmartSuite, CorelOffice, StarOffice or Visio with the SAP R/3 System. Communication and data transfer are performed using object-oriented ABAP interfaces that utilize the component concept of the 4.0 SAPGUI, as well as the standard Microsoft OLE technology.

The wide-ranging scope of functions provided by this approach to desktop integration in SAP R/3 can be divided into the following areas: application control, integrating R/3 data in documents, and communicating with the R/3 System.

Controlling a Desktop Application

Application Control

Desktop applications can be started and exited from within the R/3 System, and documents can be opened, saved, printed, and closed. In the process, document handling is performed directly through the R/3 memory and OLE, instead of the local file system used in previous approaches. Downloading files to the PC, with all the problems posed by performance, write privileges, and disk space scarcity, is no longer necessary – only somewhat more main memory is required. Furthermore, SAP-specific menus and menu items can be easily integrated in the corresponding applications via OLE.

In-Place Activation

Documents can be activated in-place for display or editing in SAPGUI 4.0 screens. The desktop application becomes a part of the R/3 screen. This represents a major simplification for the enduser, who no longer has to open an additional program in an extra window, and who only sees the menus and menu entries that are relevant for the specific situation at hand.

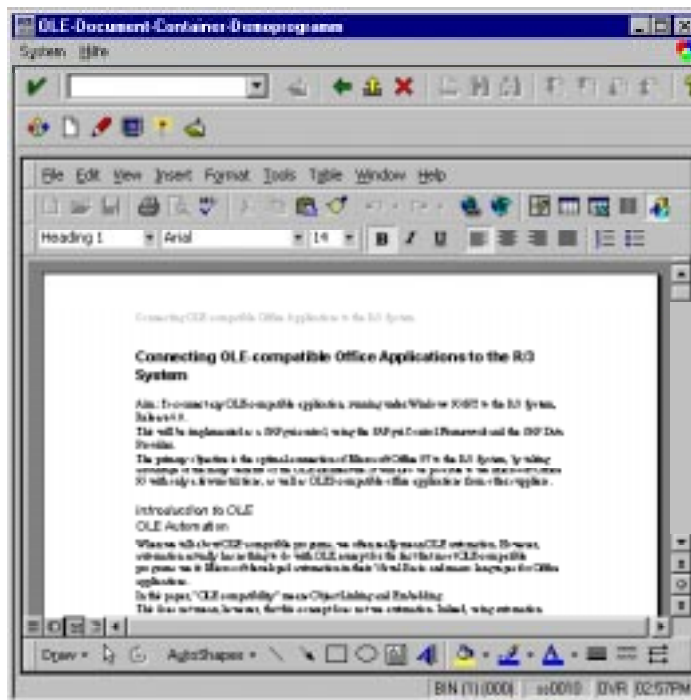


Figure 3: In-Place Activation of MS Word in the SAPGUI

Word Processor Interface

An additional Word Processor Interface, a generalized interface developed specifically for word processing systems, enables word processing-specific functions like navigating in the document, selection, editing, and formatting of texts, or assigning document templates to be executed transparently from within the R/3 System. As a result, various word processing systems – such as Microsoft Word, Corel WordPerfect, Lotus Word Pro, or even StarWriter – can be generally integrated in the R/3 System. A single, standardized ABAP interface can be used to access nearly the full functionality of any OLE-capable word processor, without requiring any application-specific



programming. A Spreadsheet Processor Interface built in the same manner will be available soon for spreadsheet programs.

Integrating R/3 Data in Documents

SAP objects such as fields, internal tables, bitmaps, and RTF texts, can be inserted in documents through OLE links. Documents can then be treated as templates that contain links to R/3 data. These links are replaced by data at runtime when the document is displayed, controlled by the R/3 System, and are updated automatically. In addition to the direct insertion of data in the document, this data can also be addressed from within a macro programming language like Visual Basic for Applications (VBA), for example.

Links to R/3 Data

In addition to many other feasible scenarios, a data exchange of this type between a desktop application and SAP R/3 is used for generating a letter from the R/3 System. In the process, the template (with the company-specific layout, such as company logo, etc.) managed in the R/3 database or the R/3 Information Repository is supplemented with address data for the sender and recipient from the R/3 System at runtime. During the design phase, the document template can be created directly in the application, such as Microsoft Word 97, while links to the R/3 data can be inserted into the document by means of the Windows clipboard. In the process, a corresponding link object is selected in the R/3 System, copied to the clipboard, and inserted as a link in the document through the "Paste Special" command. No application-specific macro programming is required. The customer decides where which R/3 data is to appear in the document, and can easily implement these decisions under WYSIWYG conditions in the desktop application.

Creating a Document Template

Communication with the R/3 System

In contrast to previous approaches, processing is performed in parallel in ABAP and on the PC – which means that both sides can respond to user inputs. Furthermore, the desktop application is capable of triggering events in the R/3 System that are then processed in the calling ABAP program. This enables two-way communication between the application and the R/3 System.

Events

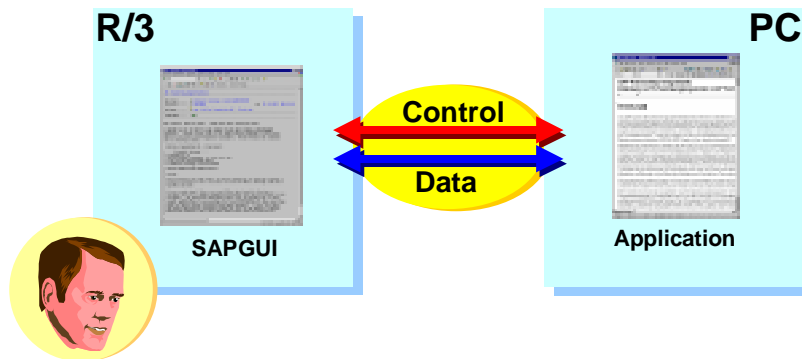


Figure 4: Desktop Integration Through ABAP Objects

Total Cost of Ownership

All these aspects of the R/3 4.0 integration technology for desktop applications result in a tremendous potential. Customers are completely flexible with regard to their choice of desktop applications and in deciding whether and when to upgrade to new versions of these applications. The application need only support OLE2 in order to be addressed from within the R/3 System. Through this separation from the actual application, the R/3 System itself can be migrated completely independently of any desktop applications and specific modifications, resulting in a significant reduction in the cost of maintenance for integration solutions.

Thanks to the range of functions and expandability of this approach, desktop applications will be integrated into more and more standard R/3 transactions in Release 4.0, enhancing the R/3 functionality without requiring changes to the system itself. In general, the increased use of existing desktop applications in the R/3 environment can – thanks to their comprehensive functionality and endusers’ familiarity with their use – significantly improve productivity and reduce training costs.

All in all, this approach enables the use of PC applications that are best suited to specific tasks, and promises significant productivity gains. Together with the reduction in training and maintenance costs mentioned above, a company’s total cost of ownership can be significantly reduced.

Technological Architecture

This section first provides a brief outline of the historical development of the OLE standard defined by Microsoft. It will then describe the technical architecture of the R/3 4.0 desktop integration technology, which is based on this OLE standard.

OLE - Object Linking and Embedding

The OLE 1.0 standard was developed in 1991 by Microsoft in order to include (embedding) or refer to (linking) external objects in documents, thus forming so-called OLE compound documents. A primary example of this function is the use of an Excel table within a Word document. This OLE document specification was expanded with the OLE 2.0 standard, which was defined in 1993, and also significantly enhanced the functionality of OLE and – based on the Microsoft Component Object Model (COM) –

created an infrastructure for the standardized, transparent communication between any software components in an object-oriented manner. As a result, OLE documents are only a part of OLE 2.0, which also encompasses OLE automation and OLE controls. Each of these specifications is based on the standardization for storing and addressing software components and transparent exchange of data between these components that was defined in OLE 2.0.

Therefore, **OLE documents** define the storage of external objects or links to external objects in documents. The foundation of the created compound documents is a type of file system within the document container for storing the data of the integrated container objects. In addition to the pure storage of data from external objects within the document, OLE also defines the protocol used by the corresponding applications to open and process these objects. As a result, editing tools of container objects and the corresponding applications can be displayed as menu items and menubars within the document container, which is a part of OLE documents called "in-place activation". **OLE automation** encompasses the program-controlled communication between software components without any interaction by the enduser. In this manner, communication takes place through an automation server defining various objects and their corresponding methods, and an automation client actively using these objects and methods. Building on these OLE documents and OLE automation, an **OLE control** is an automation-capable container object that supports events. These events can be triggered by certain user or program actions. An OLE control is capable of reacting to certain incoming events and triggering the appropriate outgoing events. In this context, an OCX is a file that contains one or more OLE controls.

OLE Documents, OLE Automation, OLE Controls

ActiveX can be thought of as an Internet-capable enhancement of OLE, and also builds on the Component Object Model. Pure ActiveX controls are leaner and achieve better performance than OLE controls, and can be integrated as interactive elements in HTML pages. By definition, OLE controls can also be called ActiveX controls. ActiveX documents represent a significant enhancement to OLE documents, particularly with regard to in-place activation.

ActiveX

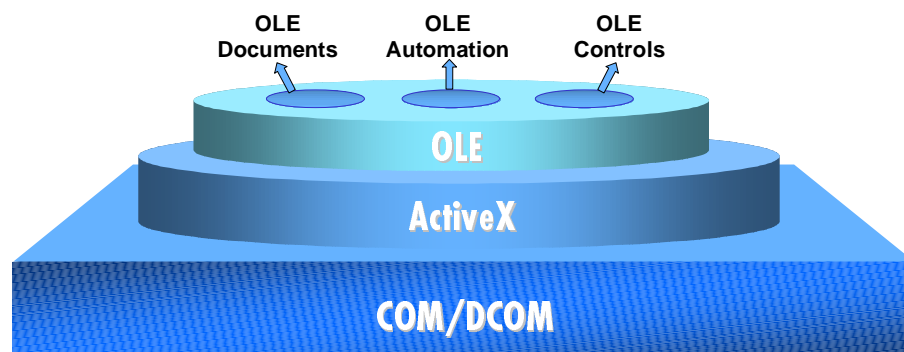


Figure 5: OLE - Object Linking and Embedding

SAP R/3 supports the full range of the OLE automation standard in Release 3.0 and later. In the process, the R/3 System can act as automation server

SAP R/3 and OLE 2.0



(OLE controls for declaring objects and methods for communicating with R/3 through the SAP Assistant) or as automation client (specific OLE language elements in ABAP are used to access objects and methods of OLE servers – such as desktop applications – through the ABAP OLE Automation Controller). With the integration technology available in R/3 Release 4.0, SAP now also supports OLE documents and OLE controls for integrating desktop applications. In the process, OLE documents and OLE controls form the foundation for embedding or linking to R/3 data in documents and in-place activation, as well as for communication between application and R/3 via events.

SAPGUI 4.0 Controls

As part of the SAPGUI 4.0 Client Component Framework, SAP has implemented various controls that significantly improve the ease of use of the GUI. For example, an editor control has been implemented that enables a running WYSIWIG PC editor to be used within the R/3 screen. This concept is as important as the customer-specific customizing and reduced administration costs, since the SAPGUI becomes even leaner, and new or changed components can be dynamically downloaded from the R/3 database at runtime. In addition to various other controls, SAP also provides the SAP Document Container Control and the SAP Data Provider as specific GUI controls particularly important for integrating PC applications.

The **SAP Document Container Control** simulates the OLE Document Container and publishes methods and attributes for communicating with a desktop application via OLE interfaces and events. In R/3 Release 4.0C, the SAP Document Container Control has been enhanced to a generic ActiveX Document Container. As a result, the in-place activation of any ActiveX documents – such as input forms created with Visual Basic 5 – is possible.

The **SAP Data Provider** is a container and converter for most any type of data format. Inbound data in a specific format is converted to an outbound format determined by the address application, based on the MIME Internet standard. The SAP Data Provider buffers the data from documents that are managed in the R/3 System. These documents are addressed via their URL (Uniform Resource Locator). Furthermore, the SAP Data Provider buffers the R/3 data that is to be inserted into a document through OLE links. Data contained in the data provider can be directly inserted in the document (via links), and can also be addressed in the macro programming language of a desktop application.

ABAP Objects

Both controls possess a simple, generic interface to the R/3 System through ABAP objects, the object-oriented language enhancement of the ABAP programming language in R/3 4.0. SAP implemented this enhancement to meet application-oriented and business requirements, and it enables – through encapsulation, inheritance, and polymorphism – object-oriented software development with ABAP. In particular, the full range of event handling for ABAP objects is supported during communication to the SAP Document Container Control, which enables communication with the R/3 System and greatly simplifies the programming interface.

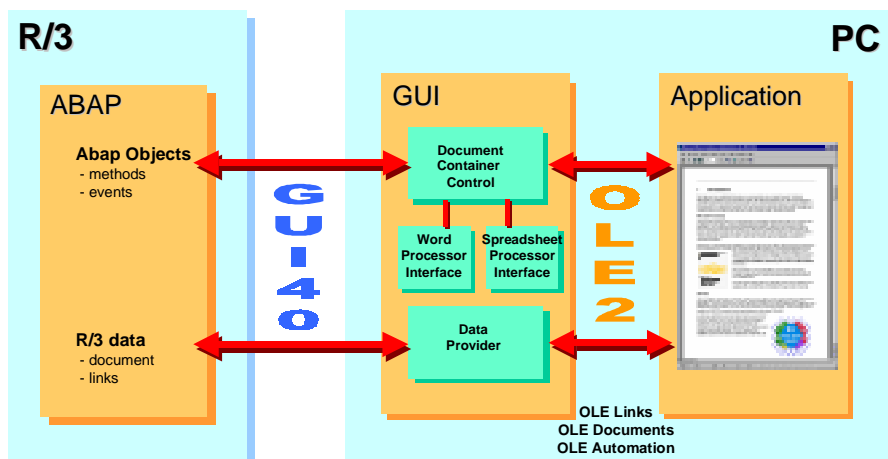


Figure 6: Technological Architecture of Desktop Integration Through ABAP Objects

Certain functions – such as inserting an internal R/3 table directly as a table within a text document, for example – have to be performed interactively with the desktop application (due to the necessary, subsequent formatting), and cannot be modeled directly via OLE links. In these cases, macros can be integrated in the document (or template), and are used by the corresponding application to communicate with R/3 through the SAP Document Container Control as automation server via OLE automation. These macros can retrieve R/3 data, insert them in a document, and then format that document or the table contained therein accordingly. In this manner, for example, an internal table of the calling ABAP program can be passed on to a desktop application (like Microsoft Excel), formatted, and edited by a user, and the changed table can then be completely reimported into the R/3 System.

Management of the macros required for such jobs is simplified by a VB Script Engine for the SAP Document Container Control, which is available in R/3 4.0C. In this case, macros can then be saved as text directly in R/3 (instead of in the document or the corresponding document template) and can be addressed from ABAP via the VB script interface of the SAP Document Container.

To integrate a PC application with the R/3 System via ABAP objects in this manner, the following system requirements must be met:

- R/3 4.0 and SAPGUI 4.0
- Microsoft Windows 95 or Windows NT PC
- OLE-capable desktop application

OLE Automation

System Requirements

Sample Applications

Using the graphics and chart functionality of Microsoft Excel 97 in the R/3 System:

Microsoft Excel 97 can be integrated in R/3 4.0 transactions, enabling use of the full range of Excel functionality by these transactions. This section describes the graphical formatting of R/3 data in Excel charts, including the underlying process flow.

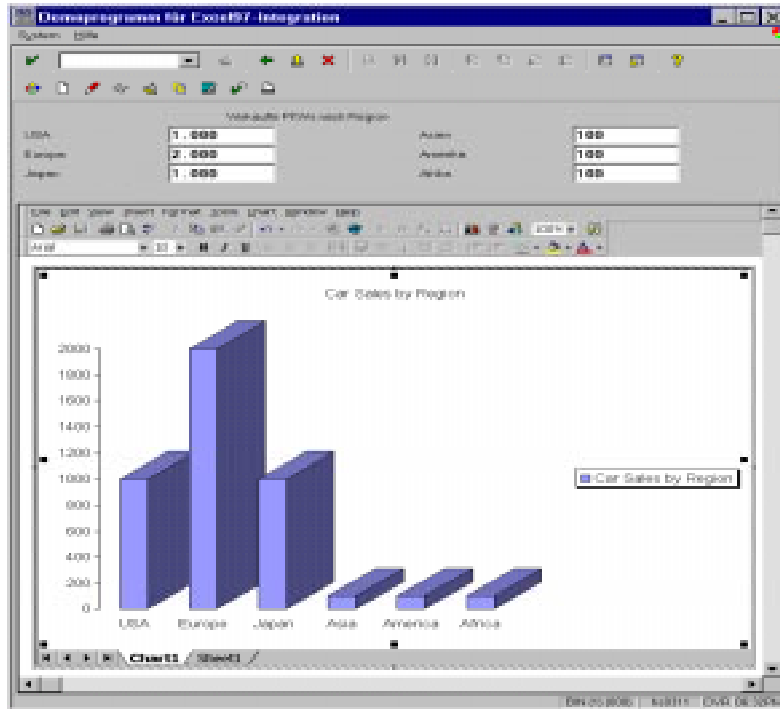


Figure 7: In-Place Activation of an Excel Diagram in an R/3 Screen

- ❑ Excel 97 is started within the R/3 screen, and a specific document that is managed in the R/3 System is opened.
 - A certain sheet in the folder (Sheet1 in the example) contains links to R/3 data, which is updated when the document is opened and then again whenever the data is changed in the R/3 System.
 - The R/3 enduser sees a different page (Chart1 in the example), which displays the data in the form of a bar graph.
- ❑ The user can now make any desired changes to the appearance of the chart in Excel – chart type, formatting, and axis scale – or even add a new data source to the chart.
- ❑ Finally, the enduser can print the chart, save the entire file locally, or even send it as an e-mail, which breaks the links to the R/3 data.

A similar scenario can be implemented for other spreadsheet programs, using their services for data formatting (pivot tables, filters, grouping, etc.).

Entering a letter or fax from within R/3 using Microsoft Word 97:

Microsoft Word 97 can be integrated in R/3 4.0 transactions. R/3 can use the entire word processing functionality of Word. This section describes an

example of using Word to generate a letter or fax, including the underlying process flow.

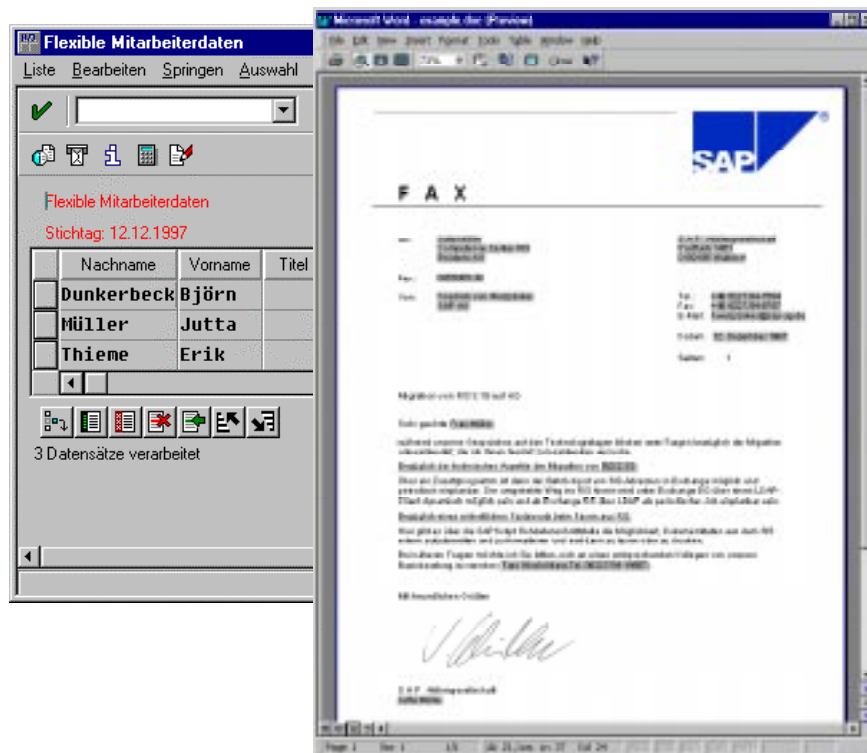


Figure 8: Generating a Fax from Within the R/3 System

- ❑ The author, sender, and recipient of the document are selected from within an R/3 transaction.
- ❑ Microsoft Word 97 is started from within the R/3 transaction, and an appropriate document (letter, fax, etc.), which is managed in R/3, is opened – taking the document language into account.
- ❑ In defined places, the document contains links to R/3 data, which is used to insert the following data when the document is opened:
 - Company logo
 - Data for author, sender, recipient
 - Recipient-specific data within the letter text
 - Bitmap with scanned sender signature
- ❑ The document can be printed or faxed from within the R/3 System.
- ❑ For multiple recipients, the document is printed or faxed as often as necessary, while the links to the R/3 data are updated before each individual print or fax transaction.



In the same way, this scenario can be implemented with other word processing programs, such as Lotus Word Pro, Corel WordPerfect or StarWriter.

Summary and Outlook

The described integration of desktop applications in the SAP R/3 System via ABAP objects and the component concept of the SAPGUI has tremendous potential. Desktop integration in SAP R/3 alone represents a significant gain in productivity for endusers. The applications that are best suited to the task at hand can be used in many places in the R/3 System. Users are usually familiar with the operation of these applications, which means that training costs can be reduced. When the technical implementation of the desktop integration provides options for the selection and migration of desktop applications that are as flexible as the described solution, the required maintenance is also low. As a result, the total cost of ownership can be significantly reduced.

During the course of R/3 Release 4.0 development, the approaches described above will be used to integrate even more desktop applications and components in suitable places in the standard R/3 transactions, resulting in ever greater benefits for endusers. In parallel, the functionality of the integration technology will continue to be enhanced.