Information is more than just mere numbers. The consolidation of structured, unstructured, and process information forms a data pool that gives a company a competitive edge. In this chapter, you will learn more about the components SAP NetWeaver Business Intelligence, Knowledge Management and Collaboration, and SAP NetWeaver Enterprise Search.

11 Components for Business Information Management

Information is one of the critical factors of production for an enterprise. It represents the foundation for optimized control of the production process, and thus plays a decisive role in achieving defined enterprise goals. In the following sections, all SAP NetWeaver areas that are related to information integration are described. These include:

- SAP NetWeaver Business Intelligence (BI)
- SAP NetWeaver Master Data Management (MDM)
- Knowledge Management (KM) and Collaboration
- SAP NetWeaver Enterprise Search

11.1 SAP NetWeaver BI

Decision-makers require information systems to implement and justify their decisions through a sound starting basis. Information systems must provide evaluations that focus on these goals.

Business intelligence (BI) systems include all applications used for decision-making support. These applications can influence decision-making processes directly or indirectly. This concept of BI systems therefore includes the entire process support, from data source, to data preparation, to data presentation to the user in the user interface. In the follow-

ing sections, the main functionality will be described with a special focus on the components of a BI system.

11.1.1 General Structure of Business Intelligence Systems

The structure of BI systems is based on the process that data has to pass until it is used by the decision-maker. This is illustrated in Figure 11.1.

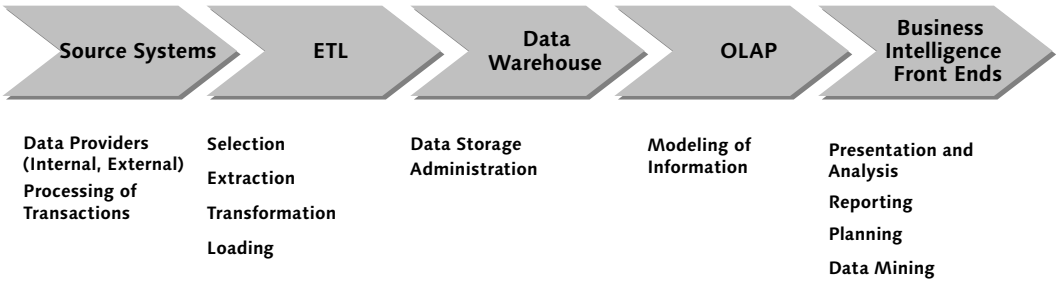


Figure 11.1 Components of a BI System

BI processes

Source systems are primarily information systems for managing operative processes[1] that, in contrast to data warehouse environments based on *Online Analytical Processing* (OLAP), focus on transactions and not on analysis.[2] The extraction, transformation, and loading process (ETL) maps the transition between these two differently oriented concepts.

According to Wiliam H. Inmon[3], data warehousing is a subject-oriented, integrated, time-variant, nonvolatile collection of data in support of management's decision-making process and is used as a data basis for the analysis deploying the OLAP concept. An OLAP system is supposed to provide fast, interactive, and manifold accesses to relevant information for managers and employees. Information can be viewed from multidimensional perspectives during the decision-making support process. For this reason, a data warehouse has to provide tools that ensure the modeling of this information. Simultaneously, the administration and data warehouse management has to be reasonably supported for a growing number of users and rapidly increasing data volumes.

1 As mapped in SAP ERP 6.0.

2 Bange, Carsten: *Data Warehousing and Dat Integration*. Munich 2003.

3 Inmon, Wiliam H.: *Building the Data Warehouse*. New York 1993.

The end user also has the option to display and evaluate enterprise data from the data warehouse by using BI front ends. For evaluation, the end user is provided with numerous interactive navigation and analysis options.

The components presented are primarily targeted to prepare information for an enterprise in such a manner that a goal-oriented enterprise management can be implemented. This goal is achieved in BI through the support of reporting, planning, and analysis.

Reporting

Reporting includes integrated internal and external reporting, that is, statement of accounts, to map historical information. Reporting that is strongly oriented toward key figure structures can occur in different ways:

- Periodized, standardized reporting (Push method)
- Ad-hoc Query and query of spontaneous information requirements
- Exception reporting for occurrence of certain events

Planning

Planning is a goal-oriented, notional design process of future actions with the goal to prepare decisions and to make management decisions based on systematic preparation. In contrast to reporting, data is viewed from a future-oriented perspective here, and business planning tasks must be carried out via specialized planning tools. Based on a sound analysis of the past and adjustment to new planning propositions, planning data not existing yet must be generated.

Analysis

The analysis examines the business situation on the basis of planning and reporting, and provides information for decision preparation.

Planning, analysis, and reporting are closely linked, and are supposed to mesh in a continuous process for integrated enterprise management. In real life, planning as a "wish" for the future is measured with the reporting function and evaluated by means of analyses.

Data mining

In addition to the planning, analysis, and reporting elements, *data mining* is another component of SAP NetWeaver BI. Data mining as an undirected analysis tool can recognize autonomous data patterns in large datasets to identify the most meaningful patterns. In addition, these patterns have to be displayed for the user in a prepared manner and offer

further analysis potential in the BI system to support the other three main components.

In this section, the following main BI system functions were identified:

- ETL
- Modeling
- Administration and Data Warehouse Management
- Reporting
- Planning
- Analysis

In the next section, we'll first check which main functions are covered by the SAP NetWeaver BI system. Subsequently, the system components will be described in greater detail.

11.1.2 BI Components in SAP NetWeaver

The core functions of a BI system in the SAP landscape are mapped by SAP NetWeaver BI. Other SAP systems can, in turn, use functions of the central SAP NetWeaver BI system. SAP NetWeaver BI as a data warehouse environment offers applications for integrated enterprise management on the basis of data warehouse and OLAP concepts. But how does SAP NetWeaver BI provide the main BI system functions mentioned in Section 11.1.1?

DataSource concept

ETL processes are mapped through SAP NetWeaver BI's *DataSource concept* to ensure the integration of various source systems and transfer of data, and, if required, adjustment of data to be transferred. Modeling is carried out in SAP NetWeaver BI's Data Warehousing Workbench. Here, in the BI back end, data models are implemented which form the basis for planning, analysis, and reporting. The requirements of modern data warehouse management and comprehensive options for SAP NetWeaver BI administration, can, for example, be implemented using the following concepts:

- Monitoring systems
- Authorization concept
- Lifecycle management

BEx Suite

Furthermore, SAP NetWeaver BI aims to present information in a user-friendly manner. Reporting and analysis are implemented using the *Business Explorer Suite* (BEx Suite). With the *BEx Query Designer* (see Section 11.1.5) you can create queries for the data basis. These can then be used in the *BEx Analyzer* (see Section 11.1.5) to analyze datasets from all perspectives. Because the BEx Analyzer is based on Excel you can simultaneously use Excel-related functions, such as the formula function. Furthermore, the BEx Suite supports the design and implementation of web applications for planning, analysis, and reporting through *SAP NetWeaver Web Application Designer (WAD)*, as well as the realization and printout of formatted reports through *Report Designer*.

SAP NetWeaver BI Integrated Planning implements the third subprocess of integrated enterprise management in SAP NetWeaver BI presented in Section 11.1.1.

In addition, SAP NetWeaver BI also offers data mining functionality using the Analysis Process Designer. You can also design analytical applications with SAP NetWeaver Visual Composer (see Section 14.1.3). This is a portal component whose effects on SAP NetWeaver BI applications will be explained in Section 11.1.6.

As shown in Figure 11.2, SAP NetWeaver BI supports the following main functions:

- ETL using the DataSource concept (Section 11.1.3)
- Modeling in the Data Warehousing Workbench (DWB) (Section 11.1.2)
- Data Warehouse Management and administration through authorization concepts, Lifecycle Management scenarios, and monitoring systems (Section 11.1.4)
- Reporting based on BEx Suite (Section 11.1.5)
- Planning via BI Integrated Planning (Section 11.1.6)
- Analysis through the BEx Suite and SAP NetWeaver Visual Composer (Sections 11.1.6 and 14.1.3)

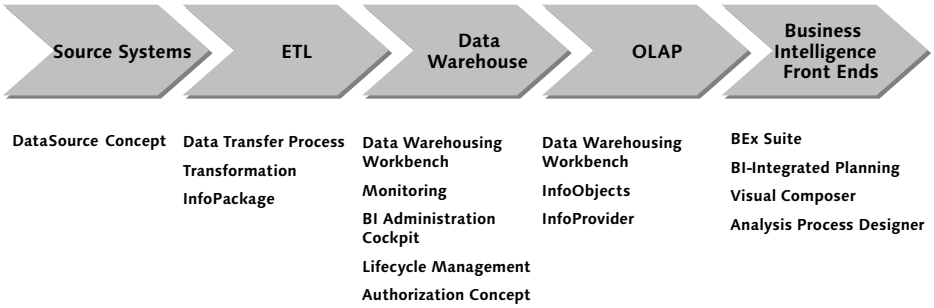


Figure 11.2 BI Components in SAP NetWeaver BI

These main functions will be presented and explained in detail in the following sections.

11.1.3 Modeling in Enterprise Data Warehouse

IT-supported planning, analysis, and reporting systems have to provide user support for modeling the business processes and structures that are supposed to be mapped. The modeling of these different informational concepts in an enterprise is achieved by means of a data model.

Data Warehousing Workbench

The DWB is the main tool for modeling data in SAP NetWeaver BI and serves to control and manage the dataset.

The DWB is used to define and structure all data models that decision-makers can access with the various analysis tools. The basic building blocks for this data model are characteristics and key figures. Characteristics are classification terms, such as customer or company code. They are used to describe and differentiate the dataset, and represent reference objects for key figures. Key figures are data expressed in quantitative values that are uniquely described using characteristics. In SAP NetWeaver BI, characteristics and key figures are modeled using *InfoObjects.*

InfoObjects

InfoObjects are the smallest unit in SAP NetWeaver BI to represent business-related information in a structured manner. These InfoObjects are required to determine and define data targets in which the defined data is stored. Data targets for implementing reporting and analysis are called InfoProviders. InfoProviders are divided into three groups:

InfoProvider

- **InfoCube**
  An InfoCube describes a dataset that can be evaluated using, for example, BEx Querys (see Section 11.1.5). Data characterized by characteristics and key figures in InfoObjects is physically stored here. In addition to standard InfoCubes with read access to data, real-time-enabled InfoCubes provide write access to data stored in the InfoCube.
- **InfoObjects as InfoProviders**
  If reports and analyses are supposed to be carried out directly on InfoObjects without being contained in other InfoProviders, they must be defined as InfoProviders.
- **DataStore Object (DSO)**
  DSOs are used to record master and transaction data, frequently at a highly detailed level. Data can also be evaluated using queries. However, data storage is different here: It is stored in a transparent, flat table and not in fact and dimension tables as would be the case in InfoCubes.

Moreover, there are InfoProviders that do not serve as a physical data storage, but represent a logical view of data:

- **VirtualProvider**
  Its data is not stored in the object, but is directly read for reporting and analysis. It does not provide write access.
- **InfoSets**
  InfoSets form a semantic layer above the data sources while providing all database technologies. The main focus is on possible usage of joins.
- **MultiProvider**
  The MultiProvider itself does not contain any data. It is used to merge data from different InfoProviders and enables an integrative view of data from different providers.
- **Aggregation level**
  Aggregation levels are used as InfoProviders for BI Integrated Planning. They only contain characteristics and key figures of a real-time InfoCube relevant for the planning view and aggregate characteristics and key figures that are not selected (see Section 11.1.6).

DataSource and Persistent Staging Area

During data modeling, two additional components play an important role within the Data Warehousing Workbench. A DataSource always refers to exactly one source system (for example, an ERP system, an SAP NetWeaver BI system, etc.) and defines a quantity of fields that form the starting point for data transfer from the source system in SAP NetWeaver BI. An InfoPackage determines the selection conditions above these fields for a data request in the BI system and triggers the loading process from the source system in SAP NetWeaver BI. The *Persistent Staging Area* (PSA) is the inbound memory for data in SAP NetWeaver BI, where the data from the source system defined via DataSource is temporarily stored before it is further processed. This inbound layer is directly managed via DataSource. From PSA, data can be forwarded to any InfoProvider.

The basic building blocks that were presented thus far for modeling in SAP NetWeaver BI give many options to provide information in the SAP NetWeaver BI system. Bearing this variety in mind, the question arises how it can be guaranteed that the quality of data is ensured and aligned to business requirements already during the modeling phase? For this reason, the layer architecture of BI modeling is explained below.

Layer Architecture of BI Modeling

Growing demands from user departments, increasing numbers of users and ever-increasing data quantities while simultaneously maintaining high-performance rates result in continuously growing BI installations and require better BI system structuring for better maintenance. Moreover, enterprises focus on company management based on BI information. Poor data quality results in incorrect analyses and incorrect decisions of the decision-makers.

Therefore, the quality must be already ensured during the development phase, and supported by service-level definitions and best-practice approaches. The concept presented below is aimed to control the complexity within SAP NetWeaver BI and consequently to reduce the operating and maintenance costs. Moreover, it is supposed to specifically address the problem of data consistency. Up to now, BI applications as standalone solutions have generated a data volume that is difficult to manage and cannot be checked for quality. This data volume is a collec-

tion of different projects and diverse requirements. These standalone solutions provide answers for previous questions, but are not able to respond flexibly to future requirements.

Planned architecture in several layers

For the development of BI applications, an architecture is supposed to be used for all BI projects of a company as shown in Figure 11.3. In this architecture, horizontal and vertical orientation should be defined.

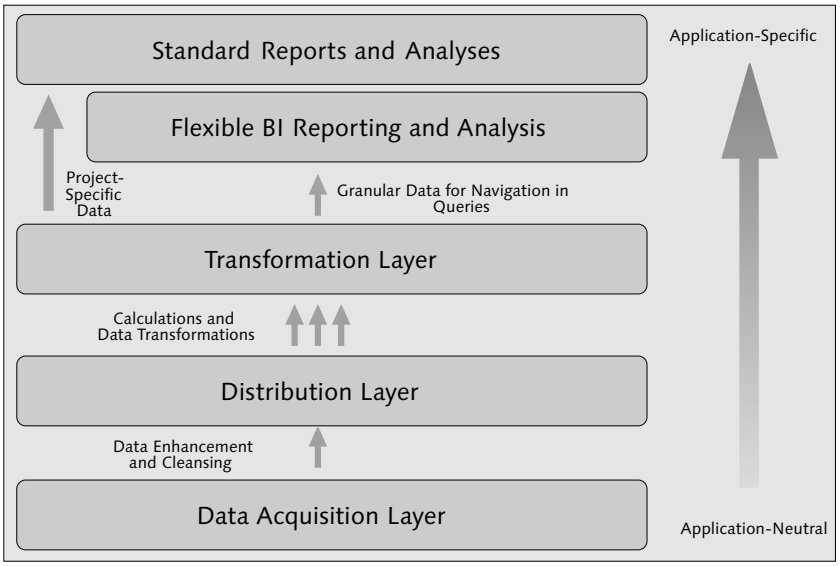


Figure 11.3 Layer Architecture of BI Modeling

The horizontal structuring describes data in different layers, while each layer is defined by its data granularity and its relation to real project requirements. Starting at any data source, data is supposed to be collected and stored without any changes in an acquisition layer after extraction. This layer stores data from the source systems unfiltered and can be mapped through DataStore objects that are collected unchanged after extraction. An intermediate step prepares this data in terms of quality and integrity. Unfiltered raw data is then enhanced and cleansed to form an application-neutral starting point. This enables flexible response to various future requirements. DataStore objects can be used in this layer as well.

In the next layer, data from the underlying layer can be merged business-controlled; this means that the focus is on reporting and planning requirements from the individual departments. Merging is done through calculations and other transformations. The generated, generally usable data can be opened in reports via the extensive navigation functions. For users that require flexible reporting with analysis functionality, data transformed in the lower layer must be further processed in more detail. This ensures comprehensible use of data in queries. Moreover, specific data of an individual project relating to the requirements of user departments are displayed in the highest layer. To do this, you can select the required data from the granular data.

In addition to this horizontal structuring, more flexibility can be generated in the BI system by adding vertical structuring that, for example, can map regional organizations.

Besides flexible modeling in the BI system, SAP provides Business Content as an alternative to using predefined model templates. This enables users to get started with SAP NetWeaver BI quickly.

Business Intelligence Content

One major advantage of the SAP NetWeaver BI is its integrated Business Intelligence Content. SAP offers predefined models (both role-specific and task-specific) and components, based on consistent metadata, to support the entire data warehouse process from data extraction to analysis for quick startup. Predefined components of the SAP NetWeaver BI system can be, for example, InfoCubes, InfoObjects, or Queries. Over time, more and more models have been developed in field projects of customers in collaboration with SAP, and are now available as best-practice templates within SAP NetWeaver BI. These templates can offer a quick startup for customers, because these models can be used immediately and adjusted to customer requirements, if necessary. BI Content lets you achieve initial results extremely quickly within a data warehouse project based on which further Customizing can be implemented with regard to customer requirements.

Business-related models

In the Content context, the SAP system provides specific, preconfigured extractors (plug-ins) that you can install as add-ons to the SAP systems.

You can use these extractors to import both master data and transaction data to SAP NetWeaver BI. Within the SAP NetWeaver BI system, complete, preconfigured business models can be activated, including a wide range of reports that build on this model. Another frequent practical example is the use of content for cost center accounting and its reports.

During modeling you should already consider which data from which source systems must be integrated in the SAP NetWeaver BI system to support planning, reporting, and analysis. The following section describes these considerations in further detail.

11.1.4 ETL in Enterprise Data Warehouse

Heterogeneous system landscapes

The practical examples in Chapters 4 to 7 identified the problem of heterogeneous system landscapes that complicate consistent mapping and use of company-wide integrated data. In addition to data from transactional systems, you also have to transfer data from various other source systems to your data warehouse environment. You require this data, for example, as a basis for planning, or to implement reporting and analysis. If you want to define a report on current sales figures of a product and the deviations compared to the previous year in SAP NetWeaver BI, the sales data are generally taken from a transactional ERP system. ETL tools let you import data into SAP NetWeaver BI from a wide variety of data sources, and transform, enrich, consolidate, and cleanse it in many different ways. To do this, you have to define the source systems, how these systems can be linked, and when the data from these systems are required.

Source Systems

In a heterogeneous system landscape, many systems exist whose data is required for processes mapped in the BI system, among other things, for linking external systems. This includes coupling of other SAP NetWeaver BI systems used within the company and the use of data from different relational databases. Often, you also have to integrate external data into your BI system. This external data can be integrated by information providers, for example, in the form of Web services. Moreover, this external information could be stored in an Excel file.

These source systems are integrated in SAP NetWeaver BI using the DataSource concept. Depending on the source system to be integrated and the interfaces provided different types of DataSources are used.

The DataSource concept

You already read about DataSources in the *DWB* section. They define the transition and mapping between data from the source system to the structures in SAP NetWeaver BI. To ensure the integration of the source systems, you are provided with the following DataSources:

- DB Connect DataSources for relational databases
- Universal Data Integration DataSources to integrate third-party systems
- Integration of text and Excel files
- Web services
- Integration of classic Business Warehouse (BW) 3.5 DataSources via BI Service Application Programming Interface (API)

DB Connect

The DB Connect interface enables direct access to relational databases, such as Oracle or DB2. You can address these tables directly and import their content into SAP NetWeaver BI. You can set integration parameters in the database table adapter to define the DataSource structure and fields to be extracted. You can also generate a data preview following the definition.

UD Integration

Universal Connect Data Sources based on *Universal Data* (UD) *Integration* enable integration in external systems via standard connectors. For this reason, SAP NetWeaver BI uses the SAP NetWeaver Application Server (AS) via the Java Enterprise Edition (JEE) platform. Here, you are provided with a JEE Connector Architecture including a group of four Java-capable connectors (JDBC, XMLA, ODBO, and SAP Query connectors) to access a wide variety of source systems. Using these standards you can integrate third-party products, such as Hyperion or SAS, to access data that are stored on a non–SAP NetWeaver BI system via a joint data basis. You can configure UD connectors through the JEE engine.

Web services

You can use Web services to transfer data to PSA. To do this, you should create a so-called Push Package as an InfoPackage. The DataSource itself uses a Web service adapter that generates both the Simple Object Access Protocol (SOAP)-compatible Web service and an Advanced Business Application Programming (ABAP) function module to load the data into the SAP NetWeaver BI system.

Within an SAP NetWeaver BI environment you can apply the BI service API to use classic BW 3.5 DataSources that deploy (in contrast to BI 7.0 DataSources) transfer rules and structures instead of transformations. When migrating to SAP NetWeaver BI 7.0 you can decide whether you want to adopt your existing DataSources to the new concept. The benefit of deploying existing classic DataSources is that you can still use existing transfer rules (particularly when transferring data from SAP ERP) and you don't have to replace them by transformations.

Additionally, you can create a PC file system in SAP NetWeaver BI as a source system. Furthermore, you can load data that are provided as text files, for example, in Excel CSV format, to the InfoProviders.

To transfer data to be extracted from its sources to SAP NetWeaver BI's InfoProvider and to completely map the ETL process, the data transfer process can be used.

Data Transfer Process (DTP)

Data transfer process (DTP)

The DTP controls data transfer between two objects within the SAP NetWeaver BI system. On the one hand, this can be the data flow between PSA, that is, the input data layer of the SAP NetWeaver BI system, and the InfoProviders. On the other hand, this can also be the data transfer between different InfoProviders. You can also address an Open Hub target, that is, a target outside the BI system. The transfer must be carried out via transformations and can be defined through filters. You can use transformations to transform data input into output format using specific rules, and to establish how target values are determined.

The DTP has the potential to update different targets starting at a single source (for example, PSA) and separate the delta process for these tar-

gets. Based on the data in the target InfoProvider, only the data in the source that was changed or was not available since the last loading process is transferred to the data target.

If you want to use the DTP for transferring from the PSA to the InfoProvider, you must trigger the loading process in the PSA using an InfoPackage. As of this point, DTP carries out transfers within the SAP NetWeaver BI system. An InfoPackage can only load data into the PSA without implementing transformations. Classic BW 3.5 DataSources, however, lets you directly update in the data target.

You can integrate DTPs and InfoPackages into process chains if you want to automate the loading process. You can also trigger this process manually.

Real-Time Data Acquisition

For BI projects, for which real-time provision of operational data in SAP NetWeaver BI is particularly important, the regular loading process that is often executed at night cannot guarantee timeliness of data. For this reason, real-time data warehouse processes can be mapped for two possible scenarios in the BI system to implement operational reporting.

You can prepare real-time reporting for real-time data via an InfoPackage for real-time data acquisition loading the data into PSA. A DTP subsequently transfers this data from PSA to a DSO. You can also fill PSA through Web services and transfer it into a DSO through DTP. Using a daemon, that is, a process running in the background and providing specific services, you can trigger loading of InfoPackages at regular intervals if checking for new datasets in the source system was successful, and transfer from PSA to DSO. You can monitor the daemon by means of a real-time data monitor.

You now have to monitor and administer or manage over an entire lifecycle the data and models discussed thus far in the SAP NetWeaver BI system. In the following section we will discuss the options in SAP NetWeaver BI to solve these issues.

11.1.5 Data Warehouse Management and Administration

Challenges

In the *Layer Architecture of BI Modeling* section you were familiarized with the problems and challenges the BI system has to face:

- Higher data volume
- High data quality
- Higher performance
- Increasing number of users

To meet all these challenges, the SAP NetWeaver BI system must offer tools to manage the complexity that results from the preceding points.

Process Chains and Monitoring

An increasing number of applications implemented through the SAP NetWeaver BI system results in increasing data volume. This means that you have to carefully plan high numbers of daily loading processes to ensure automatic process flows and uniform system load distribution. Simultaneously, you have to monitor error-free loading processes.

Monitoring

You use monitoring in SAP NetWeaver BI to monitor all of the data loading processes and manage scheduling. Data loading processes are executed using *process chains*. Large interdependent loading processes are controlled using higher-level process chains (metachains). Follow-on actions can be activated depending on which events occur. For example, you can only start dependent InfoCube loading processes when the higher-level loading process has completed. Process chains can be scheduled and activated either by time-dependent events or triggered by events. Time control enables periodic scheduling of process chains, which, for example, are supposed to be carried out every night at a specific time. Monitoring lets you trace status progress of process chains, and detect and analyze errors. Using this method for error detection you can minimize the time required for error elimination despite the high number of processes and data.

BI Administration Cockpit

Administration Cockpit

To control the complexity of a modern data warehouse you can use the SAP NetWeaver BI's Administration Cockpit for data and quality checks. It supports the BI administrator in status monitoring and in performance optimization by giving an overview of the objects and processes in the SAP NetWeaver BI system. You can access it via the SAP NetWeaver Portal to request further information on critical system situations or to start applications for error elimination. Possible scenarios are display of query response times, loading times of loading processes, or display of erroneous data in PSA. You can display this data on monitors based on the delivered standard queries and use SAP NetWeaver BI statistics as reference. BI statistics are delivered as technical content. Therefore — similar to Business Content — templates for the user exist. However, they are not based on business-related, but on technical models.

Authorization concept

Role-based authorization

In a data warehouse, you must ensure data quality checks and quality through targeted control of authorizations for your users to avoid unwanted entries or to make relevant data available to specific users. Individual user access to the data in the SAP NetWeaver BI system is controlled through a detailed, role-based authorization concept. Existing authorizations can be transferred automatically from upstream R/3 systems. The authorizations within a cost center hierarchy, which are saved in detail in Cost Center Accounting in the R/3 system, are an example of this. Special extractors are used to import this authorization information into the specific InfoProvider for this purpose. You can use this information to generate authorizations automatically in SAP NetWeaver BI. These authorizations are much different than the authorization concepts in the operative R/3 systems, however: While authorizations in these R/3 Systems are transaction-based, the authorizations in SAP NetWeaver BI are defined more by analytical aspects.

Lifecycle Management

Data volume management

In addition to the growing number of BI applications, there is another reason for ever-increasing data volume. BI systems have been on the

market for a long time now and frequently they have been used for many years. During that time, a high data volume has accrued in the SAP NetWeaver BI systems. Therefore, every enterprise using Enterprise Data Warehouse has to consider if all data stored in the warehouse really has to be made available at all times. In this respect, you can use the following scenarios to decide how an existing dataset is handled. One decision criterion for selecting these scenarios is the data volume used. As a second criterion, you have to consider how frequently data is used. The following four scenarios can be identified:

- Use of BI Accelerator
- Storage of data in SAP NetWeaver BI
- Nearline storage scenario
- Classic archiving

If high volumes of data are frequently used in InfoCubes you can deploy the BI Accelerator described in Section 11.1.7 to optimize query runs with regard to response times. For frequent online use of data, for example, in queries, data is supposed to be provided in Data Warehouse without using an application like the BI Accelerator due to acceptable run times and low data volumes.

Nearline storage

Another scenario can be applied for data not frequently used. In this case, you can use an extended (separate) Enterprise Data Warehouse that is linked via nearline storage (NLS). Here, data is outsourced from the system and is still available with read access. There are already several NLS providers that enable this scenario within SAP NetWeaver BI. If you require data from NLS providers you can access them via data transfer processes or the Nearline LookUp API. To do this, data first has to be loaded to the NLS provider via a data archiving process. The last scenario deals with data that is hardly ever used. Here, you should carry out classic archiving.

11.1.6 Enterprise Reporting and Analysis

Among the most important functions in a data warehouse solution are the simple analysis of the integrated data and setup of a reporting frame-

work. The reporting framework supplies the decision-makers with information. The delivery medium needs to be flexible. In addition to conventional spreadsheet programs, such as Excel, the information should also be available through web browsers or an enterprise portal. Different groups of recipients need different media to work with the information efficiently. Employees in the controlling area work mainly in Excel, and find the functions to format their information there. In contrast, a top manager who uses information systems needs a central point of access via a Management Cockpit, where he can log on once and can then access all information centrally in the familiar user interface to gain an overview of the status in his or her area of responsibility.

SAP Business Explorer

The SAP Business Explorer Suite (BEx) is a set of tools used for analysis of data stored in the data warehouse. These include:

- Query Designer to create queries on InfoProviders
- BEx Analyzer to analyze data in Excel workbooks
- BEx Web Analyzer for web-based ad-hoc analysis of data
- WAD to create web applications
- Report Designer to generate print-optimized, formatted reports
- Information Broadcasting to publish reports and analyses

Using these tools you can publish information as reports and analyses via Excel, Internet browsers, enterprise portals, and various mobile end devices, such as Personal Digital Assistants (PDAs).

BEx Query Designer

Reporting

Queries are stored and carried out for specific data sources in the SAP NetWeaver BI system. The Query Designer is a central tool for defining queries based on which Excel workbooks and web applications are created.

A query is always based on a specific DataProvider. The query can be created using the characteristics and key figures contained in the InfoProvider. The basic structure of queries is mainly determined by three components:

- Creation of filters to limit the view on data in the filter area
- Selection of characteristics and key figures in query rows
- Selection of characteristics and key figures in query columns

Filter

Filter values limit data to a specific view. This requirement may include that you can only display specific cost centers in cost center reporting. You can store these filters and reuse them. To restrict characteristics you can deploy variables that enable selection of characteristic values through entry or automatic restriction based on authorizations or customer exits. In addition to restricting characteristics via a static filter you can also create many different default values in the filter area that are displayed to the user when the query is called for the first time. For runtime you can then change these values.

Rows and columns

In addition, you have to determine key figures and characteristics for rows and columns as shown in Figure 11.4. Key figures of an InfoProvider can be restricted under the term *restricted key figure* for reuse in characteristics selections. *Calculated key figures* are defined through formulas in which basic, calculated, or restricted key figures can be used. You also have the option to deploy reusable structures for rows and columns in which selections or formulas are embedded. They statically describe a data request or the analytical calculations required, that means, the structure is always the same for every call. The number of rows and columns can thus be forecast exactly. Without any structures the number is dynamic and depends on the characteristics in rows or columns. If structures are used in rows and columns, individual matrix cells can be separately defined through the cell editor using selections and formulas.

Moreover, exceptions and conditions can be specified. Exceptions define exceptional situations in which data have to be highlighted to indicate critical situations for users. In a query involving plan/actual comparisons you could highlight those values whose deviation exceeds the target by a defined value (either absolute or relative). Conditions define the data areas to be displayed. You can define that only data with a key figure value exceeding a certain value is displayed.

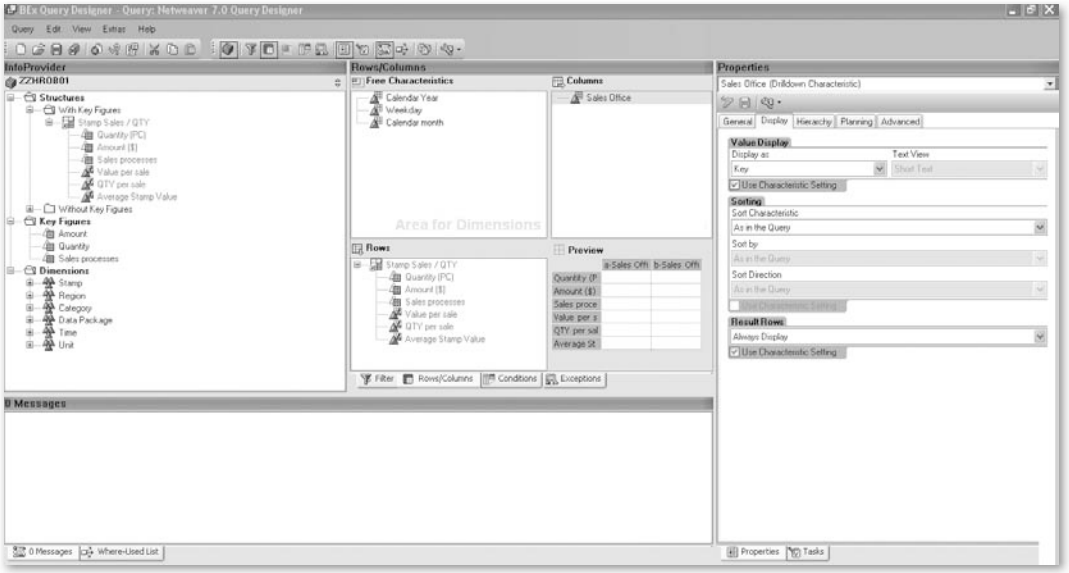


Figure 11.4 Query Designer

The result set is reduced using conditions and remains unchanged using exceptions.

Another important Query Designer functionality is the creation of planning layouts as described in Section 11.1.6.

Hierarchies

Using the Query Designer you can also implement currency and unit conversion functions. Moreover, the SAP NetWeaver BI system and Query Designer provide a display of hierarchies. If you want to use time-dependent hierarchies in the query, you can even display individual leaves of a hierarchy below multiple nodes, depending on the validity period.

BEx Web Analyzer

The BEx Web Analyzer enables intuitive access to BI reports and ad-hoc analyses on BI DataProviders. You can save the data within a standard template in a report with different charts, for example, which you can select from a dropdown box. Predefined functions in the user interface let you display additional information, such as basis timeliness of data, for the reports.

Reuse of ad-hoc analyses

For this function, drag and drop is primarily used to add, remove, or filter characteristics for ad-hoc analysis. You can include, remove, or drag rows or columns to the filter area. Moreover, you can create conditions and exceptions ad-hoc that directly impact the query display. Alternatively, you can use traffic light icons for status exceptions that are based on absolute key figures and arrow icons for trend exceptions that are based on relative key figures. You can assign these icons to the respective alert level to improve the information value of these figures. The reports created in this way can be stored in the portal or sent via the BEx Information Broadcaster (see the *Information Broadcasting* section). This enables reuse of ad-hoc analyses already created.

BEx Analyzer

In contrast to the Web Analyzer for ad-hoc analysis, the BEx Analyzer is based on the conventional Excel application, supplemented with add-ins for the BI functions. The advantage of this combination is that SAP NetWeaver BI has a uniform and integrated data basis so that different Excel files from individual areas don't have to be consolidated for enterprise evaluation. Furthermore, known Excel formatting functions and formulas can be deployed to format reports and implement additional calculations. The BEx Analyzer is based on existing queries and views that were created using the Query Designer.

Analysis vs. Design

In the Analyzer a distinction is made between analysis mode and design mode. In analysis mode the user navigates through the report results. For navigation you can use the drag and drop interface with which characteristics are, for example, separated or filtered. The following section describes the functions of the design mode for designing workbooks.

Here, standard items are available that can be added to the workbook for configuration. Examples for these items are: analysis table for displaying the queries, a navigation area for changing view of data, filters for limiting characteristics, or a push button for using the different default functions.

Close integration with Excel

Today, workbook formatting is more closely linked to Excel functions than before. To enable exact cell formatting using Excel functionality, the basic query has to consist of two fixed structures. Thus, a fixed definable number of cell values can be forecast for each coordinate. That means that for this specific area formatting can be completely determined through Excel functions. This includes the cell color, frames, and Excel-based exceptions that are not predefined in the query and can be entered using Excel formulas. You can also insert company logos and design charts through Excel. Besides these formatting functions, you can also add calculations based on Excel formulas to the workbook. Here, the BI report data can be used as the initial value for a separate additional calculation area where Excel formulas are used to implement simulation. Mapping every query result cell as an Excel formula enables you to access and change individual result cells of any DataProvider. Consequently, you can integrate additional calculation functions and user-defined formatting in every cell. Figure 11.5 shows a normal workbook and the conversion of a query cell into an Excel formula.

If the BI application requires that the users are supposed to access SAP NetWeaver BI applications without SAP NetWeaver BI frontend being installed, you can only use web-based frontends that can be displayed on Internet browsers. The design of these frontends is supported by Web Application Designer.

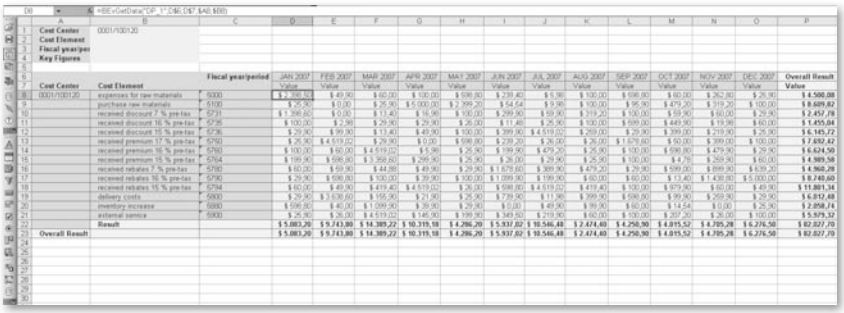


Figure 11.5 Workbook in BEx Analyzer

Web Application Designer

Developing web applications

The BEx WAD lets you develop demanding web applications that you can integrate in the SAP NetWeaver Portal. Web items provide basic functions for displaying and navigating reports on web interfaces. In addition, you can use queries and views as well as other data sources as DataProvider in WAD. This includes data from SAP NetWeaver BI, third-party data warehouses, and Online Transaction Processing (OLTP) sources from other systems. Using the WAD developers can design their applications more easily because many web items and additional functions are already provided. Thus, a user-friendly web interface can be created. In this web interface they can analyze data required, illustrate it graphically, and adapt data or the analysis to their requirements.

Web items

The WAD groups web items according to different areas. Standard items include the most frequently used items, for example, an analysis item for table display of queries integrated via a DataProvider, or a chart item for chart display. Moreover, the advanced web items provide you with functions, such as maps for geographical reporting, or input fields to fill formula variables with manually entered values. You can also integrate items, such as links, texts, or menu bars in the interface.

The following description focuses on web items that enable structured web application design.

Structuring of web items

With regard to web interface structuring, three web items are of particular importance. Thus, you can create tabs without any programming. For example, in one tab you can display the planned sales quantities individually for each month, while in another tab you can illustrate cumulated values to create a general overview. Using the container item and, in particular, the container layout item, you can combine different web items and assign them to tabs without integrating Hyper Text Markup Language (HTML) or JavaScript code. This assignment can be carried out in regular tables, but also dynamically in rows or columns to flexibly respond to layout requirements. In addition to a clear structure within the web application, graphic visualization of charts plays an important role for the layout of SAP NetWeaver BI applications.

Charts

To graphically display data that exists in table form in an analysis item, the WAD contains a chart wizard to enable decision-making support and interpretation aid. In WAD, the chart wizard simplifies creation of different chart types similar to Excel. The wizard guides you through the entire chart design process during which rows, categories, and colors are determined prior to adjusting the attributes of axes and rows. Subsequently, the graphic can be used in WAD without any further adjustments. The WAD, however, does not only provide potential for structuring and visualizing BI information in web interfaces, but also predefined functions and commands.

Command wizard

You can use the WAD's command wizard to simplify navigation in reports and easily integrate planning functions in a web application. For this reason, standard commands are provided that are supposed to avoid unnecessary coding and additional effort. Frequently used commands can be added to the list of favorites. The commands are divided into four main groups:

- **Commands for web items**
  These include commands for specific web items. For example, a web item can be reset to initial status, or its parameters can be changed.
- **Commands for web templates**
  These commands impact the entire web template. The most important commands include setting of variable values for the variables used within the web template, and export of web application, for example in PDF format or to Excel. Moreover, the template can be sent via the Information Broadcaster using a command.
- **Commands for planning applications**
  These commands map the planning function in a WAD web application. Planning functions can be initiated or planning data can be updated. Furthermore, data in the InfoProvider is written back using a command.
- **Commands DataProvider**
  This category includes commands that are particularly aimed to standard navigation functions in queries. For example, drilldowns can

be triggered, filters replaced or documents created during data commenting. Moreover, you can expand hierarchy nodes, process conditions and exceptions, or adjust display properties of queries using these commands.

Use of JavaScript

In addition, commands in WAD can be converted to JavaScript to expand standard commands. In the planning area, you could generate a pop-up window for confirmation that opens prior to saving data and acts as a safety mechanism in the web application.

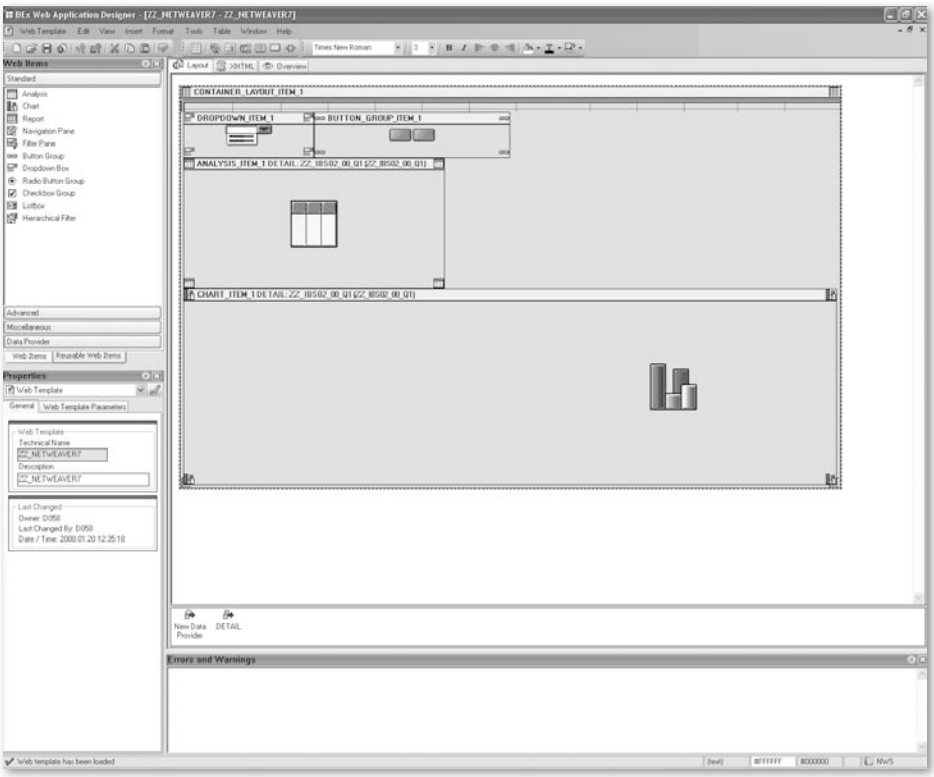


Figure 11.6 Design of WAD Web Application

Figure 11.6 illustrates how a simple web application is structured through a container layout using a dropdown box, analysis item, and a chart. In addition, the analysis item can be drilled down by cost elements using a command allocated to a button. The result of this design is displayed in Figure 11.7.

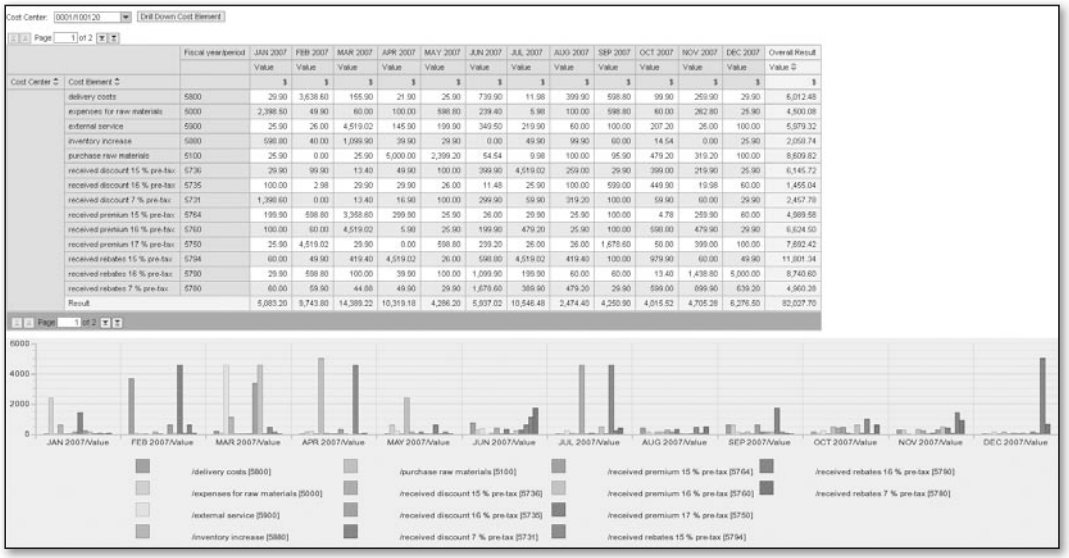


Figure 11.7 Simple Web Application

Template wizard

An innovation that simplifies creation of web applications is the provision of BI patterns in WAD. These are configured through a wizard for direct use. The BI patterns provide web templates that only have to be parameterized by the user. They are based on the simple combination of analysis item and chart item, and one or two DataProviders to be defined. Moreover, you are provided with an information consumer pattern that offers a menu bar with predefined functions and an enhanced navigations area. This enables the information consumer to navigate to the wanted level of detail without the need to create his own web application. If you use this template you can't process or make any changes in WAD.

In addition, you can make custom web applications available for reuse or as templates to create new applications. This promotes the approach to create smaller web templates that can be combined to a larger application in the context of a service-oriented architecture.

Report Designer

In the previous sections, we explained the potentials of the BEx Suite that particularly aims at the analysis of data contained in SAP NetWeaver

BI using all navigation means provided. For specific reports that are generated in a company navigation in the data is not relevant at all. Here the focus is on formatted display and the possibility to create printable reports according to company-specific requirements. The report designer described in the following sections is supposed to cover these requirements and to complement the existing tools.

Formatted Reports

Specific target groups within the company require reports that don't have to use conventional navigation options within a query. Instead, the results are supposed to be displayed in a specific report format that provides a clear, print-optimized, and precisely defined layout (header and footer, company logo, specific styles, and so on). Frequently, colors and fonts are defined as well. The BEx Report Designer is a development tool for the SAP NetWeaver BI system that offers functions for creating these formatted reports. As a visual tool, it can display a preview of the final report already in the design mode.

A BEx Query or a Query View form the basis for a BEx Report that is assigned to the respective report, that means, the Report Designer provides no direct access to the InfoProvider. It concentrates on formatted display and not on flexible analysis. A report may contain several report areas that are based on a DataProvider. Moreover, headers and footers can be specified. Comprehensive formatting options are available if an area contains a DataProvider that comprises structures in rows and columns. Thus, the position of a field is precisely defined to enable unrestricted field positioning within the report in this static area. In a dynamic area that contains only one key figure structure in the columns and a variable number of characteristics in the rows, the number of fields is not determined until runtime. This enables restricted formatting options only.

Concept of row pattern

Actual formatting is based on the row pattern concept that is very similar to the format template concept in Excel and enables determination of various row types that are supposed to be formatted in the same way. Using such a row pattern in the Report Designer, you can determine colors and fonts, define row height and width, or merge cells. In addition, you can create chart sections using the chart wizard already familiar from WAD. These are also based on queries and graphically prepare the information displayed.

In Figure 11.8 the report is processed using the Report Designer. The final report is shown in Figure 11.9.

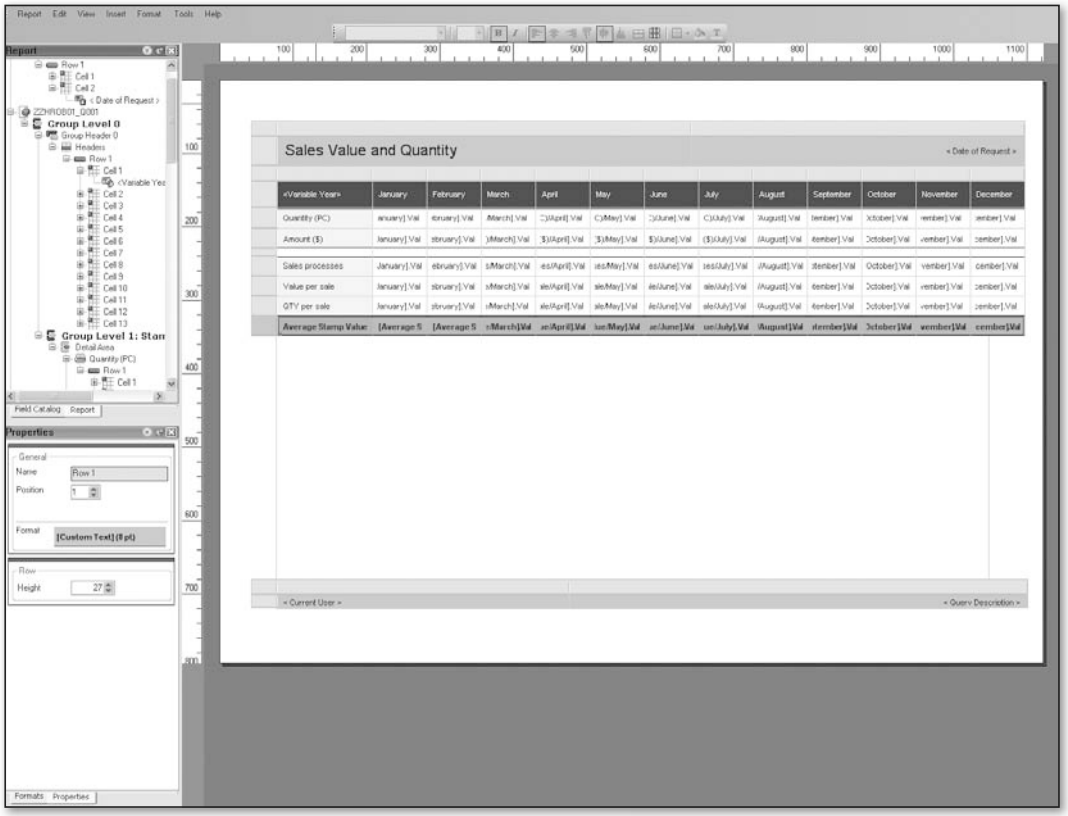


Figure 11.8 Report Designer

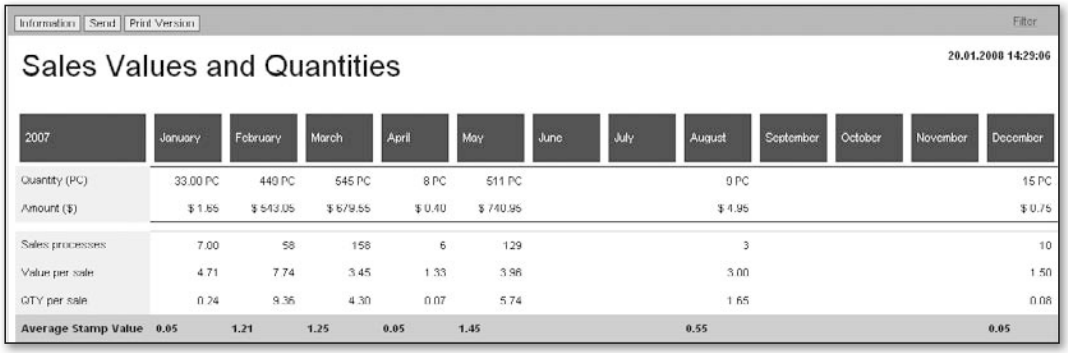


Figure 11.9 Formatted Report in Report Designer

Print optimization

Print optimization is another central topic of the Report Designer. A report can be output on the web or converted into a PDF file for printout or dispatch. You can implement this directly via the Report Designer or via the BEx Broadcaster that will be presented in the following section.

Information Broadcasting

Shipping of BI information

In the previous sections you were provided with various options for preparing information in the SAP NetWeaver BI system. Now you have to ensure that the information is published at the right time in the right format to the right recipient. To do this, you are provided with the BEx Broadcaster in SAP NetWeaver BI. Using the BEx Broadcaster you can send BEx Queries, workbooks, web applications, and BEx Reports in various formats (HTML, MHTML, PDF, ZIP, Links, SAP Alerts, and so on). In addition to the users registered in the SAP system, you can also reach non-SAP users via email. You can select the recipient in many different ways:

- Selection of individual recipients
- Selection of user groups
- Distribution lists
- Role-specific shipping

Besides selecting recipients, you can also variably determine the dispatch time. The following options are provided:

- Distribution triggered by events
- Distribution triggered by exceptions
- Ad-hoc scheduling
- Dispatch at predefined time

You can also flexibly select the dispatch channels. In addition to email dispatch, the SAP NetWeaver Portal plays an important role here as it forms the basis for KM using SAP software. Through portal integration any documents can be attached to BI data and KM services, such as discussions or Text Retrieval and Extraction (TREX) searches, and used. The Broadcaster not only lets you send BI data, but extract non-SAP data as

well through Java connectors via UDI, which means that the data doesn't have to physically exist in the BI system.

Scenarios for the Information Broadcaster

In an enterprise, there are several scenarios possible for the use of the Information Broadcaster. This includes various objects that can be sent, various recipients, and the time when the information is supposed to be provided. The warehouse stock report is a very good example to illustrate this. On the one hand, this may require that a report on the current warehouse stock is immediately sent to a specific recipient. On the other hand, scenarios are possible that address the specific characteristics of reporting. Thus it must be guaranteed that, for example, monthly overview reports are sent automatically to provide the expected reports to the management at specified times according to the push method. Furthermore, it must be ensured that exception reports are generated for the responsible person if the planned value considerably deviates from inventory to take immediate action. The basic scenarios and the extended functionality of the Information Broadcaster will be discussed in the following sections.

You can call the broadcaster from all BEx tools or via the portal. A wizard guides you through the definition of all required parameters. This definition mainly includes creation of a new setting and its processing, which depends on the distribution type and output format, as well as planning settings. You can also filter web applications and queries via the MHTML output format. Filter options are not available for workbooks yet. Please note that a Precalculation Service is required for workbook precalculations. The Precalculation Service is an individual component with separate installation. It is available via SAP NetWeaver BI frontend patches and is usually installed on a separate server. Alternatively, you can also install a client. Then, you have to manage the Precalculation Service in SAP NetWeaver BI Customizing.

Exception broadcasting

In an enterprise it is often required that reports are only sent if critical situations occur. This case can be mapped with exception broadcasting. Exception broadcasting is based on the definition of exception rules in a query. For this case, there are two distribution type options. The exception data can either be sent via email, or an alert can be generated using an alert framework. Alerts are configured in the BI backend on the central alert server. For the Information Broadcaster you are provided

with the information from the configured alert category, and you can determine which values are relevant for the characteristics and the alert broadcast. You can directly transfer the recipients to the broadcast setting or copy them from the recipient definition in the alert category.

Events and fixed times

In addition to exceptions, the requirement to send information after specific events or at fixed times was described. Therefore, you have the option to send information via the broadcaster after an InfoProvider has been updated. In the process chain, which is used to trigger the InfoProvider update, you can integrate the event data change process type. If this process chain is activated, you can select the scheduling function in the broadcaster to implement changes to the InfoProvider data. Additionally, you can start dispatch at fixed, predefined times using the broadcaster. To do this, a job must be defined in the BI backend. You can trigger this job on a daily, weekly, or monthly basis as required or for a predefined period of time.

In addition to these main functions, you can adapt the broadcaster with further functions to optimally supplement your organization. The broadcaster can send emails via *bursting* whose recipients are derived from master data in the BI system. Thus, recipients can be approached who are not users in the SAP NetWeaver BI system. The recipient receives a filtered report that only contains the data defined in the email address characteristics, for example, only for the cost center for which the recipient is responsible.

In addition to the email or portal channels, you can also send broadcasting objects to a printer defined in the system. In situations for which good query performance must be ensured, you can trigger precalculation and filling of OLAP and MDX caches using the Information Broadcaster. For example, you can implement precalculation at night to present reports with optimized query performance reports to the upper management the next morning.

11.1.7 Integrated Planning and Analytics

SAP NetWeaver BI Integrated Planning (BI-IP)

The integrated planning component *SAP NetWeaver Business Intelligence Integrated Planning* (BI-IP) is a solution for users to integrate planning applications and scenarios. These can be compared to reports already

created using analyses to generate new potentials with regard to company control. Besides the analysis functions of the BEx Suite, the Analysis Process Designer and the SAP NetWeaver Visual Composer (see Section 14.1.3) provide further analysis potentials and are presented in this chapter in addition to integrated planning.

Process-Oriented Use of Integrated Planning

Planning scenario

Planning scenarios can be uniformly mapped through SAP components while avoiding integration gaps. These used to occur particularly for planning in Excel. Many documents were inaccurately consolidated without any workflow support of the planning process. A sample scenario from the cost center planning area will map the functionality and process-oriented procedure in a project with integrated enterprise planning. This scenario enables, for example, manual entry of annual plan values for cost centers and types via planning layouts as well as distribution of these annual values to the individual months using different planning functions. In this case, the annual values can be distributed to the individual months proportionately to the actual data of the previous year or according to specific keys to be entered. With further planning functions you can implement distribution between the individual cost centers. Planning data is then available for reporting immediately after entry of change. The planning data is compared with actual data to directly analyze deviations between planned and actual values using integrated planning. The cost center scenario helps you to identify in the course of the year whether the annual target value can be reached or whether measures have to be taken accordingly.

Portal integration

Integration in the SAP NetWeaver Portal is recommended to enter and further process planning data, as specific portal communication functions are required for integrated planning. However, you don't necessarily have to implement planning in the portal. Users log on to the portal and can use the planning layout for manual data input to assemble the planning data for their enterprise areas, based on the actual data that is also integrated in the portal. The portal offers users central access to all planning applications via Single Sign-On (SSO). Due to the portal's role-based concept they can only see information relevant to their work.

Moreover, the portal is essential for the use of the Guided Procedure for workflow support that will be described in the following section.

Planning workflow

A Status and Tracking System (STS) is used to control the planning process. STS enables monitoring of the current planning round status to determine which planner has already entered his planned values. Besides structuring the planning process, STS is also used to clearly assign subtasks to responsible persons while simultaneously considering fixed dates. For mapping a complex planning workflow whose requirements go far beyond the potential of STS, using Guided Procedures (see Section 14.1.4) that enable flexible design of collaborative planning processes is recommended. Through Guided Procedures you can map the planning process in a holistic manner. In addition to the planning layout, you can also integrate offline processes in Guided Procedures, for example, via Interactive Forms. You can also attach further information to the planner that is important for planning. In our cost center example, the responsible controller can trigger the Guided Procedure and attach Office documents important for planning. Consequently, the persons responsible for cost centers are notified via the Portal or email that their intervention is required. After having entered and processed the data, the process step can be concluded. Subsequently, the superordinate controller can decide whether the planned values have to be re-processed or the planning round can be completed.

SAP NetWeaver Visual Composer

The portal offers further planning options, for example, for administration of planning propositions. For example, you can determine in advance specific combinations of cost centers and cost types that are supposed to be plannable. You can also use a portal application within rolling planning to enable the user department to set the next planning period outside the backend. Here, the SAP NetWeaver Visual Composer is used as it can communicate with the BI backend or queries via different interfaces (for instance, RFCs) and thus is suitable for planning administration. Users who assume only a few administration tasks don't have to go via the backend, which may result in authorization problems. Administration of planning propositions can also be integrated in the planning process via Guided Procedures.

Retraction to the R/3 system

The last step in the planning scenario can be the retraction of planning data to the SAP R/3 system. As you can see, this process enables real

progress toward the integration of planning, reporting, and analysis through holistic layout of integrated planning processes via different systems. Besides holistic, process-oriented use of SAP tools for enterprise planning, the trend is toward template-based planning software. Users are provided with predefined templates and configuration interfaces that they can use to build their own planning process. Examples for this approach are: the SAP Business Planning And Consolidation solution, or Planning Excellence by IBSolution GmbH, which already builds on the SAP NetWeaver platform.

Modeling of Planning Applications

Integrated planning includes two different modes. On the one hand, it provides modeling options to flexibly define the desired planning layout and functions. On the other hand, it also enables the use of existing planning models to implement enterprise planning. In the following section, the potentials of planning modeling will be presented.

Planning Modeler

The Planning Modeler is a central, web-based planning unit and is used for modeling the planning process. Within the Planning Modeler, the following basic modeling options are available for planning:

- Creation and modification of aggregation levels
- Implementation of characteristics relationships
- Implementation of data slices for locking planning data
- Layout of planning filters
- Implementation of planning functions and planning sequences

The Planning Modeler enables planning modeling if InfoProviders have been created in advance. Aggregation levels are new InfoProvider types. They are always created based on existing, plannable InfoProviders, that is, real-time InfoCubes or MultiProviders. They select the key figures and characteristics for which planning is supposed to be implemented. You can restrict these selections by creating a filter for specific characteristic values to map small working pacts for the planner. You can use these filters later for queries and planning functions. Characteristics rela-

tionships and data slices are further concepts within the Planning Modeler. Using characteristic relationships you can establish rules between different characteristics to guarantee consistency and harmonization of data within the InfoProvider. The real-time InfoProvider and its respective aggregation level form the basis for establishing characteristics relationships. In addition to checking for valid characteristics combinations within the aggregation level, they enable automatic derivation of characteristics and default values for valid combinations. With data slices you can lock an exactly defined part of data within the InfoProvider to prevent modification of the data involved. They are not based on characteristics combinations, but on restrictions of characteristic values. They are primarily used in planning scenarios if planning versions or data are supposed to be frozen and may not be changed any longer.

Planning functions

Using the Planning Modeler, you can also model planning functions. To do this, you are provided with several predefined planning functions based on which values from a planning version can be copied to the next version to establish the latest planning version based on the values of the previous version. Further examples of standard functions are:

- Copy function, for copying different planning versions
- Revaluation functions, for calculating percentage discounts on sales
- Distribution functions, for distributing planned annul value for individual periods based on the reference data of previous planning years
- Currency conversion
- Unit conversion
- Repost, to transfer a specific amount from one account position to another

Fox formula functions

If you can't map the requirements using the standard functions mentioned, the Fox formula functions provide you with predefined components for the planner to generate calculations or more complex distributions (for example, for distributions between cost centers) within the Planning Modeler without requiring ABAP or Java programming. The user-defined planning functions are the most complex, but also the most flexible type of planning functions. Developers can use the entire range

of ABAP programming. This feature of integrated planning is important in two different cases: It is used in cases where Fox formulas are not sufficient or if this planning function type is suitable for reuse. Up to now, planning sequences had to be established in planning projects to map a frequently used subprocess, for example, copying values of different versions while simultaneously revaluating or calculating the copied values. By creating planning function types you can use them for different subplans within the entire company. You can parameterize the function types created for different subplan requirements.

Planning sequences

You can still create planning sequences in integrated planning. Planning sequences string simple planning functions to one planning complex and can be restricted to special characteristic values by adding filters.

Design of Planning Frontend

The design of planning applications includes both the implementation of the previously mentioned elements, such as planning functions and planning sequences, and realization of manual planning layouts for entering planning data, also referred to as ready-for-input queries. In integrated planning, these planning layouts are provided to users in two different forms within the frontend. On the one hand, users can deploy BEx Analyzer Workbooks for planning. On the other hand, web applications created using the WAD can implement a planning application within the web browser without having to access planning through a special SAP frontend.

Planning characteristics of the Query Designer

Within the SAP NetWeaver BI area, the Query Designer is used as the starting point for interaction with the user. A ready-for-input query is based on the same query technology deployed for reports. In contrast to the old BW-BPS, known functions, such as navigation, drilldown, or exceptions, can be used for planning. Integrated planning also makes sure that variables are no longer created separately for planning and reporting. Variables created and used in the Planning Modeler can also be applied for creating queries in the Query Designer. Likewise, variables created with the Query Designer can be viewed in the Planning Modeler.

This is supplemented by special functions that are only aimed for planning. Ready-for-input queries use aggregation levels created with the Planning Modeler as InfoProviders. You can now administer via the key figure options whether data can be changed by input and planning functions. Another advantage of using the Query Designer is the flexibility with which cells and their ready-for-input status can be controlled through the cell editor for planning. Moreover, planning functionality is integrated in the Query Designer. In addition to the planning of hierarchy nodes using different planning modes (bottom-up, top-down), the Query Designer also provides distribution of totals on a disaggregated level via variable distribution types.

Starting from the ready-for-input query and functions and sequences already created as basic building blocks for planning, you have to decide whether users can plan in Excel or web environments to merge individual elements to one holistic application.

Web-based planning applications

Using the WAD you can create web applications through which you can enter planning figures and previously generated process planning functions. Furthermore, you can compare planning figures and reports. The WAD's different web items let you implement these requirements. The analysis item is used for displaying reports and planning layouts in table form with a holistic look and feel. Dropdown boxes enable restriction of variable characteristics. Moreover, you can allocate commands to a button to trigger planning functions or planning sequences.

Excel-based planning

Alternatively, the planning user interface can also be implemented in an Excel workbook. In the BEx Analyzer's design mode you have the option of adding dropdown boxes, planning functions, and buttons for interface modeling. This is supplemented by known Excel functions depending on the usage requirements. In a planning scenario, you can enter planning figures and define a separate area for implementing additional calculations by combining planning and Excel functionality. If required, you can also plan in Excel workbooks offline; planning data are then made available online in a second step. A major difference to the WAD is that you have to access BEx Tools for using Excel workbooks, whereas an application created with the WAD can be independently used via a web browser.

Analysis Process Designer

In addition to planning and reporting, users can detect undiscovered relations in the SAP NetWeaver BI system's data volume for goal-oriented enterprise control. SAP's data mining solution is the Analysis Process Designer (APD) . You define an analysis process in a graphical user interface. In the process, one or more data sources are merged in individual steps, transformed using mathematical and statistical calculations, and prepared for further examination. You can then save this new data in the appropriate InfoProvider and analyze it. In addition to creating and changing data mining models, you can also train with different SAP NetWeaver BI data within these models to enhance the data mining model. Moreover, you can execute and visualize data mining methods. Examples for this include:

- Forecast with decision trees
- Determination of frequency distributions
- Cluster models
- Integration of third-party data mining models

In the previous sections we explained the different potentials available in SAP NetWeaver BI standard. Now you will be presented future developments in the SAP NetWeaver BI area.

Embedded BI

In many enterprises, operative and decision-making systems are strictly separated, even though specific persons within the enterprise use both system types. Here, SAP NetWeaver Composition Environment (see Section 14.1) provides tools for creating composite applications that integrate operative and analytical process steps. This integration and additional SAP workflow support between the individual process steps is called *Embedded BI*. This term is used for applications that process user-specific and context-specific data for each employee within a state-of-the-art user interface independent of the systems involved.

SAP NetWeaver Visual Composer

End users are provided with a holistic interface that can use operative and analytical data and services created with SAP NetWeaver Visual Composer. SAP NetWeaver Visual Composer enables you to flexibly develop

model-based applications, and to design user interfaces and applications without using ABAP code. You can also integrate BI queries in the Visual Composer model. If the data granularity that is processed for analysis in the query of the Visual Composer model is no longer sufficient you can directly jump from the SAP NetWeaver Composition Environment to the Business Explorer tools to enable more precise analyses of the dataset. The SAP NetWeaver Visual Composer enables direct embedding and integration of SAP NetWeaver BI functionality in a larger context.

BI Consumer Services

You can integrate data in this integrative analysis application using BI Consumer Services. Here, data from SAP applications, such as SAP NetWeaver, but also from relational and OLAP external sources, are supported. This is achieved through BI connectors for BI-specific integration, and BI Java connectors for integration of OLAP or relational DataSources. BI Consumer Services thus enable a flexible user interface while simultaneously separating underlying datasets and design tools. Future BI applications could, for example, appear as described next.

A query in SAP NetWeaver BI is the starting point that displays the number of articles sold and the corresponding customer. This query is displayed in an interactive user interfaced created with SAP NetWeaver Visual Composer. Within this query you can navigate, sort, and hierarchically display using BI tools. Besides BI component integration, you can also integrate additional information from the ERP system due to the characteristics of a Visual Composer model (see Section 14.1.3). Thus you can call master data of a customer that was displayed and selected in the BI query, or display additional analysis methods via Web services. This brief example already indicates the integration options of an SAP NetWeaver Visual Composer for SAP NetWeaver BI applications, as BI information enhanced with additional information from operative systems and external data can be used even more effectively.

Outlook SAP NetWeaver BI applications

In this subsection special attention was drawn to the SAP NetWeaver Visual Composer as a future tool for designing user interfaces based on BI information. The remaining BI tools presented in this book, however, will also be significant. The significance of these tools derives from the different user groups that are identified within the use of SAP NetWeaver BI. The following differentiations give a final overview of the flexibil-

ity of the presented analysis, reporting, and planning functions in SAP NetWeaver BI.

For runtime, normal users can use predefined Excel workbooks, formatted reports, or Visual Composer Cockpits that can be called by default. Business users that require standard reports and in-depth information can create new analyses using the BEx Analyzer or BEx Web Analyzer. For creating BI applications the development is going from strict separation between IT specialist and user department to business process expert who can generate applications based on underlying services via the SAP NetWeaver Visual Composer. The SAP NetWeaver Visual Composer and the Query Designer are both used as the basis for creating analysis and planning queries, whereas the WAD will become less important due to the increasing significance of the SAP NetWeaver Visual Composers.

11.1.8 Performance Optimization through the SAP NetWeaver BI Accelerator

The preceding sections indicate the many application options of the SAP NetWeaver BI Suite for planning, reporting, and analysis. This, in turn, results in new challenges as correctly enhanced information at the right time was identify as a requirement in addition to ever-increasing numbers of users and growing data volume. Nevertheless, reports and analyses still have to be available immediately, even in extreme cases.

Complexity costs through aggregates

Previous BI-integrated solutions for higher performance of query calls, such as aggregates, can meet these requirements only to a limited extent because their maintenance results in higher complexity costs. To meet the requirements, SAP provides the BI Accelerator (BIA). The BIA is a solution that supports SAP's Appliance Strategy. "Appliance" means that the BIA software is already preinstalled and configured on a separate hardware server, in which several blade servers[4] are linked via a joint memory area depending on the sizing. BIA is therefore delivered as an off-the-shelf black box solution and is integrated in existing SAP

4 Thanks to the blade server's design they can be inserted in so-called slots of blade center on top of each other or side-by-side. They are connected with the backplane to provide benefits through high scalability and flexibility, easy maintenance and high performance density.

NetWeaver BI systems through RFC connection. Thus, fast operational readiness is made possible through the pre-installation and integration is achieved with little effort.

Areas of application

For this appliance, areas of application can be found in all industry segments. If queries are executed on several millions of datasets and low, stable runtime is supposed to be ensured, BIA can ensure good response times. These reductions can also be achieved for frequent drilldown or slice-and-dice operations. In contrast to BI-internal possibilities (Aggregates, Precalculation, OLAP cache) for enhanced performance, BIA is characterized by high performance and simultaneous high reusability. Aggregates as standard solutions can provide you with higher performance improvements; however, it is not possible to optimally adjust aggregate to all company queries. Moreover, complex maintenance results in limited numbers of aggregates in the SAP NetWeaver BI system.

TREX Extension

BIA constitutes a technical extension of TREX and enables fast search options based on structured data. The transparency approach of this appliance solution is supposed to provide you with enhanced performance for query execution without influencing the users' workflows. The basic principle of BIA is to provide InfoCubes redundantly replicated in compressed, but not in aggregated format. These InfoCubes are first indexed and loaded into the BIA's data storage. Here, each InfoCube is subdivided into several indices and recombined via a logical BIA index. The indices can then be used in the main memory. It is recommended to load all indices in the main memory. For queries, the BIA creates joins and aggregations as specified in the BIA index. Moreover, data can be aggregated in parallel.

Storing data in columns

The special feature compared to data storage in classic databases is that data is stored in columns, so that for attribute value queries from all instances only the lines in one particular column have to be read. In a classic database each single line, and within these lines the corresponding attribute value, would be checked. This would be very time-consuming if no proper indexing is available. By improving the resource usage, the BIA can provide further time advantages according to the horizontal partitioning principle. Here, the indices are distributed on various physical index servers to enable BIA query parallelization. An index contains:

- Index name
- Join conditions
- Join paths
- View attributes
- Key figures

Reduced data volume through compression

There is a direct relationship between an index and an InfoCube; compression, however, reduces the data volume considerably. This compression is achieved through a dictionary-based procedure and numeric coding of indexed data. Master data, which, for example, are used in two InfoCubes, are only indexed once for BIA.

When implementing queries that relate to an InfoCube that is loaded in BIA, it is confirmed whether they have been precalculated by the Information Broadcaster. Then it is confirmed whether these queries are already contained in the OLAP cache. Subsequently, data are accessed in the BIA to generate query results. Without the BIA you would have to process the existing aggregates after the first two steps before you could access the InfoCube. The query results are finally forwarded from the Analytical Engine in SAP NetWeaver BI to the analysis frontends.

BIA maintenance

The BIA's maintenance concept provides additional advantages compared to aggregates, particularly for changing master data or hierarchies in so-called change runs or for index updates. The former becomes part of the BIA index and can thus be implemented in a time-saving manner. You don't have to make changes in the fact table as the BIA index and the InfoCube have the same granularity level.

For an index update, the indices are created first. Then the data from the database is loaded as a temporary index in the main memory via an RFC connection, and finally persisted on the disk via a commit. If newly loaded data in the InfoCube is to be added to the BIA index, this is done via a delta index so that only the delta load has to be indexed.

11.2 Knowledge Management and Collaboration

KM bundles all information of a company that is not directly linked to transactions. The goal is to prepare all unstructured information, like

documents or discussions, and to provide it to all persons involved in the process.

The KM component used to be a technical part of the SAP NetWeaver Portal in the initial SAP NetWeaver versions; functionally, however, belonged to the information integration area. In the meantime, the KM has not only been available in the SAP NetWeaver Portal, but also via KM services, for example, in SAP GUI or other applications.

11.2.1 Knowledge Management Requirements

Approximately 80% of all information in a company is unstructured. Therefore, you require a tool to structure this information in such a way that it can easily be found by all people involved. The KM provides corresponding structuring tools within SAP NetWeaver.

Access to unstructured information

Unstructured information is generally distributed on desktop computers, file servers, in email, groupware, and other applications. Moreover, information is stored in different productive applications, such as ERP, CRM, or Product Lifecycle Management (PLM). Another part is within the SAP NetWeaver BI system. Each of these applications is provided with an individual user interface and offers access to the respective information. Therefore, the search for, and particularly the preparation of, information is very difficult.

Furthermore, a distinction is made between the structuring of information using KM repositories and the search through these repositories. The search structure will be explained in Section 11.4 and the possible structure of enterprise search in Section 11.3. The structure of KM repositories will be detailed in Section 11.2.2.

Collaboration Platform

Another important component of the KM solution is the collaboration solution. It enables joint processing of specific contents. Its functionality mainly includes team rooms with file sharing and calendar, instant messaging, and a discussion forum.

The main purpose of this application is the creation of a portal platform where working groups and project groups can easily create work areas. This work environment can be used as a company-wide desktop. Moreover, you can use the collaboration solution to centrally store

and "search" all discussions, documents, meetings, and agreements of a working group. This way, you can access information even years after a project was completed or when new project members are accepted.

11.2.2 Knowledge Management Technical Structure

Figure 11.10 shows the different KM components.

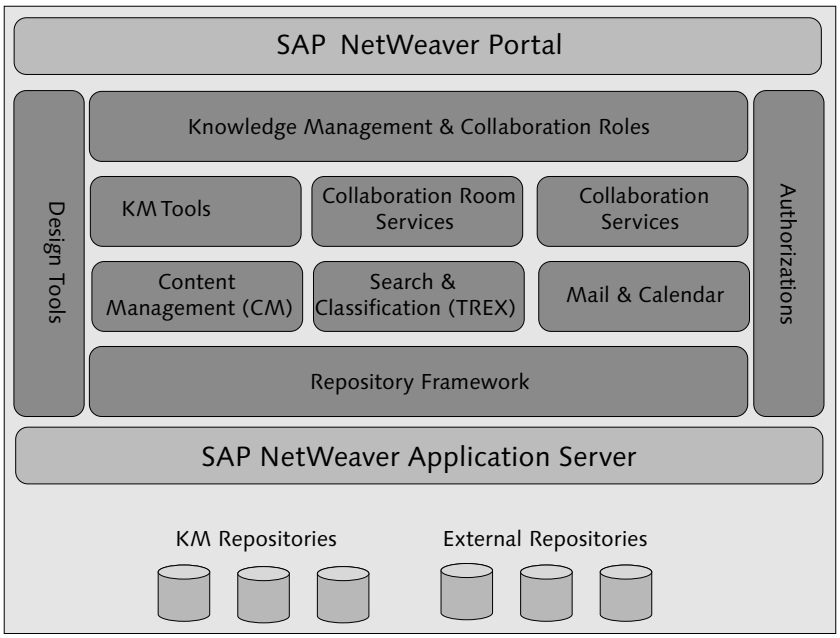


Figure 11.10 KM Components

These include:

- Repository framework
- KM tools
- Content management
- Collaboration rooms
- Collaboration services
- TREX
- Mail and calendar

Repository framework

Repository framework is the most essential part. Using a technical adapter, the respective subsystem is connected to the KM via the Repository Manager. This way, you can process all connected repositories/data sources in the same manner and always with identical tools. They can be extended repository-specific via repository services.

KM tools

KM tools include all important functions for processing repository contents. These include:

- Uploading of documents
- Creating new files
- Maintaining metadata
- Versioning documents
- Assignment of privileges
- Release workflows
- Indexing
- Classification

Available repository adapters

To simplify the KM setup for a project, a wide range of repository adapters is available. Within the SAP world this includes adapters for SAP PLM DMS, SAP NetWeaver BI, SAP CRM and various xApps (xRPM, xPD).

Third-party adapter

The SAP standard shipment includes the following adapters for third-party systems. They are available for file systems, web servers (HTTP/HTTP(S)), WebDAV (e.g., Livelink, Novell), and Lotus Domino (5.x). In addition, there are adapters for Microsoft Windows SharePoint Services, which are also addressed via the WebDAV interface. Some partners also provide adapters for third-party systems. These include adapters for IXOS DocuLink 4.6C, File Net P8, and Lotus Domino 6.0/6.5 (by Conet).

In general, your Contents can be kept in KM or referenced externally. This enables you to reference files from a file share only or to create them directly in KM. Independent of the method selected you are provided with the same functions for both files.

Content management

When you create files directly in KM, this is done in the content management area. This area is the storage location for KM. Documents that are created using the Webpage Composer[5] are also stored here.

Groupware framework

The connection of systems required for collaboration is very similar. Here as well, the repository framework is used; however, different functions are used. For example, group systems, such as Microsoft Exchange or Lotus Domino, are connected via groupware framework. This is a special repository framework that provides groupware-specific functions.

In Section 11.4, you will be given more detailed information on TREX. For this reason, we will not discuss this component at this point.

Email via SMTP transport

The Groupware Framework consists of two parts: On the one hand, the mail system is directly integrated (via Simple Mail Transfer Protocol [SMTP]), on the other hand, you can display and process emails in the SAP NetWeaver Portal using the web client functions of the respective email programs (e.g., Outlook Web Access [OWA]).

Calendar per repository

The second part of the groupware framework includes the Calendar Repository Manager. Here you can use calendar functions directly from your KM applications either in read-only or write mode. This happens via pre-implemented repositories that are already integrated in the standard version. To date, repositories are available for Microsoft Exchange and Lotus Domino. In the SAP Help Portal[6] you can check which versions are supported.

The following functions are available for both calendar integrations:

- Creating dates (recurring daily/weekly)
- Sending meeting requests (recurring daily/weekly)
- Reading, changing, and deleting dates
- Sending meeting requests, including attachments
- Planning of online meetings
- Checking availability data

5 The Webpage Composer is a CMS tool that can be used to create XML forms for the output of HTML pages.

6 *http://help.sap.com/saphelp_nw2004s/helpdata/de/ba/7996492eca44fa84af6e235d883041/frameset.htm.*

Web Service Access Layer

Within the Web Service Access Layer you are also provided with functionality to use KM functions outside of the SAP NetWeaver Portal. For example, these functions are available both in ABAP and Java. A specific example is that you can access KM contents via the SAP GUI. Figure 11.11 illustrates this structure. There is

- **Java access**
  Here you can manage repositories and set up KM services.
- **ABAP access**
  Here you can directly access KM via ABAP modules from SAP GUI.
- **Java access UI**
  Here you can create new interfaces for KM or integrate non-SAP portals.

Synchronous Collaboration Framework (SCF)

Another integration aspect is available when connecting to the Synchronous Collaboration Framework (SCF). This is a collaboration extension within the portal that allows you to operate collaborations outside the portal using clients. This SCF already has a predefined adapter for Microsoft NetMeeting and WebEx. This enables you to use established tools if these rooms are used in KM.

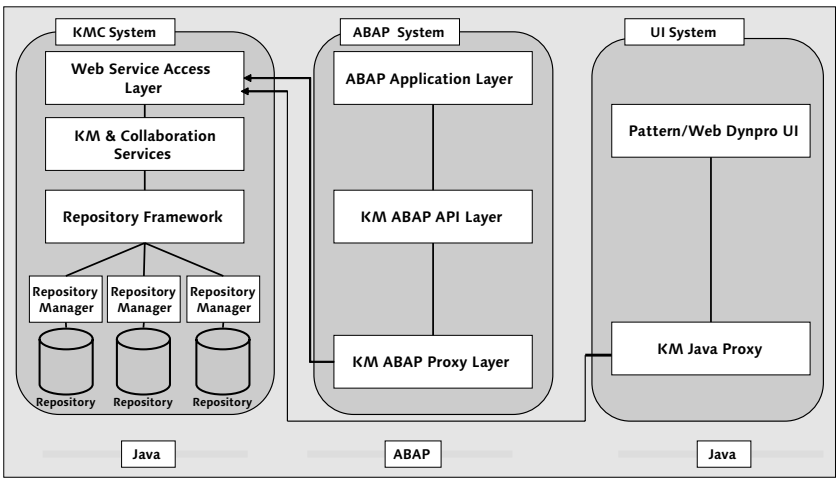


Figure 11.11 Web Service Access Layer

But you can also use the integrated collaboration functions in the SAP NetWeaver Portal.

11.2.3 Integration of Microsoft SharePoint Services

SharePoint Portal

Only a few companies use just one single portal platform. Frequently, enterprises use several portal platforms in parallel. To ensure exchange between these platforms they must communicate. The SAP NetWeaver Portal enables communication with other portals, such as Microsoft SharePoint and IBM Websphere. We will describe the connection with Microsoft SharePoint as an example.

WebDAV as an interface

SAP and Microsoft have jointly developed a *Web-based Distributed Authoring and Versioning* (WebDAV)[7] connector that enables access to all WebDAV-capable Microsoft products. The previous generic WebDAV connector in the SAP NetWeaver Portal was not able to do that. This new connector is called *Windows SharePoint Services Connector for WebDAV* (SWC). SWC allows you to access the following Microsoft services:

- Microsoft Exchange (including public folders)
- MS SharePoint Services (e.g., team room, etc.)
- MS SharePoint Portal for document storage

Metadata and processors are exchanged

Integration can cover the following points. You can edit a document both via SharePoint Services and via KM functions without any conflicts arising. This enables you to check-in documents via SharePoint Services and maintain metadata, and subsequently edit the same document in KM using the metadata previously entered. If the document is checked-out in KM this is highlighted within the SharePoint Services.

Using KM and SharePoint

This scenario applies if, for example, the marketing department stores its product documents on a Microsoft Server 2003 using SharePoint Services to manage them there. Simultaneously, all sales employees worldwide are supposed to have access to current data via the SAP NetWeaver Portal. There are two options:

7 WebDAV is an open standard for the provision of files in the Internet.

1. Integration of the disk drive through portal drive functionality to always provide current information via the directory. However, essential information like SharePoint-specific metadata, locks, and so on, are lost.
2. Integration of data through SWC for full access to all metadata and locks. Thus, all employees can access all functions at any time and start searches independent of the portal they log on to.

11.3 SAP NetWeaver Enterprise Search

Distinguishing KM and Enterprise Search

Because we have already pointed out the meaning of knowledge discovery during the introduction of KM, we will only describe the technical implementation and its possibilities for Enterprise Search.

Because users have to find structured and unstructured information, SAP developed KM and TREX (see Section 11.4) a few years ago. Both applications have been extended and adapted in the following years. Thus, KM is the search tool within the SAP landscape to find unstructured data if it is connected to KM through a repository. In addition, you can search parts of the SAP ERP system using KM.

Searching the Enterprise Search without integration

The Enterprise Search approach further pursues this idea, including several extensions. For example, all applications in an enterprise are supposed to be searched by a holistic interface without having to connect all data to KM. Moreover, a more comprehensive query language enables a better hit ratio than with TREX standard.

Thus, users can find all relevant documents from any user interface which are then prepared context-sensitive. However, Enterprise Search is not an entirely new application as it already uses existing components to a large extent, for example, TREX.

11.3.1 Technical Structure of the SAP NetWeaver Enterprise Search

The Enterprise Search is made up of three parts. Figure 11.12 illustrates this structure.

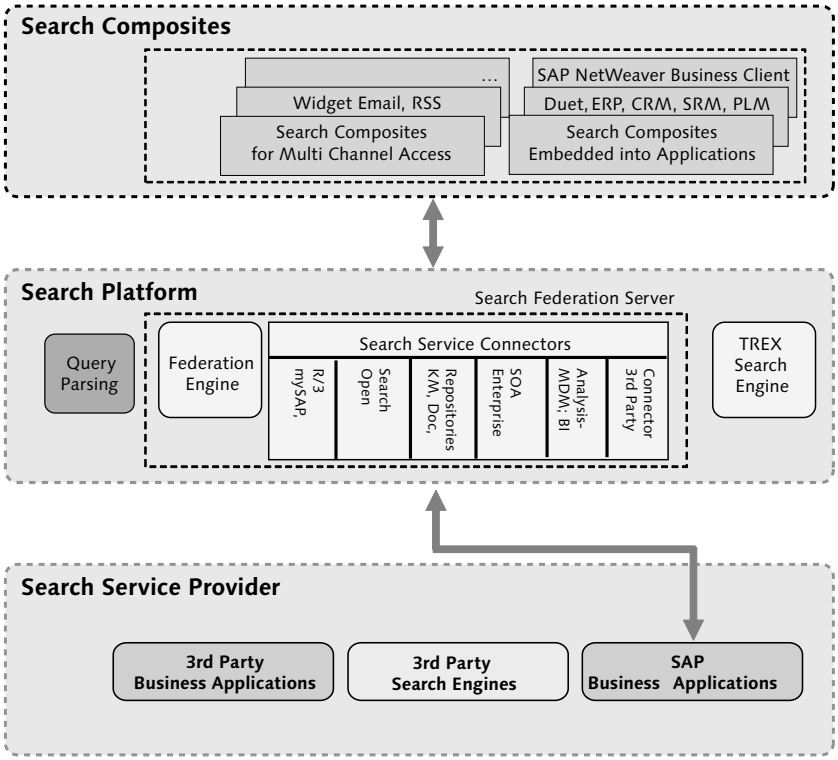


Figure 11.12 Technical Structure of Enterprise Search

Search Composites

Consistent access via different clients

The Search Composites provide access to the search. Here, you can select any frontend you like. The goal is that every user can search using his preferred interface. You can use different interfaces depending on the application case.

Currently, you can access, via widgets, Duet, SAP ERP (F4-Help), SAP NetWeaver Business Client, and the SAP NetWeaver Portal. Integration in Internet Explorer 7.0 and Firefox 2.0 using OpenSearch technology is also possible.

Search Platform

Hardware appliance

The Search Platform represents the core of the Enterprise Search. Similar to the BIA it is provided as a hardware appliance.[8] This Search Platform allows you to manage all connected data sources and to control the search process. The Query Parser intelligently distributes search queries or returns them to the user.

The Search Platform consists of the Search Federation Server, Query Parser, and TREX.

Search Service Provider

Various search sources

All data providers are combined under search service providers. This includes both business applications, such as SAP ERP, and other search services, like Google Search Appliance.

11.3.2 Search Platform

The Search Platform is an independent application for processing search queries. It is the backbone of the Enterprise Search. We will explain its individual components in the following sections. These components are shown in Figure 11.12.

Query Parser

Query Parser for syntax check

The Query Parser takes over the logical check of search queries and forwarding to the Search Federation Server. It acts like a spell check, comparable to the Google logic "Did you mean:." Here, the search query is checked in the Default Parser, which checks spelling mistakes and other rules. Subsequently, the user can be asked if he wants to change his query. You can also use the Custom Parser. Here, you can store company-specific rules comparable to the spell check. Both parsers access a recognizer in the background, which in turn can be connected with TREX. This allows you to take over rules from the preprocessor for TREX. Figure 11.13 illustrates this structure.

8 The customer receives preconfigured hardware. This is based on blade hardware and can thus be adapted by adding new blades.

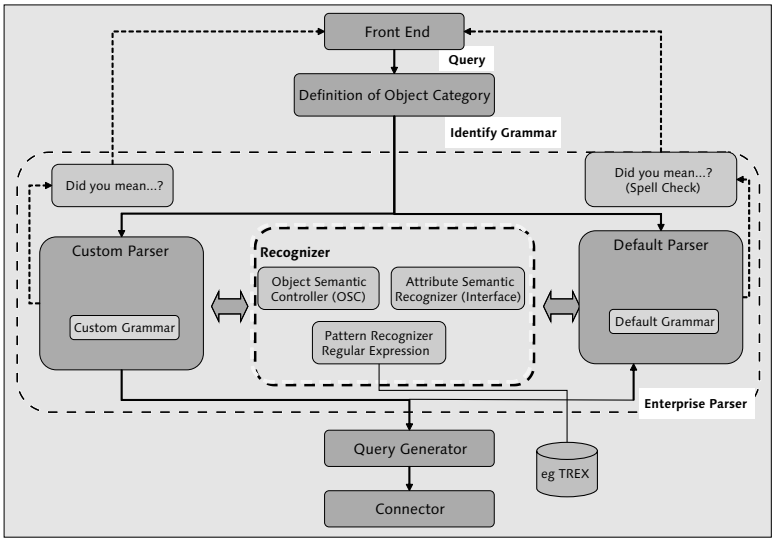
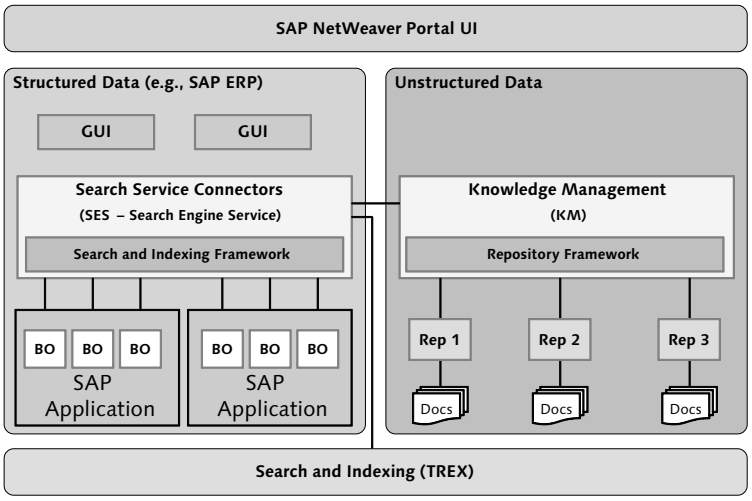


Figure 11.13 Query Parser

Search Service Connector

The Search Platform's most important components are the connected search sources. They are connected via the Search Service Connector (SSC). Figure 11.14 illustrates the structure of SSC.



BO = Business Object Rep = Document Repository Docs = Documents

Figure 11.14 SSC Structure

SSC is the interface to the business objects that are to be searched. It uses a concept similar to repositories, which are used for searches in unstructured data.

Forty-three business objects as standard

SAP ERP 6.0 includes an SSC interface for 43 business objects.[9] If a business object is connected to the Search Platform via SSC, all master data included therein can be searched using the search composites. Index updating is almost online. It takes about one minute until the changed master data from the SAP ERP system is taken into account in the search. You can also use the intelligent search within the F4 Help of SAP ERP.

SSC is also responsible for security. Here, the log-in information of the user is forwarded from SSC to the respective subsystem to be searched.

Federation Engine

The Federation Engine is supposed to combine search results from different SSCs, to group them logically, and present them to the user. It is comparable to the index server in TREX, which also combines results from different search engines.

TREX

TREX searches SAP systems

TREX ensures technical indexing of all SAP systems that are connected via SSC. Moreover, it manages all indices from the KM environment.

11.3.3 Integration of the Third-Party Search

Another interesting aspect is the integration of third-party search applications. This integration is possible both on the search source level and the frontend level. Here, SAP has focused on the OpenSearch standard that was first published by A9.com[10] (an Amazon company).

Simple integration in Internet Explorer and Firefox

This standard enables easy integration of SAP Enterprise Search in applications, such as Internet Explorer 7.0 or Firefox. You only require to clicks to start the search in Enterprise Search.

9 At *https://www.sdn.sap.com/irj/sdn/go/portal/prtroot/docs/library/uuid/a751a1ec0a01-0010-f0ba-89e4c5cd0261* SDN gives a good explanation on the supported business objects.

10 Further information is available at *http://www.a9.com*.

The results of this OpenSearch is provided in an OpenSearch-compatible format and can be output in any OpenSearch web client.

Easy integration of Google Search Appliance

At this point, we would like to point out that third-party search engines that are already installed in the company can also be integrated. This is can be implemented, for example, with the Google Search Appliance. Other search providers with an OpenSearch approach can thus be integrated easily.

11.4 TREX

TREX is the search engine within the SAP NetWeaver platform. It was developed for KM and SAP NetWeaver BI. In the meantime, however, it has been deployed as a search engine for many other systems as well. Its main functions are:

- Text search with fuzzy logic
- Automatic storing of index information
- Automatic document classification with taxonomies
- Multilingual index via several repositories
- Search in external sources

Today, TREX is not just limited to the search in KM repositories and SAP NetWeaver BI. The following systems can also be searched using TREX:

Searchable applications

- SAP NetWeaver BI
- SAP NetWeaver MDM
- KM
- SAP ERP HCM Expert Finder (a solution to find experts within a company)
- SAP PLM Document Management Systems (DMS)
- SAP CRM Internet Sales

TREX enables searches within SAP applications.

11.4.1 Technical Structure of TREX

Usually, you install TREX as an independent SAP system (see Section 14.2.1). For smaller installations, it can be useful to install TREX directly

in an existing SAP NetWeaver system. Figure 11.15 illustrates the TREX structure.

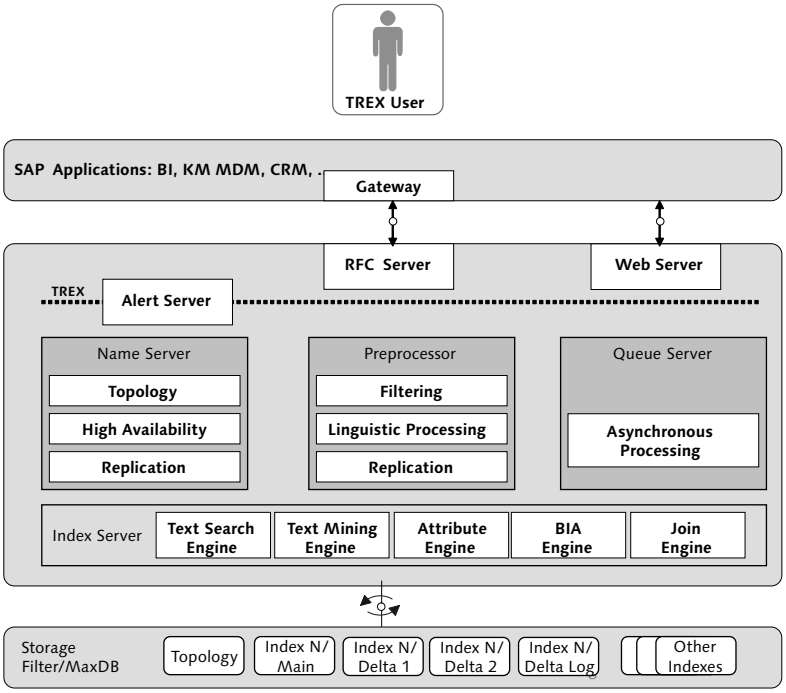


Figure 11.15 Technical Structure of TREX

TREX consists of four main components, which are described in the following sections.

Index Server

Index creation

The index server creates the indices required for the search for unstructured contents; these indices are generated for each repository that is connected with KM. For all other repositories the index is directly created. The index server has three different components:

- **Text search engine**
  The text search engine searches all connected data sources (e.g., a KM repository) and groups them according to language and document type. If a search is started for one of these indices, spelling, language, and other metadata are taken into account.

- **Text mining engine**
  The text mining engine is used to cluster information. Clustering can be done according to metadata and structured hierarchically (e.g., as taxonomy); but relations between individual documents can also be established (for example, "similar documents"). This logic is created independently by TREX.
- **Attribute engine**
  The attribute engine is used to store cluster information and taxonomies. It exclusively searches attributes of documents (metadata) and creates its own index based on these attributes.

Name Server

Monitoring

Because a TREX environment can consist of several TREX servers, you require a central unit to manage connections. The name server takes over this function. It monitors that all TREX servers are running, recognizes IP addresses, and ensures that a server doesn't receive any queries if it fails.

Queue Server

Indexing control

The queue server controls indexing. Using the queue server enables you to carry out indexing not directly online, but at times when the system is less loaded. It can also control replication on several index servers.

Preprocessor

Reading of documents

The preprocessor fills the index server with the documents to be searched. It converts files in HTML, while simultaneously keeping the document structure. It also reads the documents' metadata and transfers it to the index server.

11.4.2 Additional Components

TREX Admin Tool

The individual servers are managed using the TREX administration tool, which is an independent application for implementing all administration steps. The admin tool is available as an operating system-independent Java application. Some administration parts are also available under ABAP to ensure system monitoring.

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