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SAP Architecture Bluebook

SAP ERP 6.0 (HCM)

Version 1.0

September 2007

Acknowledgement

The following colleagues contributed in various ways to make this or previous editions of the document possible: Biraj Mandavlli and Vijaya Sarathi Durvasula (E-Recruiting), Ravi Murthy (EIC), Seshatalpasai Madala (Enterprise Learning), Puspen Chattopadhyay, Christian Behrens, Holger Bohle, and Andreas Kemmler.

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1 Architecture Summary

SAP ERP Human Capital Management (SAP ERP HCM) is the SAP solution for managing the people working for an organization. SAP ERP HCM is part of SAP Enterprise Resource Planning (SAP ERP), but it can be deployed separately of the other ERP applications to protect sensitive employee data.

SAP ERP HCM is split into three layers of applications. The foundation is the HCM core applications which implement the core HR processes such as organizational management, personnel administration, payroll, personal development, and time management. They provide data and functions, which are reused by HCM extension applications to support additional processes like e-recruiting and enterprise learning. On top reside the HCM service delivery applications, which enable users to interact with the HCM applications via different channels and media, for example self-services, employee interaction center and online forms.

The HCM data model is based on infotypes. One infotype defines the data structure for semantically related data, which is stored together on the database and also displayed together on the user interface. Infotypes support the time-dependent storage of data, which is important in HCM processes.

HCM processes are typically country-specific and have to comply with a lot of legal requirements. Infotypes support different country-specific variants of UI logic. Also the business logic can be extended for processing of country-specific logic. In payroll country-specific payroll drivers have been introduced to provide country-specific payroll runs.

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2 Introduction of SAP ERP HCM

Human capital management is the strategic and coherent approach to the management of the people working for an organization. The goal of human capital management is to help an organization to meet strategic goals by attracting, and maintaining employees and also to manage them effectively.

SAP ERP Human Capital Management (SAP ERP HCM) is the SAP application for human capital management and is part of SAP ERP, which is the SAP solution for enterprise resource planning. Besides HCM it includes the following applications (see figure 2-1):

- Corporate services
- Operations which embraces sales and distribution (SD), logistics (LO), material management (MM)
- Financials (FI)
- Industry-specific Functionality

In general all SAP ERP applications follow the common architecture guidelines (see [ERP06]). Service enabling of SAP Business Suite is described in a separate architecture bluebook (see [SAP06]). Enterprise services for SAP ERP HCM are implemented according to the same principles.

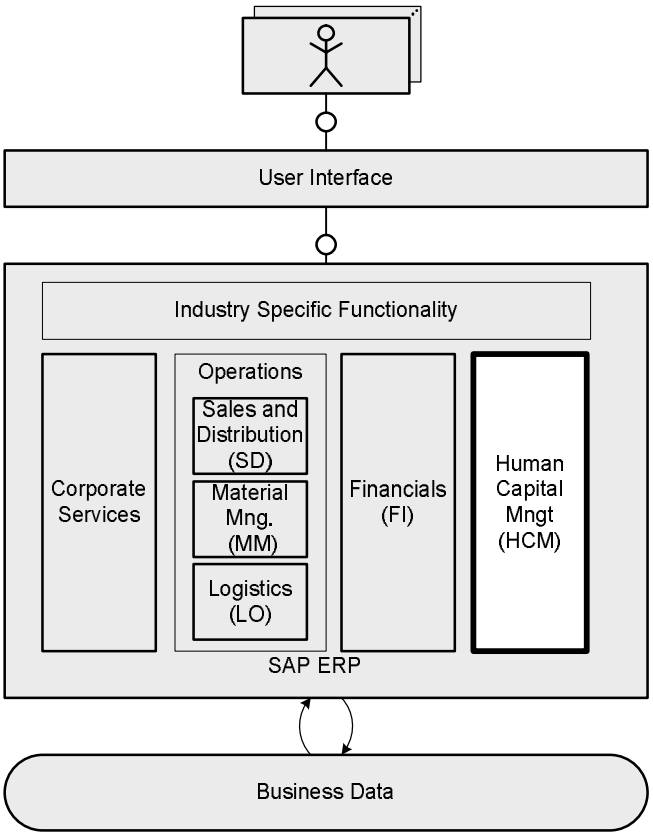

Figure 2-1 SAP ERP

SAP ERP HCM can be deployed together with the other applications of SAP ERP on one system as depicted in the figure, or on a separate system. As employee data is very sensitive data the later is the typical deployment for productive usage. Further information about different deployment possibilities are explained in SAP ERP Master Guide (see [SAP07]).

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SAP ERP is part of SAP Business Suite. In integrated scenarios SAP ERP HCM is the leading application for employee master data, which is replicated to SAP SRM and SAP CRM.

2.1 Supported Business Processes

SAP ERP HCM supports business processes in the following areas:

- Talent Management: Support people during every phase of their employment - from recruitment through training, development, and retention. Find the right people, put their talent to best use, align employee goals with corporate goals, maximize the impact of training, and retain top performers.
- Workforce Process Management: Streamline and integrate essential workforce processes such as employee administration, organizational management, time management, benefits, payroll, and legal reporting. SAP ERP HCM standardizes and consolidates all workforce-related processes and data onto a single platform, while ensuring adherence to country-specific regulations and laws.
- Workforce Deployment: Deploy the right people with the right skills to the right positions at the right time. Create project teams based on skills and availability, monitor progress on projects, track time, and analyze results for strategic decision making. SAP ERP HCM supports the assignment of workers to appropriate jobs, projects, and teams and the optimal scheduling of call center staff and retail staff.

Further details about the HCM business processes can be found in [Bad07], [KLR04], and [KRY06].

2.2 Layers of HCM Applications

Basically SAP ERP HCM is split into three layers of applications (see figure 2-2). The foundation is the HCM core applications which implement the core HR processes such as organizational management, personnel administration, payroll, personal development, and time management. They provide data and functions, which are reused by HCM extension applications to support additional processes like e-recruiting and enterprise learning. On top reside the HCM service delivery applications, which enable users to interact with the HCM applications via different channels and media, for example self-services, employee interaction center and online forms. Organizational management provides the basis for organizational planning in other SAP Business Suite applications such as SAP CRM, SAP SRM as well as SAP Business Workflow.

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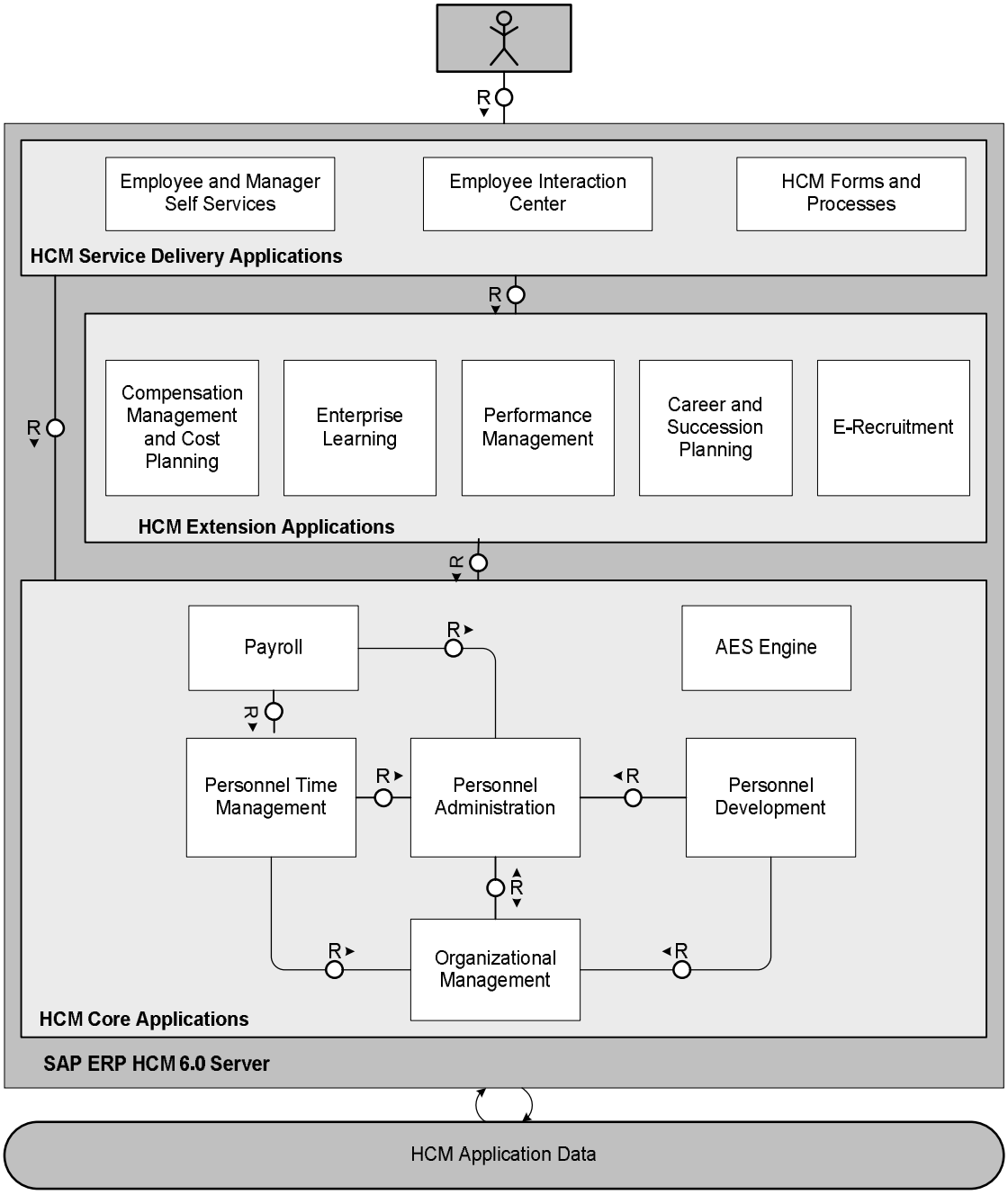

Figure 2-2 Architecture Overview SAP ERP HCM

HCM core applications are the following:

- Personnel administration (PA)
- Personnel development (PD)
- Organizational management (OM)
- Personnel time management
- Payroll
- Appraisal, evaluation and survey engine (AES engine)

HCM extension applications target a specific use case. A good example for an extension application is enterprise learning, which supports organizing classroom training, as well as producing and consuming e-learning content. They have their own business logic, but reuse functionality and data of the core applications, for example employee data or time recordings.

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E-recruiting which supports online job offering and online job application is an extension application, which can be installed on a separate server. Currently SAP HCM includes the following extension applications:

- Compensation management and personnel cost planning
- Enterprise learning
- Performance management
- Career and succession planning
- E-recruiting

There are additional HCM extension applications that are specific for certain regions and countries. Examples are benefits management, pension funds, and claims. These applications are not shown in the overview diagram.

HCM core as well as extension applications provide their own user interface. But there are additional output channels for delivering HCM services. These are self services offered via a Web browser, Web forms, or telephone and e-mail supported by the employee interaction center. Currently the following HCM service delivery applications exist:

- Self services for employees and managers (ESS, MSS)
- HCM processes and forms
- Employee interaction center (EIC)

In addition HCM functionality is offered as BAPIs and enterprise services. All applications use SAP NetWeaver Business Information for reporting and analytics.

2.3 Scope of the Document

In this document we describe the conceptual architecture of SAP ERP HCM release 6.0. It is based on SAP NetWeaver 7.0 (formerly called SAP NetWeaver 2004s).

The intension of this document is to provide an overview of the SAP ERP HCM architecture, which means that it cannot cover all details and all applications. First the main architecture concepts of the HCM core applications are explained.

In addition the architectures of enterprise learning and e-recruiting are described as these are the most interesting examples of the HCM extension applications. The architecture of the extension applications compensation management and personnel cost planning, performance management, and career and succession planning are not described in this document because they encapsulate just functional blocks within the ABAP server.

Finally the basic architecture of HCM service delivery applications are depicted, as there are self services, HCM processes and forms, and employee interaction center.

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3 HCM Core Applications

3.1 Personnel Administration (PA)

Personnel administration (PA) deals with the administrative activities related to employee master data such employee personal data, address details, bank details, work agreement information, and so on. Employee master data has multiple country-specific specificities and needs to be compliant to legal requirements. Examples are tax details, social security rules and pension administration. The HCM extension applications benefits management and compensation management are based on personnel administration.

In this chapter we focus on the central architecture concepts of personnel administration and not the application itself.

3.1.1 Infotype Concept

In SAP ERP HCM infotypes are the units of information. One infotype defines the data structure for semantically related data, which is stored together on the database and also displayed together on the user interface. Each Infotype has a own database table structure, which stores all instances of the infotype as records.

Each infotype is well-defined by a 4 digit number, which is also used to name the corresponding database table. So PAnnnn is the database table of infotype nnnn. For example infotype 0001 includes the attributes for employee organizational assignment. The data of infotype 0001 is stored in database table PA0001.

In HCM typically data is valid only in a certain period of time. For example employee's bank details are valid from March 1st 2007 to October 30, 2007. Infotypes support the time-dependent storage of data. When data is updated then old data is internally time delimited using a date dependent validity of the record.

The infotype framework (see chapter 3.1.2) creates for each infotype a data entry screen for displaying and editing its attributes.

The usage of the infotypes depends on the use case and is therefore different in personnel administration and personnel development. In PA infotypes are used to store administrative employee data (such as personal information, address, bank details, benefits and social security), time data (such as leave, attendance) and payroll relevant data (such as compensation and tax details). In personnel development the organizational hierarchy is described using only two infotypes. One describes the nodes of the hierarchy, the other the relationships (see chapter 3.2.1). Additional infotypes are used to store the attributes.

3.1.2 PA Infotype Framework

The PA infotype framework provides design time tools for definition and implementation of infotypes and a runtime engine. Based on the defined data structure of the infotype the PA infotype framework generates the required technical object like data and table structures, ABAP classes, and modules.

At runtime the PA infotype framework provides the following generic features:

- Persistency handling
- Buffering of data using read and write buffers
- Time delimitation handling
- Change management documents (infotype data change log)

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- Authorization handling

In older releases the PA infotypes were generated as ABAP module pools. One module pool contained the application-specific business logic together with the generated user interface. Several function modules and BAPIs were made available which call these dialog modules for dark processing.

Since the release SAP R/3 Enterprise a new PA infotype framework is available based on ABAP OO classes. All infotypes are now available in the new framework, too. Within the new infotype framework business logic specific for infotypes is decoupled from generic functionality such as the user interface. For each infotype application-specific business logic is encapsulated in a separate class. The new framework is used for all new extension and service delivery applications as well as for enterprise services proxy implementation. Existing module pools based on the former framework are continued to be supported for existing transactions.

The PA infotype framework uses technical infotypes to store internal technical information of the infotypes. So database structures, dialog modules, module pools, and iDOC definition is stored in the infotype customizing tables T777D and T777ID. Additional technical customizing information (like time constraints, display characteristics) for PA infotypes is stored in T582A table.

3.1.3 PA Infotype Internationalization and Extensibility

SAP ERP HCM supports more than 40 countries with different legal requirements. Due to this the globalization and extension features become extremely important. Infotypes support many customizing features for having different variants of the UI logic for various country versions, for example enabling and hiding of UI fields, changing field attributes. Also the business logic can be inherited and extended for special processing of country-specific requirements. Customers also have the choice of extending the infotype structure, business logic as well as the UI screens. A workbench transaction (PM01) is provided for globalization and customer-specific extensions.

3.2 Personnel Development (PD)

Personnel development deals with the activities related to employee development, for example capture employee potential and qualifications, career and succession planning, and creation of development plans. Personnel development as well as organizational management are based on the PD infotypes.

3.2.1 The PD Infotype Concept

Conceptually PA infotypes and PD infotypes are similar. Both are defined by a data structure, are identified by a 4 digit number, and have their own persistency table (table names: HRPnnnn). However they target different use cases.

PA handles only employee related data. For each semantically related subset of attributes it uses a separate PA infotype. In contrast PD works with a variety of business entities which relate to the company's organizational structure and job roles. Examples are organizational unit, position, job, e-recruiting object for candidate, and appraisal. As the relationships between these entities change often, for example between position and organizational unit, PD supports the flexible adaptation of these relationships. To do so, the object concept has been introduced, which separates object instances and their relationships in separate infotypes. Each PD business entity is represented as object within the PD infotypes. The PD infotype framework uses specific infotypes (1000, 1001 and 1002) to maintain instances of PD objects and their relationships. Other infotypes are used for storing additional attributes of objects.

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Object types are defined in a customizing table (T778O) using two characters (A-Z*). It is possible to integrate objects, which are not persisted within PD, such as cost center from FI and user from user management. These infotypes are defined in table T77EO.

For all object types (except with external persistency) object instances are created in infotype 1000. The corresponding object descriptions are maintained in infotype 1002. Additional object attributes are maintained using different additional infotypes.

Relationships define links between individual object instances. Relationship types are defined in customizing table T778V by 3 character string (SAP name range 000-999). Relationships are bi-directional and the direction is identified by character A (Bottom Up) and B (Top Down).

Each relationship between to instances is stored in both directions using infotype 1001. For some external objects just one direction is stored.

Search for objects within organizational management is based on a concept called evaluation path. It uses infotype 1000 and 1001 information to identify the objects along a defined structural path.

Example:

Organizational unit has object type '**O**' and position has object type '**S**'.

Organizational unit 00000001 "Executive Board" and position 99999999 "CEO" are stored in infotype 1000 together with their object types.

Position (S) belongs to Organizational Unit (O) is described by relationship type A003; Organizational Unit (O) incorporates Position (S) is described by relationship type B003

Now in infotype 1001 the following relationships are maintained:

99999999 -> A003 -> 00000001

00000001 -> B003 -> 99999999

Examples of important PD infotypes such as organizational unit, position, employee, and candidate and their relationships are depicted in appendix (see chapter 6.2 and 6.3).

3.2.2 PD Infotype Framework

PD infotype framework provides the same generic features as PA infotype framework (persistency handling, buffering, time delimitation handling, document change management (log), authorization handling). PD infotype framework is developed in software component SAP BASIS. Also the basic infotypes (1000, 1001, 1002) and the organizational management are part of SAP BASIS to enable reuse across SAP ERP and SAP Business Suite.

In older releases the PD infotypes were developed as ABAP module pools with UI and business logic embedded in the same module pool. Several function modules and BAPIs were made available that used to call these dialog modules for dark processing.

A new PD infotype framework (based on OO ABAP classes) is available since SAP R/3 Enterprise release and some infotypes are made available in the new framework. However both frameworks are used in parallel.

The tables which store internal technical characteristics such as database structures, dialog modules, module pools, and iDOC definitions of infotypes are shared with PA infotype framework (see chapter 3.1.2).

PD infotype framework provides a design time environment (transaction PPCI) to extend and create new infotypes for customers. Customers can create own objects in infotype 1000 and add new infotypes for the attributes. They can also extend SAP objects by additional attributes.

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3.3 Organizational Management

Organizational management is used to create an organizational plan, which describes the functional structure of an enterprise. It includes organizational unit, position, task, job and so on. Organizational management is used by HCM core and extension applications for example to evaluate headcount, identify reporting structures and assign agents to workflow tasks. So organizational management is integrated with personnel administration (bi-directional) so that the changes made in personnel data (for example change of position) is correctly reflected in the organizational plan and vice versa.

The authorization concept of SAP ERP HCM uses organizational management, too. The access rights to many objects within HCM depends on the organizational structure of the enterprise. For example a manager is only allowed to access data of employees reporting to him. It is possible to define authorization profiles based on the user's position and generate the corresponding authorization role and profile (transaction PFCG). There are PD infotypes available for defining the position based authorization profiles.

Technically organizational management is based on the concept of PD objects and PD infotypes as described in section 3.2. The main PD objects used in organizational management and their relationships are shown in Appendix, figure 6-2.

The central functionality of organizational management, in especially creating the organizational structure, is part of software components SAP BASIS and SAP ABA to enable reuse by all applications of SAP Business Suite.

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3.4 Personnel Time Management

Personnel time management supports all processes related to planning, recording and valuation of internal and external work as well as absence data. Time and labor data can be recorded centrally by a time clerk or by each employee himself.

Master data required for time management is stored in PA infotypes. Examples are absences (infotype 2001) and quotas (infotype 2006). For decoupled access to time infotypes an additional business logic layer, the business logic processor layer (BLP) has been introduced.

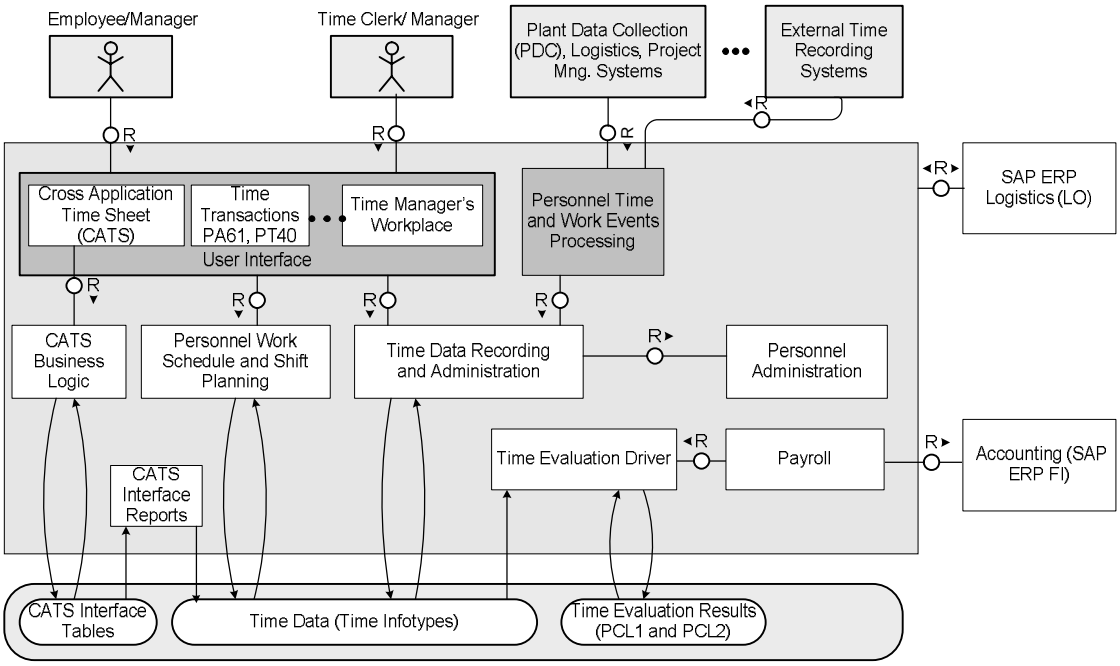

Figure 3-1 Architecture of Time Management Application

The architecture of personnel time management comprises the following components (see figure 3-1):

- Personnel work schedule and shift planning provides functionality for planning working times, shifts and absences. Employee qualifications, working time preferences, and statutory requirements can be taken into account for shift planning. This functionality can be integrated with SAP ERP Logistics for capacity planning and order scheduling.
- Time data recording and administration is the core of the time management application. It is used to maintain and store all work time recordings. It receives employee-related data from PA, for example number of vacation days. For recording and administration of time related data it provides the following interfaces:
  - Time manager's workplace is a specialized user interface for time clerks and managers to capture and correct time related events. Also there is a transaction PA61 that is widely used for time recording data.
  - External time recording systems, such as time recording clocks or plant data collection systems can be integrated using file-based integration via the HR-PDC interface. There are various certified third party products available which support the interface.

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- Cross application time sheet (CATS) provides self services to managers and employees for time recording and tasks. CATS enables cross application processes like payment to employees, project monitoring or creating invoices for billing. CATS is integrated with time management, payroll, logistics (plant maintenance, project systems, customer service) and SAP ERP accounting for confirmation of work and activity allocation. In the diagram only the recording part relevant from time management perspective is shown and not all possible integrations. Several interfaces are provided to integrate CATS with time management and other applications. Basically CATS has its own persistency mechanism based on CATS interface tables. The data is transferred from CATS to other applications like time management infotypes using interface reports.
- Time evaluation component valuates employees' working times. It calculates planned times and overtime, administrates time accounts and forms wage types, updates time quotas, and is used to check working time specifications. Time evaluation determines overtime and bonus wage types by taking into account holiday calendar, conditions and durations of work performed. It also enables accrual of absence entitlements. Incentive wage calculations are used for performance based remuneration. Typically employee related data is transferred from logistics (production planning, plant maintenance, project systems).

  Data determined by incentive wages and time evaluation are transferred to payroll for payment processing.

  Time evaluation is performed by a driver program that uses a particular schema and rules to determine the time results. Conceptually the time driver and schema is similar to payroll driver and schema that is explained in chapter 3.5.2.

The data transfers with external systems are done via interface database tables and also by external upload and download functionality. For data transfer with SAP ERP logistics, various background jobs can be scheduled for extraction reports.

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3.5 Payroll

Payroll supports all processes related to the remuneration of each employee. Based on the employee's time recordings and working contract the payroll application calculates the gross and net pay, which comprises the individual payments and deductions that are calculated during a payroll period. The payroll result is generally transferred to SAP ERP Financials (SAP ERP FI), which posts the cost and triggers payment to the employee, for example via check or bank transfer. SAP ERP HCM can create data medium exchange files (DME) for triggering payments directly, tool.

3.5.1 Initiation of Payroll Runs

Payroll administrators can configure payroll runs using the HR process workbench (see figure 3-2). The HR process workbench is a design time tool to design a process template for executing payroll runs and initiate subsequent activities like posting the results to SAP ERP FI and providing pay slips for the employee. The administrator selects a process template, which defines the sequence of activities (for example payroll posting and bank transfer document preparation) to be performed before and after payroll runs.

Payroll administrators can start and monitor payroll runs manually using the HR process workbench. As payroll runs are executed regularly on a monthly basis, the administrator typically plans payroll runs as jobs starting at a defined point in time using the job scheduler.

Payroll runs are executed by payroll drivers which are dedicated programs for controlling the sequence of payroll processing activities. The sequence can be configured using payroll schema and rules (see section 3.5.2). To adhere to country-specific legal and statutory requirements for each country a specific payroll driver is provided. When starting a payroll run, the administrator selects the payroll driver, which corresponds to the employees' country.

Payroll supports also payroll runs apart from regular pay cycles (off-cycle payroll processing), They are triggered using the off-cycle workbench (not in the diagram).

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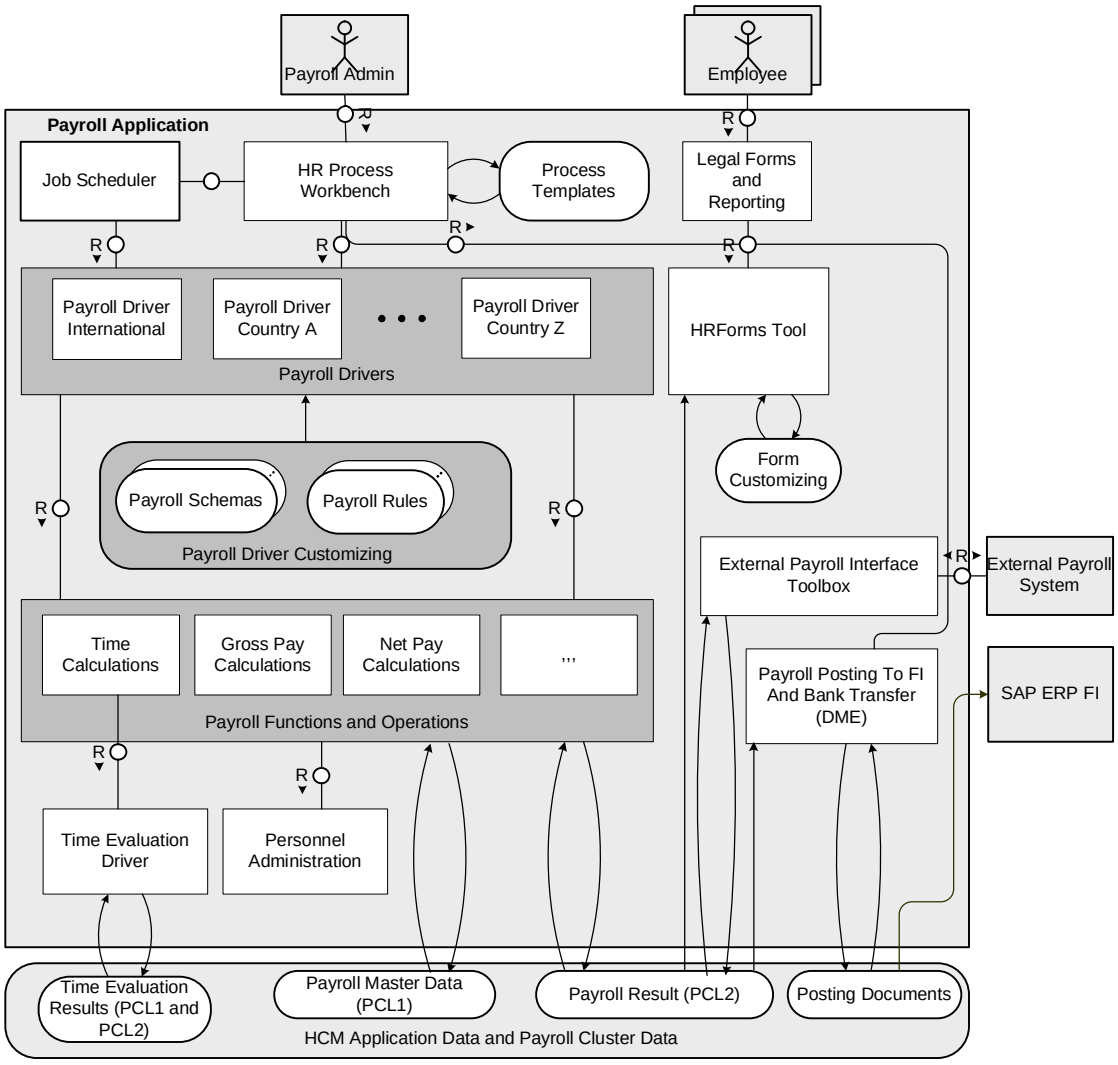

Figure 3-2 Architecture of Payroll Application

3.5.2 Execution of Payroll Runs

The payroll driver is the main program used to run the payroll. For each country version supported by SAP ERP HCM there is a country specific payroll driver (see figure 3-2). Payroll driver is configured by a country specific schema and by rules (see figure 3-3). A schema is the central customizing object of payroll application and defines the payroll functions and personnel calculations rules for one payroll run. Typically a country specific payroll driver uses only one main schema but some customers use the option of different schemas for different processing units (based on geographic and enterprise structures).

- Payroll functions provide logic for payroll calculations. Payroll functions access personal administration to retrieve information about the employee, his contract, and organizational information. In addition the payroll driver calls payroll functions to calculate benefits, taxes, as well as net and gross amount. For example there is one payroll function which considers employees' time data which results from time evaluation driver.
- Payroll personnel calculation rules define under which conditions which payroll operations are executed by the payroll driver. The rules contain the most basic logic used in payroll.

- Payroll operations are the basic operations that provide smallest possible granularity of operations (like mathematical operands). Payroll operations are used to manipulate the wage types, which are basically the placeholders for storage of rates, amounts, and numbers. The properties of a wage type define how the processing happens on amounts and rates during a payroll run. An example for a payroll operation is to multiply the number of working hours by a hourly rate and store the result in the amount of a wage type.

Technically speaking payroll functions as well as payroll operations are ABAP form routines included in the payroll driver and that are called from payroll driver according to the schema. The data declaration for these form routines is done centrally in the payroll driver

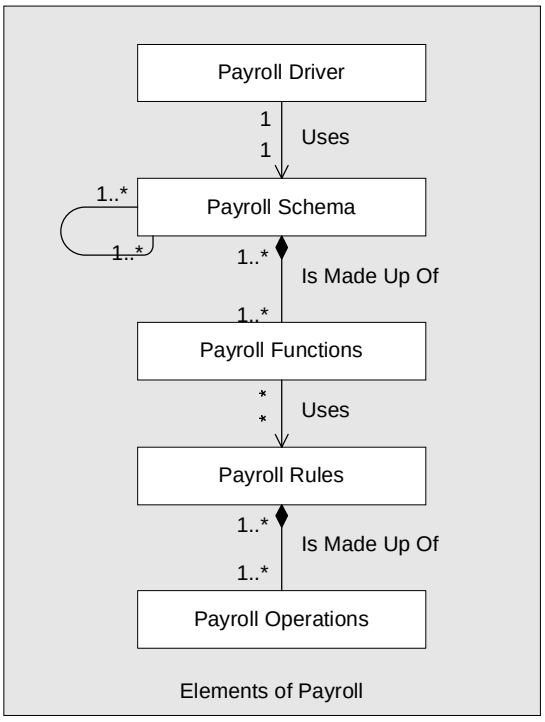

Figure 3-3 Schema and Rules Relationships

3.5.3 Payroll Results

After the payroll run, the results are stored in the following two payroll cluster data tables (see figure 3-2):

- PCL1 which stores master data and time data, such as confirmation from time recording, infotype texts, incentive wage time tickets
- PCL2 which stores payroll results (results of wage types post payroll, cumulated values) and secondary information like generated schemas (schema image used for payroll)

The payroll results contain information that is relevant for accounting which is part of SAP ERP FI. The “posting to accounting” component extracts the accounting-relevant data from the payroll results and stores them as posting data. The preparation of posting data includes mapping of wage types to symbolic accounts relevant for posting. Afterwards it transfers the posting data to the accounting components of SAP ERP FI/CO using ALE push mechanism.

In accounting there exist multiple country-specific programs to trigger the final payment of the wages to the employees. The preliminary data medium exchange programs valuate payroll

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results and prepare for bank transfers via data medium exchange (DME). Other programs prepare the payroll result for payment by check or cash.

Payroll results are communicated to the employee using pay slip forms. These forms are defined as smart forms or Adobe forms using the HR forms tool (see chapter 5.2). In addition HR form tools can be used to define forms for legal reporting.

The external payroll interface toolbox depicted in figure 3-2 supports multiple integration modes with external payroll applications, for example:

- Only master data export
- Gross payroll calculation in SAP ERP HCM and net payroll calculation externally
- Export master data and payroll results for further evaluation

External payroll interface toolbox is used to provide reporting outside of SAP system and for internationalization (see below).

3.5.4 Internationalization and Localization

SAP HCM payroll supports the specific local payroll processes for 47 countries. To do so, each country has a specific cluster structure for storage of country specific data and a specific payroll driver. All legal and statutory requirements that are specific for a country are fulfilled by using a corresponding payroll driver and country specific payroll schema. SAP delivers the country specific payroll drivers together with schemas that reuse some sub-schemas from international schema version. The payroll solution is kept up-to-date by providing regular legal changes via legal change packages (support package delivery mechanism).

In countries where SAP or partner solution is not available a localized solution can be developed using the international payroll driver version as basis. Another option is to use the. external payroll interface toolbox to integrate with a third party application, which supports the country-specific requirements. Then gross payroll can be processed by SAP ERP HCM and net localized payroll (taxes, social security) by the third party application.

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3.6 Appraisals, Evaluation and Survey Engine

Appraisals, evaluation and survey engine (AES engine) provides services for conducting and evaluating appraisals and surveys. AES engine is part of the software component SAP_ABA to enable reuse. It is a HCM core application used by many SAP ERP HCM applications for example in the learning solution for course evaluation (see chapter 4.2.2), in the employee interaction center to collect agent feedback (see chapter 5.3), and in e-recruiting for candidate questionnaires (see chapter 4.1.2). Especially the HCM extension application performance management uses the AES engine heavily for setting objectives and creating appraisals.

AES engine generates user interfaces based on Business Server Pages (BSP). The administration user interface is implemented using ABAP Dynpro. Applications which use the AES engine typically implement a wrapper to create an application-specific variant of the AES engine. In addition AES engine provides multiple BAdIs to enhance its functionality.

Adobe document server is used for generating Adobe documents for offline usage.

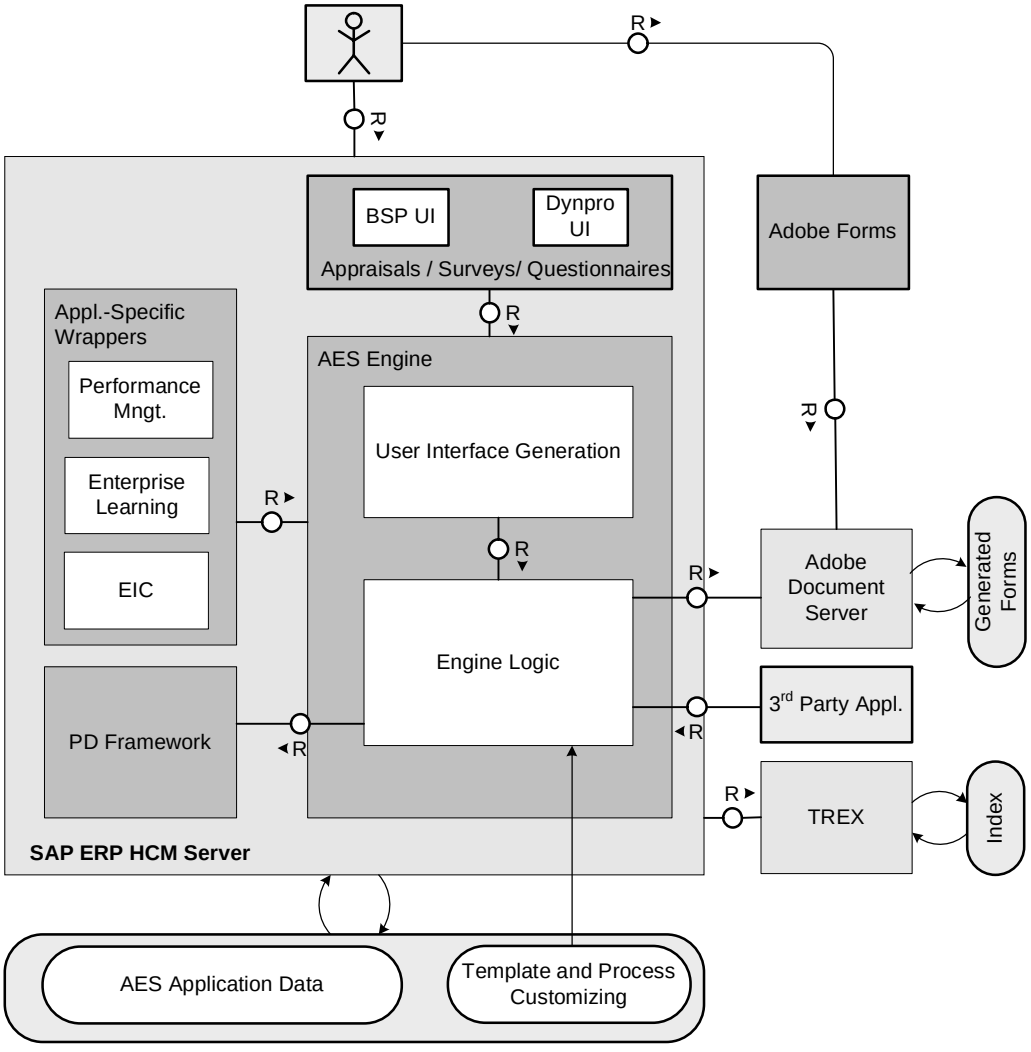

Figure 3-4 Architecture of AES Engine

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4 HCM Extension Applications

HCM extension applications enhance the core applications and support additional business scenarios. From architecture perspective most extension applications are just additional functional building blocks on top of the core applications. In the following we describe the architecture of e-recruiting and enterprise learning as they are two examples of HCM extension applications which support a standalone deployment and have therefore a different architecture.

4.1 E-Recruiting

With e-recruiting, job applicants and candidates can search for job offers, register themselves in a talent pool, and provide their job application online using a Web browser. Recruiters can post job requisitions within the e-recruiting application, but also on external job boards via HR-XML interfaces (see http://www.hr-xml.org). Applicant tracking and reporting functions helps recruiters to process job applications in an organized way and monitor the effectiveness of the recruitment department and process.

E-recruiting is an add-on to SAP ERP HCM, which can be deployed in three different ways:

- Stand-alone installation without any integration with a backend system. For initial set-up organizational data and qualification categories have to be imported via ALE from SAP ERP HCM.
- Stand-alone installation with integration into SAP ERP HCM. In this case after completing the recruiting activities, data is sent to the SAP ERP HCM for actual hiring either by using RFC or via SAP NetWeaver Exchange Infrastructure (SAP XI).
- Integral part of SAP ERP HCM installation: e-recruiting calls directly functions of SAP ERP HCM, especially from PD

Usually e-recruiting is deployed as a stand-alone installation with firewalls protecting the access from the Web to the e-recruiting applications and from the e-recruiting application to SAP ERP HCM (as depicted in figure 4-1).

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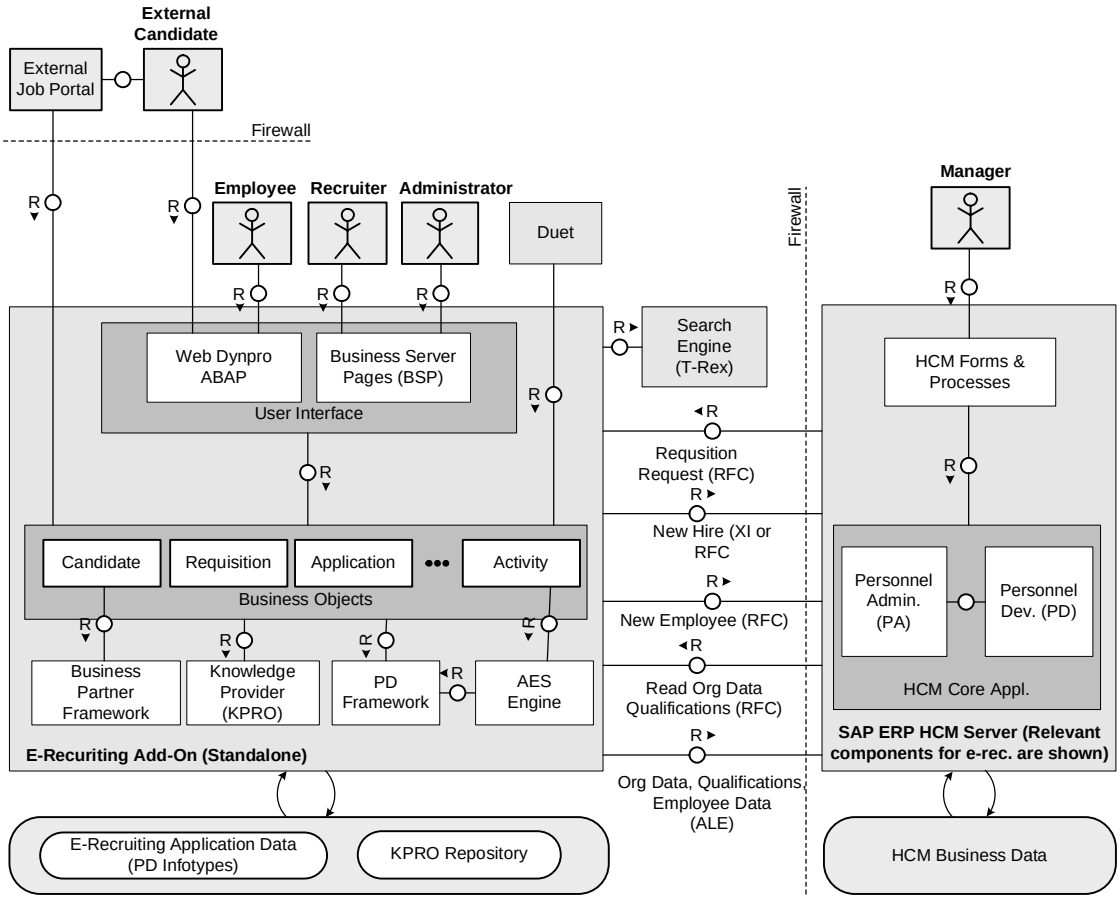

Figure 4-1 Architecture of E-Recruiting

4.1.1 User Interface

The user interface of e-recruiting is completely role based and is displayed using a Web browser. The user interface is implemented using Web Dynpro ABAP and Business Server Pages (BSP): the UI screens for the roles recruiter and administrator are based on BSP, whereas the UI screens for internal and external candidates are implemented using Web Dynpro ABAP (see figure 4-1). In addition SAP Duet is used to provide an alternative user interface to recruiters and managers within their MS Outlook client.

4.1.2 Business Objects

Business objects, such as candidate, requisition, posting, and application are used for data retrieval and manipulation tasks. Each business logic object is implemented as an ABAP OO class. Data of these e-recruiting objects are stored in PD infotypes using the underlying PD framework (see chapter 3.2.1). As a consequence the entire data model of e-recruiting is based on the PD framework. The PD objects data model is shown in appendix (see chapter 6.3). For every candidate (internal or external) in the e-recruiting system a business partner is created which holds the identity and contact data.

Appraisal evaluation and survey engine (see chapter 3.6) is used for creating, publishing, and analyzing questionnaires, which are used for capturing information and evaluating the candidates in the talent pool.

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4.1.3 Data Persistency

The e-recruiting application stores data in both structured and unstructured formats. Business object data, for example about candidates, is stored in infotypes. A background job periodically collects the data of the e-recruiting objects, converts them into XML documents and stores them into the knowledge provider (KPro). In addition knowledge provider (KPro) is used to store documents and files, which are uploaded from the applicant as part of their resume data (MS Word documents, PDF files, pictures and so on). Above mentioned KPro data is indexed by the search engine TREX to support fast search on posted jobs as well as suitable candidates.

4.1.4 Integration with Other Systems

E-recruiting provides interfaces according to HR-XML standards (see http://www.hr-xml.org) for integration with external job boards. Job requisitions can be posted to these boards and applications can be received using SAP NetWeaver XI.

If not installed on the SAP ERP HCM server, e-recruiting is integrated with SAP ERP HCM using RFC calls and ALE (see figure 4-1). The processes publication of job requisition and new data hire transfer are supported with SAP NetWeaver XI, too. Existing employee master data within PA can be transferred and mapped to internal candidate in e-recruiting. In addition PD data like skills, qualifications can also be transferred. In figure 4-1 a particular use case is depicted for requisition request. When a manager starts the process using HCM processes and forms of SAP ERP HCM server the requisition data is passed to e-recruiting via RFC.

Non-SAP ERP systems can be integrated using HR-XML interfaces and SAP NetWeaver XI.

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4.2 Enterprise Learning

The enterprise learning application of SAP ERP HCM supports following main use cases:

- Creation and publication of e-learning content
- Organization of training courses
- Learner activities

Within each scenario different components of the enterprise learning application are involved. The complete architecture is depicted in figure 4-2.

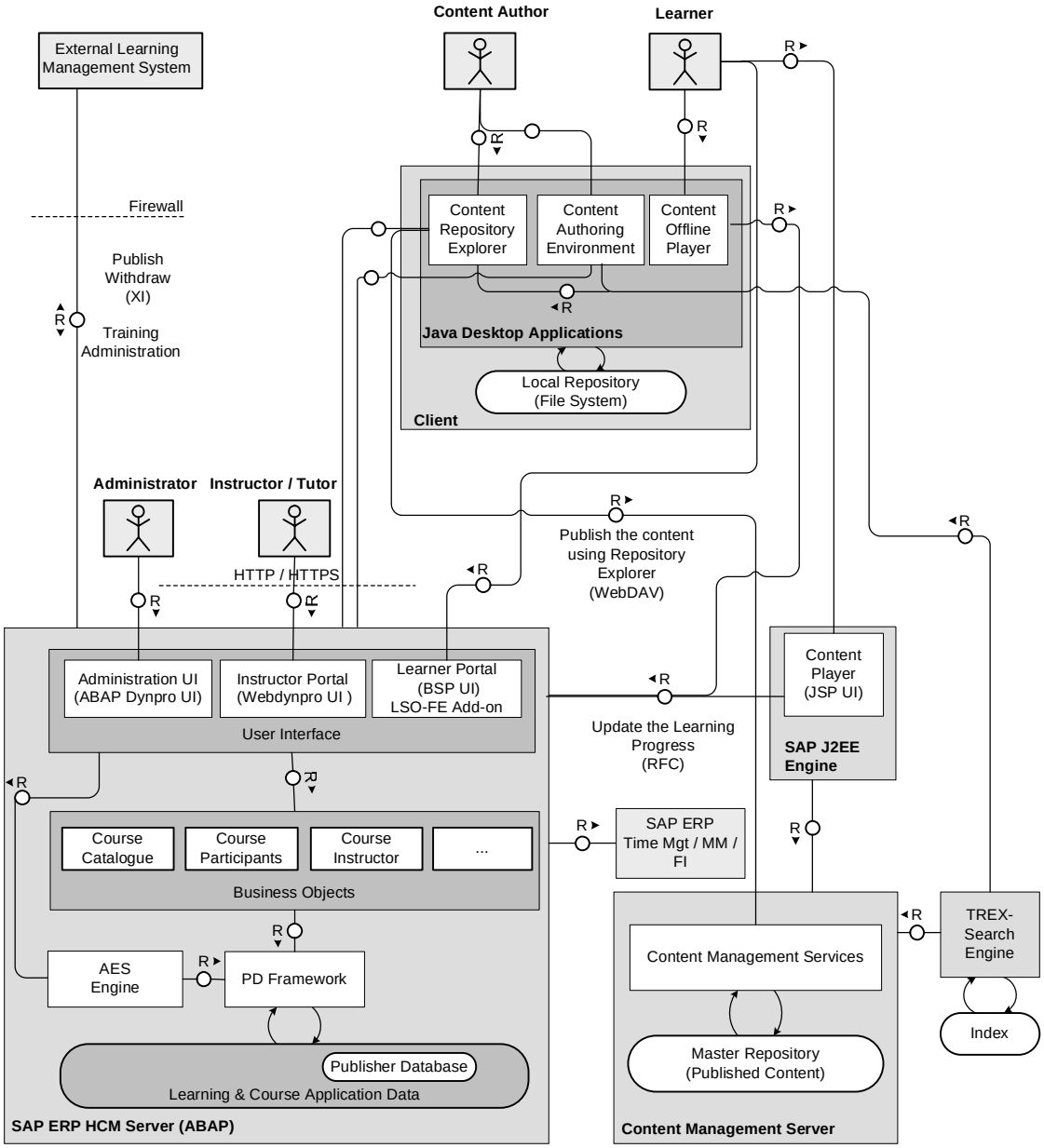

Figure 4-2 Architecture of Enterprise Learning

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4.2.1 Creation and Publication of E-Learning Content

Enterprise learning provides a set of Java desktop applications for course authors and designers to create e-learning content (see figure 4-2).

- Authoring environment which contains instructional design editor for structuring e-learning content and tests and instructional element editor and test editor for editing the course content and tests.
- Offline content player for previewing and testing of e-learning content.
- Repository explorer for publishing e-learning content.

The applications run on the users' client which enables offline usage. The created content is initially stored in the local file system. When connected, the content can be published using the repository explorer. E-learning content is made available to learners by storing it in a content management system using WebDAV. As content management system Knowledge Management of SAP NetWeaver Enterprise Portal can be used. In parallel information about offered e-learning trainings is transferred to the publisher database on SAP ERP HCM server. Publisher database is a database table that stores the meta data of the e-learning content published in content management server. The content management server can use TREX for search related functionality required for content authoring environment. The results of the search are made available in repository explorer of content authoring environment.

The e-learning offering is presented to the learners within the learning portal. If the learner books an e-learning course, he can view it online or offline using the corresponding player (see figure 4-2).

The authoring environment supports the creation of content according to SCORM1.2/ SCORM2004, which is a specification and standard from Advanced Distributed Learning (ADL) and Aviation Industry Computer-Based Training Committee (AICC). Details about SCORM2004 standards can be found at http://www.adlnet.gov/scorm/index.aspx and http://en.wikipedia.org/wiki/SCORM.

The enterprise learning solution (mainly the training and event management parts) is also integrated to other SAP ERP applications like time management (for activity recording), materials management (resource booking), and financial accounting.

4.2.2 Organization of Training Courses

The administration UI (training management functionality) of enterprise learning serves as the administration area for organizing, publishing and booking of classroom training. Training management is comprised of two main processes:

- Course offering which involves course planning and creation of course catalog
- Training administration which involves booking activities.

The instructor portal is the user interface for instructors and tutors. Instructors can access their courses to manage the course participants. They can perform appraisals to get feedback from the participants using the AES engine. Achieved qualifications can be assigned to participants and are then stored in the corresponding PD infotypes.

It is possible to integrate Adobe Connect Professional (see http://www.adobe.com/products/acrobatconnectpro/) with enterprise learning to conduct virtual classroom learning. The integration is not shown in figure 4-2.

4.2.3 Learner Activities

All offered classroom and e-learning courses are presented to the learners within the learning portal (see figure 4-2). The learning portal includes functionality to search course content and to book training courses. It also includes a content player for playing e-learning content. The

content player loads the e-learning content from the content management system whenever a learner starts it in his Web browser. The separate offline player can be used to learn offline and synchronize the learner's progress with the central learning portal online.

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5 HCM Service Delivery Applications

HCM service delivery applications provide additional output channels for HCM applications. In the following we describe the architecture of the most prominent service delivery applications, as there are:

- Self services for employees and managers (ESS and MSS)
- HCM Processes and Forms based on SAP Interactive Forms by Adobe.
- Employee Interaction Center (EIC) which provides call center functionality with role specific access to services and information for professionals

A new channel is the access of HCM services within a Microsoft Office environment based on Duet. The architecture of Duet is not discussed here since it is a separate add-on application not specific to SAP ERP HCM.

5.1 Self Service Applications

Self services provided via Web browser play a significant role in the interaction between a company's employees and managers and the SAP ERP HCM application. The self services application component enables the creation and operation of employee and manager self services (ESS and MSS). Examples of employee self services are employee personal information, leave and time management, benefits and compensation, and travel management. Examples for manager self services are employee administration, compensation and budget planning, and project planning.

Manager and employee self services are based on the following set of reusable functions and framework components (see figure 5-1):

- Homepage framework creating overview pages, from which employees and managers can access individual self services
- Floor plan manager for combining different UI components which form a self service user interface
- Employee central services for employee authentication
- Object and data provider framework (OADP) for displaying organizational structures
- Portal content and navigation for application configuration and handling navigation of self service applications.

Self services themselves are implemented using Web Dynpro Java technology and deployed in SAP NetWeaver Portal as iViews. Some self services are also developed using Webdynpro ABAP (not shown in diagram).

Guided procedure technology provided by SAP NetWeaver is used for creating multi-step user interfaces reusing ESS applications for the individual user interaction. areas An example is the combination of different ESS applications in one guided procedure called "my first days", which guides new employees through different services.

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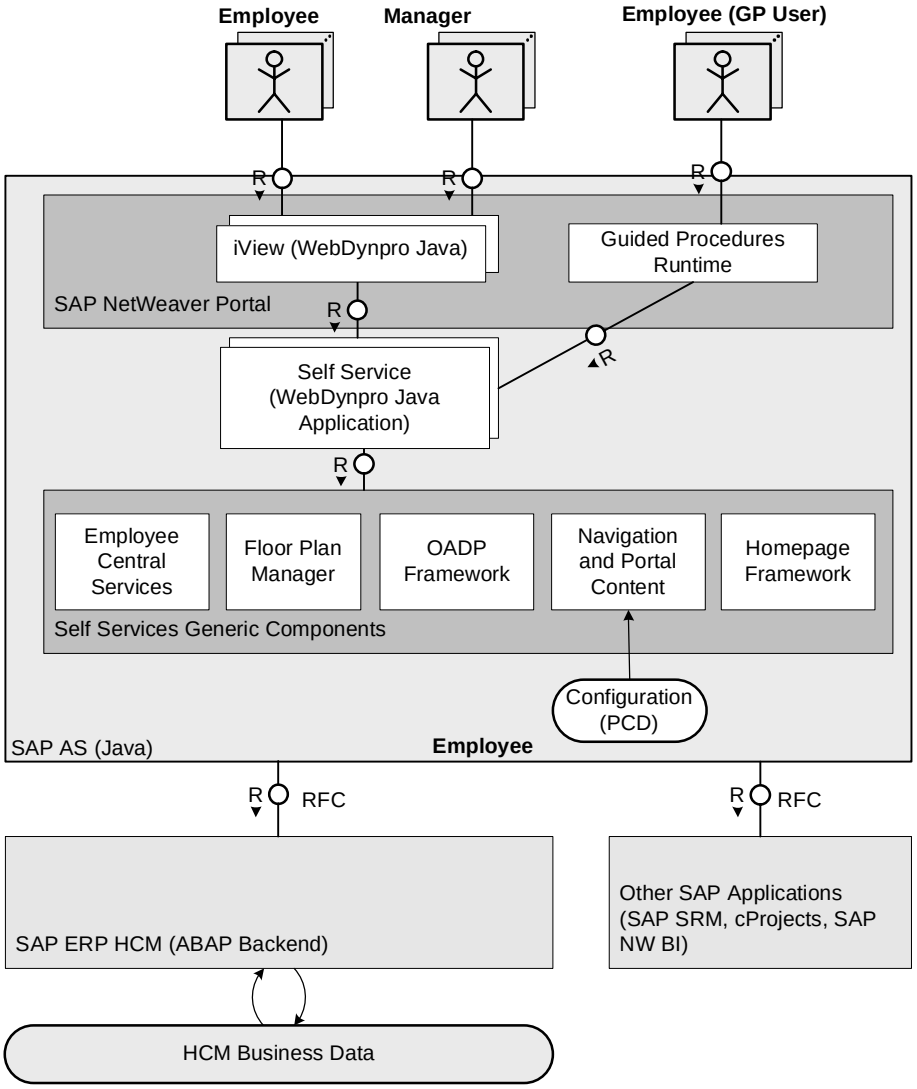

Figure 5-1 Architecture of ESS and MSS Applications

5.1.1 Floor Plan Manager for WD Java

The Webdynpro Java floor plan manager is the central design and runtime component for self services applications. Each self services consists of one floor plan which combines one or more visual application components (VAC, see figure 5-2). Each visual application component is assigned to one business logic component (BLC), which provides input checks and handles the communication with the backend.

The floor plan manager provides design time tools for the implementation of visual application components and the configuration of floor plans. For each self service application a dedicated floor plan configuration is created and stored in portal content directory (PCD). In the floor plan configuration the view assembly of the referring visual application components is defined. Visual application components can be reused in different floor plans.

At runtime the iView and the corresponding Web Dynpro Java application of the self service is instantiated (see figure 5-2). It accesses the floor plan manager main window, which passes the call to the floor plan controller. The floor plan controller retrieves the floor plan configuration via the configuration controller. Then it initiates the visual application components, defined in the configuration. The visual application components use business logic components to access the SAP ERP HCM backend using RFC.

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Since SAP Netweaver release 7.0 SP13 a floor plan manager for Web Dynpro ABAP is also available which will be used for future self-services developments.

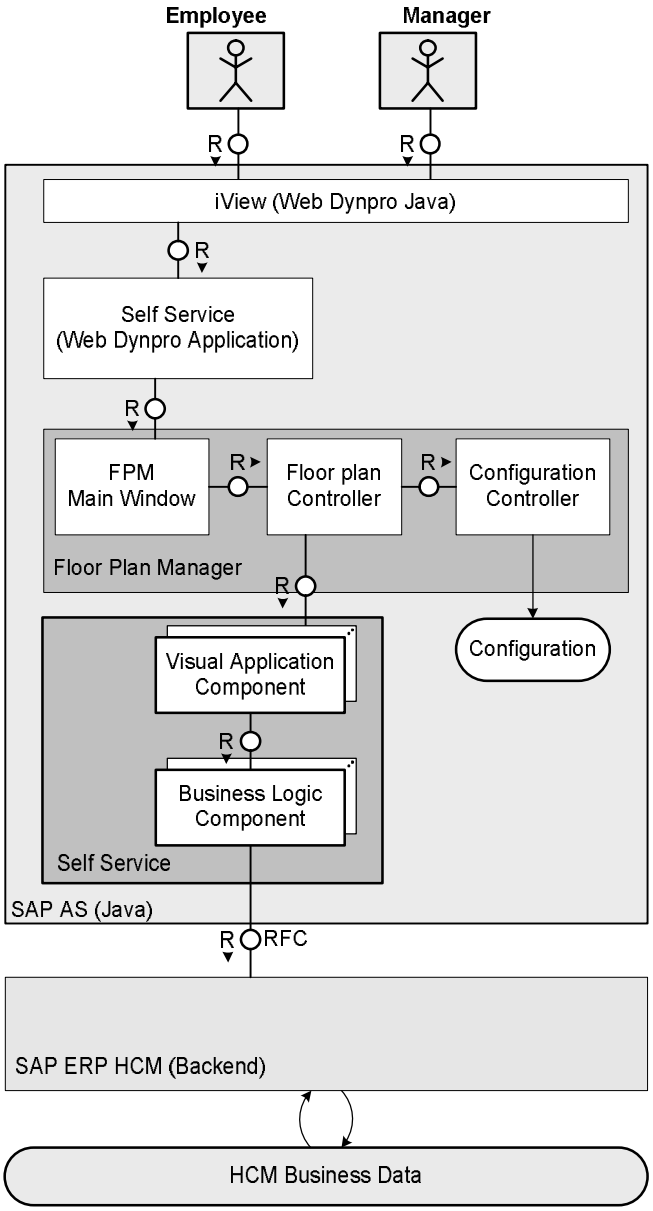

Figure 5-2 Detailed View of Floor Plan Manager WD Java for ESS and MSS

5.1.2 Home Page Framework

Homepage framework enables the creation of overview and area pages in SAP NetWeaver Portal which combine related self services.

Homepage framework consists of a Web Dynpro Java application which can be configured. The configuration defines how pages group and describe different self services and provide hyperlinks with which they can be started. For this the homepage framework uses the standard portal navigation features.

Homepage framework provides the following functions:

- Add descriptions for the individual self services that appear on the user interface

- Edit the link texts of the hyperlinks that the employees use to start the self services
- Emphasize certain services (for example, because there is an urgent deadline)
- Deactivate services
- Display employee-specific information as dynamic links (for example "Nine days of leave will expire by <Date>")

To do so, homepage framework consists of the following components;

- Web Dynpro Java application which provides the user interface of the homepages.
- Development components for handling portal navigation
- Customizing layer in SAP ERP HCM backend
- Proxy class implementation layer to implement specific logic for individual self services, for example to deactivate self services, and display application or employee specific information.

The homepage framework is mainly used to group employee self services.

5.1.3 Object and Data Provider Framework

Object and data provider (OADP) is a generic framework to display structures from organizational management in a list or tree structure. It consists of a generic, configurable Web Dynpro application. The customizing of the OADP framework is provided in SAP ERP HCM backend. There are the following two customizing areas:

- Object selection defines the rules for selecting various objects, for example the evaluation paths for searching organization structure (all employees in a manager's responsible organizational unit)
- Data provider defines columns, column groups, hierarchies and data views.

This OADP framework is used by many self services applications in MSS area.

5.2 HCM Processes and Forms

Form-based processes play a significant role in HCM. Forms are used to capture information and to apply for certain services. To address this, SAP ERP HCM provides the HCM service delivery application HCM processes and forms, which supports simple paper-like electronic processes using SAP interactive forms by Adobe. HCM processes and forms is for example used by self services, by the HR administration role and within the employee interaction center for processes like employee hiring process, employee termination process, organizational change process, maternity leave and birth of child process.

HCM processes and forms allows creating forms and defining interactive processes based on forms. Process definition and execution is based on SAP Business Workflow. HCM processes and forms supports search and tracking of processes, and automatic transfer of data to backend PA and time infotypes.

HCM Processes and Forms consist of the following components (see figure 5-3):

- User interface consisting of Web Dynpro ABAP applications and SAP interactive forms by Adobe.
- Adobe Document Server for designing and processing SAP interactive forms by Adobe. HCM processes and forms uses the ABAP application server workbench repository for Adobe forms. Forms are cached on the Adobe Document Server.
- Internal service request (ISR) framework and Adobe forms for handling interactive forms. In HCM processes and forms this framework is used as a communication layer between UI application and process object and HCM backend services layer.

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Technically ISR provides set of standard RFCs and BAdIs that applications can implement.

- Process object layer provides services, for process tracking, error handling, process search and for managing process related data (like form data, file attachments). First process object layer provides runtime persistence for each HCM process. It persists the process data like form data and uploaded attachments. For persistency of process data it uses SAP NetWeaver Case and Records Management. Attachments are stored using knowledge provider. Process object layer also provides the search capabilities on the persisted process data.
- SAP Workflow engine is used for executing processes. Workflow inbox and Universal Work List (UWL) is used for accessing work items by human process agents.
- Generic service dispatcher provides services for making the adobe forms interact with real time (online) application data. It connects to backend applications, such as PA and time management. It is possible to create custom backend application services where standard services are not available. In standard delivery services for PA infotypes, time management infotypes are provided. The generic service dispatcher provides services for online checks of input data, and for value help.
- The HCM Processes and Forms provides integrated design time environment, that acts as a single customizing transaction. It integrates various tools like the workflow builder and form designer (integrated with Adobe Live cycle designer). Within the design environment it is possible to map the fields on form to backend application data (e.g. HCM Infotype fields). The design time environment is not shown in the figure 5-3.
- HCM processes and forms provides external interfaces to support specific processes like new hire from e-recruiting. SAP XI triggers a new HCM process for hiring by creating an process object instance during inbound processing and passing on the data and attachments from the e-recruiting XI message.

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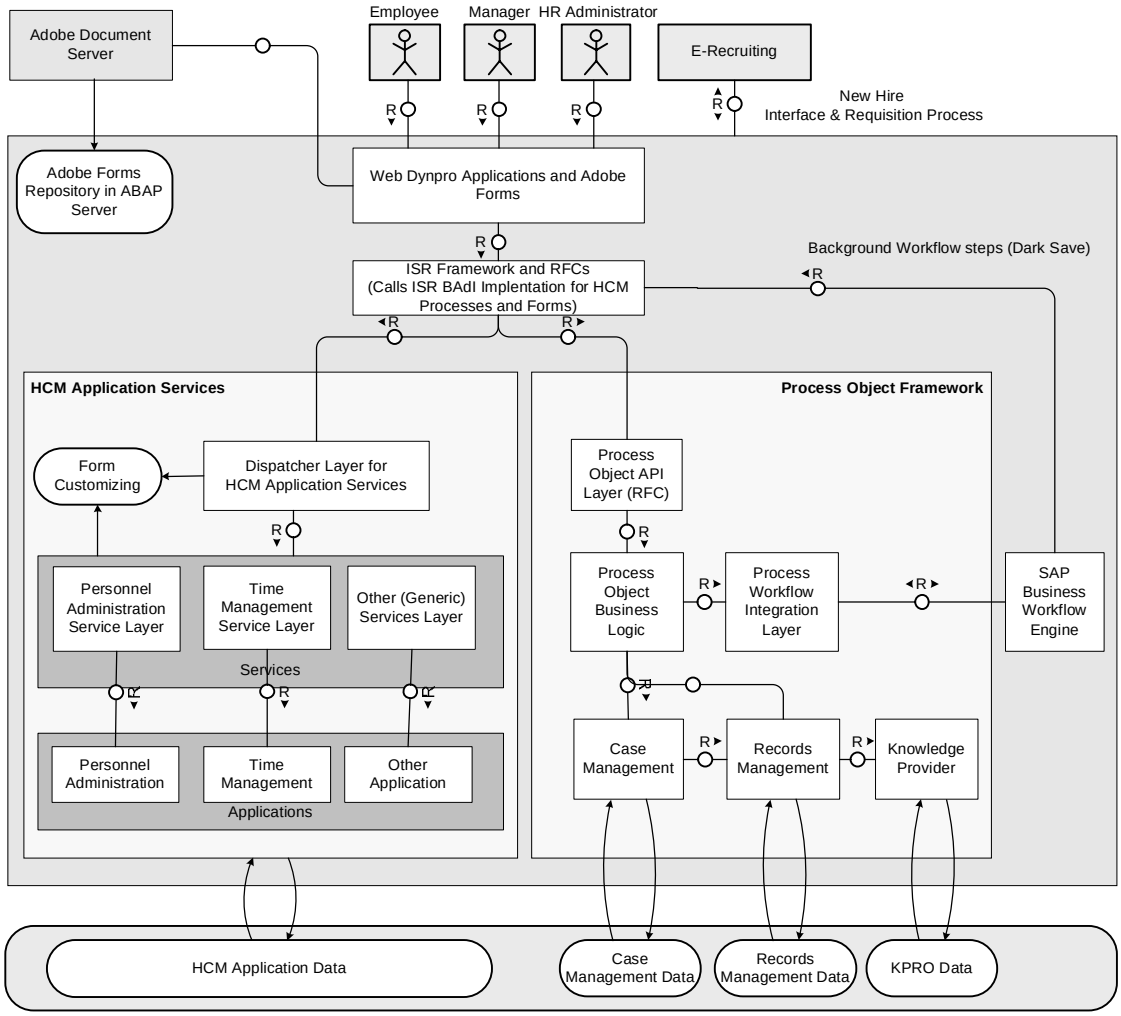

Figure 5-3 Architecture of HCM Processes and Forms

5.3 Employee Interaction Center (EIC)

The employee interaction center (EIC) is an important part of a HCM service delivery concept, especially in an organization model in which particular services are provided for the whole company by a central unit (internal or external outsourcing). Employees can contact the EIC whenever they require help or support regarding HR-related issues, for instance, when they want to request that their personal data should be changed or updated.

EIC is used mainly in the following cases, for example:

- HR services to be concentrated in one location irrespective of company locations.
- Employees have limited access to SAP ERP HCM system and ESS

EIC is based on the Interaction Center Web Client framework (IC Web Client), originally created for the interaction center of SAP CRM.

5.3.1 Interaction Center Web Client Framework

The IC Web Client framework provides the basic functionality required for the agent dashboard. It consists of the following three layers (see figure 5-4):

- User interface based on Business Server Pages (BSP), which is displayed in a Web browser

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- The business object layer (BOL) provides business objects optimized for UI presentation. The business objects retrieve their data from the underlying generic interaction layer.
- Generic interaction layer handles the data transfer between underlying application data and BOL using corresponding connectors. This layer also takes care of session management and data management of IC Web Client.

Communication management software to support telephony, fax, e-mail and so on is integrated using the integrated communication interface. Additional general information regarding IC Web Client features can be found at: http://help.sap.com/saphelp_erp2005vp/helpdata/en/07/2129d48928430ca741e03111ecee18/frameset.htm

5.3.2 Architecture of Employee Interaction Center

EIC uses the generic functionality provided by IC Web Client. To support EIC-specific functionality three components have been added: employee management, activity management, and inbox and work item management (see figure 5-4).

Technically each of these EIC components consists of two parts:

- Connector which implements the standard interfaces provided by the generic interaction layer of IC Web Client and calls the underlying HCM functionality.
- Central class with several sub-classes which implements the functionality for employee management, activity management, and inbox and work item management.

In the following each component is described in more detail.

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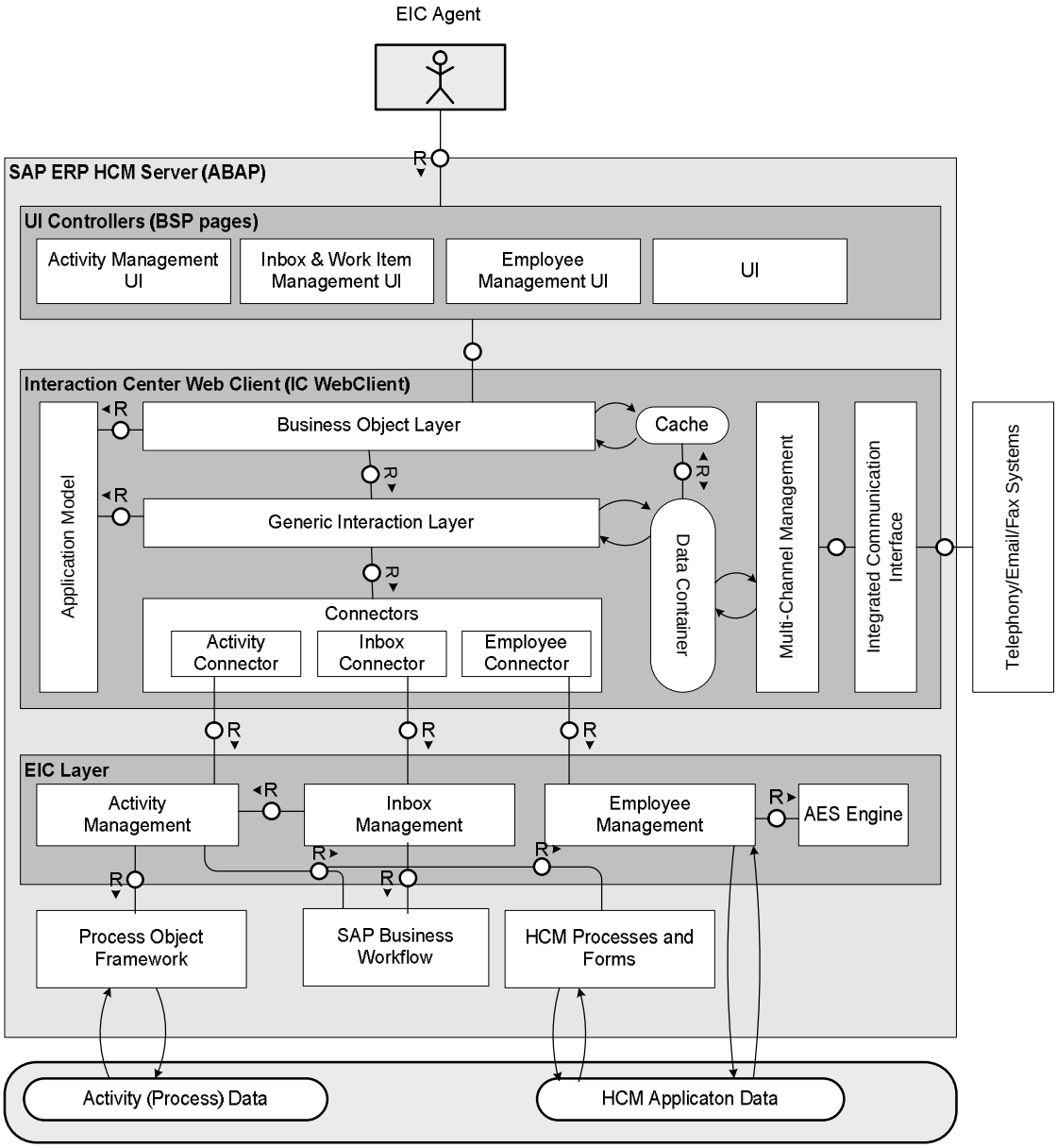

Figure 5-4 Architecture of EIC

5.3.2.1 Employee Management

Employee management automatically identifies an employee based on email id or telephone number. It allows to search for employees and to display employee details. Employee management is launched at the beginning of an EIC agent's activity. Search functionality is performed using SAPQuery application "Who is Who". Employee management also handles the interface to the digital personnel file, and launches transaction from personnel administration and ESS using the IC Web Client transaction launcher. Employee management conducts employee satisfaction survey and collects feedback using AES engine.

5.3.2.2 Activity Management

Activity management is used by the EIC agent to track service requests. The activity business object can handle notes and attachments and provides the functionality for follow-up management, such as forwarding the task to another agent or HR Administrator.

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Activities are persisted by the process object framework. Activity is finally persisted in SAP NetWeaver Case Management. Process object framework (see figure 5-3) is reused in EIC and HCM processes and forms. Additionally it is possible to start a HCM process and forward the data and attachments from the activity.

5.3.2.3 Inbox and Work Item Management

Inbox and work item management acts as central repository for processing of e-mails, work items, activities, follow-up activities, and Web requests from self-service applications. It provides features like search by different criteria's (category, status, date), and substitution. There is also a rule modeler (not shown in diagram) that can automatically handle inbox items like e-mail, web requests, and activities.

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6 Appendix

6.1 Software Components in SAP HCM

From development perspective SAP HCM is split into the following software components (see figure 6-1):

- SAP-HR 600 - which includes the core SAP HCM functionality such as PA and PD
- EA-HR 600 – extension for adding new functionality to core HCM
- E-Recruiting 6.0 – recruiting application which can be installed separately or on the same server
- LSO(FE) 600, LSO(AC) 600, LSO(OP) 600 – learning solution (e-learning) components
- SAP ESS 6.0 and SAP MSS 6.0 – self service applications for ESS, MSS,
- SAP_APPL 600 – cross HR applications like CATS
- SAP_ABA(700) and SAP_BASIS(700) which include reusable components such as AES engine, PD infotype framework, and so on

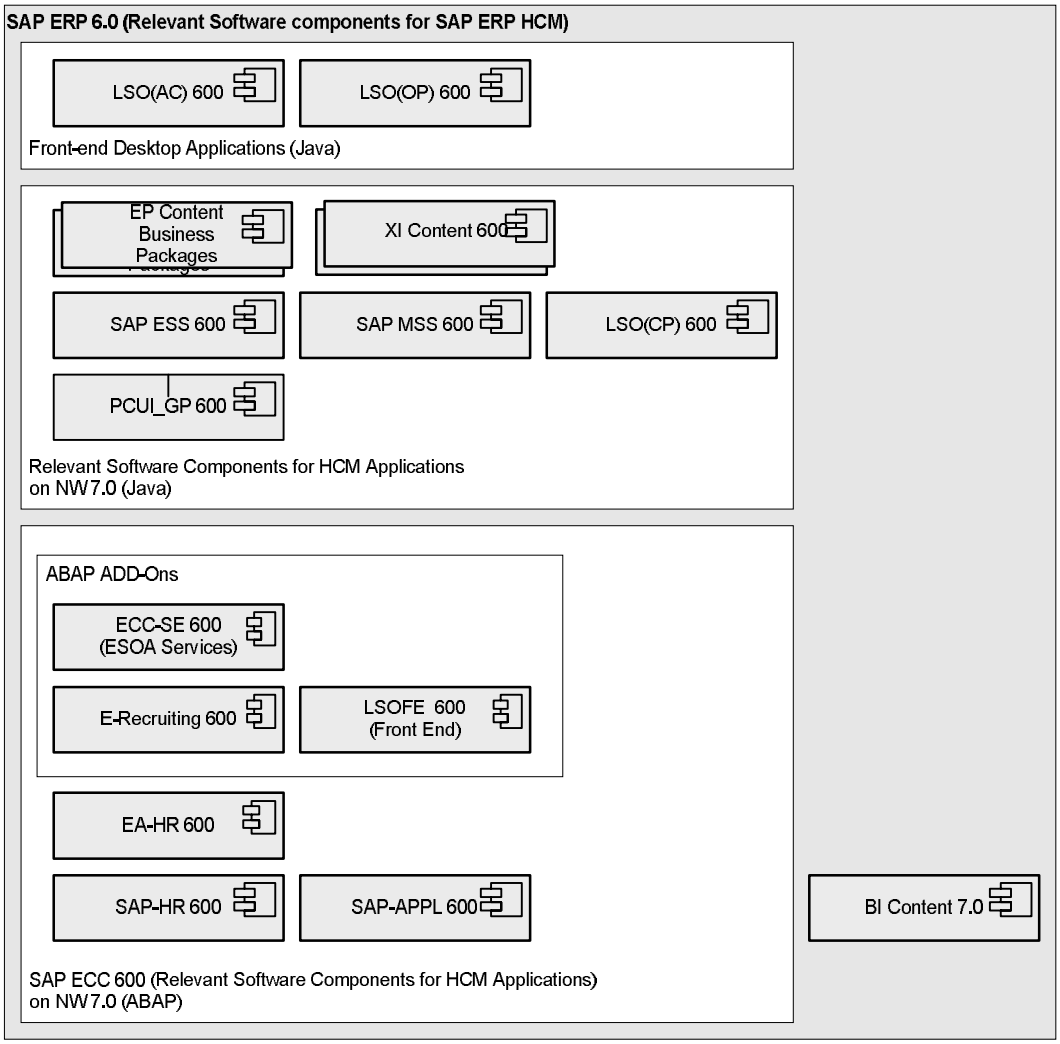

Figure 6-1 Software Components used in SAP ERP HCM

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All new developments of SAP ERP HCM are implemented in the EA-HR software component. SAP-HR component that contains the core functionality is now mainly used for minor enhancements and as well to keep the product updated from legal functionality (mainly in PA and payroll).

E-recruiting and enterprise learning are also available as separate products.

6.2 PD Objects in HCM and Organizational Management

figure 6-2 shows the object data model used in HCM and organizational management structure. The diagram covers only the important objects and relationships. There are many other relationships possible between objects which are not depicted here.

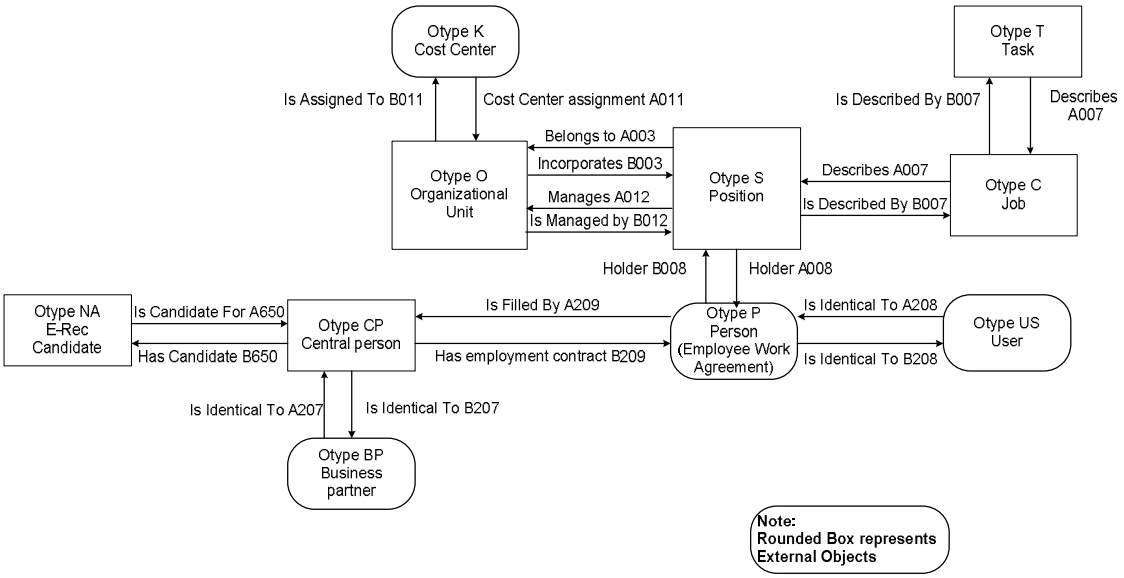

Figure 6-2 PD Objects in HCM and Organizational Management

6.3 PD Objects in E-Recruiting

figure 6-3 shows the PD object data model used in e-recruiting. The details of infotypes that are important for PD objects are mentioned, too.

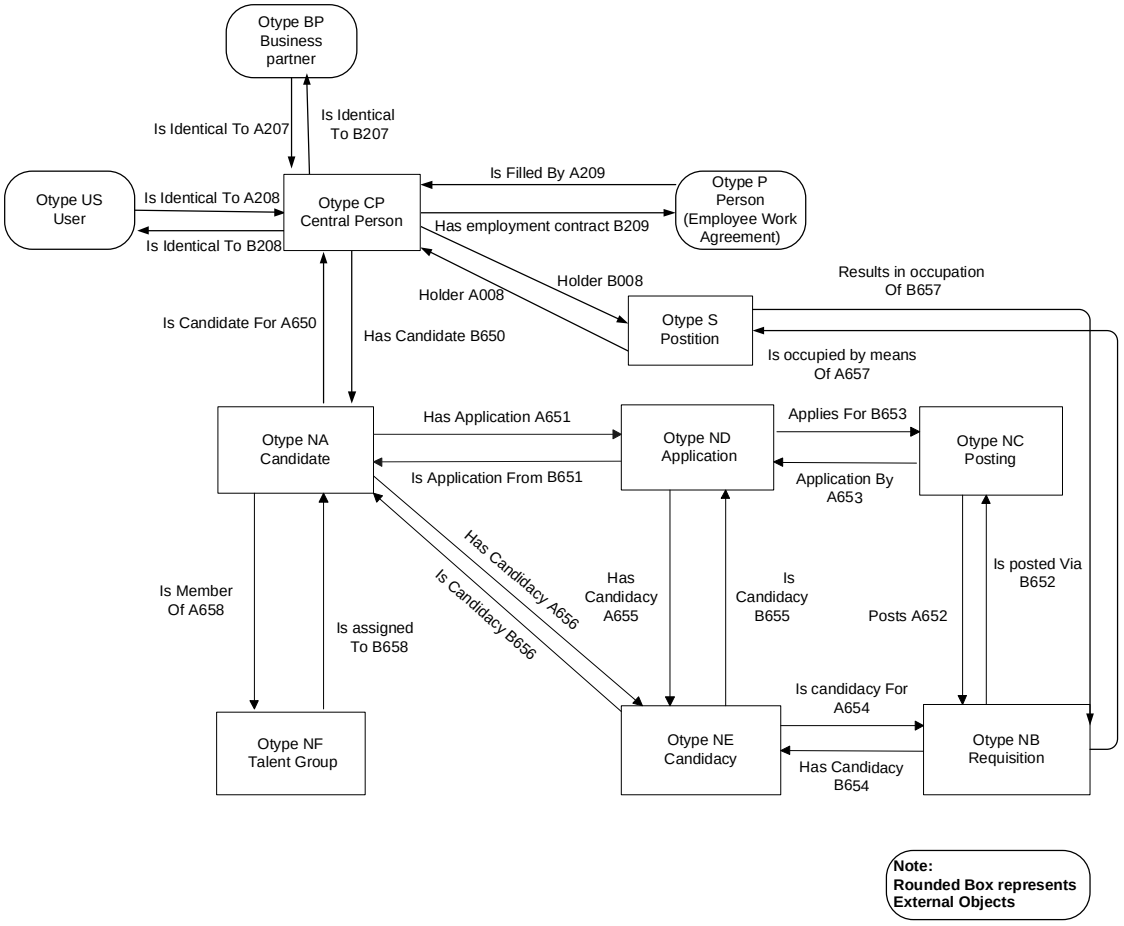

Figure 6-3 PD Objects in E-Recruiting

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7 Further Reading

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Developer's Wiki Pages:

ERP Architecture at

https://bis.wdf.sap.corp/twiki/bin/view/Applications/ERP2007Architecture

HCM Guidelines and Cookbooks (PA and PD Infotypes) at

https://bis.wdf.sap.corp/twiki/bin/view/Applications/HcmGuidelinesAndCookbooks

Self Service Development (ESS/MSS) at

https://bis.wdf.sap.corp/twiki/bin/view/Applications/XSSDevelopersCorner

Enterprise Learning at

https://bis.wdf.sap.corp/twiki/bin/view/Applications/LearningSolutionMain

8 Glossary

Term	Definition
AES	Appraisals, evaluation and survey (engine)
EIC	Employee interaction center
ESS	Employee self services
FI	Financials
HCM	Human capital management
KPro	Knowledge provider
LO	Logistics
MM	Material management
MSS	Manager self services
OADP	Object and data provider (framework)
PA	Personnel administration
PCD	Portal content directory
PD	Personnel development
SD	Sales and distribution

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