Engineering Corporate Portals

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Dipl.-Wi.-Ing. Hong Tuan Kiet Vo

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Referenten: Prof. Dr. Christof Weinhardt
Korreferent: Prof. Dr. Hartmut Schmeck

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List of Abbreviations

API	Application Programming Interface
AVE	Average Variance Extracted
B2B	Business-to-Business
B2C	Business-to-Consumer
B2E	Business-to-Employee
CoFiPot	Corporate Financial Portal
CFSC	Corporate Financial Service Center
CPU	Central Processing Unit
D&M	DeLone and McLean
EAI	Enterprise Application Integration
EBIT	Earnings before Interest and Taxes
EIP	Enterprise Information Portal
F&A	Finance and Accounting
FAQ	Frequently Asked Questions
FX	Foreign Exchange
HTML	Hypertext Markup Language
HTTP	Hypertext Transfer Protocol
IS	Information System
IT	Information Technology
JAD	Joint Application Development
LDAP	Lightweight Directory Access Protocol
PADEM	Portal Analysis and Design Method
PLS	Partial Least Square
RAD	Rapid Application Development
SOA	Service Oriented Architecture
SSL	Secure Socket Layer
TAM	Technology Acceptance Model
TBA	Theory of Planned Behavior
TMS	Treasury Management System
TRA	Theory of Reasoned Actions
UI	User Interface

URL	Uniform Resource Locator
WAD	Web Application Design
WAO	Web Application Online
WAR	Web Application Requirement
WSE	Web Site Engineering
XML	Extensible Markup Language

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Chapter 1

Introduction

The concept that underlies corporate portals is promising: corporate portals are the door to the hidden “information gems” that are dispersed throughout the corporate information network and make them available to the target audience, anytime and from anywhere. Hence, it is not surprising that during the E-Business and dotcom-hype of the late 90’s, corporate portals were considered a *must have* information system for the modern knowledge company.

In principal, a corporate portal is a component based Web information system that serves as a personalized single point of seamless access to all manners of applications, services, and information. Starting from this basic concept, there are numerous different definitions and descriptions, with most of them vary according to the actual application scenario (e.g. Dias 2001, Correia 2002, Clarke and Flaherty 2003). For example, corporate portals promise to foster information dissemination and knowledge management, strengthen the corporate communities, and support the integration of transaction- and business-services in order to streamline business processes.

However, conducting a corporate portal project is a challenging task that suffers from a still incomplete portfolio of systematic methods, proven techniques, and instruments (e.g. Amberger, Holzner et al. 2003, p.815). A Gartner study (2002) showed that a high percentage of corporate portal projects failed to meet the expectations, primarily due to an underestimation of the project complexity (Valdes, Gootzit et al. 2002). One reason is the scope of potential fields of application that requires the portal project team to derive and clearly focus the project objectives on the requirements of the specific business context (cf. Amberger, Holzner et al. 2003). In this regard, the portfolio of portal services has to be aligned according to the project objectives, while the existing services demand for configuration, management, and maintenance activities. Furthermore, the corporate portal implementation has to address not only the technical challenges of system integration but also organizational integration re-

quirements in order to connect data, information, knowledge, and people (cf. Terra and Gordon 2003; Firestone 2002).

The task of developing corporate portals from the initial analysis and design, over the development of the portal components and services, to the operation of the system is not to be underestimated. The design, development, and introduction of corporate portals require expertise and adapt methods, techniques, and instruments from a variety of different domains: Among others, one requires expertise in the development of Web information systems, instruments for the analysis and experience in the reengineering of business processes, practice in the area of information system integration, and the proficiency in designing human-computer interfaces that address the different views provided by corporate portals. Consequently, the project management requires experience in the coordination of the interdisciplinary project team while paying respect to the diversity of requirements that may arise from the different groups of stakeholders.

1.1 Research Questions & Contributions

The main objective of this work is to develop and elaborate a method for the systematic development of corporate portals. This method has to address and describe the major stages of a corporate portal project, starting from the initial analysis, over the design and development, the introduction, to the operation and the controlling and evolution of the corporate portal implementation. In order to achieve this objective in a systematic and structured manner, this work addresses research questions that focus firstly on the research subject, secondly on the development of a method for engineering corporate portals, and finally on the applicability and practical value of the elaborated methods and instruments.

I. Assessment of Research Subject

What are the main characteristics, the potential fields of applications, and the main benefits and limitations of corporate portals?

The first set of research questions focuses on the assessment of the research subject, i.e. the corporate portal. Following the discussion in literature and practice there are various opinions on the characteristics and the functionality attributed to corporate portals (cf. Dias 2001). This range of different descriptions makes it difficult to comprehend the fundamental concepts of corporate portals.

As a foundation for the main discussions on the design and development of corporate portals, this work reviews and summarizes the literature on the main types and concepts of corpo-

rate portals, thus provides the reader with a sound understanding of the fundamental characteristics that constitute the concept of the corporate portal. Furthermore, this work outlines primary fields of application in particular with regard to the potential benefits from and the limitations of a corporate portal implementation.

II. Towards a Method for the Engineering of Corporate Portals

Why is there a need for a method that fosters the development of corporate portals? What are the main method constituents, the relevant tasks and activities that need to be addressed within the stages of the engineering process?

The second set of research questions addresses the development of a method for the engineering of corporate portals. Following a review of current portal development approaches, the proposed method consists of the description of a suitable engineering process model, the relevant stages, and their relationships. Furthermore, an outline of the major tasks and activities of the engineering stages, as well as an elaboration of the associated role model provide an overview of the main method constituents. The method incorporates corporate portal specific design requirements in particularly with regard to the service oriented system architecture, which requires for an evolutionary engineering approach.

III. Embodiment, Applicability, and practical Relevance of Method Constituents

What are the suitable models, techniques, and instruments that are of practical value for conducting the main tasks within the individual stages of the engineering process?

The third set of research questions focuses on the embodiment of the main stages of the corporate portal engineering process with regard to the relevant models, methods, techniques, and instruments to conduct the main tasks and activities.

The contribution of this work lies in the identification, the adaptation, and the development of relevant methods and innovative instruments that are developed and derived with regard to a variety of different domains and disciplines. Moreover, in order to complement the theoretical discussion, the applicability and practical relevance of these methods and instruments is evaluated on the basis of a case study.

1.2 Case Study: The Corporate Financial Portal at Bayer

Throughout the course of this work, the Corporate Financial Portal project conducted at Bayer's Corporate Finance Center provides valuable practical insights that complement the theoretical elaborations.

The project was set-up as a joint project between Bayer Group's Corporate Finance department, the research group of Information Management and Systems of the University Karlsruhe, and the Chair for General Business Administration, International Management, Accounting and Auditing of the University Giessen. The goal of the Corporate Financial Portal project was to design, implement and introduce a corporate portal which provides financial information and services for the entities within the Bayer Group.

The following sections give a brief overview of the Bayer Group (Section 1.2.1) and the Corporate Financial Portal project (Section 1.2.2). Finally, Section 1.2.3 describes the integration of the *CoFiPot* case into the context of this work.

1.2.1 The Bayer Group

Bayer is a global enterprise with core competencies in three business areas: health care, nutrition, and high tech material. The Bayer Group consists of three business areas (Subgroups: Bayer HealthCare, Bayer CropScience, Bayer MaterialScience) that operate independently under the leadership of the management holding Bayer AG. In addition, Bayer service companies provide central service functions for these business areas as well as third party customers.

The strategic management of the Bayer Group is kept separate from the business areas. Governance, support and service functions for the Group Management Board are performed by the finance departments of the Corporate Centre (Bayer_Inv 2006). Figure 1 summarizes the organizational structure of the Bayer Group.

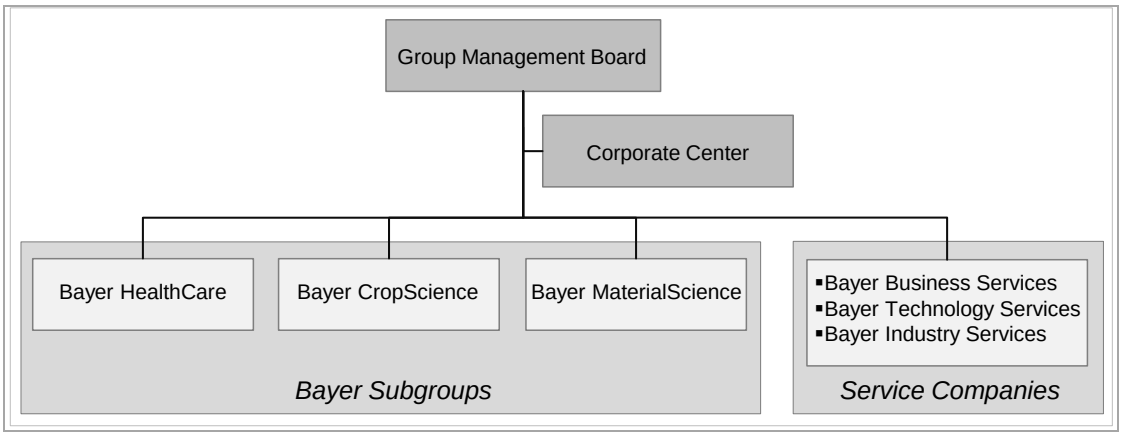


Figure 1 – Organizational structure of the Bayer Group (Bayer_Inv 2006)

Bayer is represented worldwide by approx. 350 companies with the global headquarter situated in Germany, Leverkusen. As of June 30, 2006, the Bayer Group employs a workforce of 110.200 employees:

- 61.300 in Europe (44.100 of which in Germany)
- 18.000 in North America
- 16.900 in Asia/Pacific
- 14.000 in Latin America/Africa/Middle East

Currently, the Bayer Group markets some 5.000 products among the best-selling are Aspirin®, Makrolon®, or Bayflex® Footwear. In 2005, the Bayer Group generated a net income of 27.3 billion Euros resulting in an operating result (EBIT) of 2.8 billion Euros (BayerInv 2006).

1.2.2 The Corporate Financial Portal Project

In 2000, Bayer decided to re-organize the organization of the group's financial management structure. The decision was to centralize the financial management activities at the Corporate Center in Germany, Leverkusen, hence reduce the numbers of dispersed regional financial services centers worldwide. Currently, the Bayer Group's Corporate Finance Center takes the role of a global financial services centre and bears global responsibility for the financial management of the Bayer Group.

The strategic reorganization posed new requirements and challenges on the information management of the global, corporate financial activities. On the one hand, the Corporate Finance Center had to provide the worldwide subsidiaries with the required financial information and services. On the other hand, group-level financial management decisions required the Corporate Financial Center to collect, aggregate and process the relevant financial data from the individual subsidiaries worldwide.

In order to address these information management challenges, in 2001, the Corporate Financial Portal project was initiated. The primary objective was to provide a central point of entry for all manners of financial services for the global financial community of the Bayer Group by means of an Intranet corporate portal, the *CoFiPot*[1]. The project was situated within the Corporate Financial Controlling department which among other tasks holds the functional responsibility for the financial information systems of the Corporate Finance Center.

The project was staffed with one employee from the Corporate Controlling Department and one researcher from the research group of Information Management and Systems. This team had the responsibility for the complete portal engineering process from the design, over the development, the introduction, to the operation of the *CoFiPot*. The Bayer Business Service provided support with regard to technical questions on the information systems landscape and the

[1] In the following the term *CoFiPot* is used for addressing the Corporate Financial Portal information system.
[2] http://my.yahoo.com
[3] http://www.flickr.com (photography); http://www.youtube.com (videos); http://www.blogger.com (blogs, i.e. online diaries) are examples of popular Web 2.0 portal concepts.
[4] Yahoo was selected as a random example; Lycos or Web.de are further examples.
[5] For a detailed discussion on the discipline of information management and the information management cycle the reader is referred to Butcher & Rowley (1998).

relevant systems. Furthermore, the Bayer Business Service managed the *CoFiPot* application from a technical perspective.

Project steering was conducted by the means of a steering committee that consisted of the director of the Corporate Financial Center, the heads of the corporate finance departments, and the heads of the university research groups. The selection of the steering committee members outlines the importance and scope of the Corporate Financial Portal project that affects major financial functions and central business processes. In January 2006, the project was successfully completed.

1.2.3 Sources of Case Study Data

The Corporate Financial Portal project provides the perspective for the practical relevance of the portal engineering framework components presented in the context of this work. Sources of case study data that are used for the composition of the case study sections are project and system documentations, observations, interviews, as well as the results of a survey among the users of the *CoFiPot*.

- **Documentations** and **empirical observations** comprise of general system documentations, project presentations for different purposes. These include presentations and protocols of steering committee meetings, the source code of the corporate portal application and services, transaction data from the *CoFiPot* server and associated enterprise information systems, as well as the researcher's notes. Project documentation and empirical observations are the main source of data used for composing the case study sections in the course of this work.
- **Interviews** with potential *CoFiPot* users were conducted during the project initiation to assess the basic project requirements. Furthermore, in 2005, structured interviews with experienced *CoFiPot* users (five interviews) and high level management executives involved in the project (three interviews) were conducted to evaluate their perspectives on the *CoFiPot* system and the overall impact of the Corporate Financial Portal project on the financial management processes. The interviewees were asked for their opinion on the following seven topics (cf. Appendix A):

  (1) Introduction and general questions
  (2) The project motivation and requirements (ex post)
  (3) The role of the *CoFiPot* in the context of global financial reporting processes
  (4) The impact on workflows and business process in general
  (5) The impact on strategic decisions and flexibility

(6) The impact on collaboration within the organization

(7) Success factors of the Corporate Financial Portal project

The findings from these interviews were summarized, presented, and discussed at meetings of the members of the steering committee. This practice contributes to the validity of the reported findings. In particular the case study sections of Chapter 4 and Chapter 8 incorporate the important results derived from these interviews.

- A **global survey** among the *CoFiPot* users was conducted in December 2005 in order to evaluate the users' perception of the system and the individual impact on using the system. In addition, the survey offered the possibility to leave criticism and suggestions to the Corporate Financial Portal project team. A case study section in Chapter 8 focuses on the analysis and interpretation of the survey results. The reader is referred to Appendix B for an overview of the survey structure and the survey results.

1.3 Outline

This work is divided into two parts as illustrated by Figure 2. Part I provides an introduction into the topic of corporate portals and further motivates, develops a method for the engineering of corporate portals. Part II guides the reader through every major corporate portal engineering stage, from the project initiation to the management and controlling of the corporate portal operation. Case study sections complement the theoretical discussions with detailed insights from the Corporate Financial Portal project.

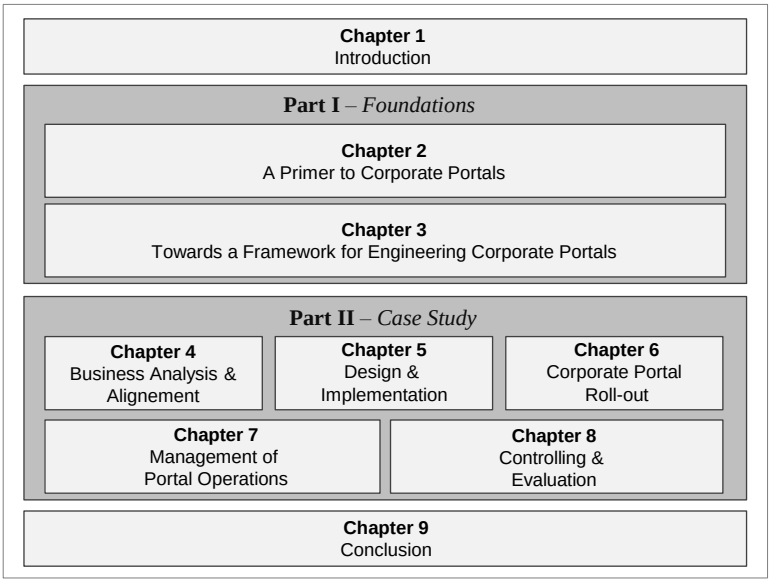


Figure 2 – Structure of this work

Part I – Foundations: Chapter 2 introduces into the topic of corporate portals and offers an overview of the different perspectives on the concept of corporate portals discussed in litera-

ture and practices. The discussion contributes to the necessary understanding of the fundamental characteristics that define corporate portals. Chapter 2 is closed with an elaboration of the typical benefits and the limitation from conducting corporate portal projects.

Following a review of current methods and approaches that are of relevance for the development of corporate portals, Chapter 3 motivates the need for a method for the engineering of corporate portals. Consequently, such a method is developed and elaborated in the remainder of the chapter. The discussion describes the main method constituents including the engineering process model, the role model, and outlines the relevant tasks and activities of the main engineering stages.

Part II – Case Study: For each of the corporate portal engineering stage, the relevant task and activities are outlined. The objective of each chapter is to develop suitable models, methods, techniques, and innovative instruments to support the tasks of the engineering stages. The applicability and practical relevance of the developed portal engineering instruments is validated on the basis of the insights from the Corporate Financial Portal project.

Chapter 4 describes the activities of the project initiation including the definition of the project goals, the project management structure, mid-term work packages, as well as instruments for project governance.

Chapter 5 elaborates on the design of the corporate portal system components (i.e. application architecture, integration architecture, information architecture) and discusses suitable development process models according to the different portal development scenarios. The introduction and promotion activities are at the center of the discussion in Chapter 6.

Chapter 7 and Chapter 8 focus on the activities of the corporate portal online phase. Chapter 7 describes the management of corporate portal operations from a technical and functional perspective. Chapter 8 addresses the evaluation of the corporate portal project from three perspectives: the business-, the system usage-, and the user's acceptance perspective. With regard to the user's acceptance perspective, Chapter 8 develops, evaluates, and verifies a measurement model for the assessment of the users' acceptance and satisfaction with corporate portals.

Chapter 9 concludes this work with a summary and critical reflection on the lessons learned, and an outlook on future work.

Part I – Foundations

Chapter 2

A Primer to Corporate Portals

Enterprise Information Portal, Knowledge Portal, Customer Process Portal, Collaboration Portal are just some terms that are used to describe different corporate portal concepts discussed in research and practice. Yet, this variety of different descriptions has led to a diffuse perception of what actually constitutes a corporate portal.

What are the central ideas underlying corporate portals? What categories of corporate portal concepts are there and where is the difference between them? Are there typical fields of application? By addressing these questions, the goal of this chapter is to build up a clear understanding of what defines a corporate portal.

In this regard, Section 2.1 briefly summarizes the history of Web portals. This is relevant, as the fundamental concepts underlying Web Portals are the same for corporate portals. Section 2.2 summarizes current descriptions of corporate portals from research and practice that allow for a general definition of what constitutes a corporate portal. Section 2.3 presents a set of criteria and approaches that foster the categorization of different types of corporate portal concepts. Finally, Section 2.4 focuses on the reasons for a corporate portal initiative and outlines benefits from a corporate portal implementation.

2.1 A Brief Look at the History of the Web Portals

Derived from the Latin "*porta",* the term *portal* stands for a gate that leads to another place (Clarke and Flatherty 2003, p.16). In a literal sense, a portal is a gateway or starting point that one has to pass to reach the desired destination. In the context of the Internet, a portal is a Web site that acts as a gateway to other Web sites which belong to a certain domain (e.g. financial information, politics, or sports) and are of interest to a certain group of people.

In the early days of the World Wide Web, the task of discovering interesting Web sites was tedious and challenging. Despite the existence of search engines that allowed a full text search within HTML documents, the exponential growth in the number of Web sites made it difficult to identify those that were of interest for the user. Further, the capability to rank the search results in a meaningful order was either nonexistent or very limited using that generation of Web search engines. The simple solution to this problem was a Web site that contained descriptions and references to other Web sites on a specific topic. This can be regarded the birth of the Web portal concept. At that time, one of the most popular of these type of Web sites was "Jerry's and David's Guide to the World Wide Web" created and maintained by David Filo and Jerry Yang in 1994 and two years later became what is now known as *Yahoo* (Yet Another Hierarchical Officious Oracle) (cf. Kalakota and Robinson 2000, Yahoo 2005). Summing up, this first generation of Web portals were basic Web sites that provided little more than rudimentary Web search services and commented Web directories to the domains of users' interest.

The commercialization of the Internet altered the perspective on the role of a Web portal. Prominent Web sites that addressed many visitors offered valuable virtual advertising space. Consequently, to increase the advertising revenue, it was important not only to attract as many users as possible, but also to keep the users on the Web site for an extended period of time (cf. Clarke and Flaherty 2003,p.16; Dewan, Freimer et al. 1999, p.166).

As a consequence, an increasing amount of original content and information services were added to the Web portal offerings, in addition to the catalogue descriptions and references to further Web sites. It was during this time that Web portals introduced new functionality and services that today are considered as basic characteristics of every portal implementation. In 1998, the concept of Web site personalization was introduced to a greater public with the *MyYahoo*[2] portal services. No longer did the user have to adopt and accept a predefined set of information and services that was composed with general audience in mind. *MyYahoo* enabled the user to customize her portal experience according to her likings such as having only soccer and financial news aggregated on his personal Web portal. Transparent integration of third party content as well as original content were the other features that characterized this second generation of Web portals (cf. Dias 2001, p.227;Stelzer 2004, pp.9-10).

Currently, one can witness the emerging of the third generation of Web portals. From a technical perspective, the maturity of Web technology enables rich and comfortable user in-

[2] http://my.yahoo.com

terfaces for dynamic Web application. Moreover, the growth in bandwidth that is available to the users fostered the trend toward end-users sharing, and discussing their self-created media on Web portals like Flickr, YouTube, or Blogger. [3] Hence, following the Web 2.0 discussion (e.g. Boll 2007) these third generation Web 2.0 portals extend the scope of the portal offerings by addressing on the commercial prospects of community building that is fostered through end-user integration.

From a content perspective, the driving forces are community building and content creation. The Internet has evolved from a data and information network to a community driven knowledge network. Today, people use services offered by Web portals to create Internet diaries (i.e. by the use of Internet-Blogs), upload, discuss and share their pictures, self-made videos and music, and even more. Current generation Web portals integrate people by offering services that facilitate community building, content creation, and sharing (e.g. Portfolio of *Google* Services, *MyYahoo* Service Portfolio, Microsoft's Windows Live Initiative). The Internet is becoming a central part of people's life and Web portals are at the core of this development helping people to organize their Web-presence. Figure 3 illustrates the increase in functionality and reach with every new generation of Web portals.

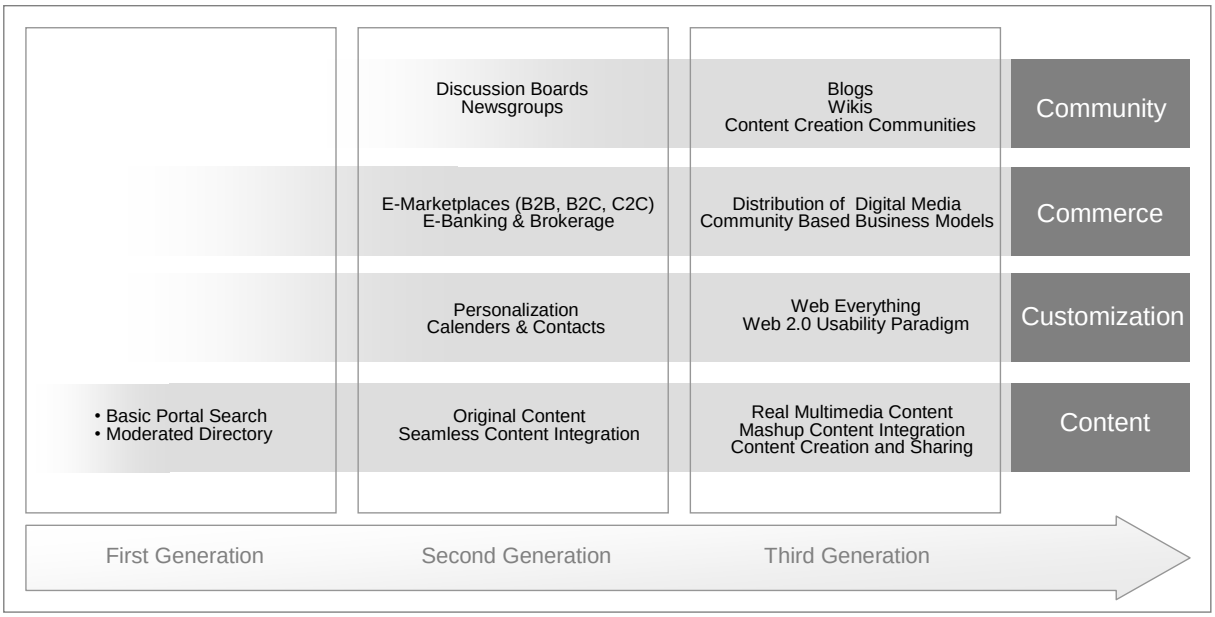


Figure 3 - Web Portal Evolution (following Hartmann 2000, p10)

It is not surprising that portal definitions varied over time to adopt new trends and to follow the evolution of the Web portals. Aspects like personalization and self customization that today are clearly associated with the concept of a Web portal were not included in the definition

[3] http://www.flickr.com (photography); http://www.youtube.com (videos); http://www.blogger.com (blogs, i.e. online diaries) are examples of popular Web 2.0 portal concepts.

of a first generation portal. For the purpose of a clear und unique reference throughout this work, a Web portal is defined as follows:

Definition 2.1 – Web Portal

> *A Web portal is an information system that serves as a **personalized**, **customizable** **single point of seamless access** to integrated information and services that are of relevance to the users of the portal.*

A brief glimpse at the current instance of the Yahoo Web portal closes the general discussion on Web portals (cf. Figure 2).[4] The portal clearly confirms to the cornerstones of the above definition. Web search functionality remains at the centre of the portal functionality and is prominently placed at the top of the site ❶, followed by personalization services ❷. The navigation bar on the left provides access to the different domains of further interest ❸. Finally, original and third party content that are seamlessly integrated share the main content space ❹.

Figure 4 - Yahoo Web Portal (www.yahoo.com as of June 2006)

[4] Yahoo was selected as a random example; Lycos or Web.de are further examples.

2.2 Different Perspectives on Corporate Portals

The Intranet was implemented and established as a corporate communication channel to share information across the organization (Collins 2001, p.4). Employees were able to access the relevant information and services through dedicated Intranet sites. Yet, with the growing number of these Intranet sites, it became more and more difficult for the users of the Intranet to identify and access the required information. Consequently, the concept of the Web portal was adapted as an instrument to facilitate the task of identifying, accessing, and processing the relevant pieces of information dispersed across the Intranet. At the source of the corporate portal discussion stands the Enterprise Information Portal (EIP). According to Dias (2001, p.274), the notion of the EIP was first introduced by Shilakes and Tylman (1998). In principal, the authors extended the scope of the Web portal definition to comprise the aspect of information management in a business context.

Subsequent discussions on corporate portals broadened the basic idea of the EIP by adding aspects of process management, collaboration, and knowledge management; while, at the same time introducing more and more labels for these "new" corporate portal concepts. As such, the term business portal was introduced to emphasize the aspect of decision making and support. In principal, the business portal can be compared to a shopping mall for knowledge-workers (Dias 2001, p.274) while otherwise staying true to the original concept of the EIP.

Ferguson (1999) extended the corporate portal concept by arguing that there are two distinct categories of corporate portals: On the one hand "decision processing" EIPs and on the other hand "collaborative processing" EIPs. The importance of fostering collaboration through portals was also supported by Murray (1999) who went one step further and introduced four distinct types of corporate portals (cited in Dias 2001, p.274). In addition to the concept of the EIP and Ferguson's Enterprise Collaborative Portal he discussed the Enterprise Expertise Portal and the Enterprise Knowledge Portals. The departure from the exclusive idea of the portal being just a gateway to corporate information is what differentiates Murray's portal discussion from the previous ones. Murray's portal types explicitly outline the role of a corporate portal in the context of business collaboration and workflow support.

This is consistent to Finkelstein's (2000) argumentation, who described a corporate portal more generally as a gateway to information *and* application services that help employees in fulfilling their work. Following this broadened notion and instead of adding even more definitions to the corporate portal discussion, Fleisch and Österle (2001, p.4) proposed the idea of the process portal that incorporates the different fields of applications of the various corporate

portal concepts discussed so far. At the center of the process portal concept is the comprehensive support of customer processes. In this context the corporate portal is regarded as an important enabler of business engineering and networking initiatives (Österle 2002, pp.23-24). Subsequent discussions on process portals departed from this customer centric perspective, arguing that every corporate portal implementation – in one way or the other – will offer services that support the respective portal stakeholders (i.e. customers, business partners and employees) with their information management needs.

Terra and Gordon (2003) discuss corporate portals from the perspective of a knowledge management portal that first and foremost assists the knowledge workers. Following their argumentation, the corporate knowledge portal facilitates complex problem solving and fosters collaboration among the organization by means of placing the information into the relevant business context (Terra and Gordon 2003, pp.114-119). In this context, Stelzer (2004, p.20) argues that the enterprise knowledge portal is the latest state of the corporate portal evolution and comprises every facet associated to corporate portals, as discussed so far.

Corporate portals are not only the topic of scientific discussion, but are also discussed by IT practitioners including service providers, market analysts, and portal vendors. Table 1 offers a selection of different views and descriptions of corporate portals terms and concepts that are found in literature and practice.

Table 1 - Corporate Portal Terms, Definitions and Concept Descriptions (own accentuations)

Terms and Concept	Definition & Descriptions
Enterprise Information Portal Merril Lynch Report by Shilakes and Tylam (1998) (cited in Dias 2001, p.274)	*"Enterprise Information portals are applications that enable companies to unlock internally and externally stored information, and provide users a* ***single gateway*** *to* ***personalized information*** *needed to make* ***informed business decisions****" …"Enterprise Information Portals are an emerging market opportunity; an* ***amalgamation of software applications*** *that* ***consolidate, manage, analyze*** *and* ***distribute information across and outside of an enterprise****.."*
Corporate Portal Collins (2001, p.7)	*"A* ***browser-based application*** *that allows* ***knowledge workers*** *to gain* ***access*** *to,* ***collaborate*** *with,* ***make decisions****, and take action on a* ***wide variety of business related information regardless of*** *the employee's virtual* ***location*** *or department affiliation, the location of the information, or the* ***format*** *in which the information is stored."*
Corporate Portal Dias (2001, p.269)	*"The corporate portal … uses metadata and eXtensible Markup Language (XML) to* ***integrate unstructured data to structured data*** *from operational databases,* ***supplying access to corporate information*** *through* ***a personalized interface****, available over the internal hypertext network - the* ***Intranet****."*
Corporate Portal Davidov (2001, p.137)	*"The key focus of portals is the* ***integrated access*** *to both,* ***information and application services****, and* ***greater levels of integration*** *between the two… Corporate Portals …* ***simplify complex information****, provide context-specific and* ***useful*** *application services, and foster* ***collaboration*** *and* ***community building*** *across the extended enterprise"*
Process Portal Puschmann and Alt (2004, p.1)	*"Process portals are understood as* ***web based****,* ***personalizable*** *and* ***integrated*** *systems to* ***access internal*** *and* ***external applications*** *which support* ***customer processes*** *and implement graphical and/or audiovisual* ***front-end integration****"*
Knowledge Portal Don Tapscott (2003, p.24)	*"Knowledge Portals provide workers with a* ***personalized desktop*** *– giving them the* ***information, knowledge,*** *and* ***resources*** *they* ***need to execute their job*** *… Their design reflects a* ***fundamental transformation*** *of our view of enterprise* ***information management****, from a series of isolated tasks to the* ***coordinated integration of knowledge****."*

In summary, the definitions and descriptions differ, according to the actual field of application and business purpose of the regarded corporate portal implementation. Hence, the authors define *their* corporate portal. Further, the concept underlying corporate portals is subject to constant evolution. A definition that captures the current state of the art will become obsolete in the future. As a consequence, the following definition abstracts from the fields of application and focuses only on the cornerstones of a corporate portal.

Definition 2.2 – Corporate Portal

> *A corporate portal is a **web-based** application that serves as a **personalized** and **customizable** and **single gateway** to all **the information, application, processes** and **people** that are **of relevance** for conducting **business operations**.*

This general definition serves as a starting point for the subsequent elaboration of categorization approaches. These help to structure the different types and concepts of corporate portals and contribute to the understanding of the overall concept of corporate portals.

2.3 A Framework for Categorizing Corporate Portals

Following the discussions in literature and practice, there exist various approaches for categorizing portals. Well-established criteria for categorizing corporate portals are the content and scope of information, user groups and network reach, level of integration, fields of applications and E-business activity.

- **Content and scope of information**: A popular approach is to differentiate portals with regard to the depth of the information content provided (low versus high level of detail) (Hartmann 2000, p.9) and the general scope of the information offering (i.e. horizontal vs. vertical content offerings) (Großman and Koschek 2005, p.30). Horizontal portals offer information and services from a wide variety of topics and without focusing on specific user groups. Yahoo, Lycos, or MSN are typical examples for Internet portals that offer content from a wide range of topics. Contrarily, the content offered by vertical portals is focused on information and services of one specific domain. Hence, vertical portals in particular address certain groups of users that share the same interest or business background. One example for vertical corporate portals is a portal for the financial community that provides financial market data and services that are first and foremost of interest for the members of the corporate finance department.
- **User groups**: The categorization of portals with regard to user groups is very similar to the content scope criterion. Following this approach, closed corporate portals are those that offer content for and are only accessible by a specific group of users (e.g. members of the financial department, executive portals, etc.). In contrast open corporate portals are accessible to the general employee (cf. Großmann and Koschek 2005, p.30).
- **Network scope**: The network scope criterion allows for two slightly different categorization approaches (Stelzer 2004, p.12). From an information content perspective, the network scope criterion distinguishes portals according to the network location of the in-

formation sources the portal has access to. Hence, Intranet portals will only provide access to internal information sources within the corporate Intranet while Internet portals also integrate public information. In contrast, network scope can also refer to access restrictions, according to which Internet portals can be assessed by the general public, extranet portals by a selected public user base, and Intranet portals by employees only (Schumacher and Schwickert 1999, p.8).

- **Level of integration**: Puschmann (2003, p.27) differentiates portals according to the depth of integration realized by a corporate portal implementation. He distinguishes between content portals, application portals and process portals. Content portals perform integration on the presentation level and offer a consistent and uniform view on original and third party Web content (i.e. HTML documents). In contrast, application portals rely on application level integration to access and expose data from underlying enterprise information systems. Process portals provide the most complete level of integration by also exposing the functionality of the underlying applications.
- **Field of application**: Portals are classified according to the primary field of application. With respect to literature, the most common corporate portal field of applications include information and knowledge management, business process and workflow integration, as well as collaboration and community building. Consequently, Stelzer (2004, pp.18-20) distinguishes between information portals, collaboration portals, application portals and knowledge portals as the archetypes of corporate portals. These corporate portal types differ in the scope and complexity of the provided functionality, starting with the information portal as the most basic form of a corporate portal.
- **E-Business activity**: With regard to the E-Business activities addressed by a portal offering, one can differentiate between Business-to-Consumer (B2C portal), Business-to-Employee (B2E portal), Business-to-Business (B2B portal) (Schumacher and Schwickert 1999, pp.8-9). The B2C Portal is the typical Internet consumer portal open to everyone. Equivalent terms are eCommerce or Consumer portal. The B2C portal offers companies the possibility to directly address potential customers as a showcase for their latest products and even as a direct distribution channel. The main purpose of a B2B portal is to integrate remote business partners. Companies usually deploy these types of portals to maintain their business relations and to foster cooperation. B2B portals are especially popular among companies that try to optimize their value network. Finally, B2E portals (also referred to as eWorkflow or employee portals) are closed information platforms that are usually accessible only within the company's private network – the corporate

Intranet. B2E portals focus on information and services that are of interest of the company's employees fostering working together and communication.

Figure 5 aggregates the most commonly used criteria for the characterization of corporate portals in one comprehensive framework. The framework adopts the common practice to distinguish between user portal reach and content scope and add E-Business activity/field of application as further dimensions for categorization.

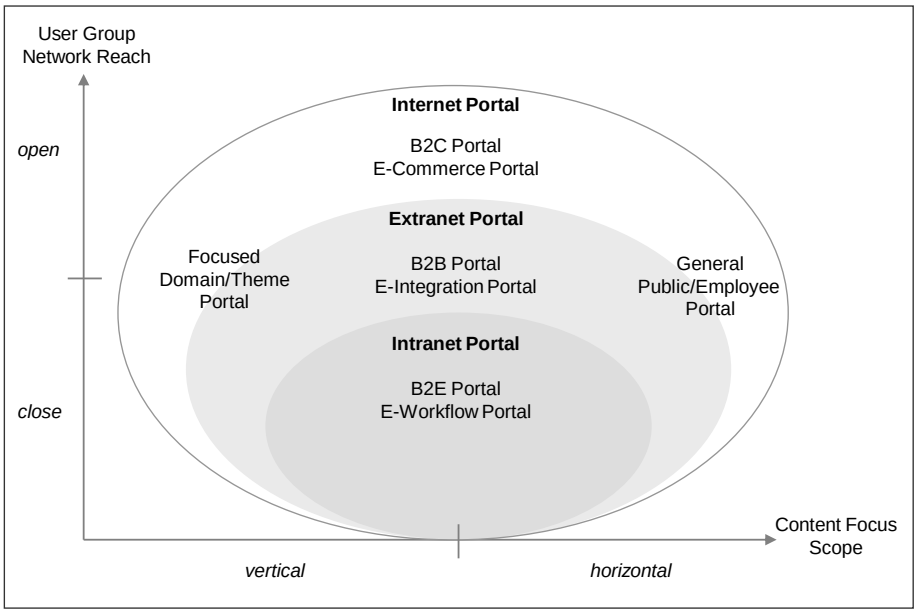


Figure 5 – Framework for categorizing corporate portals

Following this categorization framework, a corporate portal implementation that is accessible only within the corporate Intranet and addresses a specific functional domain (e.g. research and development or corporate finance) would be situated in segment ❶. If the portal is made available to users beyond the members of the domain by offering additional content and services that are also of interest to a broader audience, the portal would belong to segment ❷. The categorization according to the segments ❸ and ❹ is analogous to the first two segments with the difference that these type of corporate portals do not offer content that is exclusive to a specific domain, but address a broad range of topics.

2.4 Core Functionality and Services

This section describes the core functionalities that are offered by every corporate portal implementation. First and foremost, these include user rights management and security mechanisms, basic content management functions, as wells as personalization and search services (cf. Bauer 2001; Dias 2001; Großmann and Koschek 2005;Vlachakis, Kirchhof et al. 2005).

- **User rights management and security**: The user rights management guarantees that portal users can only access services and data they are permitted to. In general, user rights can be managed within the portal application scope or beyond through a central directory service. It is common practice to rely on the central directory service for general application-level access rights (i.e. portal application level). Access restrictions within an application that determine which content or services a user is permitted to access, are stored and managed in the application context (i.e. portal service level). Usually, these portal service level access rights are defined and managed not on the individual user level, but on user group/role level (e.g. administrator, document manager, document reader). Each legitimate portal user is assigned to the required user groups (Bauer 2001, p.144).

- **Single-sign-on:** Closely related to the user rights management is the single-sign-on mechanism that enables the portal users to access the portal applications and services without the need of further authentication. After the user signs on to the corporate portal, internal sign-on services will automatically pass on the user information to the integrated applications that the user has access to (Stelzer 2004, p.25). Note that while single-sign-on functionality is considered a blessing to portal users, it is also subject to critical discussions on security (cf. Gurzki 2004, p.36).

- **Content management**: A corporate portal implementation has to provide means to enable basic content management tasks. These include the definition and management of portal content areas in terms of design, content, and the specification and administration of access rights for these areas.

- **Personalization of content and services**: Introduced to the general public with MyYahoo (cf. section 2.1), personalization is considered among the most distinct characteristic of (corporate) portals. Personalization refers to a set of portal service components and portal application functionality that enables the user to select and arrange services and information in a way that benefits him most. Compared to conventional Web- and Intranet sites, personalization constitutes a fundamental paradigm shift: The design of personalized web-offerings has to follow a user-centric approach in contrast to the established content-centric approach.

- **Search services**: One key purpose of corporate portals is to act as a gateway to the relevant information and services. This requires the portal to cope for the ever changing and growing amount of data and information dispersed throughout the corporate network.

Consequently, the ability to search within this "sea of information" is often considered as the most important functionality of portals (cf. Gurzki 2004, p.35). With regard to corporate portals, it is generally not sufficient to rely only on full-text search strategies and limit the search scope to HTML documents. The challenge arises from the requirement to search for information on the enterprise application level. In contrast to standardized HTML content, each of these applications will probably rely on distinct semantics, data structures, and application interfaces to access the underlying data. Therefore, for every relevant application that has to be included in the portal search, one has to implement and customize distinct search strategies.

2.5 Benefits from Corporate Portals

A corporate portal project should not be conducted on the basis of technology affinity or even personal reasons, but has to address business challenges and objectives. With regard to literature and practice, there are a number of typical benefits claimed to be associated with corporate portal implementations (Dias 2001, p.282). In the following, this work discusses the main benefits from corporate portal implementations with regard to the support of typical information and knowledge management tasks (Section 2.5.1), the integration of business processes (Section 2.5.2), as well as the coordination of global collaboration processes (Section 2.5.3). Finally, Section 2.5.4 outlines the limitation of corporate portal implementations.

2.5.1 Information & Knowledge Management

Today, information and derived knowledge are among the most, if not the most important resources for a company to prevail in the global market (cf. Picot, Reichwald et al. 2001). Information management is about the planning, development, maintenance, and optimization of information flows with regard to relevant business operations and processes. This is a challenging task as business operations and processes typically rely on information that is dispersed across different applications, databases or even organizational entities (Kaiser 2000, p.19; Figure 6).[5]

[5] For a detailed discussion on the discipline of information management and the information management cycle the reader is referred to Butcher & Rowley (1998).

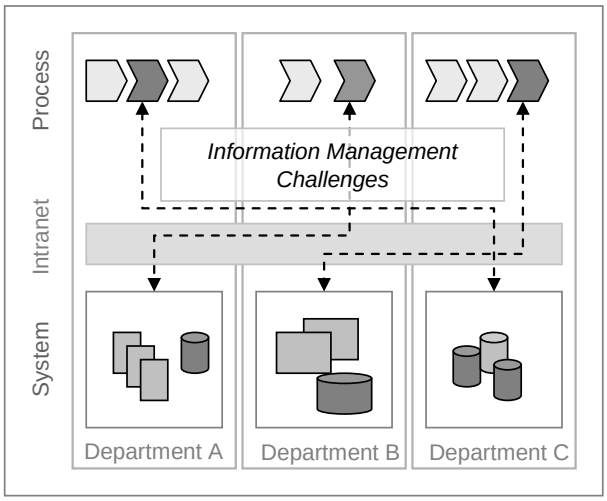


Figure 6 - Information management challenges (following Kaiser 2000, p.19)

While the Intranet offers the means to connect and access the dispersed corporate information systems, data, and documents, it is the corporate portal that offers mechanisms and instruments to address the major requirements of information management tasks with regard to the information recognition, selection and distribution activities:

- **Information recognition**: Information is worthless if it cannot be found by the employees or the employees do not know about the existence of relevant documents. For business processes, this bears the risk of making bad or wrong decisions by omitting potential relevant information. Corporate portals have to provide services that support the employees with the tasks of locating the right information either by providing suitable search service or offering sorted and edited link-directories for specific content domains.
- **Information selection**: Faced with information overload, information selection is a major challenge of today's knowledge workers. A lack in experience or domain knowledge makes it difficult for users to identify the relevant information from the results of a search query. This selection task can be supported by content areas that focus on specific domains of interest (e.g. research and development, finance, human resource support). For instance, domain experts and experienced portal users can provide and maintain FAQ-areas to support their less experienced colleagues. Users can rely on personalization service to build up their own areas of relevant information and services over time. Finally, by integrating personalized recommendation services the corporate portal can actively point out information that is of relevance to the users.[6]
- **Information usage**: Corporate portals can support information usage by facilitating one major task of knowledge workers: the meaningful processing of information retrieved

[6] For instance, recommendations services can rely on (automated) collaborative filtering mechanisms (cf. Goldberg, Nichols et al. 1992; Linden, Smith et al. 2003).

from heterogeneous information systems. A basic functionality of corporate portals (and Intranet web applications in general) is to enable a functional perspective on information that is accessible through the Intranet (Kaiser 2000, p.20). Corporate portals provide a single point of transparent access to the relevant information and can support time-consuming and error-prone data pre-processing activities like the aggregation of the data that was retrieved from different sources.

- **Distribution of information**: With Intranet, electronic mail, and instant messaging systems, the amount of time-consuming and expensive paper-based information distribution activities has been reduced significantly: information is instantly available throughout the corporate information network. Corporate portals further strengthen the notion of self-service introduced by the Intranet sites. Information self-service constitutes a fundamental shift compared to the traditional proactive distribution of information (cf. Kaiser 2001, p.20). The self-service distribution model enables information consumers to get the information when they need it, anytime and from anywhere. Moreover, the establishment of information self-service mechanisms contributes to release the information distributor of the burden to constantly monitor whether new or updated information has actually reached the target audience.
- **Information Quality**: The information quality is an important indicator of effective information management. Even if information systems and processes enable users to locate and retrieve the required information, it is the information quality that will determine the actual usage thereof. In literature, information quality is described through a variety of criteria including relevance, accuracy, ease of use, general usability, and presentation (cf. Jarvenpaa 1989; DeLone and MacLean 1992; Eppler 2003, pp.69-85). Corporate portals can support information retrieval and aggregation from corporate information sources, but will have no control over the actual quality of the external data provided. Hence, to uphold and improve the level of information quality, one has to focus on activities that have an impact on organizational aspects of information management. Corporate portals can improve external aspects of information quality (i.e. consistent presentation, aggregation and drill down, usability) but not the internal quality criteria (i.e. relevance, correctness and accuracy, trust).

In summary, one can conclude that the corporate portal takes the role of an intermediary for major information management activities (cf. Figure 5). As such, it offers the potential to simplify and improve the efficiency of existing information processes.

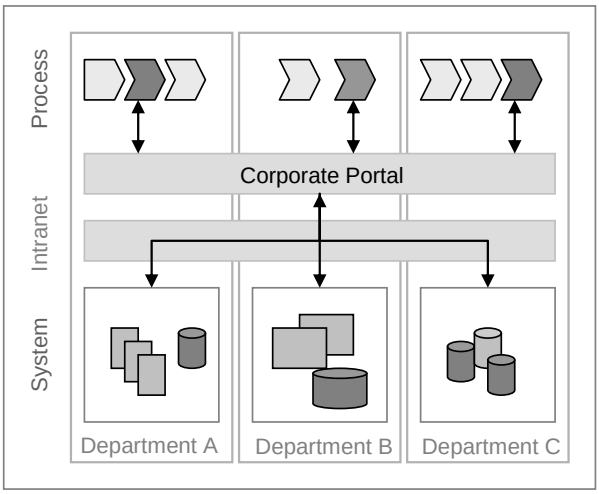


Figure 7 – Role of a corporate portal with regard to information management

2.5.2 Business Process Integration

By satisfying the key requirements of information management, corporate portals lay the foundations for improving the quality and efficiency of today's information driven business processes. In the course of further extending the scope of integration, from data and information to the integration of application functionality, corporate portals can contribute effectively to business process reengineering activities (cf. Edelman and Jussila 2000). The corporate portal fosters the business process level of integration as it can serve as a gateway to web-enabled services that expose application functionality to a broader group of potential end-users than it was originally designated.

Example 2.1: Expose Enterprise Application Functionality

The Bayer's Corporate Finance Center deploys and manages a central treasury management system. One facet of the system's functionality lies in the management of foreign exchange transactions that are closed between the corporate centre and the local entities. The system not only stores the information but offers further functionality including the valuations of these transactions.

This valuation is one example of a functionality that is of interest to a greater audience (i.e. the local subsidiaries) than just for the few selected persons that have access to the system. With the Corporate Financial Portal project, one objective was to identify functionalities of existing financial systems that are of greater interest like the one just described and provided the necessary preconditions to finally expose the functionality in form of a Web-based portal service. Using these portal services, the users have access to the functions anytime and from anywhere within the corporate information network, regardless of time and availability of their personal contact at the corporate centre.

In particular with regard to legacy systems, the long term goal of integration efforts is to build up a repository of detached business functionalities that facilitate the restructuring and development of new business processes. Again, the role of the portal is to host and expose the interactive elements of these redesigned processes. In this regard, the benefit from corporate portals constitutes from an additional degree of freedom with regard to business process redesign activities.

2.5.3 Collaboration, Communication and Coordination

Collaboration and collaborative processes can benefit from corporate portals through the deployment of portal services that facilitate communication and coordination within business processes. As employees can access portal services and information anytime and anywhere, corporate portals facilitate the communication between geographically dispersed employees. Further, by enabling the asynchronous execution of business processes, corporate portals help to reduce the coordination needs of the involved parties.

Example 2.2: Asynchronous Business Processes

The management of foreign exchange risks at Bayer requires geographically remote business entities to close hedging transactions with the corporate centre. Traditionally, this business process required the local financial manager to directly address the person in charge at the corporate centre.

With the introduction of the respective portal foreign exchange transactions services, the financial manager can now use this portal application to close valid transactions regardless of the availability at the corporate centre. In this sense, the corporate portals – or more precisely – the underlying concept of Web applications that are accessible anytime, anyplace on a 24/7 basis has enabled and facilitated the transformation of formerly synchronous activities to more flexible asynchronous activities while retaining the business requirements.

2.5.4 Limits of Corporate Portal Implementation

A quick glance at the benefits discussed so far, reveals why corporate portals are sometimes proclaimed as the “Holy Grail” for the company’s information management needs. They improve business processes, drive productivity, and foster community building while potentially providing companies with a distinct competitive advantage (Richter 2000, p.48). In particular business analysts and market research institutes argue that with such an information system at

hand, companies become more proactive, agile, competitive, and capable of executing better well-informed decisions (Dias 2001, p.285). A closer look at the proclaimed benefit reveals that there are limits to what a corporate portal is capable of.

While corporate portals can satisfy important needs of information management, there are still facets like the information quality that are subject to determinants beyond the portal scope. Moreover, business processes will not be "magically" improved just by the introduction of a corporate portal neither will portals guarantee the success of business reengineering initiatives. Collaboration, communication and coordination problems will not simply resolve just because the employees have yet another information system available. One has to realize that one primary role of the corporate portal is that of a catalyst for unlocking the benefits that originally arise from activities that are beyond the portal project scope like for example systems integration initiatives or activities of organizational restructuring (cf. Firestone 1999).

2.6 Chapter Summary

The aim of this chapter was to shed some light on the diffuse and sometimes confuse perception of the concept underlying corporate portals. In principal, corporate portals are Web portals that are applied in a business context and focus on the information need within a company's organizational limits. As such, they provide a single point of access to information, applications, services, and people that are of relevance to conduct business operations.

Following the evolution of Web Portals, the current corporate portal implementations offer services that go far beyond the rudimentary functionality of the basic Intranet sites. The scope of the functionality ranges from single-sign on and personalization, over workflow management and transaction services, to the support of collaboration and communication. As a consequence, the range of potential fields of applications that are associated with corporate portals constitutes for the variety of corporate portal definitions and descriptions found in literature and practices. To facilitate the understanding of these concepts this chapter developed a framework for categorizing the types of corporate portals according to the dimensions: content scope, network reach and business orientation. Furthermore, a critical reflection on the benefits from corporate portal implementations offered insights on the scope and boundaries of this information system concept. In this regard, the discussion outlined that corporate portals can foster information and knowledge management tasks, and facilitate business processes integration initiatives as well as collaboration and community building – but also stresses that some of the benefits that are attributed to corporate portal implementations in fact arise from activities that are beyond the actual scope of the project.

Establishing a profound understanding of the corporate portal concept is important for conducting a corporate portal project. Especially during the initial project analysis activities, this background will support the task of understanding and deriving the fundamental scope of a corporate portal implementation. In this regard, following the assessment of the main characteristics of corporate portals in this chapter, Chapter 3 moves the discussion towards the main topic of this work, the elaboration and development of methods that foster the engineering of corporate portals.

Chapter 3

Towards a Method for Engineering Corporate Portals

The design and implementation of *successful* corporate portals is a challenging task. According to a Gartner (2002) study on the success of corporate portal implementations, only ten percent of the respondents do consider their corporate portal initiative as a visible success. The analysts point out that in particular project management and organizational design facets are decisive factors for the success or failure of corporate portal initiatives.

Due to the wide range of potential fields of application, corporate portal implementations have to deal with a high variety of design parameters within the portal design scope that lead to a complex design problem (Amberger, Holzner et al. 2003, pp.801). Consequently, it is not surprising that recent discussions in literature and practice agree on the need for a systematic and structured approach towards the engineering of corporate portals.

In particular with regard to the complexity of corporate portal projects, the advantage of such an engineering method is that it offers a selection of models, techniques, and instruments that help to reduce and manage the project complexity while fostering the completeness and re-use of design and output-documentation throughout the project and beyond.

The goal of this chapter is to develop and discuss the main constituents of a method for the engineering of corporate portals. In this regard, Section 3.1 identifies the challenges, the design scope and the requirements which have to be addressed by a corporate portal engineering method. These requirements are applied in Section 3.2 to review relevant Web engineering and portal specific development approaches and frameworks. The literature review leads to the insight that there is a lack of methods to support the task of conducting a corporate portal project in a systematic and structured manner. Consequently, Section 3.3 proposes a method

for engineering corporate portals. The method is developed following an integrative approach that identifies, adapts, and develops corporate portal engineering models, techniques, and instruments with regard to the multidisciplinary project requirements. The method constituents are on the one hand theoretically developed and derived from a review of the relevant disciplines, on the other hand derived as best-practice solutions that have been developed in the context of the Corporate Financial Portal project.

The remainder of this chapter outlines the main constituents of the method including the engineering process model, an overview of the roles involved, and a brief discussion of the engineering stages and the relevant activities involved.

3.1 Scope and Requirements for a Corporate Portal Engineering Method

In order to motivate the need for a structured development method, the following section outlines a selection of major technical, functional, and organizational challenges of corporate portal implementations. These challenges have to be addressed by the respective design objects within the scope of a portal engineering method. The section concludes with a description of the main constituents of the portal engineering method. These are referred to in the subsequent literature review, as well as the developed corporate portal engineering method.

3.1.1 Challenges of Corporate Portal Implementation

A method for engineering corporate portals has to address the challenges that arise from the corporate portals fields of application and manifest in terms of technical, functional, organizational, and business requirements.

From a technical perspective, corporate portals share the general advantages and disadvantages of Web applications. While maintenance, versioning, and client-side installation issues are virtually nonexistent, corporate portals are subject to security and network attacks, unpredictable network behavior, the effects of system downtime, usage-load at peak-times, as well as browser compatibility issues that have to be considered within the design and implementation of the respective portal application components.

Integration is considered as one of the cornerstones of the benefits from a corporate portal implementation (cf. Chapter 2, Section 2.4). Yet, for the portal to foster transparent access to enterprise systems and business processes that are agnostic of the given organizational boundaries poses major technical and organizational implementation challenges, including the possible need to redesign corporate business process (cf. Figure 8).

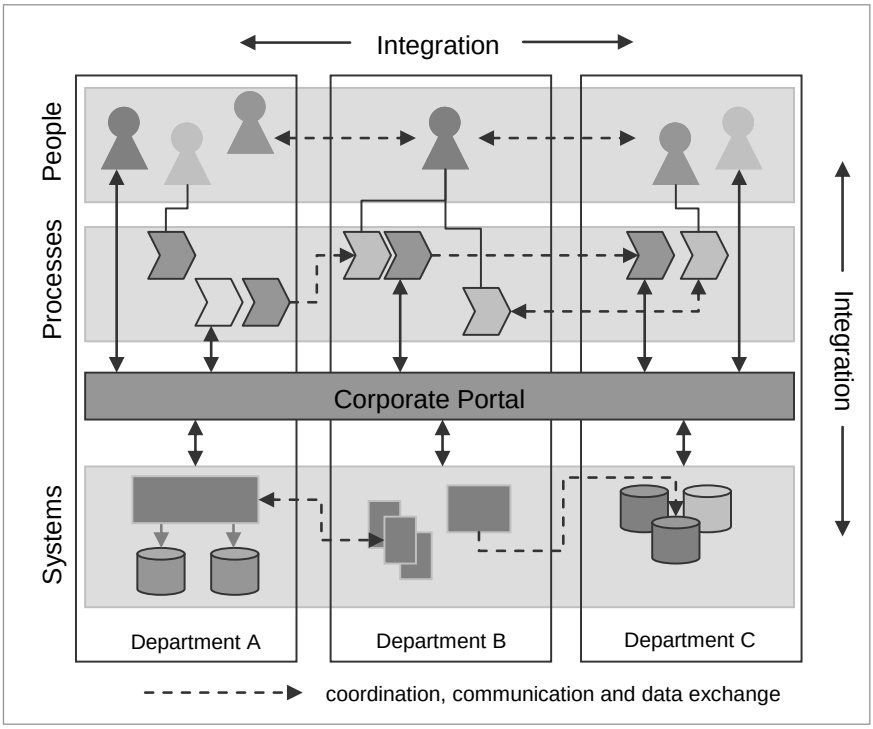


Figure 8- Scope of integration requirements in the context of corporate portals

Technically speaking, a corporate portal first and foremost provides integration on the presentation level, only. To enable integration on the process level, for example in order to enable the employees to execute business transactions using the portal, the portal has to rely on an existing integration architecture that provides the necessary means for accessing data and functions of the relevant enterprise information systems. This however is a challenging task, considering the amount and the variety of information systems that are usually present within a company's IT system landscape. A good example that points out the challenges of system integration are reports from integration initiatives conducted in the financial industry (e.g. Vo et al. 2003; Weitzel et al. 2003).

From an *organizational* perspective, corporate portals have to integrate organizational structures, people, and business processes that are dispersed across the company. Corporate portals shall address people of every background and thus should consider computer literacy, job expertise, and possible cultural differences. Consequently, the design decisions on main characteristics of the corporate portal services will depend upon the question whether the portal focuses on the needs of a specific group of users or shall address a wider scope of users with content that is of general interest to all employees. In the first case, portal services can be tailored to the specific demands of the known target audience and provide more specific functions. In the latter case, the design of the portal services has to consider the requirements of a broader, unspecified audience. In this sense, one has to develop solutions for the design of the

different views on the portal services depending on the current user's business background (Terra and Gordon 2003, p.161). This may result in differences on the navigation level but can also drill down to differences on the service level, with services offering personalized input and output-options, depending on the actual user's profile. Hence, the challenge stems from deriving a reasonable level of personalization on the portal, as well as on the level of the portal services.

Aside from the different levels of integration that need to be addressed by a portal implementation, further challenges arise from the wide range of potential fields of application (cf. Chapter 2) and from the large number of portal services. While the range of potential fields of application require the portal project team to identify and focus on those that are of relevance in the actual project context, the portfolio of portal services has to be aligned according to the project objectives in addition to the management and maintenance efforts required by each service (cf. Amberger, Holzner et al. 2003, pp.801).

The discussed challenges are not exhaustive but a selection of commonly discussed requirements of corporate portal implementations.[7] Further requirements will arise from the actual field of application that is distinct for every portal implementation. Section 3.1.2 outlines the corporate portal design objects that need to satisfy these requirements.

3.1.2 Design Scope of Corporate Portal Projects

A prerequisite for a discussion on an engineering method is to define the design of the relevant design objects of a corporate portal implementation. The embodiment of these design objects is subject to a range of technical, functional, organizational, and business requirements as defined by the actual project context.

From a technical perspective, the *application architecture* defines the fundamental portal application components, their functionality and interaction. The *integration architecture* describes interfaces as well as integration strategies and patterns that facilitate the technical and organizational integration requirements of a corporate portal implementation. Finally, the information management requirements and the design of the different views on the corporate portal are addressed by the design of the *information architecture* components.

[7] The reader is referred to Großmann and Koschek 2005 for a comprehensive discussion of functional and technical requirement on corporate portal implementations.

3.1.2.1 Application Architecture

Generally speaking, the application architecture describes the logical, functional perspective on information system architecture (cf. Kaiser 2000, p.28). The application architecture comprises the description of the main software components, as well as their relationships and interactions that support the required application functionality. In this sense, the corporate portal application architecture has to describe the components that are necessary for the support of the core portal functions as outlined in Chapter 2.4. Moreover, the application architecture of the individual portal services has to further address specific functional requirements that stem from the actual business purpose of the portal service.

3.1.2.2 Information Architecture

For corporate portals, the design of the information architecture has to establish an information space that facilitates task completion and access to information content (cf. Rosenfeld and Morville 2002, p.4). Thus, an effectively designed information architecture helps the portal users to find and organize the relevant pieces of information. The main constituents of an information architecture are information concepts (e.g. knowledge networks, information seeking behavior) and the systems the support these concepts, like for example navigation systems or search systems (Rosenfeld and Morville 2002, p.12-15). A well designed information architecture aligns the content with regard to the underlying business context, and makes it accessible to the users in a comprehendible and consistent manner. For corporate portals, the information architecture consists of the navigation architecture, elements of UI design and content layout with regard to user information processes, the description and implementation of information processes that facilitate information search, personalization mechanisms, and virtually any concept that is necessary to reduce the user's information management efforts.

3.1.2.3 Integration Architecture

Strictly speaking, the integration architecture is not a design object that is within the scope of a corporate portal implementation. Yet, integration is one of the major topics within the discussions on corporate portals (cf. Davydov 2001; Puschmann 2003; Puschmann and Alt 2004). In the context of corporate portal implementations, the integration architecture provides a description of the integration strategy and the instruments that are necessary to enable the portal services to access the functionality and data of the underlying enterprise information systems. Furthermore, the design of the integration architecture has to satisfy the flexibility and extensibility requirements with regard to future integration requirements.

3.1.3 Methodological Constituents

With regard to the literature, there is no clear definition on what constitutes a system development methodology (cf. Wynekoop and Russo 1995). There is even a debate on the correct use of the term *method* in favor of the term *methodology*. This work will not further add to this discussion, but follows Wynekoop and Russo's understanding of a system development method as a method that comprises the "…analysis, design and implementation of not only the software but at least some part of the system in which it exists…"(Wynekoop and Russo 1995, p.66). A method is defined as a systematic approach to conduct at least one phase of software development and consists of guidelines, activities, techniques, and instruments with regard to the target system.[8] In this regard, techniques are referred to as specific steps for conducting a portion of a phase of software development, while a software development process model is regarded as a representation of the sequences of stages that are traversed during development.

In the context of this work, a method for the engineering of corporate portals is a systematic approach that describes the sequence of the main stages of the portal development process including the description of the involved roles, activities, and techniques necessary to produce the output deliverables. Such deliverables within the design scope of a portal engineering method are the application architecture, the information architecture, and the integration architecture that have to satisfy the corporate portals specific implementation requirements.

3.2 Review of Current Frameworks for Engineering Corporate Portals

The following literature review focuses on general Web engineering and portal-specific development approaches. The methods are reviewed according to the methodological requirements defined in the above section, that is whether and to what degree they describe a development process model and address the portal specific design object within their elaborations. The goal of this literature review is to analyze the strengths and weaknesses of these methods and to use the insights as an important input and foundation for the portal engineering method developed in Section 3.3.

3.2.1 Web Engineering Development Methods

Web engineering is a discipline that emerged in the late 90s following the Internet revolution and the increase of applications developed for this medium. In order to foster the development and maintenance of high quality Web-based system and applications as well as to address the

[8] Overall, this definition also complies with that of the method engineering branch of research that focuses on deriving system development methods following a structured research process (cf. Gutzwiller 1994).

steady growth of Web application complexity (cf. Figure 9) Murugesan, Deshpande et al. (1999) proclaimed the need for a Web engineering.

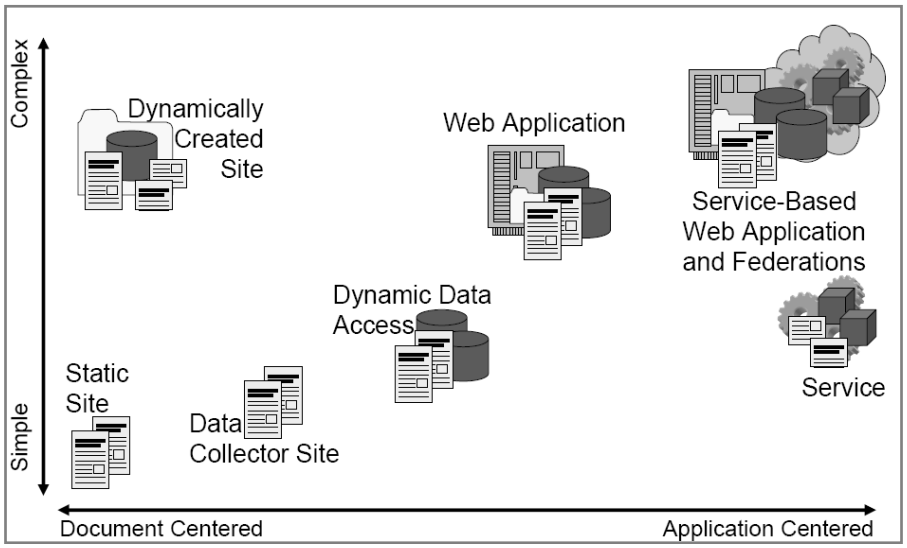


Figure 9 - Growth in functionally and technical complexity of Web applications (following Powell 1998, p.26; cf. Gaedke 2005)

Web engineering distinguishes itself from the traditional discipline of software engineering as aspects like software evolution, hardly predictable network behavior, heterogeneous and usually unknown end-users with different cultural background are of greater importance when developing applications for the Web (cf. Powell 1998; Deshpande, Murugesan et al. 2002).[9]

Definition 3.1 – Web Engineering

> *Web engineering is the application of systematic, disciplined, and quantifiable approaches to the design, production, deployment, operation, management and evolution of Web-based software products.*(Deshpande, Murugesan et al. 2002, p.3)

The focus in the following is on the assessment of Web engineering development methods that are of relevance for the development of corporate portals. These development methods build upon traditional software engineering process models like the waterfall model, evolutionary prototyping with joint application development (JAD) and extend those with aspects that are of importance for Web applications including dedicated UI design phases and a stronger emphasis on evolutionary software development.[10] The following discussion reviews the WebComposition method and the Web Site Engineering method with regard to their contribution and applicability on the development of (corporate-) portals.

[9] Grüne and Kneuper 2002 have composed an overview of references on the main Web engineering topics.
[10] For an overview on Web Engineering process models refer to Powell (1998). Coldewey 2002 provides an introduction to agile development methods in the context of Web engineering.

The WebComposition method proposed by Gaedke (2000) emphasizes the aspect of reuse in web application development and applies component-based software development concepts in Web engineering primarily. According to this approach, Web applications consist of service components (e.g. Web services) that are reused in subsequent service evolution cycles (spirals). A service evolution cycle can be described through a (simplified) three stage process that consists of evolution analysis, evolution design and evolution realization (cf. Gaedke and Turowskib 2001). Especially with regard to the current discussion on service oriented architectures (e.g. Bieberstein, Bose et al. 2006) and the fact that, from a technical perspective, portals are component-based Web applications, the central ideas of this method fit especially well to a technical perspective on the portal application framework specification, modeling and implementation.

With the Web Site Engineering (WSE) method Schwickert (2000) proposes a system engineering framework that addresses the technical and the business perspective of the development of Web applications. The WSE process model comprises the following three stages: Web Application Requirement (WAR), Web Application Design (WAD) and Web Application Online (WAO). For each stage, Schwickert (2000) defines the necessary activities, required output and gives examples of best practices. The stages also include Web application specific tasks like the UI and navigation design when appropriate. One strength of the model is that it considers the Web site operation and controlling as a separate stage during the web application lifecycle. Yet, although the framework considers the technical perspective within the WAD stage, the author focuses on the business perspective while omitting a discussion of design and implementation issues that are of relevance for Web applications in general.

In summary, the Web engineering discipline provides a foundation of methods and instruments for the general Web application related facets of engineering corporate portals. Clearly, the methods need to be extended and adapted to address the distinct functional and organizational requirements of a corporate portal implementation. Actually, the Web engineering discipline currently adds only little to the discussion on the particular requirements of developing Web-based information systems in a corporate context.[11] Consequently, the following section reviews Intranet and corporate portal specific development frameworks.

[11] The assessment of the past contributions for the Journal of Web Engineering (http://www.rintonpress.com) as well as for the International Conference on Web Engineering ICWE, shows that currently there is only little discussion on the methods and instruments to satisfy the corporate requirements on Web engineering.

3.2.2 Intranet and Corporate Portal Specific Engineering Frameworks

The evaluation of the literature and publications available on the topic of corporate portals identifies a large number of the contributions focus on the elaboration of how a corporate portal implementation can contribute to achieve certain business needs. In this sense, Collins (2001) and Terra and Gordon (2003) focus on the role of corporate portals in the context of knowledge management, Davydov (2001) addresses the aspect of e-business integration and provides a management level discussion on the corporate portals. Vo, Glaum, and Wojciechowski (2007) describe the application and business impact of a corporate portal implementation on the processes and organizational structure within the financial department of a multinational corporation. Aside from the business level discussion on corporate portals, there is literature that addresses the technical aspects of implementing corporate portal applications (e.g. Bellas 2004; Bellas, Fernández et al. 2004). Yet, there currently exist only a few contributions that focus on the methodological support of conducting corporate portal projects. A selection of these is reviewed in the following.[12]

Kaiser (2000) presents a method for the conceptual design of Intranets. The method elaborates on the analysis and strategy stage as well as key aspects of the information architecture and application architecture design. The method is relevant for the discussion of corporate portal engineering as the corporate portal is the natural evolution of the Intranet concept. Kaiser's discussion on the organizational impact, information architecture and security of the Intranet can be adapted for the engineering of corporate portals. Of course, the method lacks the discussion of portal specific aspects. Furthermore, Intranet operation, controlling and evolution are beyond the scope of this method.

Finkelstein and Aiken (2000) propose a framework for engineering enterprise portals. They especially focus on the design and implementation stage and illustrate how to implement a corporate portal from a technical perspective. The discussion centers around methods for data transformation and data modeling that facilitate the integration of structured and unstructured data. The framework does not discuss the business perspective of corporate portal initiatives. Further, integration on the process and the organizational level is not addressed, due to the limited perspective on the enterprise portal's field of applications.

Alt et al. (2004) elaborate a method for the development of process portals (cf. Chapter 2, Table 1, p.17). According to their definition, process portals are enterprise portals that espe-

[12] However, as of Sept. 2006 there are only a handful of methods discussed for the systematic development of corporate portals. Thus, the set of methods and approaches presented in this section represent the current state-of-the-art.

cially focus on the integration of (external) customer processes and facilitate the collaboration between enterprises, customers and suppliers. Following the method engineering approach (Gutzwiller 1994), their process portal framework focuses on the portal strategy, portal design and portal technology stage. The authors define input and output requirements of the individual stage, roles and further present methods and best-practices to accomplish the required output. The authors do not discuss portal implementation, introduction, operation and controlling. Further their costumer oriented perspective of process portals limits the application of their method toolset on corporate portals. This is especially true for the discussion on the strategy stage that comprises methods like the analysis of the external business network and competitive portal products that clearly are of secondary importance in a corporate portal scenario that focuses on internal processes.

The Frauenhofer IAO portal analysis and design method PADEM follows the stages of a traditional software lifecycle: the definition of the strategy, subsequent requirement analysis, conceptual design, realization, and the introduction of the portal (Gurzki, Hinderer et al. 2004). For each stage, the method defines checklists, questionnaires and offers practices that support companies in their portal selection and decision process and guide them through the portal implementation. PADEM focuses especially on providing guidance for the initial development cycle of a portal implementation while taking a consulting and management level perspective on the heterogeneous decision problems. The operation of the portal is not explicitly covered by the framework, while the technical perspective on portal implementation is covered with respect to external portal integrators.[13]

Amberger et al. (2003;2004) describe a portal engineering process that consists of five stages: requirement analysis, profitability analysis, detailed analysis of users, business processes and corporate IT, proof of concept prototyping, iterative evolution. As their work serves as an overview and motivation for a portal engineering discipline it lacks a detailed discussion of the individual stages. In a current work, Remus (2006) further describes the portal engineering process from the portal integrator's perspective. Again, the engineering process model is based on existing process models for introducing component based software packages and consists of the following five stages: analysis, design, implementation, introduction and evolution. There is no further discussion of the individual stages, but the work focuses on evaluating critical success factors that are important within the individual stages.

[13] The review of the method is based on the publicly available documentation that provides only a brief overview of the method constituents, thus the review results in Table 2, p. 39.

3.2.3 Summary

Table 2 offers an overview of the Web and portal engineering frameworks and methodologies discussed so far. The assessment of the frameworks is based on the methodological portal engineering constituents as outlined in Section 3.1.3.

Table 2 - Overview on frameworks and methodologies for engineering corporate portals

		Engineering Process Model					*Methodology*			*Portal Specifics*		
		Analysis & Strategy	Design & Implementation	Introduction & Rollout	Operations, Evaluation & Controlling	System Evolution	Roles & responsibility	Output deliverables	Techniques and activities	Application architecture	Information architecture	Integration architecture
Web Engineer.	WebComposition Method ***Gaedke 1998, 2005***	○	●	○	○	●	○	○	●	○	○	○
	Web Site Engineering ***Schwickert 2001***	●	○	●	◑	○	●	●	●	○	○	○
Intranet & Portal specific frameworks	Method for the conceptual Design of Intranets ***Kaiser 2001***	●	◑	○	○	○	●	●	●	◑	○	○
	Engineering Enterprise Portals ***Finkelstein and Aizen 2000***	◑	◑	◑	○	○	○	◑	◑	◑	○	◑
	Method for Process Portals ***Alt et. al. 2004***	●	●	◑	○	○	●	●	●	◑	○	◑
	Frauenhofer IAO PADEM ***Gurzki, Hinderer et al. 2004***	◑	◑	◑	◑	◑	◑	◑	◑	●	○	○
	Portal Engineering ***Amberger, Holzner et al. 2003***	◑	◑	◑	◑	◑	◑	○	○	○	○	○

● comprehensively covered ◑ some aspects covered and briefly discussed ○ not covered

The Web Site Engineering framework is well suited as a general framework for engineering portals. Yet, it does not accommodate for the notion of component based evolution that currently is not only important with regard to portals, but also to web applications in general. Furthermore, as a generic model for the development of Web sites it has to be tailored in order to accommodate for the portal specific design facets (e.g. design of the information architecture, different views on one and the same portal).

The method for the conceptual design of Intranets takes a role in between the generic Web engineering approaches and the corporate portal specific methods. As Intranets (i.e. Intranet sites) are precursors of corporate portals and corporate portals rely and extend the potential of

the Intranet (i.e. network) (cf. Chapter 2; Section 2.5.1) the method offers valuable insights that can be transferred to the engineering of corporate portals. This is especially true for the elaboration on the activities for the initial business analysis of the Intranet development.

With regard to the corporate portal specific approaches, none of the current approaches address the portal engineering lifecycle as complete as does the Web Site Engineering framework. The "method for developing process portals" and the PADEM framework currently are the most comprehensive (published) portal specific development approaches. However, both methods do not explicitly address the aspects of managing portal operations and portal controlling after the initial system roll-out. Further they elaborate the portal specific design facets like personalization and its impact on UI and layout design, information architecture and the role of system evolution only on a side note.

Consequently, there is the need for a theoretical founded method that fosters the systematic development of corporate portals. Such a method is developed and described in the following sections.

3.3 A Method for Engineering Corporate Portals

The method for engineering corporate portals consists of an engineering process model that emphasizes the facet of three distinct levels of portal evolution cycles and is elaborated in Section 3.3.1. Furthermore, Section 3.3.2 describes the major roles involved in the engineering process and outlines their relationships. Section 3.3.3 offers a brief overview of the individual engineering stages with regard to the corporate portal specific requirements.[14] Finally, Section 3.3.4 outlines the role of controlling stages within of the corporate portal engineering process.

3.3.1 Corporate Portal Engineering Process Model

Adapting the general software lifecycle (cf. Royce 1987; Sommerville 2004, p.66) Figure 10 depicts the portal engineering process model as developed in the context of this work. The model consists of the portal business alignment, the portal development, the portal introduction, and the portal online stage. Dotted lines represent stage transitions while solid lines illustrate feedback relations among the engineering stages. Note, that in contrast to the traditional cascading software development process, the portal engineering process allows for a transition from the portal online stage to the portal development stage to address minor changes and developments during a major evolution cycle. Furthermore, backward transitions between the

[14] For a more detailed discussion of the individual engineering stages refer to the chapters 4 – 8 respectively.

portal business alignment, the portal development, and the portal introduction stage are costly (e.g. as the sign-off processes need to be repeated), thus should be avoided.

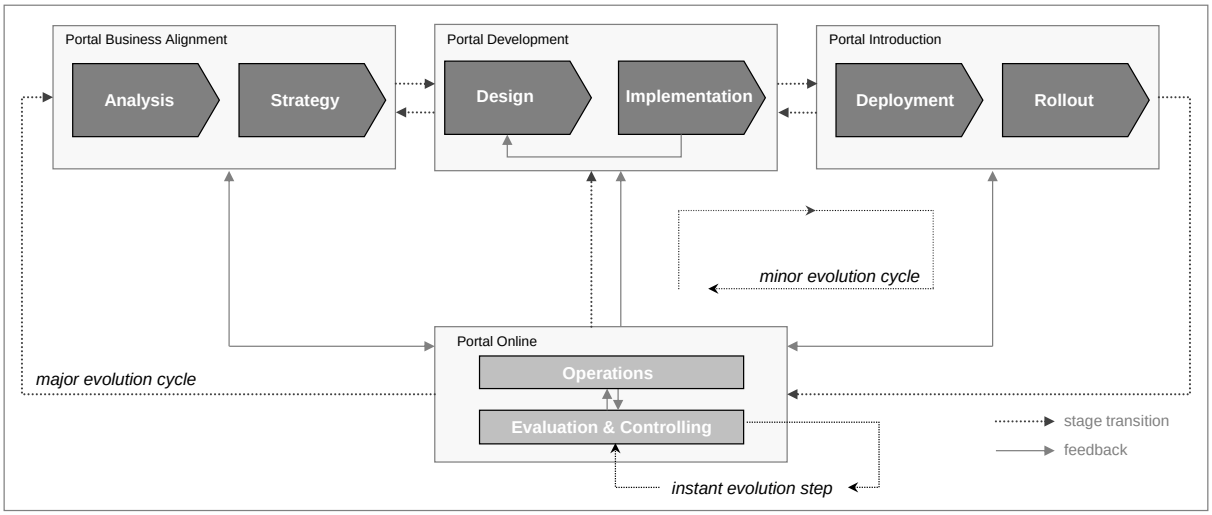


Figure 10 - A portal engineering process model (following Vo and Elsner 2007, p.343)

At the initiation of every corporate portal initiative stands the *portal business alignment* stage that comprises the requirement analysis phase, and the definition or refinement of the corporate portal strategy according to the primary business objectives.

The strategic guidelines provide the necessary directions for the subsequent *portal development* stage that focuses on the design and implementation of the portal components and services. The design and implementation activities are closely related to each other as the majority of portal components and services are designed and implemented following an iterative approach that tightly incorporates the feedback of users involved in the development process.

The *portal introduction* stage consists of the deployment (i.e. installation) of the current portal implementation and the subsequent rollout activities that are necessary to introduce the new development to the primary target users. The rollout activities include the preparation and conducting of end-user training, as well as promotion activities the likes of workshops or product demonstrations.

After the corporate portal implementation has completed the roll-out activities, the *portal online stage* focuses on those tasks that are necessary to uphold the portal operation. These include system maintenance, management, configuration, and support activities on the general portal level as well as for the individual portal services. Furthermore, the portal online stage comprises project controlling and evaluation activities. The evaluation activities focus on the assessment of the state of the corporate portal implementation as well as the business impact

of the portal project with regard to the primary project objectives. The results are the basis for subsequent project controlling activities.

Additionally, one important task within the portal online stage is the identification, evaluation, and management of user feedback and change issues that have been collected during the operation of the portal. According to the type and content of the collected feedback and change issues, the controlling activities will either directly address the feedback or minor change issues within the current portal configuration and development activities or aggregate more complex issues as input for the next major portal evolution cycle. Consequently, the model addresses system evolution on three levels of magnitudes (cf. Figure 10):

- Firstly, there are the *major evolution-cycles* that require a thorough traversing of the engineering process from the refinement of the portal business alignment to introduction of new or extended portal service components.
- Secondly, *minor evolution cycles* that are traversed within a major evolution-cycle allow for the immediate processing of bug-fixes and manageable feature requests for existing portal components and services.
- Finally, there are *instant evolution steps* that reflect changes to portal level elements like the navigation structure or content layout that can be instantly addressed during the portal operations by modifying the relevant portal configuration settings.

In principal, the management of the portal evolution cycles follows the concept of traditional software evolution cycles that consists of the change identification, the change proposal, and the evolution process in order to derive a new version of a software system (Sommerville 2004, p.499). However, Figure 11 illustrates that the management of portal evolution is more complex as it has to address these evolution cycles on the portal level as well as on the individual portal services level.

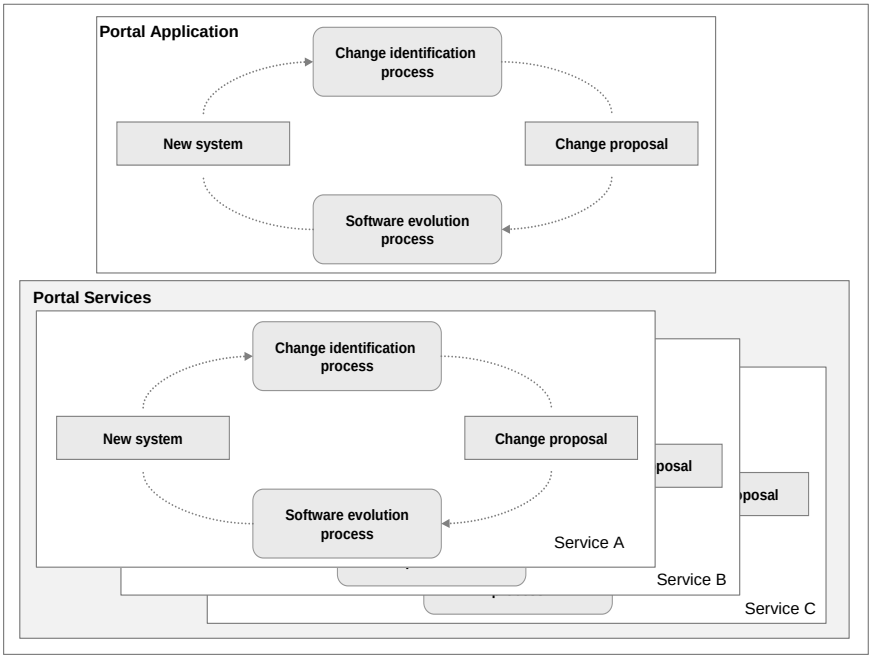


Figure 11 – Two levels of portal evolution management
(the software evolution cycle is adapted from Sommerville 2004, p.499)

Moreover, the existence of minor evolution cycles and instant evolution steps outlines the dynamic characteristics of corporate portal evolution that needs to be addressed by a respective portal evolution management framework in order to foster substantial portal evolutions (cf. Vo and Elsner 2007). Hence, the portal project team has to define processes and establish instruments the foster the tasks of aggregating, maintaining, and categorizing the catalogue of collected feedback and change issues. These instruments will support the definition of appropriate packages of change proposals to appropriately address the different levels of portal evolution.

3.3.2 Project Roles and Relationships

The relevant roles within a corporate portal project are the decision makers (i.e. project executives), the portal project manager, the portal engineers, the staff of the corporate IT department and the users. Furthermore, the portal engineer can get support and services from external portal and portal service suppliers.[15] Note, that in this work the portal engineer represents a group of people that are experts in different domains and disciplines that are required within the different project stages (e.g. information architects, web engineers, usability experts, etc.). For the purpose of a clear reference, these experts are commonly addressed as portal engineers throughout the course of this work. Figure 12 describes the relationships among the roles that are involved in a corporate portal project.

[15] The external perspective on portal players within the portal supply chain is covered by Amberger, Holzner et al. (2003). The focus of this work is on the internal, corporate perspective.

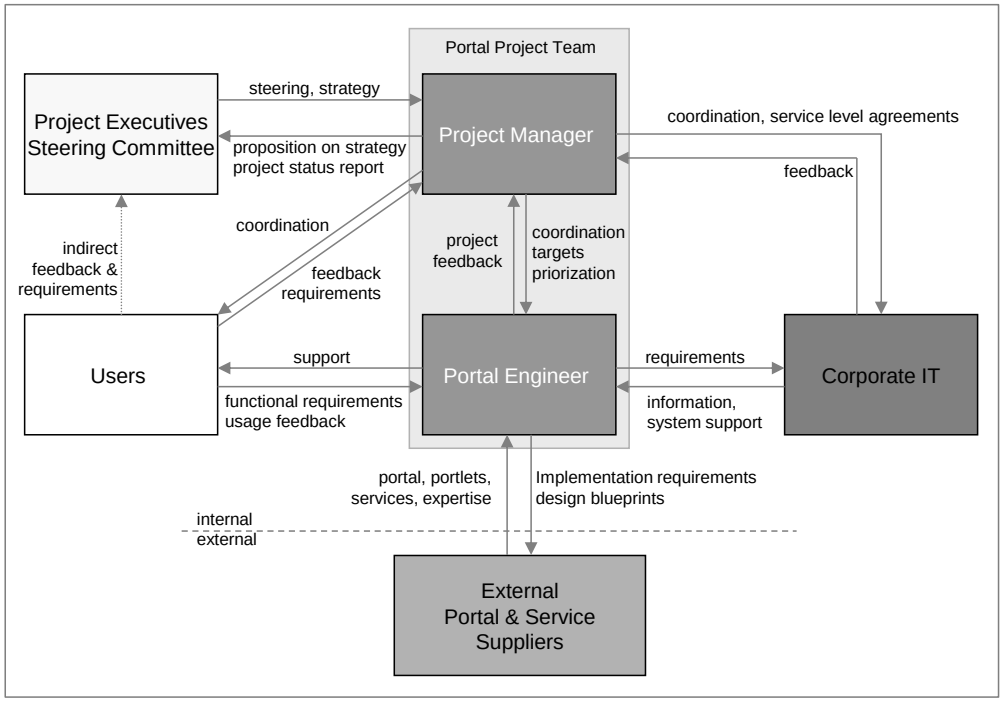


Figure 12 - Portal engineering roles and relationships

Corporate portal initiatives cause structural changes in the organization of the affected corporate domains. In order to guarantee the acceptance and success of the project, the support of high level management of these domains is essential (e.g. Remus 2006, p.5). Therefore, members of the high level management should be selected as project executives and further constitute a democratic steering committee for the purpose of project governance. This steering committee decides on the strategic direction and defines the mid and long-term targets of the corporate portal initiative. Moreover, the steering committee has to evaluate the project status on a regular basis and determine further actions (cf. Chapter 4).

The portal project manager reports to the steering committee and holds the responsibility for the success of the project. In this regard, he directly reports to the project executives. Moreover, the project manager has to manage and coordinate the actions of the portal engineers, the corporate IT department and key portal users.

The portal engineer is responsible for the system design and implementations. He receives functional requirements for new or existing portal services from the end-users and provides support when needed. From a technical perspective he works closely together with the corporate IT department that maintains the portal servers and provide necessary technical background on the relevant enterprise information systems.

Table 3 offers an overview on the roles and their responsibilities within the different portal engineering stages.

Table 3 – Roles and responsibilities with regard to portal engineering process stages

	Business Align.		Development		Introduction		Online	
	Analysis	Strategy	Design	Implementation	Deployment	Rollout	Operation	Evaluation & Controlling
Decision Makers	◑	●	○	○	○	○	○	◑
Project Manager	●	●	◑	◑	◑	◑	◑	◑
Portal Engineer	●	◑	●	●	●	●	●	●
Corporate IT Staff	◑	○	●	●	●	◑	●	◑
Portal Users	◑	○	●	◑	◑	●	◑	◑

● active involvement ◑ partial involvement ○ not directly involved

The decision makers are involved in the strategy phase and decide on the portal strategy, the project status and the main project objectives. The design and implementation stages are carried out by the portal engineer in cooperation with corporate IT department. Selected user representatives specify functional requirements for portal services that are in development and provide important feedback during the subsequent prototyping phase. The deployment and rollout is managed by the portal engineer in cooperation with the corporate IT department. Portal users that are direct stakeholders of newly developed services will be involved in the deployment procedure for the purpose of final test and implementation sign-off. User representatives will assist the portal engineer in preparing the training sessions for new portal services. During the portal operation and controlling stages, the portal engineers and the corporate IT department provide system support and maintenance, while the users provide important feedback for the project evaluation and subsequent controlling.

3.3.3 Portal Engineering Stages

The subsequent sections offer a brief overview on the activities of each of the portal engineering stages. These sections are synthesis of theoretical discussions and the generalization of the main lessons learned through the case study insights. The reader is referred to the respective chapters in the remainder of this work (Chapter 4 to 8) for a detailed elaboration of the individual stages.

3.3.3.1 Portal Business Alignment Stage – Analysis and Strategy

The portal business alignment stage consists of the requirement analysis and the subsequent definition of the portal strategy. With regard to the elaborations in Chapter 2, it is important for the success of the activities within this stage to have a clear understanding of the core fa-

cets of the corporate portal initiative. Questions that have to be addressed in this context include the definition of the portal reach (i.e. corporate vs. domain specific), the specification of the primarily field of application (e.g. process vs. knowledge management vs. collaboration focus), and finally the specification of the package of portal services that shall be implemented within the current portal engineering process cycle.

Consequently, in the front- run of the strategic decisions, one has to conduct a detailed requirement analysis that identifies the benefits and business potentials of the portal initiative and derives a sound business case for the corporate portal project. For the success of the corporate portal project it is essential to align the strategic project decisions according to the overall company's business goal.

Moreover, one critical success factor within this stage is that the decision makers and project executive need to understand the evolutionary nature of a corporate portal initiative. Unlike the introduction of more traditional enterprise information systems, corporate portals can address such a variety of possible fields of applications that it is impossible to implement a corporate portal solution that immediately covers every aspect of the "wish-list". The success of a portal initiative is in particular driven by the users that have to understand the underlying portal philosophy through working with the system. Once this is achieved, these users will raise new ideas and sound change proposals that might be beyond the initial concepts specified by the portal engineering team.

In this context, the selection of the portal services that are to be implemented and deployed with the initial corporate portal implementation is one important foundation for the acceptance of the corporate portal implementation. The key is in the selection of the services according to the results of the requirement analysis. It is crucial to first focus on simple, but useful services that provide users with a clear business benefit to attract users instead of trying to overwhelm them with functionally loaded services that are hard to comprehend.

In the subsequent portal engineering cycles, the role of the business analysis phase will shift towards the controlling of the project success in terms of evaluating business impact and acceptance of the portal services, as well as the refinement of the portal strategies to accommodate for future business requirements.

3.3.3.2 Portal Development Stage – Design and Implementation

The portal development stage comprises the design and the development of the corporate portal components and the specified services. With regard to the design, the challenge lies in the customization of the primary portal design areas according to the project requirements. These

design areas consist of the corporate portal application architecture, the integration architecture, and the information architecture as described in Section 3.1.2.

Once the design facets of a corporate portal component are described and agreed upon, it has to be implemented. The use of software development process models can support the actual implementation tasks. Yet, the selection of a suitable development model depends on the characteristics of the actual component that is to be developed. With regard to corporate portals, there are basically two categories of components: internal portal components that for example address security, or administrative functions and are not directly subject to broader user interaction, and portal service where the opposite holds true. While in the first case, a structured software development process is appropriate, the development of the latter will benefit from an incremental development model with direct user-involvement.

3.3.3.3 Portal Introduction Stage – Deployment and Rollout

The portal introduction stage consists of the deployment of the corporate portal implementation and the subsequent rollout activities to introduce and announce the new developments to the end-users. The portal engineers and the staff of the corporate IT department work closely together during deployment of the new corporate portal implementation on the productive Web server that hosts the portal application. One key requirement is that the deployment of new corporate portal versions shall have as little negative effect as possible on the people working with the portal. To satisfy this premise, one has to determine appropriate time-frames for the system deployment activities. Furthermore, the deployment procedure must be clearly communicated and documented by the persons in charge and there has to be a procedure to return to a previous version, in the case critical problems are encountered during or after the deployment.

The embodiment of subsequent rollout procedure is subject to the magnitude of changes that were introduced with the latest deployment. A “silent” rollout accompanies minor changes e.g. bug-fixes or secondary functional extensions as it is usually the case of minor evolution cycles. In this case, it will be sufficient to focus the rollout activities on those users that are immediately affected by the changes. On the other hand, the introduction of new portal services may require more elaborative rollout activities the likes of dedicated end-user training sessions, workshops, and product presentations. In this regard, a central role is assigned to the users that have been involved within the portal service development stage. These users should be integrated into the rollout activities, and furthermore be assigned to provide functional support for their colleagues during the introduction phase and beyond.

From a technical perspective the newly introduced services have to be given special attention concerning their behavior within the live-environment. Hence, special attention has to be on facets like possible security holes or adverse performance impact caused by concurrent portal services.

Finally, portal promotion activities are important in order to announce the availability of new developments and maintain a level of awareness of the system. Successful portal promotion keeps users interested in the idea of the corporate portal and supports the overall system acceptance. Portal promotion is carried out on the basis an appropriate mixture of the promotion instruments like workshops, cross-links on other Intranet sites, or newsletter campaigns.

3.3.3.4 Portal Online Stage – Operations, Evaluation, and Controlling

The management of the corporate portal operations is one crucial cornerstone of the portal online phase. The primary objective is to establish processes and instruments, as well as define responsibilities that from a functional and technical perspective guarantee the proper operation of the corporate portal and the incorporated services. With the potential large number of portal services it will make sense for the portal project team to "outsource" functional management responsibilities (e.g. content management, service level user-management) to selected users and domain experts who themselves will benefit from the users' acceptance of the respective portal service.

On the other hand, the portal online stage is characterized by the evaluation activities that are necessary for a portal project controlling. In general, the evaluation activities should address three distinct, but interrelated perspectives: the business impact perspective, the systems usage perspective, and the user acceptance perspective. Consequently, the evaluation will have to incorporate quantifiable (e.g. Web server logs) as well as qualitative (e.g. interviews, user surveys) data sources for the generation of the relevant controlling reports.

The controlling reports will be presented and discussed at the meetings of the steering committee. In this regard, these reports will provide important insights for the refinement of the strategic decisions of the subsequent portal engineering cycles.

3.3.3.5 Summary of the Tasks and Activities of the Portal Engineering Stages

Table 4 shows the main tasks and activities of the portal engineering stages as discussed in the sections above. Furthermore, the table provides a non exhaustive selection of output results for each of the portal engineering stages.

Table 4 - Tasks, activities, and output results for the stages of the corporate portal engineering process

Stages	Tasks & Activities	Output
Portal Business Alignment Stage Analysis & Strategy	Business & Requirement analysis	▪ List, map of key processes ▪ Map of IT landscape ▪ List of business requirements and identified goals ▪ Project value proposition letter
	Assessment of technology & business potential	
	Identify of key business requirements	
	Define business cases and business goals	
	Define portal strategy	▪ Documentation of - short-term strategies - mid-term strategies - long-term strategies
	Align and define set of portal strategies - short-term strategies - mid-term strategies - long-term strategies	
	Project governance	▪ Project direction ▪ Business targets ▪ Sign-off of mid-term strategy (portfolio of portal developments)
	Verify, agree on project targets	
	Agree upon project direction project milestones	
Portal Development Stage Design & Implementation	Design of portal components & portal services	▪ Documentation of requirements ▪ Blueprints of - Application architecture - Information architecture - Integration architecture
	Gather detailed requirements for portal & services	
	Design portal application architecture	
	Design information architecture	
	Design integration architecture	
	Implementation of Portal Components and Services	▪ Working portal components ▪ Working prototype of portal service ▪ Documentation of implementation results, application functions
	Implement evolutionary prototype	
	Tests	
	Approve prototype	
Portal Introduction Stage Deployment & Rollout	Deployment of portal/portal applications	▪ Change protocol & Documentation of deployment process ▪ Sign-off documentation ▪ Working installation of new corporate portal implementation
	Define deployment process & fallback strategy	
	Deployment of new portal version	
	Final sign-off of new developments & going live	
	Rollout	▪ Load test on life system ▪ Rollout planning ▪ Promotion activities (Emails, Newsletters, etc.)
	Supervise developments under real-life conditions	
	Define rollout activities	
	Promotion of new developments	
Portal Online Stage Operation, Evaluation & Controlling	Operations	▪ Support plan, responsibilities ▪ Process for tracking of issues during portal operation ▪ Maintenance reports
	Provide portal support	
	Portal maintenance	
	Portal management	
	Evaluation	▪ Controlling reports for subsequent project steering (Portal Business Alignment Stage)
	Evaluate business impact	
	Evaluate system usage	
	Evaluate user acceptance	
	Controlling	▪ Change issues, design and development guidelines
	Process evaluation results	

3.3.4 Controlling of the Corporate Portal Project

In general, the need for a controlling of information management systems stems from the fact that these have become business critical facets of today's companies. Information and the correct use thereof (i.e. knowledge) is considered the most important resource besides work power. Hence, the target of IT controlling is twofold: Firstkly, IT controlling has to determine

whether information management is conducted effectively, that is whether the general business targets are satisfied. Secondly, IT controlling has to ensure that the information systems that support the information management processes are deployed and applied in a cost efficient manner (Schmidpeter and Spitta 2002, pp.141-142). For the engineering of corporate portals, establishing a controlling framework of measurements and techniques is critical for the overall success of the project.

Section 3.3.4.1 introduces the concept of IT controlling. Sections 3.3.4.2 discusses the relevant controlling perspectives with regard to the portal engineering process stages.

3.3.4.1 An Introduction into IT Controlling

According to the discussion in literature, there exist no consistent understanding and usages of the term controlling.[16] The term "controlling" does not exclusively address the facet of "control" but also includes the notion of planning, management, regulation (cf. Horvarth 2003). Following Anthony and Dearden (1992, p.3) the "control of an organization" comprises all those devices that ensure that "it goes where its leaders want it to go". Therefore controlling is regarded in a much wider sense than the term "to control" would suggests. Yet, lately one can observe that the term "controlling" in general is used for the set of activities that comprise of aggregating, analyzing and providing the relevant information necessary to support executive level decisions (Berens and Schmitting 2004, p.158).

Like for the term "controlling", the notion of IT controlling is not clearly defined in literature, but there exists a number of concurrent perspective for the classification of IT controlling tasks and activities (cf. Gabriel and Bayer 2003, p.137). Hence, the controlling activities range from the generation of evaluation reports regarding the system efficiency and effectiveness to the coordination of the activities of the IT department, depending on the perspective taken by the respective discussion. For example, Schwickert (1998) classifies controlling according to the controlling objects, i.e. IT infrastructure, IT applications and involved staff. Heinrich (2002) adds the facet of IT project controlling and process controlling to the discussion. The strategic planning of IT projects, cost-accounting and outsourcing of IT services are cornerstones of Kargl's (1999) discussion of IT controlling. In contrast, Krcmar's (1997) chooses the stages of the system lifecycle as points of reference for his discussion of IT controlling.

[16] This is in particular true for the German literature where the term controlling is either used from the perspective of cost accounting, financial controlling or accounting in general.

As this work aims at providing an insight into the individual engineering stages of a corporate portal implementation, it makes sense to follow Krcmar's system lifecycle controlling approach and discuss the controlling of corporate portals from the perspective of the individual portal engineering stages.

3.3.4.2 IT Controlling Stages within the Corporate Portal Engineering Process

The relevant controlling stages that follow the stages of the system lifecycle (i.e. the portal engineering process) comprise of the idea controlling, project controlling and product controlling that follow the system's lifecycle (Krcmar 1997, p.251).

- The objective of the *idea controlling* is to provide the necessary level of transparency for the process of evaluating and identifying new developments or extending existing developments. The idea controlling has to guarantee that in any case these developments satisfy the overall company strategy. With regard to corporate portal projects, the idea controlling is of particular importance during the portal business alignment stage and the portal online stage. In the latter case, the goal is on aggregating and evaluating data as a decision basis for subsequent portal evolution cycles. The process of evaluating new ideas for the development can be supported by establishing a project database and defining measurements and practices that help to evaluate the benefit, risk and fit of these new ideas. In this context, Krcmar (1997, p.253) proposes to rely on traditional portfolio techniques and measurements (including risk, benefit, project technology fit and project strategy fit).

- The goal of the *project controlling* is to ensure that every action taken within the scope of the project satisfies a certain level of quality, efficiency and timeliness with regard to a successful project settlement (Krcmar 1997, p.256). Project controlling follows stages of the portal engineering process from the initial analysis to the portal online phase. The activities comprise of general project-planning and management activities as well as profitability analyses of single project developments. The project controlling relies on a sufficient project documentation that describes the main tasks, the assigned roles, the communication channels, and the information- and workflow procedures of the portal engineering process stages (cf. Lehner 1994, p.5).[17]

- Following the product introduction, the goal of the *product controlling* is to coordinate the efficient and effective usage of the information system in particular with regard to the

[17] The reader is referred to Lehner 1994 and Thaler 1995 for a comprehensive discussion on the role of documentation in the context of the general software development process. Wallmüller (1990) elaborates the role of documentation in the context of software quality.

portal online stage (Krcmar 1997, p.257). The product controlling has to ensure that the information management targets are considered in the support, maintenance and further developments and extensions of the portal. This is of particular importance with regard to the follow-up costs of the project that are often beyond the actual implementation cost.[18]

With regard to corporate portals, the question arises whether there are inherent characteristics of corporate portal projects that require for a different or modified approach to system controlling. In particular two characteristics of corporate portal projects come to play: Firstly, for every portal engineering cycle one has to consider a portfolio of service developments that *can* but do not necessarily *have* to be related with each other. Consequently, project and product controlling activities have to consider this multitude of simultaneous and potentially interrelated developments. Secondly, the notion of ongoing portal evolution stresses the importance of the product controlling activities. The controlling activities not only have to evaluate the efficient and effective system usage, but moreover have to address the collection and analysis of relevant data to manage subsequent portal evolution cycles.

3.4 Chapter Summary

This chapter elaborated on different approaches for the design, development, introduction, and operation of corporate portals. Corporate portal initiatives are subject to technical, functional, and organizational design and implementation challenges. Motivated by these challenges, the literature was reviewed for relevant and systematic approaches that support the corporate portal development life cycle. Yet, the literature review revealed that none of the current approaches comprehensively address the corporate portal specific design challenges as identified in this chapter.

Consequently, in the course of this chapter, a method for the engineering of corporate portals was developed and elaborated. The method describes a portal engineering process model as well as the roles that are involved in the engineering process and their relationships. The method constituents are developed and derived on the basis of an integrative approach that identifies, extends, and combines relevant methods and instruments from literature and practice with models, methods, and instruments developed and validated within the case study that underlies this work.

[18] The cost of product modification may exceed 50% of the systems lifecycle costs (Krcmar 1998, p.258).

The corporate portal engineering process consists of the portal business alignment, the development, the introduction, and the portal online stages. What clearly distinguishes the discussed portal engineering process model from the general software development model is that the notion of system evolution is incorporated on three levels of magnitude. Firstly, there are the major evolution-cycles that require a thorough traversing of the engineering process from the refinement of the portal business alignment to the introduction of new or significantly extended portal components. Secondly, minor evolution steps that are traversed within a major evolution-cycle allow for the immediate processing of bug-fixes and manageable feature requests for existing portal components and services. Thirdly, there are instant evolution steps that relate to configuration changes during the portal operation. In this context, this work identifies the management of portal evolutions as a major project management challenge.

The chapter closes with an overview of the main tasks and activities of the major portal engineering stages (cf. Table 4, p.48) and a brief elaboration on the role and the integration of (IT-)controlling stages within the corporate portal engineering process.

The following chapters elaborate in detail the embodiment of the individual portal engineering stages. The chapters describe the relevant tasks and activities and develop the models, techniques, and instruments to foster these tasks. The theoretical discussion is complemented by an evaluation of the applicability and practical relevance on the basis of the Corporate Financial Portal case study. Finally, each of the chapters close with a summary of the main lessons learned that is derived as a synthesis of the theoretical elaborations and the practical insights.

Part II – Case Study

Chapter 4

Business Analysis & Project Alignment

The strategic directions and organizational framework for conducting the corporate portal project are defined within the business analysis and the subsequent project alignment stage. The business analysis stage consists of three main tasks: Firstly, with the general assessment of the corporate portal technology potential, one obtains the necessary understanding of the benefits and limitations of the corporate portal concept. Secondly, the analysis of the actual business context of the portal project provides insights on the project's business potential. Finally, the elaboration of the main business cases results in the initial project proposition that describes the primary business purpose (i.e. project goals).

Following the identification of substantial and sound business cases, the activities of the project alignment phase define the project directions in terms of the portal strategy and the governance instruments. The latter foster the focus on the project goals throughout the project life cycle. The results of the initial business analysis and project alignment are refined in the subsequent portal engineering cycles to accommodate for the lessons learned during the previous development cycle.

This chapter describes the primary tasks of the business analysis (Section 4.1) and the subsequent project alignment (Section 4.2). The description of the practices, results, and insights from the Corporate Financial Portal project complement the theoretical discussion.

4.1 Analysis of Business Purpose & Goals of Corporate Portals Projects

One major challenge of the business analysis activities is the need to accommodate for the fact that the assessment of the technology potential will result in a large number of diverse tangible and intangible benefits that potentially stem from conducting a corporate portal

project. Therefore, it is crucial to clearly relate these general benefits to the actual business context and requirements.

Valid business cases that justify a corporate portal project may be derived from the insights of the business potential analysis and the results of the technology assessment. Still, that the scope of potential benefits from a corporate portal implementation requires for the consideration of business cases that would not stand the requirements of a pure profitability analysis.

The corporate portal business analysis is conducted according to the following three step process (cf. Kaiser 2000, p.119): First, the general assessment of the technology potential (Section 4.1.1), second, the analysis of the project's potential with regard to the business context (Section 4.1.2), and third, the exploration of business cases to derive substantial value propositions (Section 4.1.3). Finally, the primary project goals are derived in an iterative procedure by analyzing the initial project proposition (Section 4.1.4).

4.1.1 Technology Assessment

In general, one can distinguish between the institutional IT assessment and project-specific assessment of possible fields of applications as two distinct approaches for the analysis of the technology potential by the means of a technology assessment (cf. Steinbock 1993, p.6; Becker 1998, pp.113). The institutional IT assessment evaluates new technologies and their potential business impact on a regular basis. In this regard, the institutional IT assessment is a monitoring approach that strives to maintain a specific level of technology awareness and leadership in an innovative business environment. On the other hand, the project-specific technology assessment focuses on the analysis of the technology potential for a specific business context. Therefore, the project specific evaluation is conducted after the general potential of a technology has been identified by the institutional IT assessment.

4.1.1.1 Introduction into the Technology Assessment of Corporate Portals

As discussed in Chapter 2, Section 2.5, one major challenge for the assessment of the corporate portal technology stems from the fact that the number of different portal concept descriptions and the scope of potential applications. These make it difficult to understand the fundamental idea, and comprehend the possibilities and the limitations of this information system concept. Hence, in order to foster an objective and unprejudiced assessment of the corporate portal concept, the unique characteristics as well as strengths and weaknesses have to be identified – first of all, regardless of the actual business background (cf. Kaiser 2000, p.123). It is

crucial for key project members to establish a sound understanding of the technology in order to foster critical reflections and decisions in the subsequent project phases.

In order to form an educated opinion of the portal technology one can resort to technical literature, academic-research, and reports of market research institutions (Steinbock 1993, p.13). Further sources of practical insights are trade fairs, presentations from technology consultants, and workshops and presentation from industry practitioners. The popularity of technology workshops shows that industry practitioners are not adverse to give presentations and workshops on their technology experience.[19] This is due to the fact that they themselves rely on these sources for practical insights on new technology.

From an implementation perspective, the technology assessment has to evaluate the current state of the art of corporate portal application technology. Especially with respect to a "make-or-buy" decision (cf. de Bakker and Seebacher 2000, pp.22-23), a market research of potential portal vendors and service providers has to be conducted (e.g. Gurzki, Hinderer et al. 2005). Furthermore, the technology assessment has to consider corporate guidelines and regulations that might exist for information systems. These might affect the scope of technology options available (e.g. corporate systems have to use Java-based technology). In the case that an in-house development of a corporate portal is a viable option, e.g. due to reasons of control and flexibility, the technology assessment also has to consider the level of development expertise and resources available among the members of the portal development team.

The following case study section describes the activities and the main results of the initial technology assessment of the Corporate Financial Portal project that has been carried out as a pilot study. The case study provides an illustrative example of a general concept description and further offers insights into the decision process and the determinants of a technology selection.

4.1.1.2 *Case Study* Technology Assessment of the Corporate Financial Portal

The technology assessment of the Corporate Financial Portal project was conducted within a pilot study during the first quarter of 2001. The objective was to obtain a profound understanding of the corporate portal concept as well as the underlying technology, in particular with regard to a potential in-house development. The technology assessment primarily relied on the analysis of reports from market research agencies, academic publications, and white-

[19] One example is the "Finanzsymposium" workshop that is organized by Schwabe, Ley und Greiner, where industry practitioners among others present and discuss innovative application of information systems in the context of the financial management related topics, cf. http:// www.slg.co.at/.

papers of portal vendors (cf. Chapter 2). The main results and insights of the technology assessment were presented and discussed at the initial meeting of the project steering. The Corporate Financial Portal concept was introduced as follows:

> *"The Corporate Financial Portal will provide a single point of access to relevant data and information, offer services to automate processes, and support knowledge dissipation over the organization."* (Bayer_SC 2001)

In principal, this description of the Corporate Financial Portal concept already reflects the primary project goals (and motivation) and was extended in subsequent meetings of the project steering committee.

According to the insights from the technology assessment, the corporate portal team outlined, that the corporate portal is a special form of a Web presence that offers unique advantages over more traditional client based software systems. In summary, the general characteristics and main benefits of a corporate portal with regard to the *CoFiPot* project context were outlined as follows (cf. Bayer_SC 2001):

- Through one single point of access a corporate portal can offer a personalizable workspace that helps to manage information complexity and thus increases the efficiency and work productivity.
- The portal fosters the consistency of financial reports and support knowledge dissipation over the organization, regardless of locations and time zones. Therefore, corporate portal services can support synchronous and asynchronous processes.
- Further, a corporate portal offers means to uphold a level of cultural sensitivity towards the international portal users (e.g. personalization with regard to the user's cultural background, i.e. views on the portal).

From the implementation point of view, flexibility and control concerns favored an in-house development of the corporate portal based on existing open source portals. The major question that was raised from the assessment of the existing corporate portal application frameworks was whether to choose a system that was based on Java technology or rely on the just introduced Microsoft ASP.NET Web as a Web application development platform. One reason in favor of the Java based framework was the fact that at that time all major E-Business Intranet solutions were based on this application framework. Consequently there would have been the possibility to learn and benefit from existing implementation expe-

riences. Still, the final decision was to select the Microsoft ASP.NET technology for the following reasons:[20]

- Firstly, the analysis of the financial information systems landscape revealed that major systems were based on Microsoft technology. Thus, by relying on Microsoft technology for the corporate portal implementation, the efforts of developing the necessary integration interfaces was considered to be significantly lower than it would be the case when choosing a different application technology platform.
- Secondly, the ASP.NET technology offered a consistent object oriented programming framework for developing web applications and a comprehensive development environment (Visual Studio) that facilitated a rapid application development approach. Similar to the programming of the traditional MS Windows event model, ASP.NET relies on an event-driven architecture which promised to simplify the transition from traditional Windows application development toward the development of Web applications.
- Moreover, ASP.NET, in contrast to other Web application development frameworks offered a clear separation of code and design – the code-behind programming model. This allowed for more flexibility regarding delegation of development tasks, as the design and interface components can be developed independently.
- Finally, the level of confidence and experience of key members of the development team with Microsoft technology was one further factor in favor of the technology decision.

4.1.2 Assessment of Business Potential of Corporate Portal Implementations

The business potential analysis has to assess the current state of the relevant business processes with respect to the (general) benefits that may arise from the implementation of a corporate portal. Note, that the purpose of the assessment of the business potential is not that of a traditional project profitability analysis. Instead, the idea is to derive first insights on the benefits from corporate portals with regard to the actual project business context.

To facilitate the task of analyzing the current state of the relevant business processes, one can follow a structured analysis procedure that is based on the stepwise refinement of the business processes that need to be studied (cf. Schabert 2005, pp.41-45). The process description is obtained by a drill down from a high level process description to sub-processes and finally describing the sub-process activities. The advantage of this technique is a structured

[20] The reader is referred to e.g. Schwichtenberg 2003; Evjen 2006 and the Microsoft ASP.NET online resources (cf. http://www.asp.net) for a comprehensive overview on the ASP.NET technology platform.

approach that reduces the complexity of the analysis as the sub-processes can be assessed independently. To capture the necessary data and information on the relevant business processes, the project team relies on instruments and techniques including structured and semi-structured interviews with domain experts, observations of current practices to capture business processes, and the study of existing documentation (e.g. process documentation, process maps, organization charts).

The subsequent sections reflect on the characteristics of business processes with regard to the business potential of a corporate portal project. The relevant process characteristics are the general structure of the business processes, the information demand and structure of the underlying information process, and organizational determinants of the process (following Kaiser 2001, pp.119-121).

4.1.2.1 General Process Structure

In general, business processes can be characterized as either structured, semi-structured, or unstructured processes (Kaiser 2001, p.120).[21] A business process is structured if it is possible to ex-ante describe the individual tasks and their relationships within the process, the parties involved, and the resources needed. For semi-structured and unstructured processes, this requirement can be fulfilled to a limited degree, only. Examples for structured processes are processes that can be clearly described by a deterministic workflow like the process of requesting holidays, or the process of requesting new office-materials. Contrarily, the business processes within research & development, or general business-project related activities are typically semi-structured or even unstructured business processes that are characterized by a usually high level of information demand.

With regard to structured processes, the business potential of corporate portals lies within the possible integration and emphasis of workflow management components that guide users through the respective process. To live up to this potential it is further necessary that the corporate portal comprises the necessary service components that foster and integrate the respective process components.

4.1.2.2 Information Demand and Dispersion of Data Sources

The level of the information demand and the extent of dispersion of the relevant data sources determine the business potential of a potential corporate portal implementation. In general, business processes that are based on activities which have a high demand of data from various

[21] Furthermore, business processes can be characterized according to their activity characteristics between business processes that are conducted just once and those that are executed on a regular basis (Nippa 1995, p.54).

dispersed data sources will greatly benefit from the implementation of a corporate portal as a central point of access to these sources. Moreover, high information demand will further require the information to be processed accordingly. In this regard, the corporate portal provides means to search, identify, and process the corporate information to support the corporate knowledge worker with her information retrieval and processing tasks (cf. Chapter 2, Section 2.5.1).

4.1.2.3 Structure of Information Process

The structure of the information processes determines whether the process of finding and processing the relevant information follows a clearly defined procedure, or if the opposite is true. For structured information processes, a corporate portal can offer the means to streamline and automate the information retrieval and processing tasks and thus increase the efficiency of conducting these tasks. On the other hand, unstructured information processes can benefit from the information search and processing capabilities provided by a corporate portal. As an example, the non-routine task of analyzing financial figures can be supported by corporate portal information services that offer means to link related, browse through, and navigate to the relevant corporate data.

4.1.2.4 Organizational Characteristics of Business Processes

The organizational determinants of business processes that have to be evaluated in the context of a corporate portal project are the level of centralization, and the number of direct or indirect stakeholders of the regarded processes. There are at least two different perspectives on the level of centralization of a business process:[22]

On the one hand, centralization can be regarded with respect to the number of functional departments and business units that are spanned by a single business process. In this sense, a centralized process is primarily conducted within the border of one functional department or business unit. Contrarily, a decentralized process spans several departments or even business units with data, applications, and people that are related to one another (cf. Picot, Reichwald et al. 2001, p.392). In the latter case, a corporate portal not only provides one common point of access to the relevant corporate data, but moreover it can provide means to support the cross-organizational information processing thus fosters the integration of business processes.

On the other hand, the level of centralization can be described with respect to the number of different geographical locations where instances of business processes are conducted

[22] This work focuses on the requirements of corporate portals for the corporate Intranet. In the Internet scenario the analysis of the business network has to be incorporated into the assessment of the business potential. For a discussion of the business network analysis method, the reader is referred to Alt. et al. (2002, pp.16).

(Kaiser 2000, p.121). In this regard, a centralized business process is conducted locally, at one place. Back-office processes, like the confirmation of transactions are typical examples of centralized business processes. In contrast, a decentralized process is characterized by the fact that instances of the process are conducted at geographically dispersed locations. The sales and services domain provides a number of characteristic examples for decentralized business processes. One example is the on-site support for customers that are geographically dispersed. The benefit from a corporate portal is to provide a comprehensive access to the required information services for all of these sales-agents.

Finally, the number of stakeholders of a business process has an effect on the business potential of a corporate portal project. In general, a service provided by a corporate portal can be accessed by anyone who is interested in the service, without the need for any kind of client-side installation. A new user immediately benefits from the corporate portal service, while the additional administration efforts and cost per new user can be neglected. Hence, the more users are working with a portal service, the more the company will benefit from an increase in the efficiency of the underlying business process.

4.1.2.5 Business Potential Assessment Schema

Table 5 provides an overview of the discussed business process properties. For every process property the basic characteristics are illustrated according to their influence on the business potential.

Table 5 – Assessment of business potential of corporate portals (following Kaiser 2000, p.122)

Business Process Property	***low*** **Business Potential** ***high***	**Remarks**
Structure of process	*structured** ↑ *semi structured* ↑ *unstructured* ↑	*increased potential for structured processes with regard to workflow services.
Information demand	*low* ↑ *medium* ↑ *high* ↑	-
Dispersion of data sources	*low* ↑ *medium* ↑ *high* ↑	-
Structure of information process	*structured** ↑ *semi-structured* ↑ *unstructured* ↑	*increased potential for structured processes that can be automated.
Level of centralization	*centralized** ↑ *hybrid* ↑ *decentralized* ↑	*increased potential for centralized processes that require dispersed information.
Number of stakeholders	*limited* ↑ *medium-size* ↑ *large* ↑	-

In practice, the analysis of business processes will derive process descriptions that relate to different levels of business potential depending on the identified characteristic of the regarded business process property. As one example, assume that the analysis identifies a centralized business process which is conducted at the corporate center and has a limited number of stakeholders that are immediately involved and interested in the process. Regarding these characteristics, there is only a limited business potential from conducting a corporate portal project. Yet, suppose that this process is highly unstructured and requires the processing of data and information that is dispersed across the organization. Furthermore, assume that the process is a business critical process and periodically conducted with great effort. With regard to these additional assumptions, a corporate portal implementation can offer access to the required data sources and furthermore facilitate the information process by the means of information services for data aggregation, validation, and reporting ultimately improving the effectiveness and efficiency of the process.

In summary, the assessment of the business potential results in a comprehensive overview and description of the relevant business processes and relates these with the potential benefits and limitations of a corporate portal project. These insights will strongly influence the decision on whether to further pursue or abandon the project due to a limited business potential.

The following case study section describes the activities and results of the assessment of the business potential of the Corporate Financial Portal project. The business potential assessment schema as outlined in Table 5 is applied to evaluate Bayer's foreign exchange management processes. The case study section underlines the importance of indentifying key business processes with a large number of stakeholders as subjects for a business potential assessment.

4.1.2.5 *Case Study* **Assessment of the Business Potential of the CoFiPot project**

The assessment of the business potential of the Corporate Financial Portal project was conducted on the basis of interviews with domain experts, empirical observation of the primary financial management processes, and the study of existing documentation on these processes. The foreign exchange management was at the centre of the assessment as it takes a central role within Bayer's financial management activities. Furthermore, the analysis also considered general characteristics of the business process and organizational structure of the Corporate Finance Center.

Bayer's foreign exchange management (*FX* management) process consists of three main stages: first the evaluation of the foreign exchange exposure, second, the hedging of the identified exposure, and third, the monitoring and reporting of the hedging results.

The analysis of the FX management process outlined that the process is *well structured* with a clearly defined responsibilities. Furthermore, the information demand of each of the primary process stages is clearly defined: For the evaluation of the FX exposure, data from selling and buying products (stored in the *dispersed* accounting systems) and information on the relevant FX market rates is required. The hedging of the identified exposure by the means of closing hedging transactions requires information on the deal quotes that is based on the current market data. Finally, the monitoring and reporting of the hedging results is conducted according to the evaluation of the market-value of the hedging transactions.

Regarding the evaluation of the *level of centralization* one has to distinguish between the group-level FX management activities and the entity-level activities. The group-level activities are conducted at the Corporate Finance Center and aggregate the FX exposure data from the geographically dispersed entities. On the other hand, the individual entities do manage their FX exposure locally. In order to hedge their exposure, they have to close internal transactions with the Corporate Finance Center.

In principal, Bayer's FX management process is the same for every entity and the group-level management activities. Therefore, there is a *large base of stakeholders* of the FX management process that comprises the entities' FX managers and the Corporate Finance Center.

With regard to the identified characteristics of the FX management process, the assessment of the related business potential by applying the evaluation scheme described in Chapter 4.1.2 (Table 5) suggests to further pursue the corporate portal project for the following reasons:

- From the group-level perspective, the Corporate Financial Portal will provide means to access, aggregate and analyze the exposure data of all relevant entities. Moreover, the quality of the group-level FX management decisions depends on the completeness and quality of the exposure data collected by the entities. In this context, a corporate portal can provide user-friendly services that standardize the procedure of reporting this data to the Corporate Finance Center. Furthermore, as the practice of monitoring the FX exposure is the practically the same on the entity-level and the group-perspective, it makes sense to offer the respective portal services to the entities to let them benefit from the expertise that underlies the group-level process implementations.

- Following the evaluation of the FX exposure, the local FX managers can hedge the identified exposure by the means of internal transactions with the Corporate Finance Center. The benefit from a Corporate Financial Portal stems from the opportunity to capture this well-structured trading-process by means of portal services that are made available to all FX managers anywhere and anytime, thus eliminating the coordination requirements, while at the same time streamlining the overall process.
- Finally, the tasks of evaluating and reporting the hedging results can be facilitated by means of a corporate portal service that offers direct access to the relevant transaction and market data, as well as further services that support the report generation. Again, as the principal reporting requirements are the same for the group-level and entity-level activities, with a Corporate Financial Portal all stakeholders can likewise benefit from the provided services.

In general, the business potential of a Corporate Financial Portal stems from the means provided to access and process the high amount of dispersed financial data in a structured manner. Furthermore, the Corporate Financial Portal concept in general can be regarded as a mean for the standardization and establishment of proven and validated business practices throughout the financial community.

4.1.3 Developing the Corporate Portal Business Case

The assessment of the general business potential of a corporate portal lays the foundation for the development of specific business cases that clearly outlines the purpose of pursuing a corporate portal project. In order to foster the process of deriving sound business cases, this work adapts a two step procedure as proposed by Powell (1998, p.93). The first step is to explore the general business problems that can be addressed by the corporate portal project. On the basis of these problems, within the second step, a set of sound business purposes and goals are derived in order to define a project value proposition.

4.1.3.1 Exploring the Business Problems

To explore suitable fields of applications, one can rely on techniques that stimulate the process of creative thinking including brainstorming, workshops, and small group discussions with potential end-users as well as domain experts. The application of these techniques can be structured by asking the following questions (cf. Powell 1998, pp.94-98):

(i) What is the main motivation for the corporate portal?
(ii) Why is the corporate portal needed?
(iii) Who is the corporate portal for?

Answers to the first question foster the identification of only the most sound and substantial motivation for pursuing a corporate portal project. This focus is crucial, as a corporate portal potentially addresses a wide range of services for different business purposes (e.g. Chapter 2, Section 2.5). Addressing all of these potential business purposes simultaneously, is not a good idea in the initial phase of the project, for the obvious reason of complexity. Instead, the project management has to take advantage of the evolutionary nature of a corporate portal development and address further business cases within subsequent engineering cycles.

The second question elaborates further on the answers to the first question. Answers to this question provide a list of sound tangible and intangible reasons that support the main motivation for implementing a corporate portal. Examples of such reasons are the increase in the efficiency of the employees' information processes, the reduction of the cost of document publishing, or the community building among the users of the corporate portal.[23]

Finally, the third question addresses the fact that a successful corporate portal implementation has to satisfy the requirement of the target audience. Therefore, it is important to identify the main target audience and understand their particular needs with regard to the specification and design of the corporate portal services. There is a difference whether a corporate portal mainly addresses users from one department and region only, or if the target is an international user basis. Additionally, it is interesting to assess the technical background in terms of access to the Intranet, as well as the general attitude of selected users regarding the usefulness and benefit of a corporate portal.

The general problem definition is composed on the basis of the insights from exploring the main business problems (Powell 1998, pp.99-100). The objective of the problem definition is to state the main motivation for a corporate portal and outlines a set of current business problems that can be addressed by a corporate portal project.

4.1.3.2 Developing the Corporate Portal Project Goals

Based on the problem definition the primary purpose and goals of the project have to clearly describe how the corporate portal is going to solve some these problems. Thus, the set of the identified business goals reflects the project's value proposition that will determine the project executives' decision on whether or not to further pursue the project. In this regard, the task of developing the primary business goals requires a general-level requirements analysis that derives the most fundamental project objectives. These project objectives outline the directions

[23] The reader is referred to Terra and Gordon (2003, pp.140-141) who have composed an extensive list of reasons, objective and business goals for a corporate portal project. The list is based on an industry survey.

that need to be considered in the specific requirements analysis of the individual corporate portal components and services.

The task of developing the business goals can be facilitated by following an iterative approach to explore the feasibility of a business goal. This work adapts the "Whirlpool" approach for critical concept exploration (Powell 1998, p.102). Figure 13 illustrates the process for the iterative development of business goals.

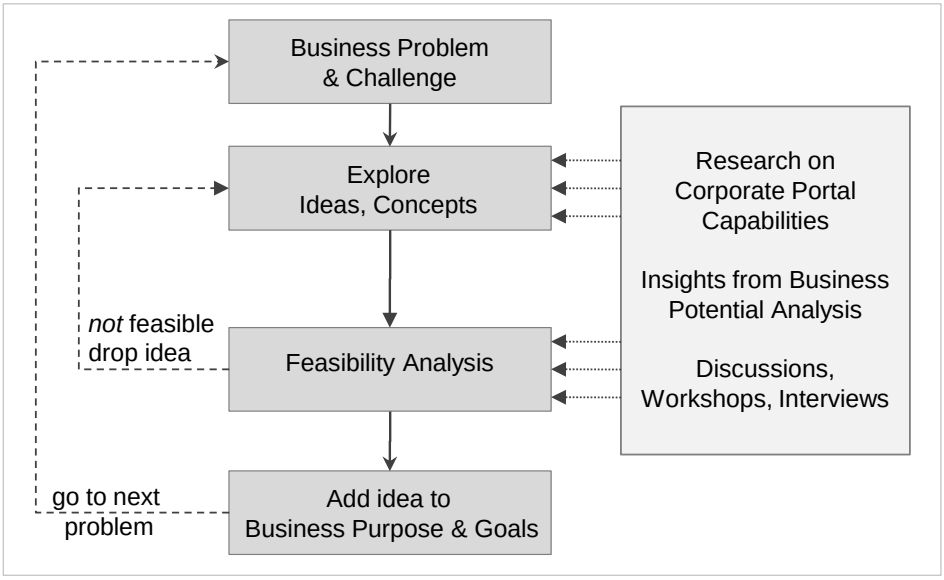


Figure 13 – Iterative development of business goals (following Powell 1998, p.102, "Whirlpool" approach)

For every business problem as identified by the problem definition, the research on the corporate portal capabilities and the insights from the business potential analysis support the exploration of ideas and concepts concerning the regarded problem. A feasibility analysis is conducted on every explored concept. Discussions, workshops, and interviews with potential end-users provide important external input for the assessment of a concept proposition. In the case that the assessment of the feasibility holds, the concept is added to the set of sound and substantial business purposes. Else, the concept is dropped for a new concept to be explored.

To illustrate the application and relevance of this iterative goals identification process, the following case study section outlines the activities and results from developing the business case for the CoFiPot project. Moreover, the case study section provides an example for a problem definition and a business purpose proposition. Although the developed business purpose proposition applies first and foremost for the Bayer context, discussions with other industry practitioners that share a similar organization background indicated the potential for a generalization of the proposed concepts.

4.1.3.3 *Case Study* The Business Case for the CoFiPot Project

In general, the activities for identifying, exploring and developing a sound business case for the *CoFiPot* project benefited from the fact that project theme clearly limited the scope of viable business cases. As described in Section 4.1.1.2, the basic idea of introducing a corporate portal as a central platform for the information requirements of Bayer's financial community reflects the main motivation of the project.

Explore the Problem Definition

To identify and explore business reasons that support the main project motivation, the project team conducted brainstorming sessions, and small-group discussions to come up with a number of general business needs that could be addressed by the project. These preliminary results were presented and discussed at workshops, for example at meetings of the finance and accounting F&A managers (e.g. Bayer_Pr 2000). Furthermore, interviews with potential end-users fostered the elaboration of the cornerstones for the project positioning in an iterative manner. The final results were presented and discussed in the first meetings of the project steering committee (Bayer_SC 2001). Answering the set of questions discussed in Chapter 4.1.3.1 derived the cornerstones of the project problem definition as follows:

(i) The *main motivation* for the *CoFiPot* project was to establish a central platform for information and service for Bayer's financial community.

(ii) The *business reasons* that outline the need for a corporate financial portal are primarily related to the strategic re-organization of the Bayer Group's financial management structure that posed distinct requirements on the information management processes of the Bayer's financial management. The main business reasons that illustrate the need for a corporate portal were identified and discussed as follows:

- The Corporate Financial Center has to provide the worldwide subsidiaries with the required financial information and services in terms of an in-house banking.
- The international "costumers" are subject to distinct business requirements and cultural background that need to be considered by the Corporate Finance Center.
- The Corporate Finance Center holds the responsibility for the group-level financial management. Financial management decisions on the group-level require the Corporate Finance Center to collect, aggregate, and process the relevant financial data from the dispersed subsidiaries, worldwide.

(iii) The *target-audience* of the *CoFiPot* would comprise of the members of the Corporate Finance Center, the financial staff of the local entities worldwide, as well as the common Bayer employee who is interested in Bayer related financial information on a general level.

Development of the Project's Business Purpose & Goals

In order to derive and develop the primary project goals, the project team explored ideas and concepts that outlined how the *CoFiPot* implementation can address the information management requirements that followed the strategic re-organization of the financial management structure. The exploration focused on two perspectives:

- On the one hand, ideas and concept to support the activities within the Corporate Finance Center were explored. The *CoFiPot* has to provide means to access financial corporate and market data, and furthermore support the processing of this data as well as the generation of group-level reports. Furthermore, there exists a range of key-functionality of the existing financial systems that are only available to a limited numbers of users. For example, the task of entering internal foreign exchange (FX) hedging transaction into the central corporate treasury management system and the task of retrieving the information for subsequent reporting activities requires expertise in using the corporate treasury management system. In this regard, the *CoFiPot* can provide services that encapsulate this key functionality and make it available to a broader audience through a simple and intuitive Web interface, anytime and from anywhere.
- On the other hand, the quality of the group-level activities depends on the information and data provided by the subsidiaries (e.g. for the financial planning). Therefore, concepts were elaborated that support the financial management activities and requirements of the affiliates, while at the same time fostered the collection of the relevant data addressing the group-level demand. In this sense, the fundamental idea was to offer to the local affiliates a set of *CoFiPot* services for their reporting and transaction requirements that relies on the data they have provided beforehand. As an example, it would make sense for the affiliates to close internal and report external FX hedging transactions if they can subsequently benefit from the reporting services of the *CoFiPot* for their accounting requirements. Following this *participation-and-reward* strategy, the Corporate Finance Center can enforce the collection of local data by providing *CoFiPot* services that offer sound incentives from the local subsidiaries perspective (cf. Figure 14).

In summary, the major business purpose of the *CoFiPot* would be to offer means to aggregate data, functionality, and expertise from the Corporate Finance Center and the local sub-

sidiaries alike, and to expose all this by the means of a personalized and user-friendly Web interface that is accessible at anytime and from anywhere (Figure 14). In this regard, the *CoFiPot* would increase the effectiveness and efficiency of the financial management activities of the local subsidiaries, as well as the Corporate Finance Center.[24]

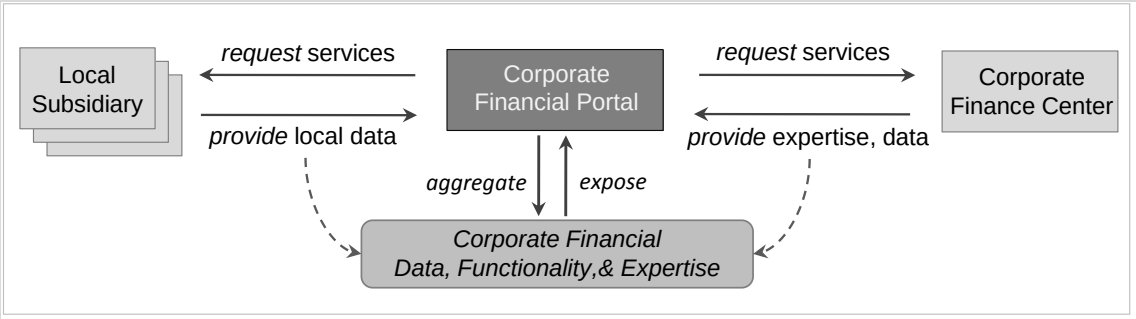


Figure 14 –*CoFiPot* business purpose proposition

The feasibility of this concept was discussed with a number of potential end-users of the Corporate Finance Center. Furthermore, interviews with finance and accounting F&A executives from the Andean Region, China, Mexico, and Brazil complemented the assessment with the necessary insights from the point of view of the local subsidiaries (e.g. Bayer_Nt 2001). The F&A executives outlined that for them, the provision of financial market- and company data is an immediate benefit. Moreover, the F&A managers mentioned basic functional requirement that should be considered in the design and implementation of the first *CoFiPot* prototype.

Finally, the main objectives of the *CoFiPot* project presented and discussed at the first meeting of the members of the project steering in June 2001 were as follows:

The *CoFiPot* will...

(i) provide on single point of access to relevant data and services.

(ii) offer services to automate processes.

(iii) support knowledge dissipation over the organization.

4.2 Strategic Business Alignment of Corporate Portal Projects

Following the development of the main business goals, the definition of the portal strategy outlines the directions to achieve these goals (Section 4.2.1). Moreover, in order to enforce the business alignment of the corporate portal project, instruments that foster project governance need to be established (Section 4.2.2).

[24] The presentation of Bayer's corporate finance director on the topic "*CoFiPot* Think Globally, Act Locally"(Bayer_Pr 2005) summarized this concept and outlined the key success factors for the implementation of this concept.

4.2.1 Developing the Corporate Portal Strategy

In general terms, a strategy defines a plan of activities that enforces the achievement of a particular goal. For the engineering of corporate portals, the strategy determines the feasibility of implementing and establishing the corporate portal with regard to the project goals (Collins 2001, p.51). Activities as defined by a corporate portal strategy are not restricted to the identification, design, and implementation of corporate portal components and services. Moreover, activities comprise of all tasks and actions related to the corporate portal engineering process, for example activities concerning the promotions of the corporate portal.

Developing a strategy for the implementation of a corporate portal is a challenging task, again due to the fact that a corporate portal project offers a wide range of viable activities that address different business purposes. Therefore, it is crucial with respect to the effectiveness of the corporate portal strategy to identify and focus on a set of viable strategies that address the different levels of the project goals (cf. Rothschild 1979 p.224). In this context, it makes sense to differentiate between short-, mid-, and long-term sets of portal strategies:

- The *long-term strategy* outlines a high-level plan of actions that relates to the primary project goals. The implementation time-frame of long-term strategy is at least 18 months, usually longer (i.e. resemble the project run-time). In general, the long-term strategy defines the general characteristics of main content areas and the fundamental characteristics of the underlying portal services.
- The *mid-term strategy* addresses the project goals within a time-frame of 6-18 months, which relates to approximately two to three major portal engineering cycles. While the long-term strategy outlines the plan of actions on a global level, the mid-term strategy focuses on the activities for embodiment design of the content areas. Hence, a mid-term strategy will outline the plan of activities related to one specific content area and define the range and characteristics of the services provided by this area.
- The *short-term strategy* defines a detailed plan of actions within the time-frame of one major portal engineering cycle. The short-term strategy specifies a portfolio of portal services to be implemented in the current engineering cycle. With regard to the design and development of the initial corporate portal prototype, it is critical to focus on the implementation of services that address a large number of users and offer an immediate benefit to the users, i.e. realizing “quick wins”.

4.2.2 Governance & Strategic Steering of Corporate Portal Projects

The project governance of corporate portals consists of a framework of measurements as well as an institution that supervises the alignment of the corporate portal strategy and the related activities according the project's business goals. Therefore, the project governance activities are not only restricted to the business analysis and alignment stage, but take an important role throughout the portal engineering lifecycle (cf. Chapter 3, Figure 10, p.41)

With regard to the establishment of an institution for the purpose of project governance, Detlor (2003, p.137) proposes to establish a democratic steering committee. It is within the responsibility of the steering committee to evaluate and adopt on the set of proposed portal strategies. Moreover, with regard to subsequent portal engineering cycles, the steering committee has to regularly evaluate and foster the progress of the project according to the portal strategy (cf. Kütz 2005, pp.74-75).

Ideally, the members of the steering committee should be management and executive level representatives of the different groups of corporate portal stakeholders. This selection guarantees that the decisions on the project level will take into account the business needs of the respective target audience. Moreover, the members of the steering committee not only supervise the progress and directions of the project but can also support and promote the project by publicly expressing their support and commitment towards the corporate portal initiatives within their area of organizational responsibility. Studies on the success factors of a corporate portal project underline the important role of high level management support for the organizational project acceptance and success (e.g. Remus 2006).

The assessment of the business alignment of the corporate portal project is conducted on the basis of a set of suitable performance measurements. For the effectiveness of the project governance activities, it is crucial that these are relevant measurements that address the related project goals. Clearly, the challenge lies in the fact that some of the project goals will most likely address intangible facets of a corporate portal projects (e.g. community building). In these cases, it will be difficult to derive suitable quantitative measurements to determine the level of achievement of these project objectives. Thus, one has to consider semi-quantitative or qualitative measurements that rely on user surveys, or anecdotal evidence from interviews as primary sources of evidence (cf. Table 6). In either way, it is within the responsibility of the project executives (on the basis of the steering committee meetings) to define and agree on a set of suitable measurements for the evaluation of the success of the project, as

the saying "…*if you can't measure it, you can't manage it*…" (Peter F. Drucker) also holds true for strategic steering of corporate portal projects.

Table 6 shows a selection of quantitative, semi-quantitative, and qualitative corporate portal business goals and the related sources of evidence.

Table 6 – Selection of business goals related to quantitative, semi-quantitative, and qualitative measurements (following Terra and Gordon 2003, pp.142-145)

	Corporate Portal Business Goals	Sources of Evidence	Examples
quantitative	▪ Improvement of the efficiency of business processes ▪ Improvement	▪ transaction data ▪ costs sheets ▪ bills ▪ …	▪ Red. employee service costs ▪ Red. costs of system integration ▪ Red. costs of communication ▪ ...
semi-quantitative	▪ Gains in productivity related to improvement in information management processes. ▪ Improvement of knowledge management and collaboration within the organization	▪ user surveys ▪ interviews ▪ anecdotal evidence ▪ system usage logs ▪ …	▪ Red. time to publish documents ▪ Red. time to find information ▪ Increased revenue, sales ▪ Usage of corporate portal ▪ …
qualitative	▪ Improvement of user satisfaction regarding working conditions, employee's morale, communication, etc.	▪ user surveys ▪ interviews ▪ anecdotal evidence ▪ …	▪ Perceived performance impact ▪ Perceived satisfaction ▪ Improved communication ▪ …

The purpose of the following case study section is to illustrate the role of a steering committee for the governance and organizational backing of the *CoFiPot* project. Moreover the case study provides illustrative examples for the different level of corporate portal strategies.

4.2.3 *Case Study* Strategy and Steering of the Corporate Financial Portal Project

A steering committee was established as an institution for the governance of the Corporate Financial Portal project. The members of the steering committee comprised of the respective department heads of the Corporate Finance Center, the director of the Corporate Finance Center, and the heads of the chairs from the involved universities. A meeting of the steering committee was conducted once every six to nine months, a time-frame that round about relates to one main *CoFiPot* engineering cycle. The goal of the steering committee meetings was to present and discuss the progress of the project and to elaborate and define the set of long-, mid-, and short-term activities to address the main project goals within the subsequent engineering cycles.

The *long-term strategy* of the Corporate Financial Portal project was elaborated and agreed upon at the initial meeting of the project steering committee in June 2001. The project management outlined that in order to satisfy the project objectives, the *CoFiPot* would offer

reporting and transaction services for the main financial management domains, in particular with regard to treasury management, financial controlling, and financial planning. Additionally, the *CoFiPot* would host a public area with a number of services that provide access to market-data including corporate accounting rates and financial news. Besides, there would be a knowledge base area with information on worldwide contacts, affiliates, financial guidelines, reports, and documents on financial management topics.

To structure the task of implementing the long-term strategy, the project management defined *mid-term strategies* that focused on the implementation activities within one of the *CoFiPot* areas as described by the long-term strategy. Furthermore, for each of these mid-term strategies, *short-term work packages* were defined that clearly described the activities and defined the *CoFiPot* services that would be in the focus of the activities of the subsequent portal engineering cycle.

As one example, the *CoFiPot* project started with the implementation of a mid-term strategy that focused on activities that were related to the FX management domain. It was crucial for the success of the first *CoFiPot* prototype to provide services that clearly outlined the benefit of the *CoFiPot* project and furthermore fostered the visibility of the project throughout Bayer's financial community. In this regard, the FX management domain was selected according to the insights of the business potential analysis and the positive feedback from the interviews related to the assessment of the business goals. Following the successful implementation of the first portfolio of FX management services, other *CoFiPot* areas (e.g. cash management, services for the financial planning) were addressed in the subsequent engineering cycles.

Figure 15 illustrates a selection of *CoFiPot* strategies as presented and agreed upon within the project's steering committee meetings.[25] Note, that the implementation of the distinct mid-term strategies did overlap, in particular with the increase in development manpower in the second half of the project run-time.

[25] cf. *CoFiPot* steering committee presentations from 2001 to 2005: Bayer_SC 2001; Bayer_SC 2001b; Bayer_SC 2002; Bayer_SC 2002b; Bayer_SC 2003; Bayer_SC 2004; Bayer_SC 2004b; Bayer_SC 2005

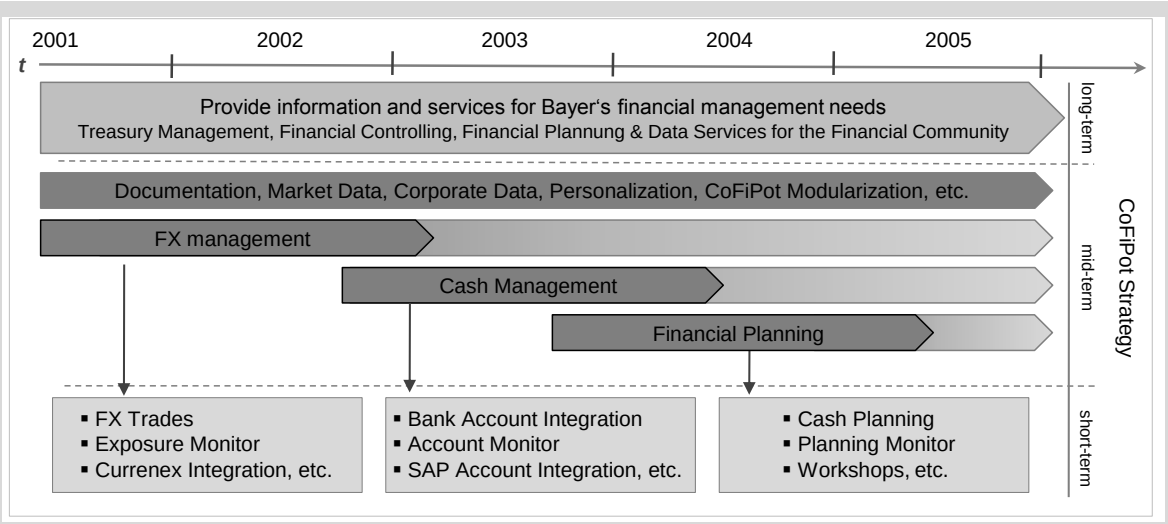


Figure 15 – Selection of different levels of portal implementation strategies from 2001 to 2005

In summary, the Corporate Financial Portal project insights underline the importance of establishing a project steering committee that consists of high-level management executives. Not only did the meetings of the project steering committee mark important milestones of the project progress, but the fact that the strategic decisions were implemented in accordance with these high-level executives provided an important level of organizational backing for the project activities. Additionally, from the perspective of promoting the project within the target user-community, the high-level management support provided a fair amount of visibility of the project in particular within their immediate area of organizational responsibility (cf. *CoFiPot* expert interviews, Appendix A.2, Part 7).

4.3 Chapter Summary

The business analysis and project alignment stage define the directions for the activities within the subsequent portal engineering cycle and are of particular importance during the initial phase of a corporate portal project.

The objective of the business analysis is to identify the current business problems and assess whether there is a substantial benefit from pursuing a corporate portal project; and if so, derive business objectives that clearly outline the business purpose of a corporate portal. The *CoFiPot* project experience showed that it does make sense to conduct the business analysis as a limited pilot project that involves workshops, discussions, and interviews with representatives of the potential target groups. This early involvement of the potential end-users not only ensures the development of a set of business objectives that addresses the users' needs but also fosters the general visibility of the project.

The activities within the business alignment phase ensure that the corporate portal project satisfies the business objectives. The definition of long-, mid-, and short term strategies that describe plans of actions on different levels of detail and time-frames provides the necessary directions for the achievement of the project goals. With respect to the governance of the project, a steering committee of high-level executives supervises the progress of the project and moreover provides the necessary organizational backing of important project decisions and activities that further strengthens the visibility of the project.

Following the definition of the project strategies and establishment of the project governance, Chapter 5 elaborates the main design components and relevant development models that foster the implementation of corporate portal services.

Chapter 5

Design & Implementation

The design and implementation of corporate portals components and individual portal services is not an "*out-of-the-box*" experience. The challenge lays in the customization of the primary portal design elements according to the project context and business requirements. Hence, the objective of this chapter is to elaborate references of the design of the portal application architecture, outline strategies for the integration architecture, and develop concepts for the information architecture.

The actual task of developing and implementing the corporate portal components and services can be facilitated by following suitable software development process models. The decision on the most appropriate development model depends on the characteristics and type of the portal component that has to be implemented. Development models that foster a structured, sequential development process, like the *Waterfall* model, support the implementation of portal application components that are characterized by a well known and defined set of requirements. On the other hand, agile evolutionary approaches are better suited for the development of portal services with an initially incomplete set of functional requirements and design specifications.

In the following, Section 5.1 elaborates requirements and design patterns that foster the specification of the main corporate portal application-, the integration-, and the information architecture components. Section 5.2 then focuses on software engineering process models that foster the implementation tasks. The Corporate Financial Portal case study sections provide the complementing insights on the customization and implementation of the reference models as well as insights on the development practices for typical corporate portal development scenarios.

5.1 Design Elements of Corporate Portals

The following sections focus on the characteristics of the main design elements of corporate portals. Section 5.1.1 elaborates the functional requirements on the corporate portal application architecture and describes a reference designs for the portal application architecture. Section 5.1.2 describes the different levels of integration in the context of corporate portals and elaborates the implications of corporate portal projects on systems integration initiatives. Finally, Section 5.1.3 outlines information architecture concepts for corporate portals and describes best practice design patterns that have been derived from the case study insights.

5.1.1 Corporate Portal Application Architecture

The corporate portal application architecture describes the primary system components and their relationships according to the main technical and functional application requirements. With regard to the current generation of corporate portal implementations available, either as open-source frameworks or provided by corporate portal vendors (cf. Vlachakis, Kirchhof et al. 2005;Gartner 2006), a corporate portal application consists of the portal engine application components that provide the fundamental portal functions and the individual portal services that are integrated by the means of a common portal interface. These portal services are self-contained Web applications that are subject to specific business requirements.

5.1.1.1 Requirements

The primary functional requirement on the portal application architecture is to provide the necessary means that allows for the dynamic integration and management of portal services[26] according to the user request (cf. Gurzki 2006, pp.39-40). The integration occurs on the presentation level, as the portal application server dynamically generates HTML pages that incorporate the representation of the individual portal services according to the portal structure and portal page - layout configuration. In this regard, the corporate portal application server provides a transparent access to the requested portal services. Figure 16 illustrates the portal service integration and page creation process.

[26] In technical discussions, portal services are commonly referred to as portlets. Thus, the term “portlet” is the identifier for a Java portal service container, that provides a plug-able user-interface component to the presentation of Information Systems (Abdelnur and Hepper 2003, p.13). For the purpose of consistence reference, this work uses the general term portal service.

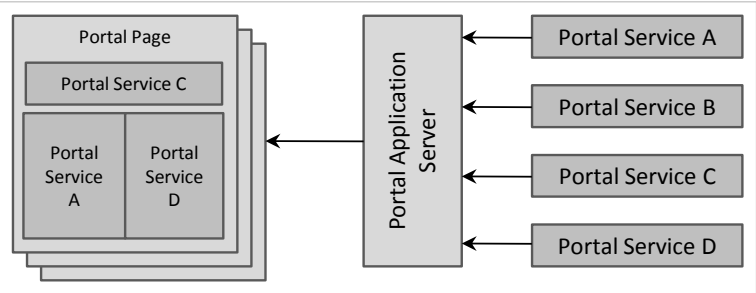


Figure 16 – Portal service integration and page creation (following Abdelnur and Hepper 2003, p.20)

Additionally, the corporate portal application has to support basic portal use cases and framework management functions including the configuration and management of the portal structure and layout, support for basic content management, user authentication, single sign-on, role-based security concepts, as well as user management tasks.

- **Configuration of portal structure Management portal layout**

  The corporate portal application framework has to provide components that allow for the configuration of the portal structure, as well as the general portal layout. The portal structure defines the overall portal structure with the main portal content areas, as well as the navigational links between these areas (Gurzki 2006, p.41). Moreover, the portal structure defines which areas and services are accessible to what kind of user-roles.

- **Management portal layout, personalization**

  The corporate portal application framework has to include layout management components that are responsible for the composition and generation of the portal pages according to the user's configuration and security rights (cf. personalization; Bellas, Fernández et al. 2004, p.234).

- **Basic Content Management**

  The corporate portal application framework has to provide means for the management of static content that is not dynamically generated. One example is the specification and configuration of the portal master-page that outlines the main content areas including the site-header, footer, and navigation area.

- **Authentication and Single Sign-On**

  With regard to security requirements, the authentication components and mechanisms verify the digital identity of a (user sign-in) request. There are different ways to implement authentication mechanisms. As one example one can rely on the basic HTTP Web server authentication mechanism, or implement and use a public key infrastructure (e.g. Puschmann 2003, pp.90-92). In this context, single sign-on mechanisms allow the portal

user to access portal services and enterprise applications without the further need for authentication.

- **Role-based Security Concept**

  Although it is technically possible to associate and manage access to portal content on an individual user basis, the common practice is to implement a role-based security concept based on portal-roles due to reasons of user management complexity (cf. Großmann and Koschek 2005, p.105). Moreover, these portal-roles are at the center of the mechanisms for adapting portal structure, content, and layout according to the roles, as well as the management of service level access rights.

- **User management**

  A corporate portal has to offer components for the administration of the portal users. These user-management components have to provide the necessary means to assign the required portal security roles to the users, thus specifying the content areas and services a user has access to.

From a technical perspective, the corporate portal application architecture has to consider aspects like performance, reliability, and scalability. However, these technical requirements are usually addressed by mechanisms of the underlying application platform (e.g. .NET).

5.1.1.2 A Reference Application Architecture for Corporate Portal

Figure 17 illustrates a portal application reference architecture that comprises the portal server Web application, the portal skeleton (1), the portal server engine (2) that support the basic functional requirements, and a repository of individual portal services (3). The Portal Service API (Application Programming Interface) has to be implemented by all portal services and provides the means for the communication among the portal Web application, the portal server engine components, and the individual services.[27]

[27] The corporate portal application architecture is commonly discussed to represent a 4-tier architecture design, with the end-user client, the portal Web application (Web server tier), the portal server engine (application server tier), and the (external) portal data each representing one tier of the architecture (Puschmann 2003, p.43).

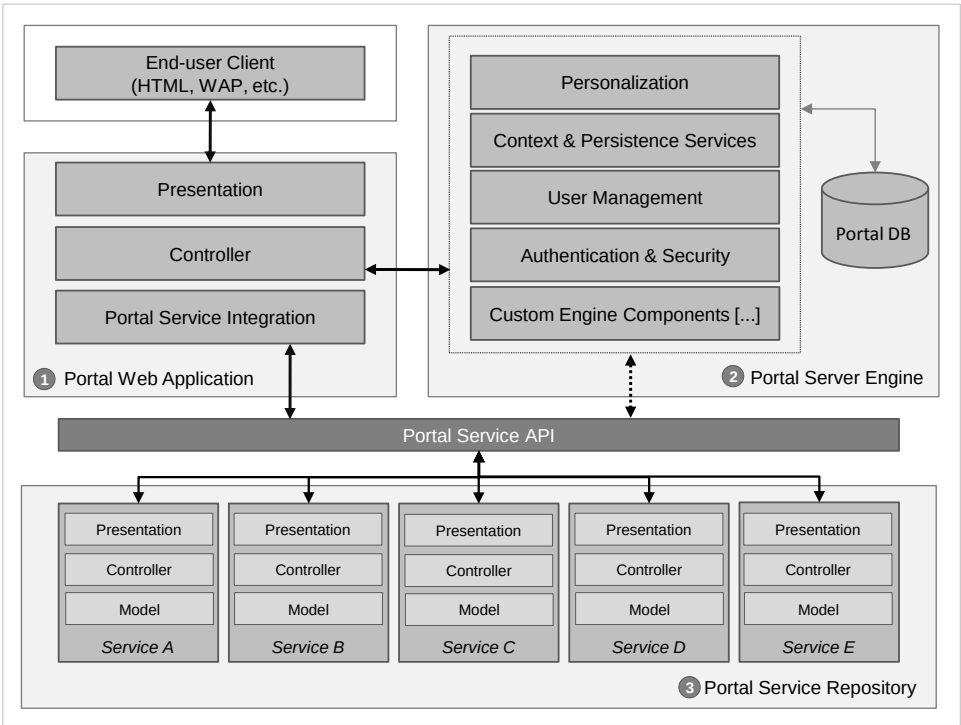


Figure 17 - Reference application architecture for corporate portals

The *Portal Web Application* is structure according to the Model-View-Controller design pattern (cf. Reenskaug 1978; Jacyntho, Schwabe et al. 2002, p.3) that clearly separates the presentation components (view) from the data components (model), by means of an intermediate coordination component (controller). At the core of the *Portal Web Application* is the *Controller* component that coordinates the interactions of the *Portal Server Engine* functionality and the portal services provided by the *Portal Service Integration* component. Moreover, the *Presentation* component performs the server-side generation of the requested portal pages according to the portal structure and layout configuration underlying the current usage context.

The *Portal Server Engine* contains the application components that are necessary in order to support the main portal use cases as outlined in Section 5.1.1.1. Thus, there are components that support and are subject to the personalization-, user management-, single sign-on, as well as authentication and security requirements. Moreover, the *Portal Server Engine* has to implement mechanisms to store and manage the data of the current application state and usage context.[28] These mechanisms build upon the existing mechanisms for Web application state management as provided by the underlying Web application development framework (e.g. Sun ONE Architecture, ASP.NET, cf. Gurzki 2006, p.38). The basic portal application func-

[28] For comprehensive discussion of the main functional components of corporate portals refer to Großmann and Koschek 2005, pp.157-170; Vlachakis, Kirchhof et al. 2005; Gurzki 2006

tionality can be extended by introducing further custom portal engine components. Examples are services that generate portal level messages, or system heath monitoring components (cf. Chapter 7). The *Portal Server Engine* components communicate with the portal services by the means of the *Portal Service API*. As one example, this can allow the *Portal Server Engine* components to request portal service functionality in a programmatic way (cf. Vo, Weinhardt et al. 2006).[29]

The *Portal Service Repository* consists of the individual portal services. A portal service is a self-contained Web application with a presentation layer, a controller, and the data access components. As such, portal services can be designed and developed separately. With the *Portal Service API*, the portal services inherit the necessary properties, methods, and interfaces in order to behave properly within the corporate portal application environment. Most importantly, the *Portal Service API* will provide the necessary means to allow for the dynamic invocation and seamless integration of the portal services into the current portal application context.

The first generation of portal framework implementations was characterized by a lack of standardization that made it difficult to consume portal services across different portal implementation. To overcome these limitations, current generation portal framework implementations rely on the following standards that define a common Portal Service API: the Web Services for Remote Portlets WSRP (cf. OASIS 2004) and the Java Portlet specification (cf. Abdelnur and Hepper 2003; Sun and IBM 2003). While the Java Portlet specification defines a Portal Server API for the implementation of *local* portal services, portal services that are developed according to the WSRP standard addresses the development of portal services that can be consumed by *remote* portal applications through the means of standard Web Service interfaces (cf. Bellas 2004).

The following case study section describes the design and implementation, as well as outlines the evolution of the corporate portal application architecture according to changes in the project requirements. Furthermore, for illustrative purpose and as best-practice solutions, the case study section provides insights on the implementation of a role based concept and the sign-in, authentication, and personalization use-case.

[29] The reader is referred to Vo, Weinhardt et al. (2006) for a detailed discussion of the implementation and practical benefits that stems from the programmatic execution of portal services.

5.1.1.3 *Case Study* The CoFiPot Application Architecture

The *CoFiPot* implementation is originally based on the open-source IBuySpy portal starter kit. Microsoft provided the IBuySpy portal starter kit as a show case and best-practice of how to implement a Web application framework by the means of the ASP.NET web application development platform (Walker, Brinkman et al. 2006, pp.2-11). This portal framework was adopted by a number of open-source initiatives as the foundation for more advanced portal frameworks with the DotNetNuke[30] portal framework being the most prominent example.

The IBuySpy portal starter kit uses a multi-tier application architecture that implements the Model-View-Controller design pattern. A number of components provide the basic portal engine functionality including security, user management, and portal configuration on top of the portal data layer as described in Chapter 5.1.1.1 (refer to next sections for details on use case implementations). Furthermore, the *PortalModuleBase* API functions as a basic Portal Service API and allows for the invocation and dynamic integration of the IBuySpy portal services into the IBuySpy Web application skeleton (Microsoft 2002, p.3).[31] Figure 18 shows the IBuySpy application architecture as implemented by the first *CoFiPot* version.

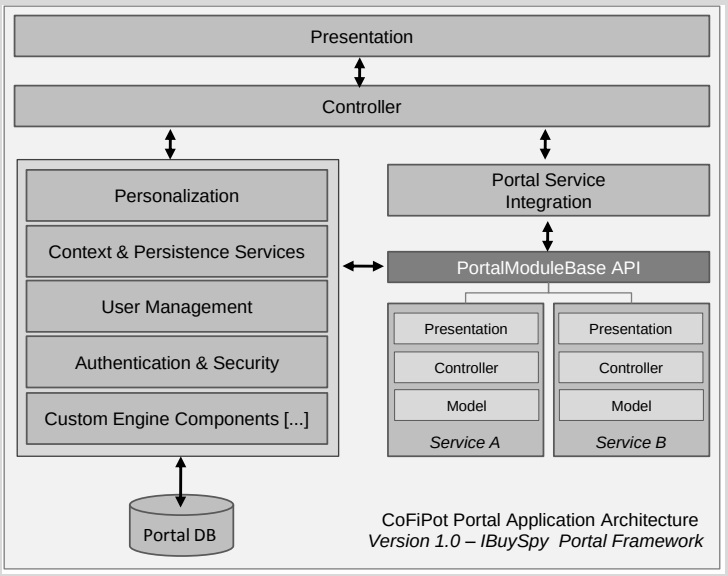


Figure 18 – The *CoFiPot* Application Architecture implementing the IBuySpy Portal framework

The IBuySpy portal implementation served as an important starting point for the evolution of the *CoFiPot* application architecture. One major drawback of the IBuySpy portal

[30] www.dotnetnuke.com
[31] The reader is referred to the ASP.NET Whitepaper on the IBuySpy Portal Framework for a detailed discussion of the framework components.

architecture is the fact that it resembles the reference architecture only on a conceptual level. The conceptual separation between the portal engine components, the Web application components, and the portal services, does not translate into distinct project assemblies, but every application component is part of one single large portal application assembly. While this implementation has no effect on the proper operation of the portal application, it did however limit the flexibility of the development tasks. On the one hand, with every extension to the corporate portal application, it became more difficult to keep on overview of the application architecture. On the other hand, the code size and complexity made it difficult to explain and outsource development tasks. Therefore, it became necessary to extract and regroup the *CoFiPot* application components into three independent application framework components: the portal engine, the portal application, and the portal services.

The current *CoFiPot* application architecture implements the reference architecture as illustrated by Figure 17 and described in Chapter 5.1.1.2. From a development perspective, the re-structuring and the strict separation of the principal portal application framework components has improved the effectives of the development tasks. It has become possible to clearly assign a development tasks to a specific application area and rest assure that this task can be conducted without affecting developments in other application areas. Therefore, the outsourcing of portal development tasks, in particular the development of portal services, has become a feasible option. For the development of corporate portal services, developers are only required to inherit the *CoFiPot* Portal Service API (i.e. *CoFiPot Module Base* API) to ensure that the resulting portal service can be consumed by the *CoFiPot* Portal Server implementation.

As best-practice solutions, the following sections describe the *CoFiPot* portal-roles concept and outline the *CoFiPot* implementation of the Sing-In, Authentication, and Personalization Use-Case use case.

CoFiPot Portal Roles Concept

The *CoFiPot* portal-roles take a central role within the mechanisms for the management and personalization of the portal structure and layout, as well as the security concept implemented by the portal services. As depicted in Figure 19, the concept of the *CoFiPot* Security Role is derived from the actual organizational roles (e.g. cash manger, foreign exchange manager). The employee's organizational role defines her domain of work and her functions and tasks within this domain. The same holds true for the *CoFiPot* security role within the *CoFiPot* scope that users are assigned to. On the one hand, the *CoFiPot* portal

structure and layout is adapted depending on the user's security roles (e.g. for cash managers a cash management content area will be offered). On the other hand, the security roles determine the level of functionality and data access provided by the portal services she has access to (cf. Figure 19).

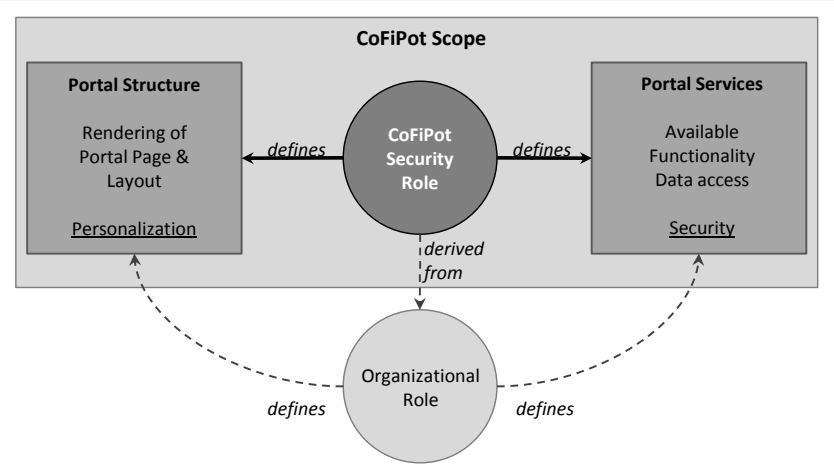


Figure 19 – *CoFiPot* security roles concept

For the portal services, the *CoFiPot* implements three levels of access for the *CoFiPot* services: *read*, *write*, and *manage* that can be associated with *CoFiPot* security roles. In general, users that are assigned read rights are able to request service reports, only. Users with write rights are offered further options to alter or submit data like for instance reporting financial data. Lastly, user with manage rights are furthermore offered administrative functions, for example in order to manage business configuration settings for the specific *CoFiPot* service.

Figure 20 illustrates the *CoFiPot* security roles with regard to the *CoFiPot* services. The *CoFiPot* user Alice is in the *Planning Manager* security role and thus has full access to the *CoFiPot Financial Planning* service. On the other hand, the *CoFiPot* user Charlie is in the role *Planning Reader*, thus he is only able to request and read the reports provided by the *CoFiPot Financial Planning* service.[32]

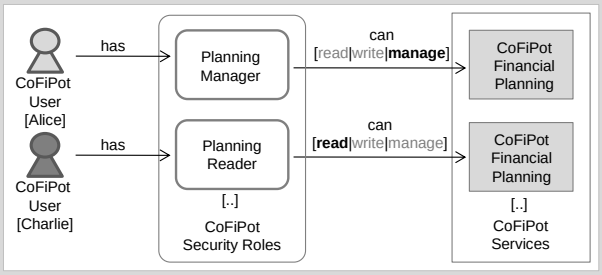


Figure 20 – *CoFiPot* users and security roles

[32] The *CoFiPot* administrative services that are required for managing the *CoFiPot* security roles with regard to the portal structure and the access level provided by the portal services are described in detail in Chapter 7.

CoFiPot Sign-In, Authentication, and Personalization Use-Case Implementation

The *CoFiPot* implements support for the fundamental portal use-cases. As one example, Figure 21 describes the sign-in, and authentication of a portal user, as well as the personalization of the portal service offerings according to the user's preferences.

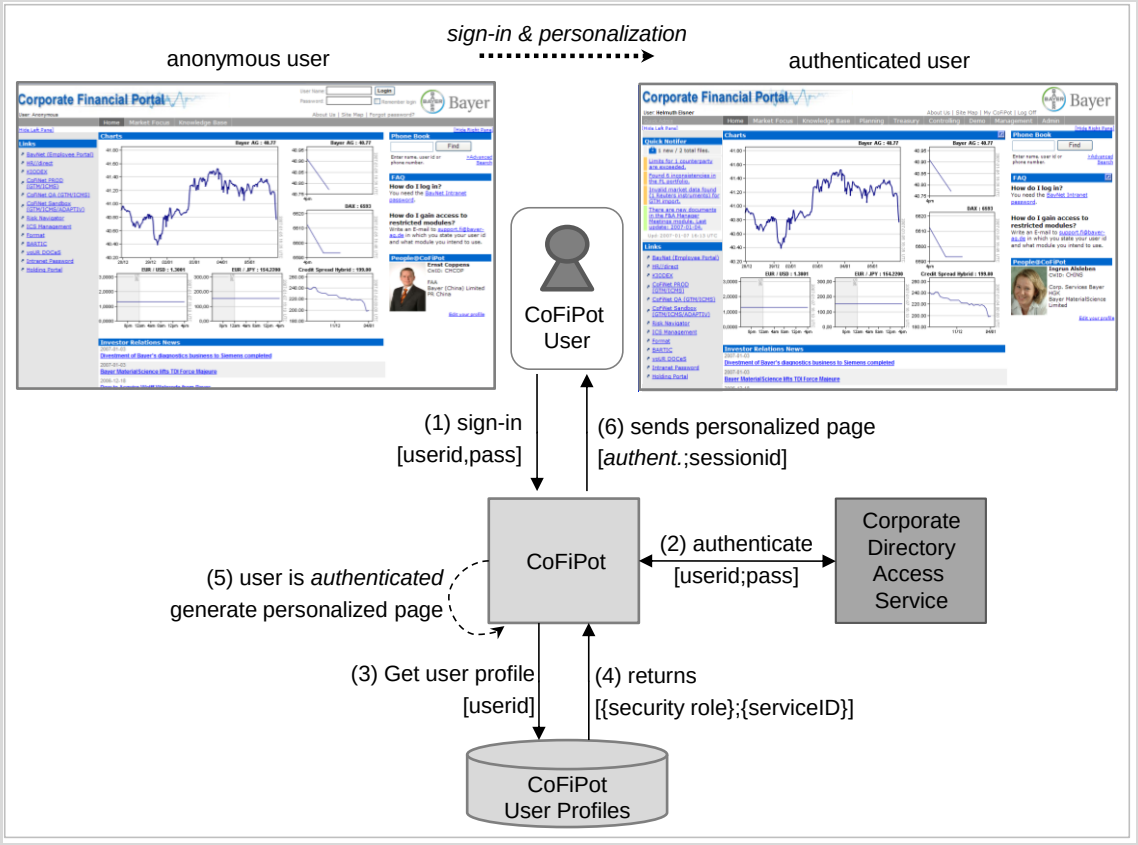


Figure 21 – *CoFiPot* sign-in, authentication, and personalization use case

In order to sign-in, the user has to submit his credentials (i.e. userID, password). In principal, the authentication component implements the basic HTTP Web server authentication mechanism using the Secure Socket Layer SSL communication protocol (cf. Rescorla 2003). Yet, the user's sign-in credentials are not verified against the *CoFiPot* user database, but against the external corporate directory access service. By relying on this external corporate user directory, the users do not have to remember dedicated login information for the *CoFiPot*. After the corporate directory access service confirms the user credentials, the *CoFiPot* retrieves the information on the user's preferences that is stored in the *CoFiPot* user database. Among others, the user preferences comprise of information on the *CoFiPot* security roles that specify the user's access level. On the basis of the information on the user's preferences, the CoFiPot controller and presentation components render the personalized portal page that is then send to the user's Web client.

5.1.2 Corporate Portals Integration Architecture

One key benefit attributed to corporate portals is that these information systems foster the integration of people, processes and other information systems throughout the organization as well as between different organizations (cf. Chapter 3, Section 3.1.1). Though, strictly speaking, a corporate portal provides integration on the presentation level, only.

It is important to realize that the scope of the corporate portal application framework does not incorporate the methods and instruments required for the portal services to connect to and access the functionality and data of the underlying enterprise information systems. Instead, the corporate portal services have to rely on the integration strategies, approaches, and instruments implemented and provided by the underlying systems integration architecture. Due to the scope and complexity of systems level integration, the corporate systems integration initiatives should be addressed by dedicated projects. In this context, a corporate portal project may influence these systems integration initiatives with specific integration requirements.

The purpose of this section is to discuss the different level of integration in the context of a corporate portal implementation and thus to provide the understanding of the scope to be covered by a corporate portal initiative and that of a enterprise systems integration project, as well as the implications on the latter.

5.1.2.1 Levels of Corporate Portal Integration Architecture

With regard to corporate portals, the integration architecture has to address integration requirements on at least three distinct levels: the portal level integration, the business process level integration, and the systems level integration. For the latter, two typical integration strategies are described.

- **Portal Level Integration**

  Portal level integration refers to the presentation level of integration of external application functionality and data. As the portal services share a common user-interface and layout, the user is left unaware of the information systems that actually provide him with the functionality and data he is working with. Portal level integration is inherent to the concept of a Web portal as one single point of seamless access to information and functionality and is realized by the portal services that provide a transparent presentation level wrapper for the integrated systems (cf. generation of portal pages).

- **Business Process Level Integration**

  Generally, business process integration deals with the "…invocation of processes in the correct and proper order to support the management and execution of common processes that exists in and between application…" (Linthicum 2003, p.11). In this regard, a corporate portal can support the implementation of these common processes by integrating portal services that encapsulate and expose the relevant underlying process components. The corporate portal provides the management framework for the invocation of these portal services in the correct order and customized for the target audience.

- **Systems Level Integration**

  The system level integration architecture defines the set of instruments and integration approaches for information systems to connect to and communicate with one another.

  Methods and instruments to support integration on the systems level are discussed within the topic of Enterprise Application Integration EAI. EAI addresses general mechanisms, strategies, and instruments for the integration of heterogeneous information systems on the application transaction level with the objective to compose new business processes (e.g. Linthicum 2000; Kaib 2002). The communication of heterogeneous systems is realized by the means of integration middleware components. In general, these middleware components implement mechanisms for the mapping of the different data formats from one system to the other. Following the EAI discussions, the implementation of this integration middleware usually follows a hub-and-spoke, many-to-many strategy, such that for every system that is to be integrated one has to establish only one connection to the integration middleware hub (e.g. Linthicum 2004, p.116; Kaib 2002, pp.86-87; Figure 20, *many-to-many strategy*). Figure 22 illustrates the difference between the point-to-point and the many-to-many integration strategy commonly implemented in EAI initiatives.

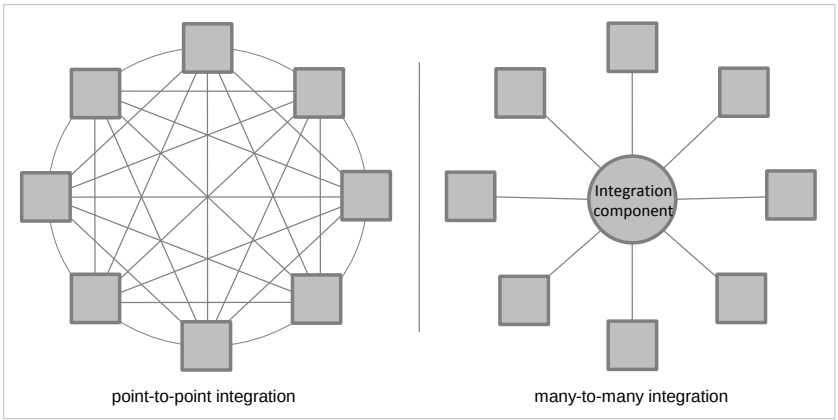


Figure 22 – Point-to-point integration vs. many-to-many integration strategy (following Großmann and Koschek 2005, pp.117-118)

The benefit of establishing a many-to-many integration strategy is the reduction of the number of direct system connections that need to be maintained from $n(n-1)/2$ in case of the point-to-point integration to *n* (with *n* being the number of systems that have to be connected). Furthermore, the integration of a new system only requires establishing one more connection with the integration middleware system instead of $n-1$ connections to all other systems. The same holds true if one existing system has to be replaced (cf. Schelp and Winter 2002, p.9).

This integration flexibility comes at the cost of establishing and maintaining the central middleware system. It requires discipline from the system administrators and developers to agree on intermediate system-independent data formats that are necessary to consistently translate the data-format from one system to another. This will translate to a more complex design task than that of defining direct connection between two systems. Hence, for organizations that rely on a small number of information systems only, the many-to-many integration approach might be too much of a good thing.

In the context of corporate portals and integration, the opposite situation will be more likely the case. One will have to deal with a potential large number of information systems that need to be accessed by a large number of the portal services. In this regard, the hub-and-spoke integration strategy will limit the number of direct connection between the portal services and the relevant information systems. Accordingly, every portal service has to communicate with the central integration middleware in order to access the relevant information systems.

In summary, the portal level integration is inherently provided by every corporate portal application. The implementation of business process level integration is on the one hand subject to the results of the business analysis and alignment phase that has to identify the relevant common processes and the underlying process components that have to be implemented as portal services. In this regard, the systems level integration architecture takes a crucial role as it defines the integration strategy that is to be implemented by the portal services.

The design and implementation of the systems level integration architecture is at the center of the following case study section. The case study illustrates the importance of implementing a central integration layer based on common business objects, especially with regard to the demands of future integration requirements.

5.1.2.2 *Case Study* CoFiPot Systems Level Integration Architecture

The first batch of *CoFiPot* services that were developed followed a point-to-point approach to integrate the functionality and data of the underlying information systems. However, the development team realized that this approach was not going to scale with the growing number of portal services. Furthermore, the portal service developers encountered a number of cases in which new *CoFiPot* services would require the same or similar access to one information system as it has already been realized by existing services. From a practical perspective, solving this situation translated to a simple cut-and-paste and modification of the relevant interfaces. Yet, not having the possibility to conveniently re-use existing application code and faced with the thread to have to modify a large number of *CoFiPot* services once critical parameters of the underlying applications change, has lead to the implementation of a dedicated *CoFiPot* Integration Layer.

Every integrated application system only maintains direct connections to the *CoFiPot* integration layer, not to the *CoFiPot* services. To foster modularization and facilitate re-use of application functions, the *CoFiPot* Integration Layer defines application independent business objects and useful business logic. The *CoFiPot* services integrate and use these application independent components only. Figure 23 illustrates the role of the *CoFiPot* Integration Layer with regard to a selection of information systems that are involved for Bayer's treasury management processes. The information systems are only directly connected to the *CoFiPot* Integration Layer that maps the application specific data on *CoFiPot* Business Object and wraps application specific functionality within *CoFiPot* Business Logic components.

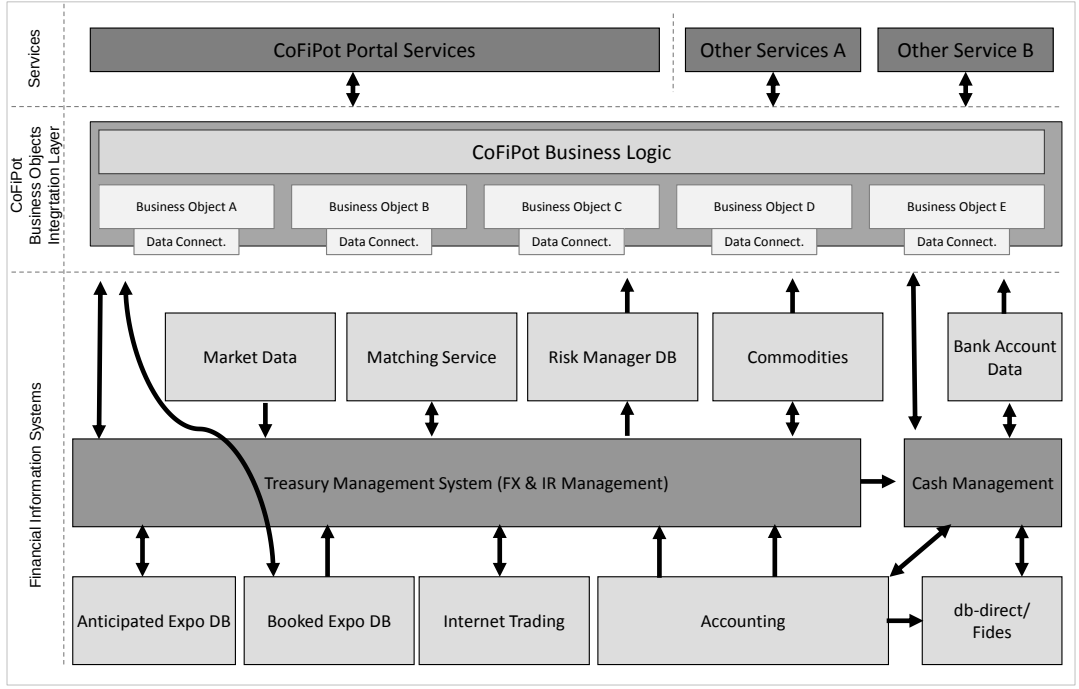


Figure 23 - *CoFiPot* integration architecture in the context of treasury management systems

The introduction of the *CoFiPot* Integration Layer resulted in a number of benefits: The *CoFiPot* services became independent from the underlying applications. Breaking changes to an application interface now only require adaptations within the data access components of the *CoFiPot* Integration Layer, but no maintenance efforts on the individual *CoFiPot* service level. This fact proved useful during the LANXESS company spin-off in January 2005 (LANXESS 2007) that required the porting of the *CoFiPot* to the information systems landscape of the newly founded company. With the *CoFiPot* Integration Layer concept, only the interfaces within the data access layer had to be modified according to the requirements of the LANXESS systems which drastically reduced the efforts of porting the application to the new systems landscape (Bayer_SC 2005).

The *CoFiPot* Integration Layer not only improved the flexibility for integration tasks, but in addition facilitated the development of new *CoFiPot* services by providing a convenient concept to re-use existing business components. Moreover, the *CoFiPot* Business Objects are not exclusive to the *CoFiPot* services. The *CoFiPot* Business Objects Integration Layer provides business objects to a number of different applications of the financial information systems landscape. One example is the seamless integration of external foreign exchange multibank marketplaces into the Bayer's FX management processes. The *CoFiPot* foreign exchange business objects could be re-used in order to save the data on the external transactions to Bayer's treasury management system (cf. Börsen-Zeitung 2003; Vo, Wojciechowski et al. 2005).

5.1.3 Information Architecture Concepts for Corporate Portals

The information architecture consists of information concepts, components, and design patterns that organize and structure the information content (cf. Rosenfeld and Morville 1998, p.4-8). Thus, the design scope encompasses the specification of the navigation structure, the definition of the terminology and labels used to mark specific content areas, the design of user-interface components, as well as the implementation of proven patterns and processes that support the user's information process. The purpose of the following sections is to describe the concepts and proven design patterns for the main information architecture components.

5.1.3.1 Outline and Requirements

The primary challenge of and requirement on the design and specification of the information architecture components arises from the fact that people are different: A navigation structure that is considered straight forward by one group of users might be incomprehensible for others. Therefore, the information architecture design has to accommodate for the different views on the corporate portal as well as on the individual portal services.

On the portal level, the goal of the information architecture is to provide the portal users with the necessary means to search, identify, and navigate to the relevant portal content areas and the integrated services. Principally, the information architecture on the portal level have to consider the background of all potential portal users thus should pay particular respect to a simple and intuitive design of the relevant components.

For the portal services, the same holds true for the design of *public* portal services, i.e. portal services that target all users. On the other hand, portal services that address a specific target audience will further have to address the specific requirements of this target audience within the design of the respective information architecture components.

5.1.3.2 Components of Corporate Portal Information Architecture

Following Rosenfeld and Morville (2002), the information architecture consists of components that belong to organization systems, labeling systems, navigation systems, or searching systems.[33]

Organization systems foster the categorization and organization of portal areas and information content by defining organization schemes and structures. The organization scheme

[33] The purpose of this work is to provide a brief overview of the fundamental types of information architecture components. The reader is referred to Rosenfeld and Morville (2002) for a comprehensive elaboration of the different concepts.

defines the properties of content items that are used for the grouping of items. As an example, a chronological organizational scheme can be used to group news items according to their news-date. In contrast, the organizational structure describes the relationship between the content items and the group they belong to (Rosenfeld and Morville 2002, p.55): A taxonomy that defines that the trees are one kind of plants is one simple example of a strictly hierarchical organizational structure. In contrast, Hypertext links are an example of a nonlinear way for structuring content (Rosenfeld and Morville 2002, p.73). Organizational structures play an important role in the design of corporate portals as they define the basic paths for navigating through the content provided.

Labeling systems define how the content is addressed by means of representative terms. In principal, labels are nothing more than the representation of a "…larger chunks of information…" (Rosenfeld and Morville 2002, p.76). Labels facilitate the orientation and navigation within the content provided. One example of a suitable label is the term "home" that associates that the user can return to the portal Home Page by clicking on this label. Further examples are "contact us", or "FAQ", or iconic symbols like a shopping card. While labels are useful as headlines for structuring the content and important to represent navigation options, they have to be selected carefully or else might cause confusion and misinterpretation among the users that will result in frustration and a negative attitude towards the system. In the context of corporate portals, this is especially important for the selection of the labels that are used within the public portal areas.

Navigation systems provide users with means to browse through the portal content. The task of the navigation systems is to prevent that the users get lost while browsing through the content. Thus the navigation systems have to clearly outline (e.g. Rosenfeld and Morville 2002; Nielsen 2000, p.188):

(i) *what a user can do* (ii) *where she can go* (iii) *where she has been*

Basically, navigation systems comprise of global, local, and contextual navigation components that are embedded within the Web pages themselves (Rosenfeld and Morville 2002, p.107). Global navigation components outline the major areas where a user can go. Local navigation components (sometimes also referred to as secondary navigation components) tell the user on which items she has access within a specific content area. Finally, the contextual navigation systems are embedded within the content itself and allow for a direct navigation to related content, usually by means of hyperlinks. In this sense, contextual navigation provides the flexibility to bypass the hierarchical navigation paths defined by the global and local navi-

gation level. Furthermore, supplementary navigation systems like sitemaps, indexes, guides, or search systems are portal services that provide additional means of navigation and finding information (Rosenfeld and Morville 2002, p.107). Sitemaps offer a comprehensive view of the global and local navigation levels, usually by the means of a navigation tree. Closely related to sitemaps are indexes that provide a list of content items according to an organization scheme and provide direct access to these items. Guides, on the other hand, are often used as an instrument for providing a linear navigation through a set of content items that share a common subject. A tutorial is a characteristic example of a guide.

Searching systems enable the search for information. The main design parameters of search systems comprise of the search algorithm, the design and placement of the search user-interface component, and the context and user-centric processing and presentation of the search results (Rosenfeld and Morville 2002, p.136).[34] Although, the search function was central to the first generation of portals one should consider the question whether and what type of search function the actual corporate portal implementation requires. As an example, a full-text search engine is neither necessary nor appropriate for a corporate portal that primarily focuses on processing and providing financial data, i.e. dynamically generated numbers make up a primary part of the output content. In the end, what matters is that the user has a convenient way to find the information she is looking for, either with the support of search systems or by other means of the information architecture.

The following case study section describes the design of the main components of the *CoFiPot* information architecture. While part of the design is subject to the Bayer guidelines on the design of Intranet sites, the case study describes original design patterns that have been derived as best-practice solutions as a result of an evolutionary development process.

5.1.3.3 *Case Study* Components of the CoFiPot Information Architecture

Bayer's corporate design guidelines have been the starting point for deriving the current state of the *CoFiPot* information architecture. To foster consistent Web presences throughout the Bayer Intranet, the guidelines define the general Web site structure, the correct use of corporate colors, and provide a set of terms and symbols that can and should be used within the respective Web sites. With regard to the Web site structure, the guidelines define that an Intranet Web site has to comprise of a site header that host navigation functions and three distinct content panes: a left, middle, and a right pane. Main portal content is displayed within the

[34] The reader is referred to Baeza-Yates and Ribeiro-Neto 2005 for a comprehensive elaboration on the topic of information retrieval.

middle pane that occupies the majority of the screen estate, while the left and right panes host secondary content.

CoFiPot Portal Level Information Architecture Components

The **primary navigation systems** are integrated into the *CoFiPot* site structure as follows: The general navigation systems are placed within the site header and outline the main *CoFiPot* content areas a user has access to. After the user navigates to one of these content areas, the label representing this area is highlighted for orientation purposes. Furthermore, the portal services that belong to this content area are accessible through a local navigation system within the left pane. The content of the *CoFiPot* services is displayed in the middle pane and incorporates means to support contextual navigation. **Supplementary navigation systems** including the implementation of a *CoFiPot* site map, as well as basic guidelines as for conducting typical financial management tasks complement the primary navigation systems. Figure 24 illustrates the *CoFiPot* Web site structure and the integration of the primary navigation systems.

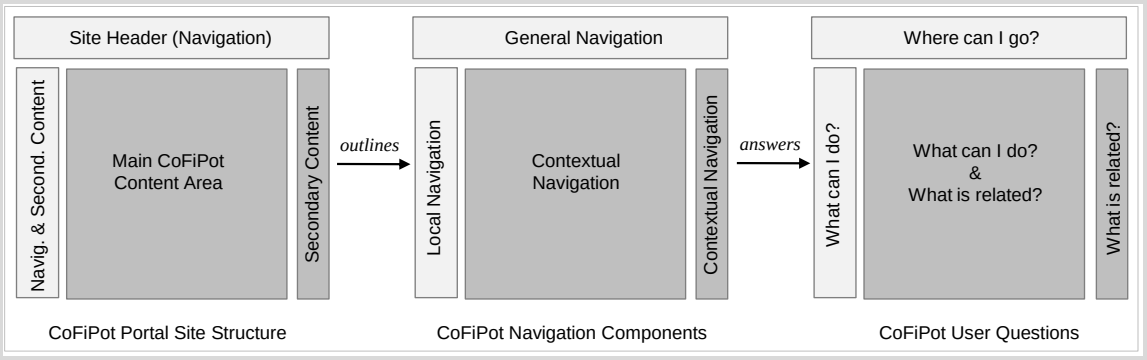


Figure 24 – *CoFiPot* primary navigation system components

The **organizational structure** that defines the global and local navigation choices in parts resembles the functional structure of the Corporate Finance Center. Basically, the main *CoFiPot* content areas can be broken up into three types: public areas, areas of interest for the financial management, and administrative areas. The public areas consist of the *CoFiPot* Home Page "*Home*", the "*Market Focus*" area that provides market data of general interest, and the "*Knowledge Base*" that manages documents on topics of Bayer's financial management. The financial management related areas currently comprise of the "*Treasury*" area with services for the treasury management tasks, the "*Controlling*" area that focuses on services to support the financial controlling processes, and the "*Planning*" area that aggregates services for the financial planning processes. Finally, the administrative area that is only accessible by the *CoFiPot* portal administrators and a small number of expert users, includes the "*Management*" area for user-management related tasks, the

"*Demo*" area that host *CoFiPot* services that are still in development, and the "*Admin*" area for *CoFiPot* related administration needs.

Labeling systems are based on a set of representative terms, symbols and the use of color-coding complement the *CoFiPot* information architecture. Labels within the public *CoFiPot* areas borrow terms and iconic symbols from other Bayer Intranet sites and well prominent public Internet portals. In this regard, the goal is not to invent and introduce new symbols or terms but to confront the users with concepts that they are most likely already familiar of by visiting other Web presences. As an example, a (not always visible) warn-sign is used to represent important messages. One further example is the color-coding of the workflow-related messages generated by the *CoFiPot* Notifier service that helps the users to prioritize their workflows messages.

Searching systems play a minor role within the *CoFiPot* information architecture. As the content provided by *CoFiPot* services primarily consists of the structured aggregation of financial numbers the typical full-text based search is meaningless. Search systems are integrated on an individual *CoFiPot* service basis. For example, it makes sense to have a full text search over the Bayer phone book data. Yet, with the increasing number of portal services there are plans for a portal level searching system that provides a search among the metadata describing the functionality of each *CoFiPot* service.

Figure 25 illustrates a selection of the information architecture components in the context of the *CoFiPot* Home Page and with a *CoFiPot* user signed into the system, thus personalization mechanisms are applied. In the case that a new, unregistered user visits the *CoFiPot*, the Home Page will be *stripped* of all the personalized information components like the *Quick Notifier* messages (left-pane), or the *My CoFiPot* area (header, supplementary navigation). Thus, the user will only have access to the public content areas. Note that the left-pane local navigation system is absent from the Home Page, but will be present as soon as the user delves into one of the other *CoFiPot* areas.

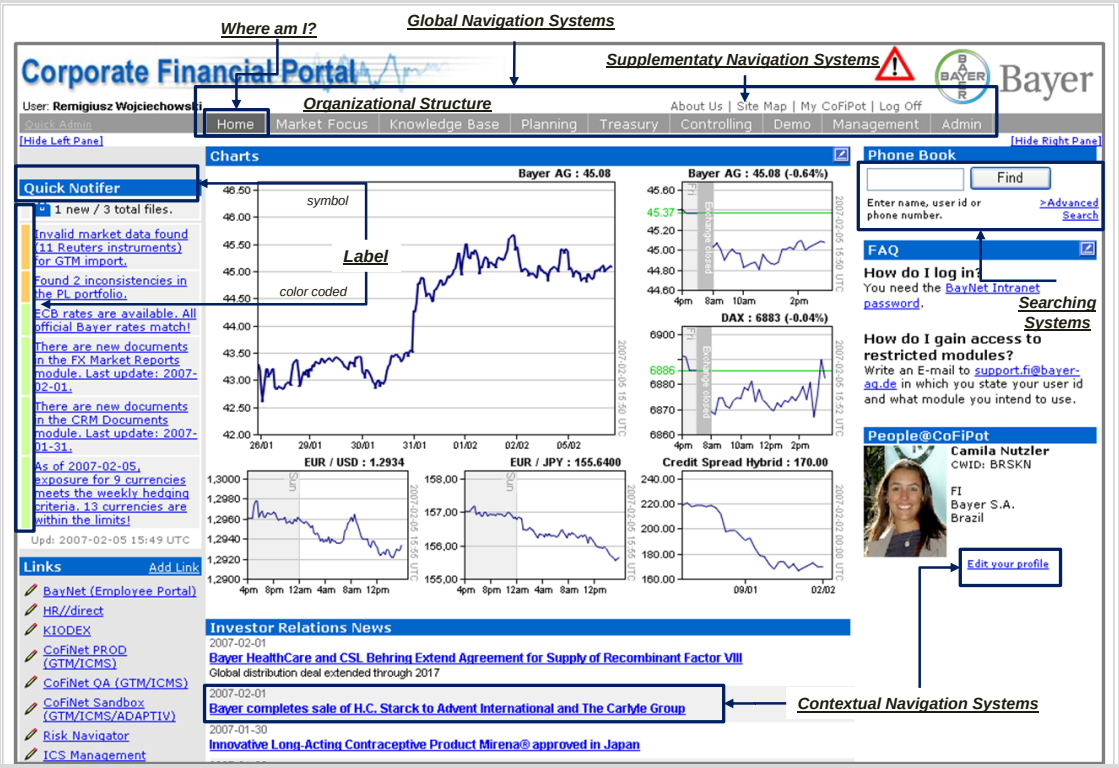


Figure 25 – *CoFiPot* portal level information architecture components

CoFiPot Service Level Information Architecture Components

Following the observation that it is easier for the *CoFiPot* users to interact with the *CoFiPot* services if they are confronted with information architecture components they are used to work with, the layout structure and information architecture components of *CoFiPot* services was unified. Figure 26 shows the basic structure of a typical *CoFiPot* service, and the embedded **primary navigation systems** with regard to the user's information process.

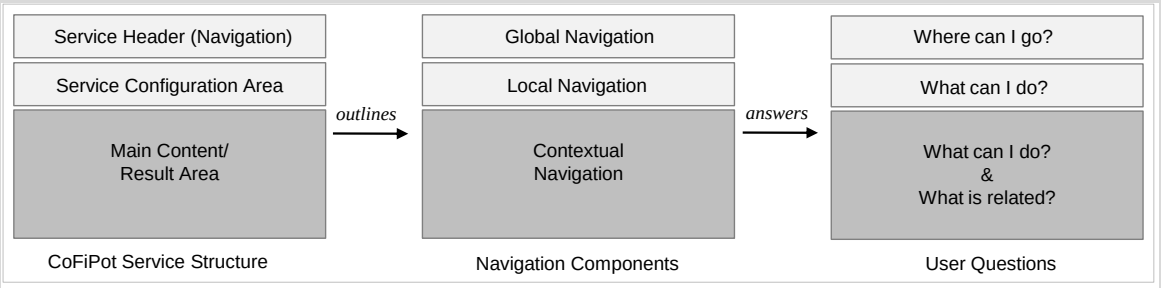


Figure 26 – *CoFiPot* service structure and primary navigation systems

Every *CoFiPot* service is structure into three parts: the service header, the service configuration area, and the main content area for the results of service requests. The service header incorporates the global **navigation systems** to switch between main functional areas of the service: usually a reporting area, a data-management area, and general service administration area. The interaction and configuration options within one of these areas are handled by local navigation systems within the service configuration area. As one example,

for the service reporting area, the local navigation systems will provide a set of filters, input, and selections components that allow the user the specify her reporting requests. Contextual navigation systems like drill-down components or hyperlinks enable the user to browse through the details of the generated reports.

Past implementations of *CoFiPot* service relied on one level of navigation, only. However with the development of more complex services, that try to follow a more comprehensive approach to address the requirement of one specific business process, it was necessary to add a second level of navigation to reduce the complexity of using the service. Therefore, for the current *CoFiPot* services, the **organizational structure** defines functional areas according to the steps of the underlying business process. One example is the *CoFiPot FX Trades* service that supports the foreign exchange transaction management process. This process is divided into two stages: the deal-entry, and monitoring the deal with appropriate reports. Consequently, the *CoFiPot FX Trade* service offers a "*Deal-Entry*" area and a "*Reporting*" area to structure the services functionality according the main stages of the underlying business process.

Like it is the case with the public *CoFiPot* content, the **labeling systems** applied within the *CoFiPot* services rely on a selection of representative symbols, comprehensible terms, and the use of color-codes. Yet, one addition is the use of technical terms. As non-public *CoFiPot* services address users with a particular business background, it is possible and makes sense to use technical terms that these people are familiar with as labels within the scope of the respective services. For instance, "Competitive Bids", "Exposure", or "Benchmark" are commonly used terms in the context of foreign exchange management, require no further explanation and thus can be used as labels. Actually, not relying on the exact technical terms would be confusing.

Figure 27 illustrates a selection of the information architecture components deployed within the *CoFiPot* services on the basis of the *CoFiPot* FX Trades service.

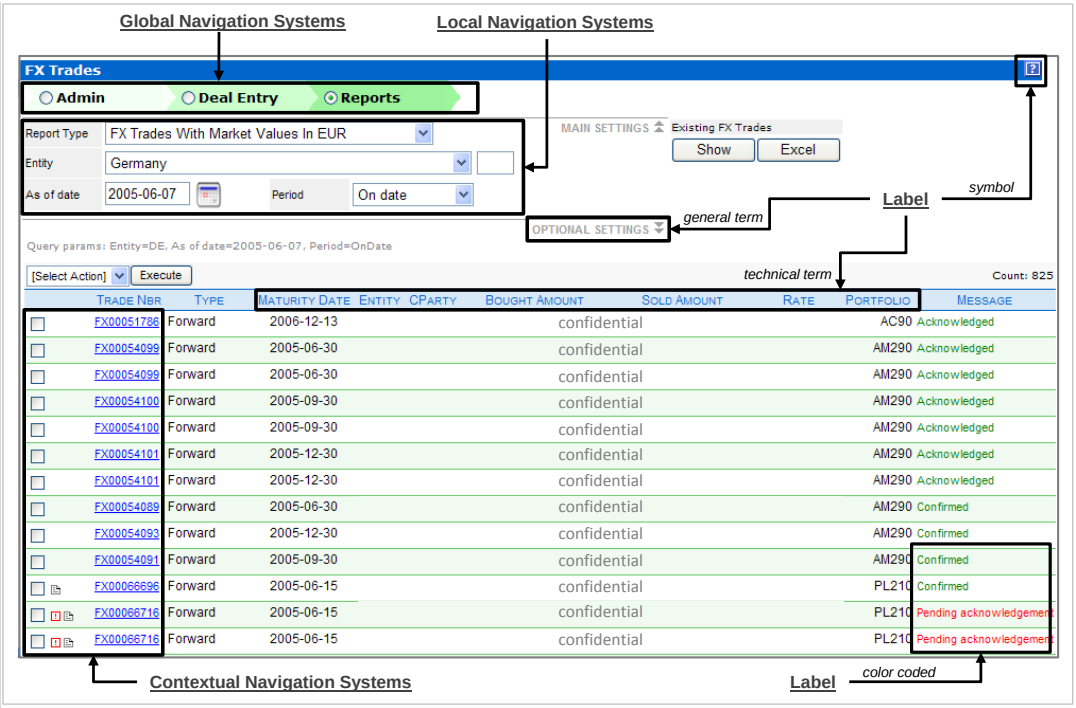


Figure 27 – Information architecture components on the *CoFiPot* service level (screenshot from *CoFiPot* FX Trades service)

The current state of the *CoFiPot* information architecture implementation is the result of an evolutionary design and development process. Screenshots of the *CoFiPot* homepage from 2002 to the current version in 2007 (cf. Appendix D) illustrate that the design of the *CoFiPot* information architecture concepts has been under a state of constant evolution.

As a matter of fact, part of the current design of main information architecture components is the result of an iterative design approach and the subsequent observation of the users' acceptance. Information components that are based on a good design-concept received positive user feedback and the concept was adapted to other similar usage scenarios. Generally, receiving user requests for the adaption of newly introduced information architecture concepts to other *CoFiPot* areas is a good indicator of a successful concept. Examples are the drill-down approach for contextual navigation through hierarchical result data, or the addition of the functional navigation areas within *CoFiPot* services as discussed in the above section. Contrarily, bad design-decisions either cause the components to be simply ignored by the users or result in confusion and subsequent complaints.

Currently, the Corporate Financial Portal team is preparing for one major evolution of the information architecture, as the maturity of Web 2.0 technologies allows for a more dynamic and rich client interaction. However, the focus is still on the process of understanding how to apply these new technologies in a meaningful way to support the users' information processes.

5.2 Development Process Models for Corporate Portal Components

The selection of an appropriate process model to foster the task of developing and implementing corporate portal components depends on the type, the characteristics, and the usage scenario of the respective components. This section covers the Waterfall Model as an example of a strictly structured approach to software development (Section 5.2.1), and software prototyping as an evolutionary alternative (Section 5.2.2). Finally, the case study section outlines the selection of the suitable development models with regard to the development of the different types of *CoFiPot* components.

5.2.1 The Waterfall Model for Structured Development

In 1970, Royce introduced the *Waterfall* model as an adaptation of general system engineering processes. Although Royce also described and favored an iterative approach to software development, it was the *Waterfall* model that gained widespread popularity (Royce 1987).

The *Waterfall* model describes a software development process that follows a sequential five stage process from the initial requirement analysis, over the system and software design, the implementation, the integration and system testing, to the final operation and management (Sommerville 2004, p.67). Every stage-transition is followed by a detailed documentation to sign-off the results of each stage. This consideration of documentation activities within the development process is a major advantage of the *Waterfall* model as it supports project controlling tasks. On the other hand, only a limited type of software development projects can be conducted following this strict separation of the individual development stages. In practice, the tasks of the individual stages will overlap as for example one might encounter problems during the design stage that require for a rework of the initial set of requirements (Sommerville 2004, p.67). However, following the *Waterfall* model, these iterations between stages are costly due to the need to reproduce and approve the relevant documentation.

In the context of developing corporate portal components, it makes sense to rely on the *Waterfall* model for those components that are based on a clearly understood and defined set of requirements that are not likely to change during the development process. Typical examples are portal application components and portal services that do not address to the general portal user, like administrative services or internal security components.

5.2.2 Evolutionary Development and Software Prototyping

Evolutionary development models address the fact that in practice the requirements of a software development are often not completely known at the project initiation but will arise and

evolve during the development process. Therefore, the basic idea of evolutionary development models is to develop an initial implementation of the software that is subsequently shown to the target user. On the basis of the user feedback, intermediate versions are developed until a significant state of maturity is reached, the final product. In contrast to the Waterfall Model, the requirement specification, development, and validation stages are closely interleaved (Sommerville 2004, p.68). Figure 28 shows the concept of the evolutionary development process.

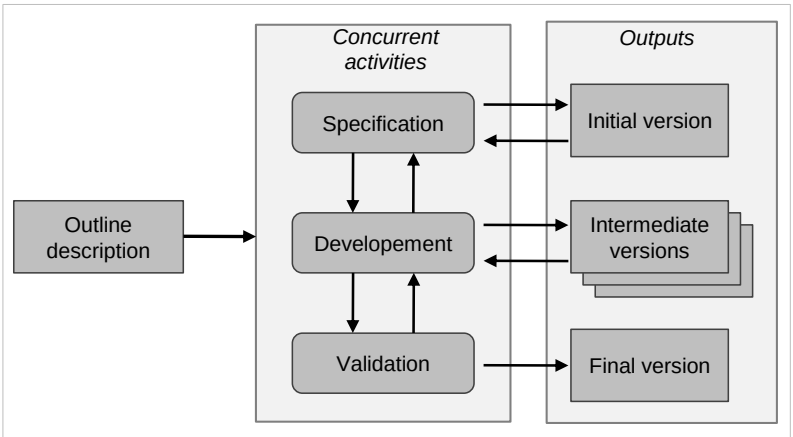


Figure 28 – Evolutionary development (Sommerville 2004, p.68)

Evolutionary development is usually regarded from two distinct perspectives: *incremental development*, and *throw-away prototyping* (Sommerville 2004, p.395).[35] While the goal of the former approach is to produce an operative prototype that is to be delivered to the end-users, the latter aims at developing a throw-away prototype, that is only used to help the understanding of what to implement and derive the final requirements.

Yet, evolutionary software development is not without drawbacks (Sommerville 2004, p.69): From a project controlling perspective, the evolutionary development process only provides limited information on the current state of the project. Furthermore, the incremental development approach tends to foster the development of poorly structured systems that become difficult to manage. Therefore, Sommerville recommends to apply the evolutionary development approach only to small and medium size software projects.

On the other hand, by incorporating the facet of user-involvement as a primary model component, evolutionary development models foster the development of software systems that more completely reflect the users' requirements. As users can experience, and have influ-

[35] Note, that the literature does not use the term and concept of *prototyping* consistently. Sommerville uses the term "prototype" exclusively in the context of a throw-away system. However, other authors differentiate between an operative and a throw-away prototype, with the former representing the result from the incremental development as described by Sommerville.

ence on the system features during the development process, the final product is most likely to meet to users' expectations in terms of functionality, quality, and usability of the component.

In summary, the evolutionary development procedures are best applied to the development of systems of a manageable size that are subject to a high level of interaction with the end-user. With regard to Corporate Portal components, this is the case for information architecture components as well as general portal services.[36]

The following case study section describes the application of development models in the context of the different portal development scenarios. Confirming the theoretical discussion, the development of internal *CoFiPot* components follows a structured development process while the development of *CoFiPot* services benefits from an incremental development model.

5.1.3 *Case Study* Developing CoFiPot Components & Services

The development process of *CoFiPot* components depends on the characteristics of the component that is to be developed. *CoFiPot* components like portal server engine components or *CoFiPot* services that do not address to the general user base do not benefit from user-interaction during the development phase. Therefore, for this group of *CoFiPot* components, the development process reflects that of a structured sequential software development process model.

On the other hand, *CoFiPot* components that will be subject to the interaction with a large number of users – this includes all primary *CoFiPot* services – are developed according to a two-stage incremental development approach. This approach was derived following the experience that it is difficult for the stakeholders to exactly express and define their requirements on the *CoFiPot* service within the initial phase of the development. The incremental development process that results in intermediate software versions helps them to experience the service concepts in an early stage, and to get an understanding of what is possible and what is beyond the scope of a reasonable development requirement. Figure 29 illustrates this two-stage prototyping process for developing *CoFiPot* components.

[36] The reader is referred to Coldewey 2002 for an introduction into the application of agile development methods for the development Web applications.

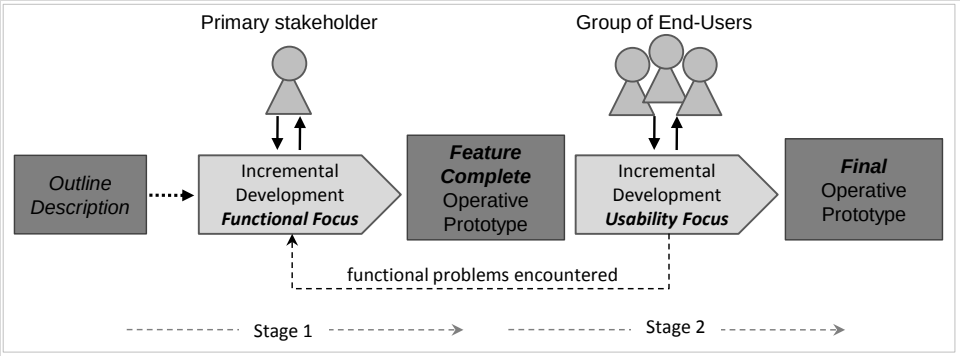


Figure 29 – Two-stage development process for *CoFiPot* components

The result of the first stage is a *feature complete* operational prototype that is incrementally developed while incorporating the feedback of the primary stakeholder. In the second stage, this operational prototype is made available to a selected group of *CoFiPot* end-users. These users evaluate the new component in an operative environment. Feedback on the usability design facets of the component is directly incorporate within the subsequent prototype iteration. The result of the second prototyping stage is an operative prototype that can be deployed to the general user basis. However, if the testers encounter breaking functional problems (e.g. faulty implementation of business processes), the second stage is aborted and the project returns to the first prototyping stage.

5.3 Chapter Summary

The main design elements of corporate portal implementations discussed in this chapter are the application architecture, the integration architecture, and the information architecture.

The majority of portal implementations currently available are virtually based on the same application architecture design: The application architecture is described by the Web application components, the portal server components that provides the primary portal functions including security, personalization, or user management components. Furthermore, there is the repository of portal services: self-contained Web applications that are invoked and dynamically integrated into the context of the portal Web application by the means of a common Portal Service API. The *CoFiPot* architecture at first followed this reference design on a conceptual level only. Yet, with the growing system complexity these primary application architecture components were separated. This separation has provided the necessary level of flexibility and in particular scalability with regard to future developments and addresses the requirements of a growing size of the portal development team.

The integration architecture describes the instruments and approaches that are necessary for the portal services to connect to the relevant information systems. Due to the large number of heterogeneous systems that have to be connected in the context of corporate portal projects, a many-to-many integration approach will be the preferred over a point-to-point integration approach. With regard to the *CoFiPot* scenario, the implementation of a centralized integration layer based on common business objects has provided an important level of flexibility in order to face future integration requirements.

The design of the information architecture components has to consider the different views on the corporate portal. As users are different, there is no such thing as a "reference" for information architecture, but the *CoFiPot* development practice showed that one has to come up with an adequate design patterns as a result of a highly iterative design and developing process. Yet, there are best practices, including the overall limitation of the number of different design pattern, and the reoccurring use of proven patterns.

Once the general requirements are defined and the overall design facets of a corporate portal component are described and agreed on, the component has to be implemented. To structure the actual implementation tasks, one can rely on software engineering process models. Yet, the selection of the suitable development model depends highly on the characteristics of the regarded component. With regard to corporate portals, there are basically two categories of components: internal portal components for security, or user management functions that are not directly subject to user interaction and general portal service, where the opposite holds true. While in the first case, a structured software development process appropriate, the development of the latter will benefit from an incremental development model that incorporates user-involvement.

Following the elaborations on the design and implementation, Chapter 6 describes the relevant activities for the deployment and roll-out of the newly developed portal components

Chapter 6

Roll-Out of Corporate Portals

Following the design and implementation of new corporate portal components and services, the roll-out stage comprises the relevant activities to make these developments available and furthermore, introduce them to the end-users.

From a technical perspective, the new corporate portal version has to be deployed, replacing the current installation. In this context, it is important to note that Web applications are not subject to the distribution and installation challenges of traditional client software. The installation of the new portal version on the productive (live) Web server will immediately be available and affect all users that are currently working with the system. Therefore, the deployment procedure has to ensure, that the version that is being deployed can be tested and approved before it is finally released to the users.

Once, the new corporate portal version is deployed the portal team has to address activities for the support and training of the end-users. These not only include the documentation of the new service functions, but depending on the complexity and the business role of the respective corporate portal services might also require the planning and execution of end-user training sessions and workshops.

Finally, the roll-out stage initiates promotion activities to announce the availability of the new developments to the end-users. Depending on the requirements in terms of user reach and level of interaction, a mix of different promotion instruments has to be applied. In general, the promotion activities are not only restricted to the roll-out stage but should also be conducted regularly to foster the visibility of the information system within the organization.

In the following, Section 6.1 outlines the principal steps for the deployment of a corporate portal application. Section 6.2 focuses on the facets of end-user training and support. Section 6.3 discusses communication channels for the promotion of corporate portals. The case study

sections describing the insights and experience from the *CoFiPot* project complement the theoretical discussions.

6.1 Deployment of Corporate Portals

In its most simple form, the deployment of a corporate portal or Web application refers to the installation of the new version on the Web server that hosts the live system. Yet, with business critical portal services it will prove useful to assess the correctness of the services' functionality in the productive environment, before actually releasing the new version to the end-users. Furthermore, the stakeholders of the newly developed portal services might insist on the final approval of the services within the live business environment. In the following, this work describes a deployment procedure that consists of the following three steps: the installation of the new version (Section 6.1.1), the approval of major components and services (Section 6.1.2), and the final release (Section 6.1.3).

6.1.1 Installation of Web Applications

The ease of installation and distribution is one of the major advantages of Web applications over the respective procedures regarding traditional client-based software (cf. Balzert 2000, p.946): A Web application has to be installed just once on the Web server that hosts the live system. After the installation, it is immediately available to all users that have access to this server using a standard internet browser that today is an integral part of every major operation system. Hence, the problems that are traditionally related to software distribution and installation on a range of different end-user environments are virtually non existence.

Yet, the installation of Web applications is not without challenges. The fact that the Web application is instantly available also implies that it will be immediately unavailable in the case that the installation procedure fails. Furthermore, the instant the application is installed on the server it will become temporarily unavailable to the users working with application at that moment. These users will lose their current session information (e.g. information that stores the current business state) which might pose a problem if they were working with business critical applications.

Therefore, it is useful to study the site's access statistics in order to determine time-frames that are suitable for conducting a deployment procedure. For this purpose, one can rely on common Web log analyzers and reports that show the number of visits to the corporate portal for the hours of a day or per week (cf. Chapter 8, Section 8.2). A more sophisticated approach is to monitor the usage of business critical applications and implement mechanisms to lock

the usage of these applications just before starting with a deployment procedure. To prevent the system of being locked for an extensive time period, it makes sense to only lock the applications right before the final installation and the release within the productive environment.

Furthermore, in order to facilitate the final tests and system approval activities, a proven practice is to rely on a deployment Web site that is hosted by the Web server in parallel to the current live site. The latest corporate portal version is installed on this deployment site that is subject to the same system configuration settings as the current productive site. The inherent advantage stems from the fact, that the system tests and approval activities can be conducted with minimal influence on the current installation and the remaining users. In case, the installation on the deployment site fails to meet the requirement for approval, the deployment site can be disabled without further notice. Of course, as the data basis of the deployment and the live-site is the same, testing of transaction services has to be closely supervised as it may have an effect on related business processes.

6.1.2 Final System Tests, Configuration, & Approval

The objective of the final system tests is to ensure that the newly developed components do function in the live environment as they do in the development environment. In this stage, the objective is not to test of every single facet of the service functionality; this has been performed throughout the iterative development procedure (cf. Chapter 5). Instead the focus has to be on examining whether the new developed services behave as expected in the live environment. In this regard, special attention should be on the configuration and the state of the live-connections maintained with the integrated information systems.

Moreover, some services may require setting up the configuration for the actual business environment. Usually, these tasks will include the definition of the relevant security roles, or the definition of initial parameters needed by the specific service. Once the system has been configured and tested by the corporate portal team, it is handed over to the stakeholders for the purpose of the system approval.

The formal system approval (cf. Balzert 2000, pp.1086-1087) marks the final step of the actual service development process. The stakeholders will use the service and perform functional test according to the initial requirement in the actual business environment. If the portal service meets the initial requirement, the service is officially approved (signed-off) and ready to be released to the target users.

6.1.3 Release

The release is the last step of the deployment procedure. With the release, the new corporate portal components and services are made available to the end-users by overwriting the current live site with the new corporate portal version. To enable a fast recovery of the previous working version, in case the release procedure fails or unexpected, critical errors are encountered during operation, the current working version on the productive site should be saved as a backup. A return to the previous version is then possible by simply overwriting the current installation with a working version from the repository of previous versions.

The subsequent case study section describes the deployment procedure used to install and release new versions of the *CoFiPot*. The procedure has evolved as a best-practice approach from the experiences of numerous deployment procedures conducted over the years. The described procedure allows for final tests and approval of the new *CoFiPot* version within the actual business environment, before releasing it to the end-users.

6.1.4 *Case Study* CoFiPot Deployment Procedure

The current CoFiPot deployment procedure follows a three step process: The installation of the new *CoFiPot* version in parallel to the current productive/live site is followed by the final tests and system approval procedure. Finally, the release of the new version to the end-users terminates the procedure.

6.1.4.1 CoFiPot System Environment and Responsibilities

To address the deployment requirements, the *CoFiPot* system environment is set-up as follows: The *CoFiPot* Web server hosts two sites: the live site with productive *CoFiPot* version and the deployment site that hosts the new *CoFiPot* version for the purpose of tests and system approval. In addition, there is a repository of the past working *CoFiPot* versions.

The parties involved in the deployment process are the *CoFiPot* team, the staff from the IT department, and the stakeholders of the main developments. Figure 30 describes the *CoFiPot* system environment with regard to the relationships of roles involved and their responsibilities.

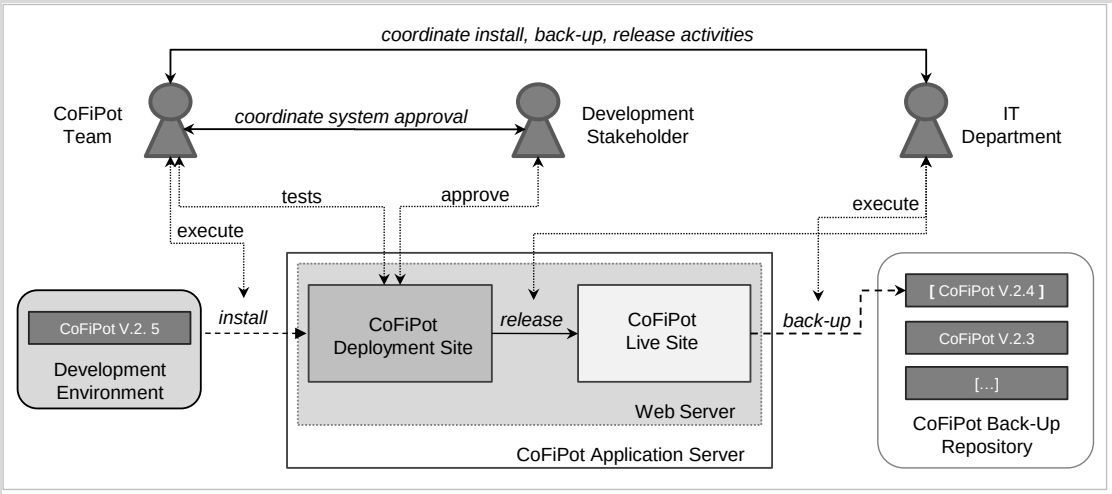


Figure 30 – *CoFiPot* deployment scenario: system environment and roles

The *CoFiPot* team is responsible for the coordination of the relevant activities with the IT department and the respective stakeholders of the developments. Furthermore, the *CoFiPot* team executes the installation process on the deployment site. The stakeholders perform the system approval. The IT department holds full responsibility for the administration of the systems involved. Consequently, it is within the responsibility of the IT department to prepare the deployment site, and execute the back-up and release procedures.

6.1.4.2 Deployment Procedure

Figure 31 describes the sequence of tasks that are involved in the *CoFiPot* deployment process as follows: First the *CoFiPot* team notifies the person responsible at the IT department on an upcoming deployment. The staff at the IT department then has to establish a new temporary deployment site on the *CoFiPot* Web server that operates in parallel to the actual live site. Subsequently, the *CoFiPot* team transfers the current *CoFiPot* version from the development environment on this deployment site. Once, the new *CoFiPot* version is accessible through the deployment site and the necessary configuration settings for the business environment are set up, the stakeholders can begin with the approval of the *CoFiPot* components and services. In parallel, the *CoFiPot* team performs a number of system tests to verify that the configuration settings are correct and the services execute as expected. Note, that in theory, this state can last as long as it takes to finish the system approval. There is no inherent time limitation for a closure of the deployment process. Yet, as working with the deployment site affects the same systems and data, as it is the case with the live site, the state of deployment should be kept as brief as possible.

If critical errors are encountered during the system approval and final tests, the deployment procedure is aborted and the *CoFiPot* team notifies the IT department to shut

down the deployment site. If no breaking errors are encountered, and the developments are approved, the new *CoFiPot* version is ready for the final release. To complete the deployment, the IT department adds the current *CoFiPot* version to the repository of previous working versions (i.e. as a backup), transfers the deployment site to the live site, and shuts down the deployment site.

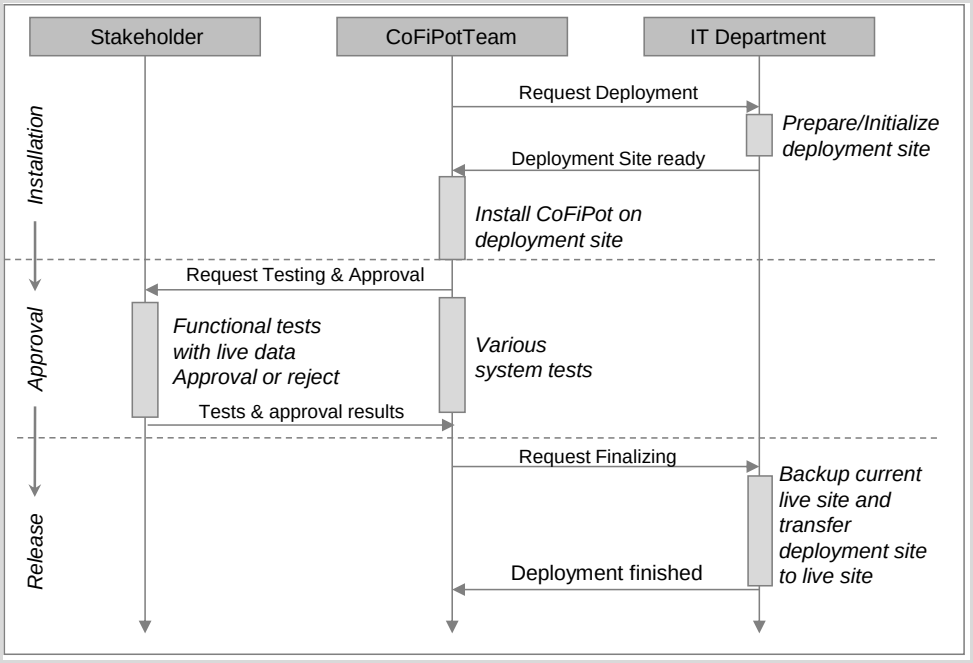


Figure 31 – *CoFiPot* deployment procedure

6.2 End-User Training

Literature discusses end-user training as a fundamental determinant of the users' system acceptance, arguing that the result of successful user-training is a motivated user with the understanding and necessary skill to use the new services in a productive environment (Compeau, Olfman et al. 1995, p.25).[37] This section briefly outlines the components of a general training and learning process (Section 6.2.1) and subsequently discusses the role of end-user training in the context of corporate portals (Section 6.2.2).

6.2.1 Training and Learning Process

Following Compeau, Olfman et al. (1995, p.26) a training-and-learning process consists of three phases: the initiation phase, the formal training and learning phase, and the post-training phase (cf. Figure 32). External determinants like the training characteristics (e.g. workshops), characteristics of the software (e.g. user interface design of Web applications), task and job

[37] Refer to Compeau, Olfman et al. (1995) for an overview of case studies and empirical studies on the topic of end-user training and information systems.

characteristics and organizational characteristics, have an influence on key decisions that are made at some point in the process.

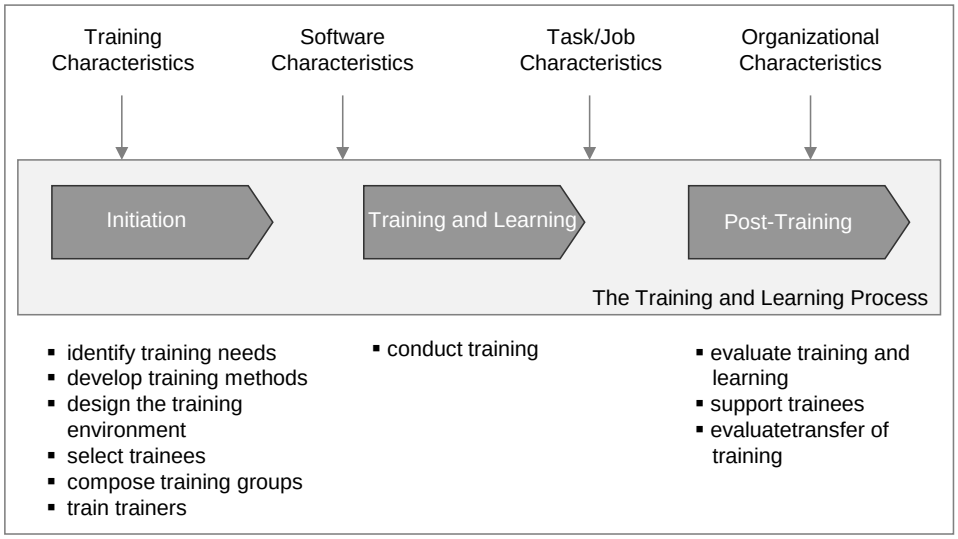


Figure 32 - Training and learning process (Compeau, Olfman et al. 1995, p.26)

- Within the *initiation phase* the necessary preparations are made for the subsequent training sessions. As the activities during this phase will strongly determine the success of the overall training initiatives, it is critical to choose the right training personal, to assemble suitable training material (e.g. product documentation and tutorials) and to identify and develop effective methods. One key aspect is to base the design decisions on the evaluation of the actual end-users' training needs. With regard to the stages of the corporate portal engineering process, the initiation phase should already be considered one integral part of the design and development stage.

- The *training and learning phase* addresses the question of how to conduct the end-user training. Is face-to-face training the right approach or should one rely on modern means of computer-based instructions and electronic learning environments? Compeau, Olfman et al. (1995, p.24) point out that effective training approaches comprise of conceptual models that describe the system components (Santhanam and Sein 1994, p.379), user manuals that foster explorative learning, and software training previews i.e. information on what outcome to expect of the training to be conducted (Webster and Martocchio 1995, p.759).

- Finally, the *post-training phase* focuses on evaluating the long-term effects of training, especially on the aspect of transferring the training insights to the actual workspace. Evaluation methods are based on the long-term tracking of user activities like the assessment of the intensity of support requests after the training has been conducted.

6.2.2 End-User Training and Corporate Portals

Reflections on the role of end-user training in the context of corporate portals, lead to the question whether there is the need for dedicated end-user training at all: After all, one primary idea of corporate portals is to offer services that are easy to use and address a wide range of users with different backgrounds. This notion should be reflected by the design of the user-interface components, as well as by the complexity of the functions provided by the portal service. Ideally, the end-user should be able to start using a portal service based on her experience in working with Internet applications and the online-documentation that is provided for the service.

As an example, one frequent use-case for a corporate portal service is to access and expose primary functionalities of enterprise information systems (cf. Chapter 2, Example 2.1). In general, users who want to directly access the functionality of these systems will require an extensive introduction and training on the use of the information system. On the other hand, corporate portal services that focus on one particular functionality thus provide a user-interface design that is significantly reduced can be used without dedicated training.

Aside from the portal services that address the interests of a general audience, a corporate portal usually also hosts more complex services. These services usually address a well defined and known group of users (e.g. a planning tool for the corporate cash managers that is neither of interest nor accessible for the general public users). For this category of services, it might be necessary to design, plan, and conduct training and learning activities following the described general training and learning process.

The following case study section elaborates the role of end-user training in the context of the Corporate Financial Portal project. One central CoFiPot design philosophy is to develop services that make “difficult things seem easy”. Therefore, dedicated end-user training played a minor role, only, and the need thereof was considered an indicator of a poor implementation of the above principle. The case study section proves that one key success factor of the Corporate Financial Portal project is to design and provide services that are easy to comprehend and to use without the need for dedicated training. For services, that are more complex and benefit from end-user training activities, the case study shows that a peer-based training-and-support approach is a practical solution to keep the training efforts within manageable scales.

6.2.3 *Case Study* End-User Training and the Corporate Financial Portal Project

A primary objective of the *CoFiPot* is to provide services that potentially address every member within Bayer's financial community. Consequently, the services have to be easy to use without the need for an introduction to the respective service functionality. This requirement is particular important considering the resources that would be necessary in order to provide end-user training on a global scale for ever major *CoFiPot* service that is launched.

The roll-out of a *CoFiPot* service is usually *not* accompanied by end-user training activities of a larger scale. Instead, the efforts focus on the design and implementation phase with the aim to create services that can be picked-up and used intuitively. This requires for a consistent user-interface design and careful considerations on the level of functionality provided by the particular services (cf. Chapter 5). Furthermore, every major *CoFiPot* service provides a brief documentation of its functionalities and a tutorial on how to conduct the main business functions of the service. The initial *CoFiPot* roll-out was accompanied by a documentation that describes general aspects of using the portal including navigation and registration for the *CoFiPot* the documentation was available for download from the knowledge base content area of the *CoFiPot* pilot implementation.

Of course, there is still the occasional need to provide support and answer questions on the use of services. To keep these activities within a manageable level, a proven practice is to hand over the part of the support and training responsibility to groups of *experienced* users. Following a peer-based support and training approach (cf. Ribak, Jacovi et al. 2002, p.134), these expert users function as experienced trainers (i.e. peers) for their colleagues.

The outsourcing of the training & support responsibility was the logical step from the tight user-involvement within the design and development of a *CoFiPot* services. These users have participated in the design and implementation of a service, hence know this service best and are interested in the acceptance of this service. Still, the success of this practice still depends on *CoFiPot* services that rely on intuitive information architecture concepts and a functional design that are easy to explain and communicate among the employees.

Over the years, the complexity of the *CoFiPot* in general and the individual services has grown. Yet, as the *CoFiPot* services follow the same design principals, users can simply start working with newly introduced services based on their experience with established services. Following the principle "*to make difficult things, seem easy*" as a primary design

philosophy of the *CoFiPot* project has helped to keep the requirement of end-user training on a manageable level (Bayer_SC 2006).

6.3 Promotion of Corporate Portals

The portal promotion activities neither start nor are limited to the roll-out phase. Already during the design and implementation stage, promotion activities should focus on building up the visibility and the expectations on portal components and services that are still in development. These "teasing" promotion activities will influence the impact of the promotion activities that follow the actual roll-out of the final version (Schwickert 2001, p.271). Furthermore, in order to foster a substantial impact from the portal promotion, it is important to repeatedly conduct promotion activities throughout the corporate portal operation stage.

With regard to corporate portals, the well known target audience of a corporate portal significantly facilitates the planning and the execution of the necessary promotion activities (Powell 1998, p.271). The instruments and activities can be customized to directly address the known interests and needs of these target users and point out the benefits that stem from using the portal services. Furthermore, corporate communication channels offer established instruments to directly address the target audience.

In general, one can distinguish between traditional *offline* communication channels (Section 6.1.3) and *online* communication channels (Section 6.3.2), with the latter relying on the use of Internet technology, i.e. the means of the corporate Intranet. Depending on the intention and target group of the actual corporate portal implementation, the mix of suitable promotion instruments has to be composed carefully (Section 6.3.3).

6.3.1 Offline Promotion Instruments

Offline promotion instruments rely on the corporate print media, the corporate broadcasting channels, or activities that involve direct communication with the target audience. *Corporate print media* and the *corporate broadcasting channels* are predestined if the objective is to reach as many users as possible. Therefore, these communication channels are well suited for the announcement of the initial corporate portal launch – especially if the announced portal addresses the general public as it is the case with a common employee portal. However, these mass communication channels only offer limited means for interaction with the target audience. Furthermore, corporate TV and radio cast are most appropriate to convey messages with limited information content like brief descriptions and general announcements.

In contrast, activities that involve *direct face-to-face communication* like speeches, workshops, or product demonstrations only address a limited target audience, in exchange for a higher degree of interaction and a higher level of information content that can be communicated. Yet, a successful and convincing speech, or product demonstration offers the potential to foster subsequent mouth-to-mouth promotion that may result in a snowball effect like spreading of the original promotion message. Moreover, speeches, workshops, and product demonstrations are well suited for convincing a (limited) target audience of the benefits and quality of a corporate portal implementation. In this regard, the possibility to interact with the users and providing direct feedback to user questions is one important and favorable characteristic inherent to these promotion instruments.

6.3.2 Online Promotion Instruments

Using the corporate Intranet, the portfolio of corporate online promotion instruments includes email messages, Intranet search engines, promotion on other Intranet sites, as well as on-site promotion. In contrast to the corporate print and broadcasting communication channels, these online promotion instruments potentially offers a higher degree of interaction with the target audience.

Using *email messages*, the promotion activities rely on one of the currently most important asynchronous communication channel. With emails, one can quickly and easily either address only a specific group of end-users with personalized messages, or compose and send a newsletter that addresses all portal users with more common information. Lately, the use of emails as a promotion instrument is critically discussed, due to the sheer masses of (unwanted) promotion mails (i.e. spam mails) and due to the inherent security risks attributed to the attachments of a message. Therefore, usage of emails for promotion purpose must be planned careful. One determinant is to define the appropriate amount and right occasion for issuing new email messages. If one confronts the user with too many emails that are of minor interest to her, she might get insensible to future emails and ignore them even if they carry important content.

Intranet search engines point out the existence and the potential relevance of the content provided by a corporate portal to the users. The importance of search engines for the online promotion becomes apparent, when considering the success and the important role of Internet search engines and directories like Yahoo and lately, in particular, Google. Internet or Intranet search engines are crucial to find content that is dispersed throughout the information network. Hence, the primary objective of promotion activities with regard to the Intranet search

engines is to ensure that the corporate portal site is listed in the intranet search index and can be easily indexed by the search engine's index service. Further, it is important to provide the necessary precondition for a quality ranking within the search results. This does not necessarily imply that the portal site should be listed in a wide variety of search results, but more importantly should focus on a high ranking within relevant search queries.[38] Consequently, the content must be organized and tagged with Meta information such as they result in meaningful search results.

Cross-linking and *advertising banners* that are placed on *other Intranet sites* and portals promote the corporate portal to the users of these sites and build up traffic from the referred site (Powell 1998, p.270). In general, Intranet sites of business units and functional departments should refer to the (general) corporate portal, and vice versa. The links and advertising banners have to be integrated in the context of the content provided by the respective the Intranet site. For example, content that relates to financial topics should refer to the Intranet portal of the financial department.

On-site promotion directly focuses on the users who are already aware and visit the corporate portal. In this context, the objective is to point out new service and developments that might be relevant for the users. In principal one can distinguish between general recommendations that are the same for all users of the portal, and personalized recommendations. General recommendations are placed on prominent places that are visible to all users, e.g. the portal home page. General recommendations have to deal with the drawback that user might tend to ignore them, in particular those that are more experience in using the portal. For instance, users can set bookmarks that link them directly to the services that are of relevance for them, therefore missing the homepage and the recommendations completely. For generating meaningful personalized recommendation, on-site promotion relies on the analysis of user information. One prominent example of on-site promotion found in the public Internet is *amazon.com* that that relies on collaborative filtering mechanisms for personalized recommendations (cf. Linden, Smith et al. 2003). With regard to the corporate environment regulations might narrow down or even permit to record and analyze personalized usage data. In its most simple form, recommendations rely on the user information like the portfolio of services a user has access to and the roles he possesses in the portal context.

[38] The reader is referred to e.g. Erlhofer 2006; Fischer 2006 for a discussion on search engine optimization.

6.3.3 Mix of Promotion Instruments

The set of instruments and activities to promote the roll-out of a corporate portal relies on a mix of suitable offline and online promotion instruments that are selected with respect to their distinct advantages and limitations. The selection of appropriate promotion instruments is subject to the actual promotion intention and the characteristics of the target group addressed by the corporate portal implementation. For instance, if the corporate portal and the offered services address to the general corporate public like it is the case with a corporate human resource portal, than offline channels like TV and corporate radio are a suitable medium to reach the large target audience. Contrarily, if the portal implementation is designed with the requirements of a specific user group in mind, it is more appropriate to focus on activities that offer a higher level interaction and allow for more information content to be communicated to the target audience - in the exchange for communication reach. In general, instruments that provide dense information content and foster high level of interaction with the target audience can usually only be deployed for a limited target audience, and visa verse.

Table 7 outlines the promotion instruments and activity discussed for the respective corporate online and offline communication channels. Furthermore, Table 7 shows the organizational reach, the information content, as well as the level of interaction associated with the respective promotion instrument.

Table 7– Summary of corporate communication channels, related instruments and their characteristics

	Channel	Instruments, Activities	Reach	Inf. Content	Interaction
offline	Print Media	Newspapers	far	low to medium	low
		Circular letters	selected groups	medium to high	low
	Broadcasting	Corporate TV, Radio casts	far	low to medium	low
	Direct Communication	Speeches, Workshops, Demonstrations	selected groups	medium - high	medium- high
online	Emails	Newsletters	portal users	medium	low-medium
		Personalized messages	specif. portal users	high	medium
	Intranet Sites	Cross linking, Banners	Intranet users	low	medium
	Search Engines	Listing in Search Engines	Intranet users	low-medium	medium
	On-Site Promotion	Homepage promotion	portal users	medium	medium
		Personalized messages	specif. portal users	high	high

In summary, the promotion of corporate portals can be regarded as a structured and controlled task, at least compared to promotion of a public product with an unknown target-audience. Yet, this does not imply that the promotion is without challenges. There is a clear difference between making your users know that there are new services available and actually convincing them to use these services (Powell 1998, p.271). In particular, if the introduction of new services shall replace existing systems and established workflows, the promotion has

to clearly point out the benefit that arise from adopting the system and the respective business practices. The following case study section describes the practices and insights of promoting the *CoFiPot*. The case study shows, that traditional direct communication takes one important role within the corporate portal promotion mix, while online communication channels need to focus on the requirements of the individual user to capture her interest.

6.3.4 *Case Study* Promoting the CoFiPot

Overall, the *CoFiPot* promotion activities were kept on a relatively low intensity throughout the project run-time. Originally, due to the lack of experience in the operation of the corporate portal, the idea was to stepwise introduce the *CoFiPot* and address selected groups of target users one after the other (e.g. first foreign exchange managers, then cash managers etc.). As the *CoFiPot* first and foremost serves the needs of Bayer's financial community, the mix of communication instruments had to specifically address this group of people. The promotion mix mainly comprised of instruments that foster direct communication like product demonstrations and workshops. Furthermore, newsletter distributed via email and on-site advertising were employed as online promotion instruments.

During the initial introduction of the *CoFiPot*, but also throughout the project runtime, *demonstrations* of the major *CoFiPot* services (e.g. *CoFiPot* foreign exchange management services) served as the primary promotion instrument. For instance, the *CoFiPot* was regularly presented within the periodic meeting of Bayer's higher-level financial managers. The idea was to convince this group of high level management and executives of the benefits from using the portal and motivate them to further spread the idea within their organizational area of responsibility, worldwide. Additionally, the visibility of the *CoFiPot* project within the Corporate Finance Center benefited from the occasional promotion activities conducted by the members of the project *steering committee* (cf. Chapter 4.2.3) who mentioned the *CoFiPot* project on various business occasions and community events (e.g. annual meeting of the employees of the Corporate Finance Center). Finally, the *stakeholders* of *CoFiPot* services accounted for their share of the promotion activities as it is within their inherent interest to foster the acceptance of the respective services.

Still, with regard to the growing number of users together with the increasing number of new *CoFiPot* services, it became necessary to establish means to notify the *CoFiPot* user base on new developments. This is especially important, as the analysis of the *CoFiPot* site usage showed that the majority of user have bookmarked the direct links to their required *CoFiPot* services and only seldom visit the *CoFiPot* homepage, the primary place

for announcing *CoFiPot* related news. Therefore, in 2004 the *CoFiPot* team started to issue *newsletters* that described the latest developments and presented important *CoFiPot* services and functional concepts. The registered *CoFiPot* users receive the newsletters via email. Current and past issues of the newsletter are accessible through the *CoFiPot* homepage. However, the newsletters satisfied as a mean to communicate general information on *CoFiPot* services, only. Direct feedback on the newsletter content was scarce and furthermore the portal team could observe a drop in the subscribers to the newsletters. While the team can only speculate on the reasons for the minor impact of this promotion instruments, these are most likely related first with the email communication channel and the fact that the newsletters simply got lost among the bulk of daily mails and second with the very general nature of the provided messages.

Therefore, currently there are plans on the design and implementation of *personalized on-site promotion instrument* as an addition to the promotion on the *CoFiPot* homepage. To address the fact that the *CoFiPot* homepage is only visited occasionally by experienced *CoFiPot* users, the basic idea is to promote new *CoFiPot* services that relate to the currently requested service. For example, users that are currently working with the *FX Exposure Monitor* service for analyzing the foreign exchange exposure can be informed on the existence of the *FX Exposure Chart* service that offers additional instruments for graphical analysis of the same data.

A survey among the international *CoFiPot* user that was conducted in December 2005 asked the users what they were using the *CoFiPot* for and whether they knew that specific tasks were actually supported by *CoFiPot* services (Appendix C, user comments). The answers to this question and especially the comments of the respondents underline, that with the current scope of the *CoFiPot* implementation, there is the need for a stronger promotion of the relevant services that are available.

6.4 Chapter Summary

This chapter focused on the activities that follow the roll-out of a corporate portal implementation. The relevant activities are the deployment of the new portal version, if necessary the preparation and conducting of end-user training activities and finally, the promotion of the new developments.

In contrast to traditional software applications, the deployment of a new corporate portal version does not have to deal with questions concerning the distribution or versioning of the installation. In principal, the installation and distribution of the corporate portal is conducted

by the means of a simple installation of the new version on the portal application server, overwriting the current installation. Yet, errors during the installation procedure or of the newly installed version will immediately affect all of the corporate portal users. Therefore, with regard to business critical services provided by a corporate portal, the deployment procedure has to allow for functional tests and final approval of the developments within the live business environment. For the *CoFiPot* that provides a number of business critical services, a three step deployment procedure has evolved as a best-practice solution. The procedure consists of the installation of the *CoFiPot* on a deployment site within the live environment, the final tests and system approval on the basis of this deployment site, and the subsequent release of the new version.

With the deployment of a new version of a corporate portal implementation, the latest developments have to be introduced to the end-users. In particular for traditional applications, the deployment of an application is usually followed by respective end-user training activities. In contrast, for corporate portals, the need for dedicated end-user training should be more of an exception than a rule. With regard to the large number of users worldwide, training initiatives will require a lot of resources. Yet, more importantly, one primary idea of a corporate portal is to provide services to a broad range of different users. To achieve this goal, the design of the corporate portal services has to ensure the right level of functional complexity and intuitive usability. By following the design philosophy “to make difficult things seem simple”, the *CoFiPot* and the majority of the *CoFiPot* services are introduced without the need for dedicated end-user training. The remaining occasional user training requirements are addressed by a training mechanism that relies on the concept of peer support and has more experienced *CoFiPot* users providing direct support for their colleagues.

In addition, promotion activities strengthen the visibility and acceptance of a corporate portal project within the target groups. The promotion activities are not restricted to the roll-out of a corporate portal implementation, but have to be repeated during the operation of the system in order to realize a significant impact. Depending on the actual purpose and target-group addressed by a corporate portal, the promotion will have to compose a suitable set of instruments that rely on the available corporate online and offline communication channels.

After the latest corporate portal implementation has been released and introduced to the users, the corporate portal team have to focus on the task that ensure the proper operation of the corporate portal. Thus, in the following, Chapter 7 focuses on the management and maintenance activities of the portal online stage.

Chapter 7

Management and Maintenance of Portal Operations

Aside from the project evaluation and controlling tasks, the portal online phase is characterized by management and maintenance activities that are necessary to uphold the proper operation of the corporate portal. These activities have to address the functional and technical requirements on the portal level, as well as of the individual portal services.

The functional management perspective addresses the content management activities, the configuration of the portal components and services, and the user management and support tasks. From a portal-level perspective, the objective is to define procedures and implement instruments that support the most common management tasks (Section 7.1.1). The challenge of the management of the individual portal services stems from the sheer number of services that need to be addressed (Section 7.1.2). In this regard, the portal team will have to consider the delegation of some of the (functional) management responsibilities to experienced users.

The technical management perspective consists of the system maintenance and monitoring activities that supervise and guarantee the system's operation on a 24/7h basis. This is especially important if the corporate portal provides business critical services. The portal level management (Section 7.2.1) requires the planning of maintenance activities (e.g. system deployments), and the monitoring of the system's health parameters. The same requirements hold true for the technical management on the portal-service level (Section 7.2.2), which moreover will require for the implementation of mechanisms that allow for the automated monitoring of

key health measurements in order to cope with the sheer number of services that have to be supervised.

From an organizational point of view, these two perspectives on the management of the portal operations involve the cooperation of the functional department and the IT department. In this regard, the coordination and communication processes between these two parties are essential in order to maintain the proper operation of the corporate portal.

7.1 Corporate Portal Management

The functional perspective on the management of the corporate portal operations has to address the functional requirements on the portal-level as well as on the level of the portal-services. From an organizational perspective, these two distinct levels of management motivate the delegation of management responsibilities. With regard to management of a large number of portal services, it makes sense to assign the responsibility for the functional support and management of the portal service to (willing and motivated) domain experts (cf. Chapter 6, Section 6.2.3).

7.1.1 Portal Level Management

The portal level management activities comprise of user management related activities that include the development of concepts for the management of security roles. Furthermore, the activities focus on the management and administration of general portal content areas and navigation structures. To support these tasks, corporate portal implementations usually provide a number of administrative services that allow for conducting user- , security-, as well as content management tasks (e.g. Walker, Brinkman et al. 2006).

7.1.1.1 User Management and Security Roles

Generally, a corporate portal will offer both, public and restricted content areas. Users that want to access the latter will have to register as a portal user. Today, every employee will possess an individual user-account that she uses for accessing the corporate information systems in general. These user accounts are managed by a central authentications service provider (e.g. Microsoft Active Directory, or directory services using LDAP[39]). To avoid the introduction of further application specific user accounts it makes sense for the corporate portal implementation to rely on the common corporate user directory for basic authentication purpose. From the user's perspective, this will remove her from the burden of remembering one further application-specific account information and enables single-sign on functionality.

[39] LDAP: Lightweight Directory Access Protocol (cf. Koutsonikola and Vakali, 2004)

Once a user has registered to the corporate portal with his user account information, this initiates a user management process that results in the user obtaining the all the portal-roles and security settings that are necessary for her job background (cf. Chapter 5, Section 5.1.1.3).

With regard to these portal-roles and the underlying security concept, the idea is to design and implement a solution that scales with the number of corporate portal users. In principal, a corporate portal application framework will provide the possibility to manage access rights on the individual user level. To address the large number of users, managing this detailed level of access security is not practical. Thus, a role-based security approach is more suitable as a pragmatic solution that scales with the number of users. In the context of corporate portals, it is common practice to define the portal-roles according to specific usage scenarios (Großmann and Koschek 2005, p.106). A portal user is then assigned to the specific portal-roles that are required for him to perform his task in the respective business scenario. To enable more detailed security rights within a business scenario, a portal role can further hold information that define whether users with this particular role may only view, or can also edit or even manage the content of a service (cf. Chapter 5.1.1).

7.1.1.3 Configuration and Management of Portal Structure and Content

The configuration of the portal structure addresses the questions which content areas should be available and how to organize these areas while providing a consistent and understandable navigation and interaction for the users (cf. Chapter 5 - Section 5.1.3). Following the fact that the corporate portal is in a constant state of evolution with new or redesigned services added over time, the same holds true for the configuration of the portal structure. Yet, as a start, it will be necessary to define portal areas that comprise of services which belong to a common business background. This initial configuration setting serves as a starting point for an evolutionary improvement. By evaluating the user's navigation and usage patterns[40] while at the same time considering new developments and direct user feedback, the organization of the portal can be modified accordingly.

For the public content areas, in particular the corporate portal homepage, the management and administrative activities have to ensure that the content is up-to-data and "attractive" to a general public. In contrast to the individual portal services that address the needs of specific user groups, the public areas target all users. In this sense, the homepage is the ideal place for news of general interest, community related content (e.g. references to current community discussions), and promotion of new services and developments. In fact, the homepage can be

[40] For this purpose, the Web server logs are one source of information for improving the portal organization. The reader is referred to Chapter 8 for a discussion of Web log analysis techniques.

regarded as the virtual “business card” of the corporate portal in the sense that it can define the users’ attitude towards the system. This is in particular true for users that are new to the system and in the process of forming their first opinion towards the system. For them (and other users alike) an “attractive” homepage that is updated on regular basis is capable of delivering the message that the users are dealing with a system that has an active community, that cares for the user’s needs (i.e. announcements of new services, updates), and provides relevant information which is up-to-date.

7.1.2 Management of Portal Services

For the portal services, the management activities comprise of service content management, service configuration, and user support tasks. With regard to the content management activities, the service management team has to guarantee that the services provide information of a specified level of quality in particular with regard to the facets of accuracy and timeliness. Moreover, complex services might need to be configured individually, e.g. in order to accommodate for new users or to address specific business events. Finally, the service management team has to provide users with functional support on using the service.

Still, the main management challenge stems from the fact that the service management most has to cope with a large number of different corporate portal services simultaneously. Hence, it makes sense to consider a delegation of management responsibilities on the portal service level.

7.1.2.1 Delegation of Management Responsibilities

In the early stages of a corporate portal implementation with a limited number of portal-services, the management of these will be handled by the portal management team. Yet, this situation is likely to change if the number of portal-services increases. A corporate portal that provides a large number of services will reach a point in its development progress, from which on the management capacity of the core portal team reaches it limit. At this point, it makes sense to consider the delegation of some of the management responsibilities to experienced portal users with the necessary domain background. This group of management users functions as primary contacts for professional support regarding a defined set of portal-services. Further, these users have content responsibility: They monitor the quality of the provided service with regard to the information quality and the functional correctness.

While the functional correctness of a service remains within the responsibility of the service developers, the quality of the information provided, in particularly with regard to the accuracy and timeliness of the information will usually depend on the data source providers.

Therefore, the responsibility for maintaining the required level of information quality should remain with the source providers. This clear distinction of responsibility should be communicated to the portal users. This of course, does not remove the portal management from the burden of monitoring the information quality of the services, but defines a clear separation of responsibility that facilitates communication and coordination activities in cases of conflict situations.

The following case study section illustrates the practice of delegating service level management tasks to experienced CoFiPot users and domain experts in order to reduce the management and support responsibilities of the core CoFiPot management team.

7.1.2.2 *Case Study* **Management of CoFiPot Services**

With the increase in the number of new *CoFiPot* services for the different financial management topics, the functional complexity of the system reached a point which marks a limit to the administration and management capacity of the core portal management team. Up to this point, the *CoFiPot* team was solely responsible for the relevant management activities on the portal level as well as the portal service level. As a consequence, in order to maintain the required level of functional support, the concept of service manager roles for a selected set of financial planning and cash management services. Thus, experienced *CoFiPot* users with the required expertise and business knowledge in the respective financial domain were assigned as members of this group of management users. Within their scope of responsibility, these users provide the support for other users, define and manage service specific security settings, and monitor and manage the content of the service (e.g. supervise data imports, release data, etc.). Further, they are in close contact to the *CoFiPot* team and the service developers to report possible service shortcomings, and propose future service improvements.

With regard to the question of finding motivated users that are willing to take over service level management responsibilities, the *CoFiPot* case has proven that in reality this poses no challenge. This is primary due to the fact that *CoFiPot* services are designed and developed according to the user's business requirements. As long as this principal holds true, there will be *CoFiPot* users that benefit from the proper operation, usage, and general acceptance of the respective services. Experiences have shown that these users are willing to take the some of the management authority.

Finally, to address the question on the responsibility for the *CoFiPot* service quality, the general consensus is that the functional responsibility remains with the *CoFiPot* team,

while the responsibility for the quality of the information provided is taken by the source provider.

7.2 Technical Perspective – Portal Monitoring and Maintenance

System monitoring and maintenance activities are the centre of the technical perspective on the management of corporate portals. In general, the relevant tasks are similar to that of other business critical information systems which operate on a 24/7h basis. From this technical management perspective, the objective is to define suitable measures and establish instruments that supervise the system's health status and send notifications in case of critical situations, including errors. In the process of addressing the identified issues, there is the requirement to define processes and tools that foster the execution of frequent maintenance activities.

Again, the system monitoring and maintenance activities have to be performed for the portal application as well as the individual portal services. From an organizational perspective, the technical maintenance is performed by the IT department in coordination with the functional department. The communication between these two parties is critical for the planning and execution of maintenance activities.

7.2.1 Portal Health Monitoring and Maintenance

7.2.1.1 System Health Monitoring

Performance counters of the application server that hosts the portal application provide the data basis for the system level monitoring activities. For the monitoring of the system health state of the application server, it is essential to obtain an overview of the current status of system resources like the CPU load, the available memory, or the free disk space. Further, it is important to evaluate and monitor possible interferences between the applications hosted simultaneously by the application server. Administrative tools that are bundled with the application server operating system can be used to supervise the relevant performance counters.

In order to monitor the current state of the portal application, one can rely on performance counters that are provided by the underlying application platform as well as measurements that are inherent to the portal application (cf. Thomas 2006). System performance counters consist of information like the number of application threads currently running, the memory consumption of the application, the effectiveness of caching strategies, number of concurrent requests, or average response time. In addition, the portal application specific measurements capture information including the number of authenticated users that are currently working

with the corporate portal, or an overview of the services that are requested. Table 8 provides a brief selection of system and portal level performance counters.

Table 8 – Selection of system performance counter, descriptions, and recommendation[41]

	Performance Counter	Description	Recommendation
Machine Level	System resources - Disk space - Physical memory	Available system memory determines the overall performance of the application.	Regularly check available system memory. Evaluate the source for memory peaks. Check application level memory consumption
	CPU load Application processes	Number of application processes running concurrently on the server. The portal application will run in one application process.	Check the ratio of application processes and the respective CPU-load. Consider to distribute the application across a number of machines.
Portal Application Level	Application Cache - # of retrievals - # Cache entries - # Total Hits - # Total Misses	Application cache and effectiveness of caching strategies are important to improve and uphold the overall application performance. Request response times can be drastically reduced through the use of effective caching.	The effectiveness of caching strategies should be evaluated regularly – especially for newly developed applications. Too large caches that are seldom accessed will have a negative effect on the system performance as important system resources are occupied.
	Requests - Type - Size - Time - State	Of interest is peak of concurrent user request. Further the application stores information about the response time of one request, request size and state of execution.	Information about the request gives comprehensive overview of the overall usage behavior and peak times. Error information can help to indentify defect links and application errors.
	Application usage - # users online - last access - system resources used	Application usage information includes the number of users currently accessing on specific application, the last access to an application as well as the resources currently used by this application	Information about the current application usage can help determine suitable maintenance time slots. Insights on the resource consumption help to identifying bottle necks and critical functions.

7.2.1.2 Portal Level Maintenance

Portal level maintenance activities are either planned or ad-hoc activities that react on critical application states (i.e. system health alert messages). Planned maintenance activities primarily focus on Web server level maintenance activities and comprise of system backup operations, deployments of new corporate portal versions (cf. Chapter 6, Section 6.1), and performing required application server maintenance activities (e.g. security-updates). One challenge with planned maintenance activities is to minimize the system down-time and thus affect as few users as possible. Hence, it is critical for the IT department to announce and coordinate these activities with the functional department in a timely manner. Suitable time-slots will be the

[41] cf. http://www.aspalliance.com for a more comprehensive list of (ASP.NET related) performance counters.

evening hours on business days, as well as week-ends for extended maintenance activities (e.g. new Web server revisions). Still, it is advisable to analyze the portal access statistics on the basis of the Web server logs to identify suitable maintenance timeslots with a low system usage.

Ad-hoc maintenance activities deal with sudden critical system states. This includes portal services that behave unexpectedly, or more serious problems like the sudden unavailability of data resources. To handle these situations effectively, the portal management and the IT department should agree upon a defined set of procedures to face the different problem types. These practices have to define a step by step procedure and outline the relevant contact persons that need to be involved, in order to solve the problem. As an example, in the case of the sudden unavailability of a critical data source, it is crucial to inform the affected users on the temporal problem and to disable the related service respectively. Further, it is important to know and contact the person in charge of the data source and to get information on the reasons for the downtime and effective solutions.

7.2.2 Monitoring and Maintenance of Portal Services

The discussions on the portal level monitoring and maintenance activities also apply on the portal services level. For the service health and performance monitoring activities information on the availability of underlying service components and database connections are of particular interest. Further, with regard to controlling and maintenance activities, on overview on the current usage activities for one service (e.g. numbers of users that are currently interacting with the service) will be useful.

As the manual monitoring is not efficient for a large numbers of portal services, the challenge lies in the design and implementation of automated monitoring and alert mechanisms. Ideally, the corporate portal implementation offers mechanisms to specify and supervise key service health measures that produce meaningful messages in case of critical service states. This can be realized by introducing a portal level monitoring services that in the backgrounds periodically examines the stats of the relevant portal services.

The service level maintenance activities are less critical in terms of system availability if the corporate portal framework allows for an independent deployment (and shut-down) of individual services. Service level performance counters like the number of users currently working with the service provides useful information for the decision on the actual execution of maintenance activities.

The objective of the following case study section is to provide insights into the CoFiPot health monitoring and maintenance activities. To support these activities, the CoFiPot implementation offers a number of services that provide data on the current system health status and furthermore offer functions to perform basic maintenance activities. Moreover, the implementation of services that periodically supervise key health figures of the CoFiPot application and automatically report critical application states have helped to reduce the monitoring efforts.

7.2.3 *Case Study* CoFiPot System Health Monitoring and Maintenance

The *CoFiPot* health monitoring activities are conducted using application status and health monitoring services that have been implemented as administrative tools. Moreover, these services also implement functions to perform frequent portal maintenance activities like flushing application caches, or resetting and restarting important *CoFiPot* engine services. Figure 33 shows the screenshots of three *CoFiPot* health monitoring and maintenance services.

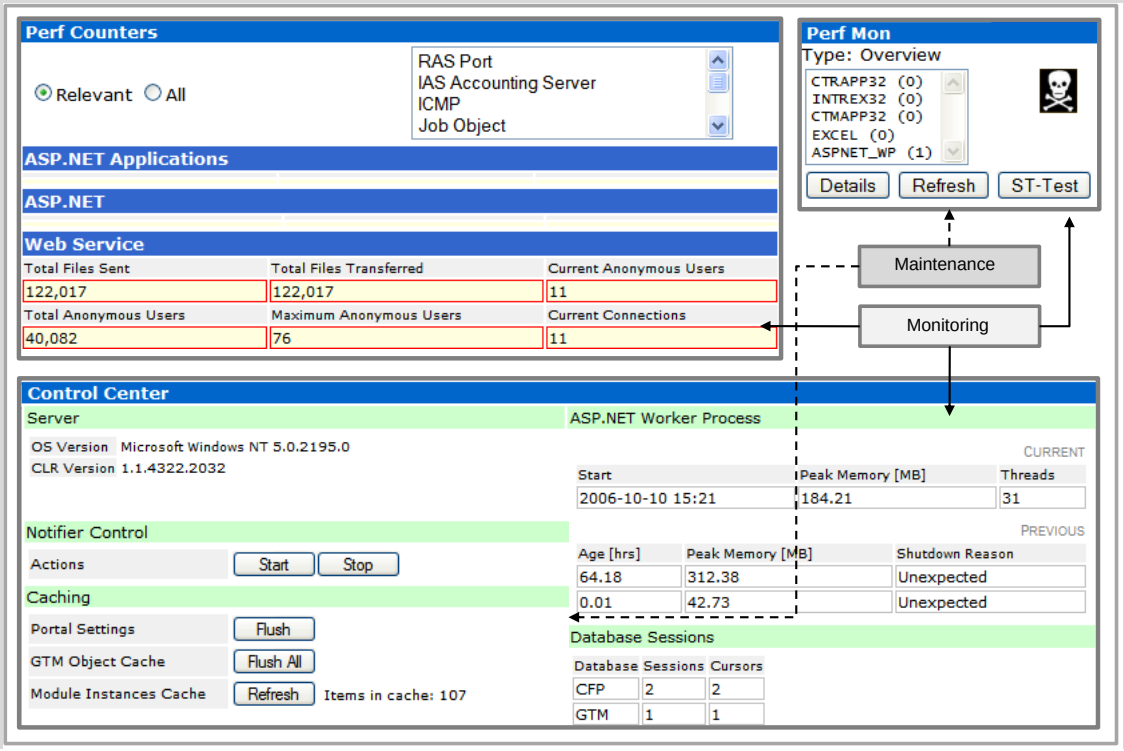


Figure 33 – Snapshot of the *CoFiPot Perf Counterns*, *Perf Mon*, and *Control Center* services

First, there is the *Perf Counters* reporting service (Figure 33 top left) that offers a comprehensive overview off all available ASP.NET Web application performance measures. Further, the *CoFiPot Control Center* (Figure 33 bottom) provides a management overview of key application performance counters (e.g. primary ASP.NET worker process performance counters), portal application configuration settings (e.g. system paths), and the current status of core engine services (e.g. notification system). The *Perf Mon* service (Figure 33 top right) offers details and key CoFiPot engine services. Additionally, the *CoFiPot* engine implements a service that monitors defined system health counters and generates notifications (as e-mails, messages for the mobile-phone, or *CoFiPot* notifications) in the case that critical thresholds are reached.

As the *CoFiPot* is used on a 24/7h basis, the major requirement on the maintenance activities is for them to affect as few users as possible. Hence, planned maintenance activities that cause a system downtime, are therefore usually scheduled at the late working hours, or week-ends. With regard to unexpected maintenance activities, past experience has shown that the majority of these deal with system services that show sudden problematic behavior. The general solution is to recycle the affected services by the means of a simple restart of the service. For these occasions, the *CoFiPot Control Center* (Figure 33 bottom) and *Perf Mon* (Figure 33 top-right) services offer the required functionality for a reset and restart of engine services, or the flushing of cache objects without affecting the *CoFiPot* application, in general.

With regard to the level of the portal services, the *CoFiPot* services automatically produce meaningful notifications in the case of unexpected errors (e.g. Email messages, short messages on mobile phones). Future plans are to extend the existing functionality and enable a customizable monitoring of relevant services level system health and performance counters like the numbers of users currently working with the service, or the availability of database connections.

7.3 Chapter Summary

The management and maintenance activities are essential to uphold the operation of the portal during the portal online phase. Thus, the main objective is to establish processes and toolkits, and define responsibilities that from a functional and technical perspective guarantee the proper operation of the corporate portal and the incorporate services

From the functional perspective, the system's complexity suggests distinctive management responsibilities for the portal and the services. The *CoFiPot* project insights showed that it does make sense to delegate the management responsibilities of key services to experienced portal users with the required professional background knowledge. These management users provide support for the other users. Further, they are responsible for supervising the service quality with regard to timeliness, accuracy and applicability.

The challenge of the technical management perspective is to establish a processes and a system of suitable system and application health measurements that supervise the portal and the services on an ongoing basis. Ideally, these measurements and maintenance tools are integrated into the corporate portal framework, as it is the case with the *CoFiPot* implementation. To address the monitoring efforts that are required to supervise the individual portal services, one proven practice is to implement service monitoring on the individual service level in the sense that each service is responsible for supervising the proper operation and availability of the direct underlying services. In the case of critical errors or system health states, the portal application should further implement means that automatically notify the persons in charge.

Finally, one key success factor of the general effectiveness of the management and maintenance activities is the coordination and communication between the technical and the functional responsibilities. This is in particular important for the planning of maintenance activities that should affect as less users as possible. In the end, all that counts from the user's perspective is that the corporate portal provides functional correct and reliable services.

In the following, Chapter 8 focuses on the project evaluation and controlling activities of the portal online stage.

Chapter 8

Evaluation of Corporate Portals

In addition to the management and maintenance of the corporate portal operations, the project controlling and evaluation activities take a decisive role within the portal online stage. One objective of the controlling activities is to evaluate the state and impact of the corporate portal project and implementation from different perspectives. As a result, the evaluation provides important information for the subsequent project management and steering activities that address further improvements and future developments. In this chapter, the main focus is on the evaluation and reporting perspective of the controlling activities. The project management and steering activities on the basis of the evaluation results are discussed in Chapter 4.

The evaluation has to address three interrelated perspectives on the impact of the corporate portal project. Firstly, from the business perspective the question is whether the corporate portal meets the project objectives in terms of a tangible business impact. Secondly, the evaluation of the system perspective answers whether and how the target audience is actually using the system. Finally, and this is particular interesting if employees are obliged to use a system, the individual's perspective focuses on the user's attitude towards the system and her perceived performance impact from using the corporate portal.

To answer these questions, the evaluation has to rely on the analysis of quantitative and qualitative data (cf. Chapter 4.2). Typical sources of quantitative data that relate to the business impact of corporate portals include transaction records and measures of business process characteristics (Section 8.1). For the evaluation of the quantifiable facets of system usage, portal visit trends and navigation pattern, the portal server Web logs contains the relevant information (Section 8.2). Finally, to explore the system acceptance, qualitative data from end-user interviews and user surveys is analyzed. On the basis of a sound measurement model, a survey study not only provides an evaluation of the individuals' performance impact from

using the system, but furthermore general insights on system determinants that influence the individuals' acceptance and satisfaction (Section 8.3).

The objective of this chapter is to identify the relevant data sources and discuss the evaluation approaches and measurement instruments that help to answer the above questions. To complement for the theoretical elaboration, the Corporate Financial Portal project provides practical insights regarding the application of the evaluation techniques and measurement instruments discussed. Additionally, the case study results and insights reported in the course of this chapter also contribute to the understanding on the effects and impact of the application of information systems on organizational practices, structures, and individuals.

8.1 The Business Impact of Corporate Portals

8.1.1 Introduction into the Business Impact Analysis of Corporate Portals

The primary project objectives are at the centre of the business impact related evaluation perspective. Again, one major challenge of the evaluation task stems from the fact that corporate portals can and probably will relate to a range tangible as well as intangible objectives. While the former can be evaluated on the basis of objective, quantifiable measurements, these might not exist for the latter. In this work, the business impact related evaluation perspective focuses on the tangible project objectives. The intangible goals associated with corporate portals like community building, the individual benefit of information sharing, are subject of the evaluation of the general system usage and user centric perspectives.

Therefore, for tangible business objects, the evaluation activities can rely on established measurement instruments for the assessment of the corporate portal project's economic efficiency.[42] Examples are cost accounting measurement (e.g. Gartner's Total Cost of Ownership; cf. Kütz 2005, pp.119-122), measurements from the area of profitability calculation (e.g. the Return on Investment), or measurements from the field of business process performance analysis (e.g. process lead time; Großmann and Koschek 2005, pp.313). Furthermore, the evaluation can incorporate custom project performance measurements as specified by the project executives on the level of the project steering (cf. Chapter 4.2.3; Table 6, p.75).

Regardless of the applied measurement instrument, the evaluation approach has to accommodate for the fact that a corporate portal in general does not solely address one single business purpose. This would contradict to the concept of a corporate portal. Instead it integrates a number of applications and services, each of which possibly serves a different busi-

[42] The reader is referred to Kütz 2005 for a comprehensive discussion of traditional IT controlling methods and measurement instruments.

ness background. In these cases, it is not practical to follow a comprehensive evaluation approach that aims to incorporate all business objectives at once, but it is more appropriate to partition the portfolio of portal services into sets of services that share one common business purpose. These sets are evaluated separately according to actual underlying business goals.

In the following sections, Bayer's foreign exchange management practice serve as an illustrative example for the evaluation of the business impact of corporate portals. The elaboration relies on the analysis of data from empirical observations, transactions, and the interviews with the expert-users and executive managers. The case study section not only provides insights on the task of evaluating the business impact, but the results also provide empirical evidence on the impact of a corporate portals on global business processes and practices.

8.1.2 *Case Study* The CoFiPot Impact on Bayer's Foreign Exchange Management

The *CoFiPot* was designed to provide different sets of services for Bayer's financial management requirements that range from financial planning to the management of different categories of financial risks. [43] Each of these sets of services has to be evaluated on the basis of its respective business goals. The following analysis addresses the impact of the *CoFiPot* on Bayer's foreign exchange FX management practices.

As a consequence of buying goods and selling products worldwide, the companies of the Bayer group have to deal with receivable and payables, which are denominated in foreign currency. These receivable and payables are exposed to fluctuations in the foreign exchange rates. Thus, according Bayer's financial guideline, the primary goal of FX management is to reduce the FX risk for the Bayer Group. One popular instrument is to use derivative FX contracts the impact of changes in exchange rates on receivables and payables can be eliminated.[44]

Bayer distinguishes between two perspectives on FX management: group level perspective and legal entity perspective. From the group perspective, the corporate financial head quarter hedges the group net exposure with external banks counterparties usually by executing FX forward contracts. This practice ensures that the FX risk of the Bayer group is hedged according to the corporate financial guidelines. Yet, the legal entities do not automatically participate from the group level hedging activities in the sense that the hedging results are not automatically attributed to the respective corporate entities and their expo-

[43] Refer to (Cooper 2000; Eun and Resnick 2004; Shapiro 2006) for a detailed discussion of (multinational) financial management functions.
[44] A brief summary on corporate foreign exchange management practices is presented by Glaum and Brunner 2003

sure. The legal entities are free to decide on their individual FX management strategy with the option to hedge their FX risk or speculate on improving their earnings by betting on positive exchange rate developments. Yet, if they decide to safe-guard their own P&L from effects of FX rate fluctuations they may hedge their exposure with the corporate financial service centre CFSC by means of internal FX hedges. Hence, the CFSC takes the role of an in-house bank and quotes market oriented prices for the requested hedging transaction.

In principal, the FX management process is the same from the group level perspective as well as from the legal entity perspective. Following Bayer's FX management practices and guidelines, the FX management process follows three main stages: The first stage identifies and measures the current FX exposure level. If the need to safe-guard the current FX exposure level is identified it is hedged with appropriate FX derivatives that offset the changes from fluctuation of the respective FX rates. Finally, there is the need for a controlling of the hedging activities including the monitoring, evaluation and reporting of hedging results – that in turn will have an influence on the FX exposure level (Figure 34).

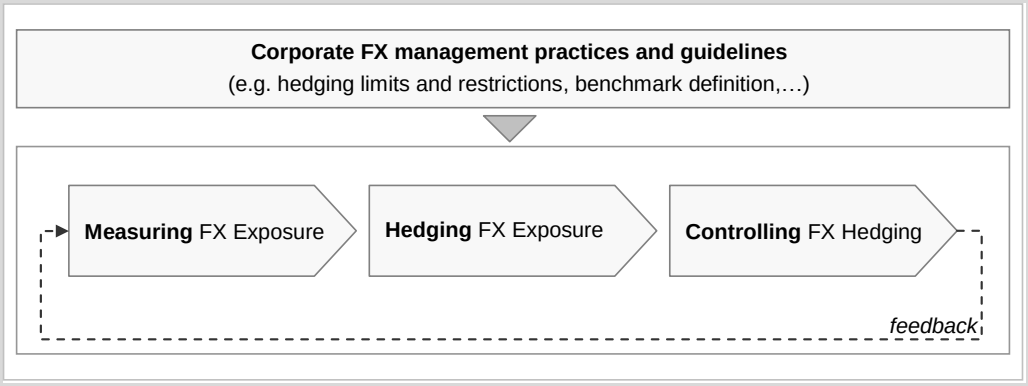


Figure 34 – Bayer's FX risk management process

In the following, the legal entity perspective on FX management is assessed with regard to the *CoFiPot* FX management services and related processes. In contrast to the group level hedging activities that are subject to a greater level of regulation, it is of particular interest to observe and evaluate the impact of the *CoFiPot* FX services on the legal entity's FX management practices.[45]

8.1.2.1 Legal Entity Perspective on the FX Management

For the legal entity, the traditional FX management process is characterized by manual tasks and coordination efforts: In order to measure the current FX exposure level, the responsible FX manager usually has to manually identify, aggregate and evaluate the relevant open positions from the local accounting systems. If the FX exposure is to be hedged,

[45] For a discussion of the group level FX management practices, in particular with regard to the integration of multi-bank FX marketplace, refer to Vo and Wojciechowski 2005; Vo, Wojciechowski et al. 2005.

the FX manager has to contact the CFSC via telephone or fax and request for a suitable FX derivative. However, conduction this task is only possible during the office hours of the respective CFSC, thus results in coordination challenges especially with regard to time zone differences. Finally, once the trade has been confirmed and closed, it is within the responsibility of the FX manager to keep track of all open derivatives, to regularly identify their fair value and to prepare and post the information to the general ledger following Bayer's accounting guidelines. Although, the relevant information is managed and processed by the CFSC's information systems it is not directly accessible for the individual FX manager.

With regard to the *CoFiPot* implementation, on the one hand, the primary aim was to support the local manager with their FX exposure management needs. Moreover, the local FX manager should have the possibility to close valid FX hedging transactions with the CFSC – regardless of office hours, geographical location and time zones. To satisfy these business requirements, two *CoFiPot* FX risk management services were developed and introduced: the *FX Exposure Monitor* and the *FX Trades CoFiPot* module. These *CoFiPot* applications have taken a central role within Bayer's refined FX management process.

Measuring FX exposure – To determine the Bayer Group net FX exposure, the relevant exposure data has to be reported by the legal entities on a regular basis. For the majority of entities this process is done automatically on the basis of a daily data import process. The remaining entities that lack the technical requirements to participate in the automated process have to report their exposure data manually either via e-mail or by directly entering the data using an exposure upload service provided by the Corporate Financial Portal (❶ in Figure 35). In either case, the reported data is stored in a central exposure data base that is managed and used primarily by the financial headquarter for the purpose of group level exposure management.

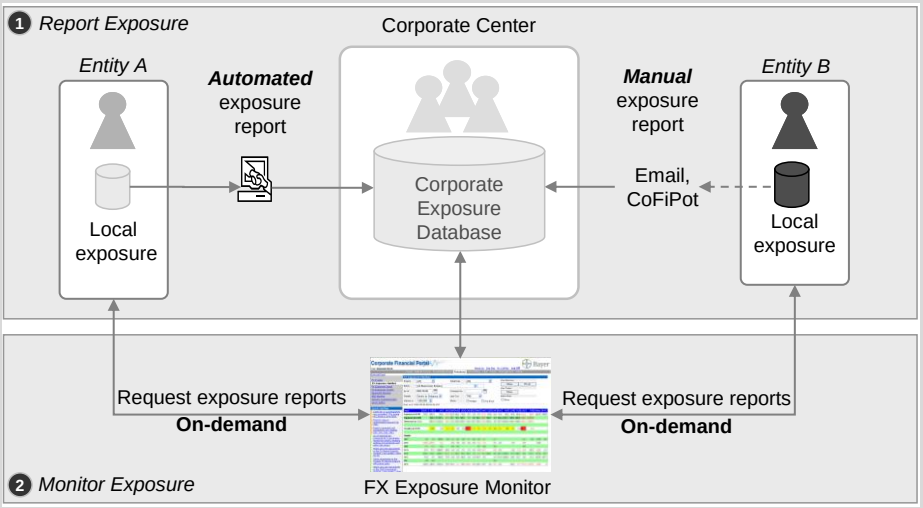


Figure 35 – Measuring FX exposure at Bayer with *CoFiPot*

The role of the *FX Exposure Monitor* is to access this exposure data base, extract the relevant data, and prepare the required exposure reports (❷ in Figure 35). Personalization services provided by the *CoFiPot* application framework enables the FX Exposure Monitor to provide exposure reports on different levels of details and aggregation with regard on the user's preferences and security level. Group-level FX managers have access to all exposure data, while local FX managers only get the exposure reports for the entities within their responsibility. By the means of the *FX Exposure Monitor* the local FX managers have access to and rely on the same exposure reporting capabilities as the group level FX managers.

The *FX Exposure Monitor* offers an on-demand report of the current FX exposure that automatically highlights critical exposure levels. The exposure report provides three levels of aggregation from the group net exposure, over the entity level, to the transaction level. Moreover, the application offers basic data warehouse *slice* and *dice* capability with regard to the dimensions region, sub group, entity and date (Figure 36).

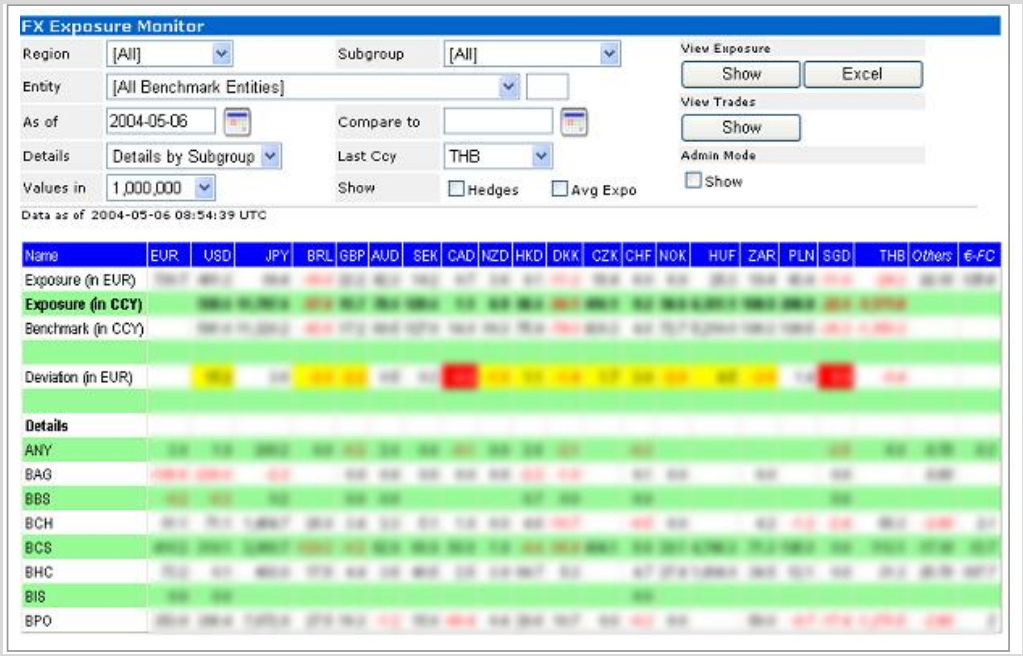


Figure 36 – *CoFiPot FX Exposure Monitor* application

Hedging FX exposure – In the case that the local FX manager identifies the need to save-guard the entity's profit and lost from FX rate fluctuations, she may do so by closing internal FX forward contracts with the CFSC. She can either rely on the traditional voice trade channel (i.e. telephone trading) or chose the *CoFiPot FX Trade Entry* application (Figure 37) to close valid FX transactions on a 24/7h basis. With the *FX Trade Entry* the FX manager has to specify the trade type, the settlement type, and the currency pair with the buy or sell amount respectively. The CoFiPot service relies on personalization mechan-

isms provided by the *CoFiPot* application framework in order to reduce the interaction complexity by pre-selecting suitable or omitting irrelevant options. Using the "get quote" functionality, the FX manager obtains a quote for the requested transaction that is based on the current market rate as provided by an external market data provider. The quote is valid for five minutes.

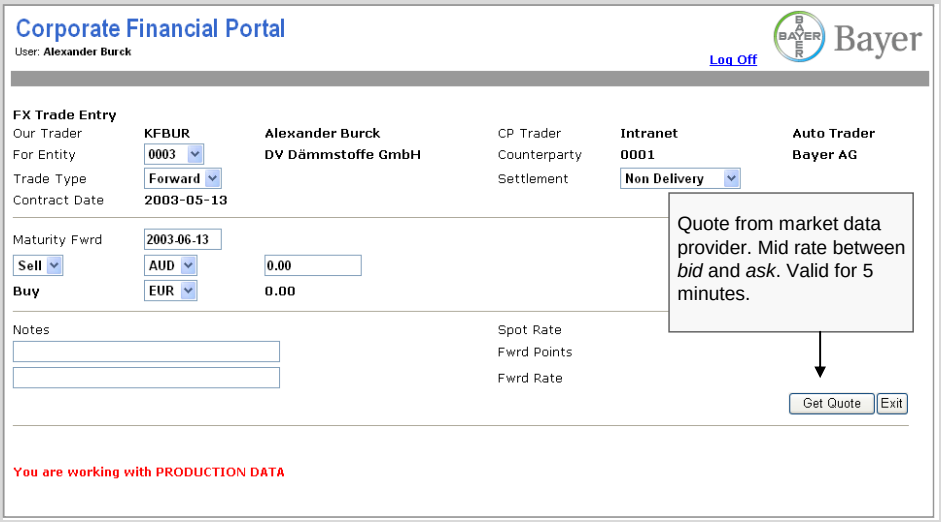


Figure 37 – *CoFiPot FX Trade Entry* application

The diagram in Figure 38 describes the FX exposure hedging process. After the FX manager executes the FX trade, the *CoFiPot FX Trade Entry* application directly saves the trade details as specified into the corporate treasury management system TMS and notifies the staff at the CFSC for final agreement and confirmation. It is important to note that regardless of the actual time the trade is processed at the CFSC, the trade conditions on execution are guaranteed. Upon agreement and confirmation, the FX manager automatically receives a confirmation letter as a contract for this hedge. The FX manager then either confirms the trade by replying to the e-mail with the confirmation letter attached or via the *CoFiPot*. Furthermore, IFRS hedge accounting requirements and guidelines is automatically created and stored for the transaction.[46]

[46] The reader is referred to Deloitte 2006 for a comprehensive discussion on the IFRS hedge accounting guidelines and requirements.

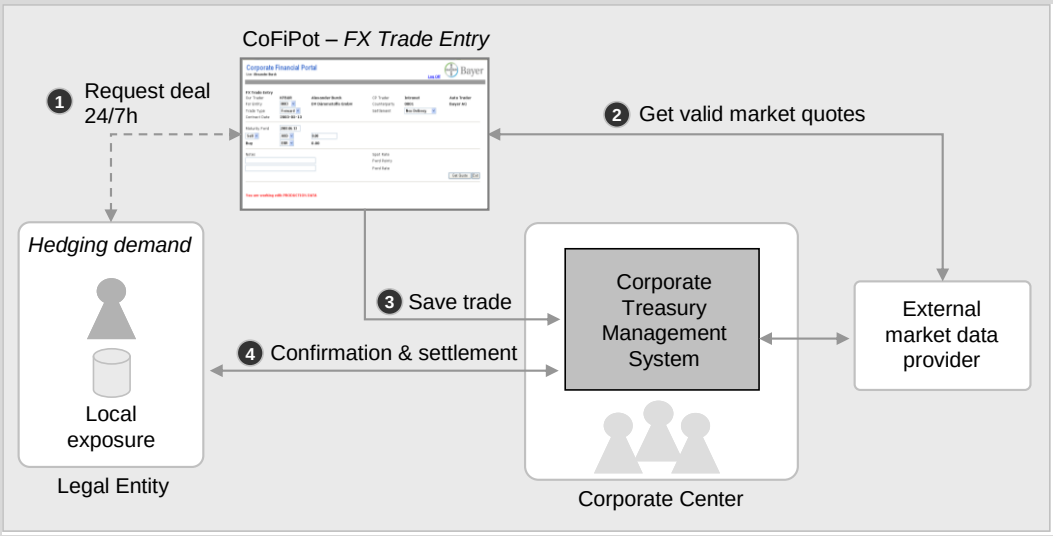


Figure 38 – Hedging FX exposure process

Controlling FX hedging activities – Every FX transaction that is closed with the CFSC is stored and managed by the corporate treasury management system TMS. Consequently, these trades automatically participate in the TMS workflows that include the valuation of the individual trades. The TMS provides FX reporting capabilities that originally were only available to the employees at the CFSC.

In this regard, the primary objective of the *CoFiPot FX Trades* application is to provide a convenient access to these FX trade reports as provided by the TMS – not only for the CFSC but for every FX manager with Bayer's financial community. With the *FX Trades* application the FX manager can request an overview of all FX trades that she is responsible for; with market values denominated either in Euro or in local currency. Following the general standards for *CoFiPot* reports, the *FX Trades* application allows for a slice and dice of the data according to the dimensions entity, portfolio, date, type, and the current trade status (Figure 39). It is important to note that the level of detail provided by the *CoFiPot FX Trades* reports satisfies the requirement of the requirements of the Bayer's accounting principles (cf. Vo, Glaum et al. 2007).

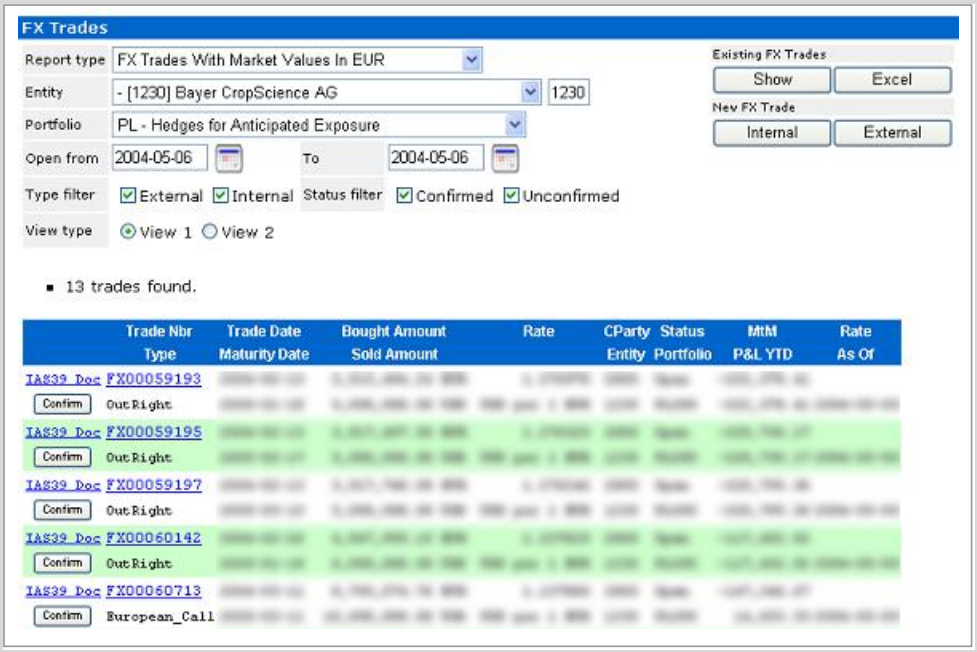


Figure 39 – *CoFiPot FX Trades* application

8.1.2.2 Reflection on the CoFiPot FX Management Process

The *CoFiPot* FX management services simplify and improve the traditional FX management process with regard to several business process related facets. The FX reporting services directly access the corporate database and provide the requested reports instantly. Hence, the generated FX reports are based on up-to-date data and are implemented with the experience of the FX experts at the CFSC. These FX experts ensure that the reports satisfy the corporate level requirements on information quality. From the corporate perspective, these reports help to foster a more consistent level of FX management quality, as the local FX managers base their decisions on reports of the same "certified" level of quality. Further, the shift in focus from the preparation of the reports to the analysis of the exposure and hedging information supports well-informed decisions.

The efficiency of the FX management process is the primary concern of the *CoFiPot* FX trading applications. With the *FX Trades Entry* service, the trade data is processed as specified by the FX manager and saved directly to the TMS upon trade execution. While the *CoFiPot* FX trading services clearly improve the comfort of the hedging task, the time it takes from the specification of the deal parameters to the execution stays almost identical to the traditional telephone process. Yet, in this case, it is not particular the FX manager but the staff at the CFSC that benefits from workflow improvements. The *FX Trade Entry* application eliminates the necessity of one real person counterparty during the task of deal specification and execution. Observation show, that the execution of this particular step

takes an average of four minutes per trade, which can be directly translated to the time-savings per trade from the perspective of the CFSC. The improvements in the trade processing workflows after the trade has been executed and saved to the TMS leads to further time savings. This is not due to a redesign of the process flow but the central controlling activities benefit from a number of *CoFiPot* services that reduce the interaction complexity of the TMS. For key activities, these services provide direct access to the required TMS functionality only. As one example, the *CoFiPot* Trade Confirmation application offers the controlling back-office staff a comprehensive overview on all open unconfirmed trades with the confirmation being a one-click activity. With regard to the application's ease-of-use, this is superior to the direct interaction with the TMS. Table 9 summarizes the main findings:[47]

Table 9 - Key characteristics: traditional vs. *CoFiPot* FX management process

	Ø Lead time		***People involved***		***CoFiPot Benefits***
	Traditional	***CoFiPot***	***Traditional***	***CoFiPot***	
Measuring FX Exposure	**> 5 minutes** Depends highly on individual workflow and preparations	**< 1 minute** *On-demand* i.e. report is created instantly	FX Manager	FX Manager	*CoFiPot* eliminates the need for data preparation, processing, etc. Time can be invested in data analysis.
Hedging FX Exposure	**Ø 4 minutes** to trade execution *with two people involved*	**Ø 4 minutes** to trade execution *only FX manager involved*	FX Manager & CFSC for *all* major activities	FX Manager CFSC *only* for trade agreement & confirmation	*CoFiPot* eliminates the error prone re-keying the trade data. Further time-savings due to improvement of trade processing workflow.
Controlling FX Hedging	**> 5 minutes** Depends highly on individual workflow and preparations	**< 1 minute** *On-demand* i.e. report is created instantly	FX Manager	FX Manager	*CoFiPot* eliminates the need for data preparation, processing, etc. Time can be invested in data analysis.

To further streamline the *entire* FX hedging process, the CFSC introduced the so called *Autohedging* service. Business entities that fulfill technical and legal prerequisites can register to the *CoFiPot Autohedging* service (Bayer_Nt 2005). The *Autohedging* service evaluates the entity's open FX exposure on a daily basis and automatically closes hedging transactions on behalf of the entity as soon as a specified exposure level is surpassed. It is possible for the entities to exclude currencies from the automatic exposure hedging process either because the foreign currency is pegged to the local currency or if the FX manager wants to apply a different FX management strategy for some currencies.

[47] cf. Appendix A, insights of interview question Part 3 and Part 4.

In summary, the *CoFiPot* FX management services help to obtain well informed management decisions and improvement in the efficiency of the actual FX trade processing. Still, the significance of these developments only comes to play if the FX managers adopt the new practices. This is assessed in the following sections.

8.1.2.3 Impact of CoFiPot on FX Hedging Practices

The assessment of the *CoFiPot* impact on the FX hedging practices is based on the transaction data from January 2001 to December 2005. The transaction data from 2001 serves as a reference of the traditional FX management practices as the *CoFiPot* FX management services were not introduced until January 2002 and made known to a wider public in June 2002. The Autohedging service was introduced for a group of pilot entities in July 2002. This group was steadily extended in the following months.

It has to be noted that the data is subject to external business events. In particular the LANXESS spin-off in January 2005 (LANXESS 2007) causes a drop in the total number of monthly hedging transactions due to the exclusion of the LANXESS entities. Figure 40 outlines the development of the hedging transactions per month for the regarded periods and shows whether the telephone or the *CoFiPot* was used as a transaction channel. Furthermore, the orange line illustrates the development of the ratio of *CoFiPot* transactions versus telephone transactions.

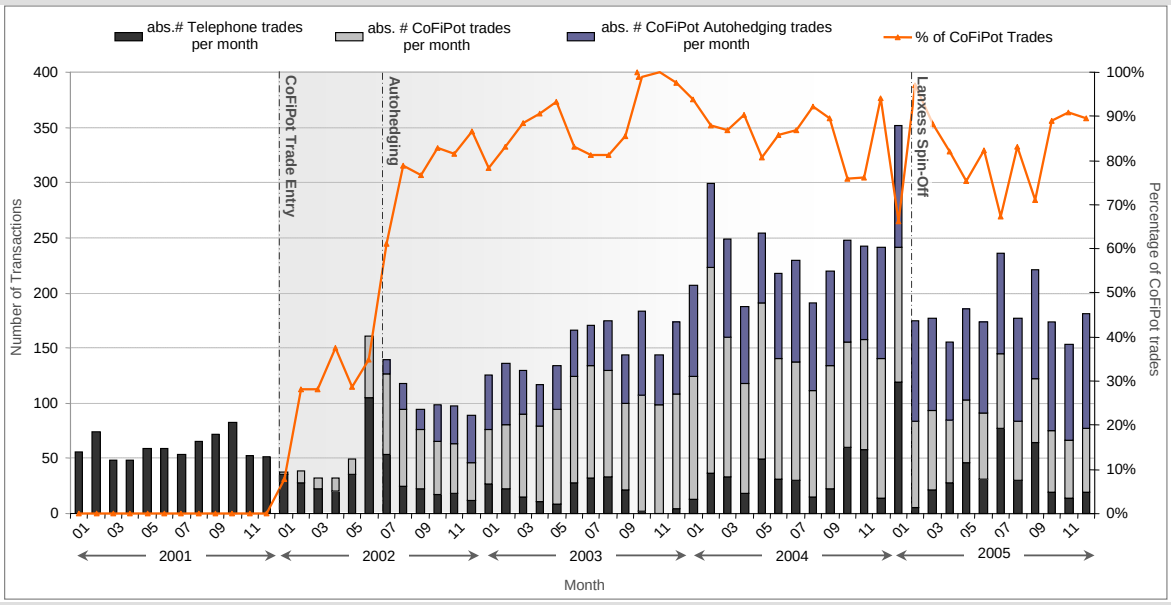


Figure 40 – *CoFiPot* vs. telephone transactions (all entities)

The evaluation of the transaction data from 2001 to 2006 shows that since the introduction of the *CoFiPot* FX management services in January 2002 the number of transactions per month has increased from an average of 60 trades per month in the year 2001 to

an average of 235 trades in the year 2005. Figure 40 further illustrates the different trading channels used for the transactions. The data reveals that following the introduction phase *CoFiPot* has replaced the traditional telephone trading for most transactions. As of July 2002 the number of *CoFiPot FX Trades Entry* trades surpasses that of telephone trades. The introduction of the *Autohedging* service has further increased the total number of *CoFiPot* hedges. Following the more intense promotion of this service in 2004, currently the *Autoheging* service accounts for approximately one half of all hedges closed. Taking aside from external business events, the *CoFiPot* currently accounts for an average of 80 percent of all hedging transactions.

There are at least two reasons for the nearly four times increase in total hedging transaction (Figure 41). First, the average number of hedges per entity is increased from an average of 4 trades to 8 trades per month. Second, and more important, the increase in hedges stems from an increased number of entities that hedge their exposure. Figure 41 shows that this number has increased from 14 entities that do hedge their exposure in 2001 to 35 entities in 2005. Both effects explain the strong increase in hedges. Fluctuations in this number are due to external business events. As an example, the LANXESS spin-off in January 2005 was followed by a departure of the respective entities that consequently has lead to a reduction of the hedging activities in the subsequent periods as shown in Figure 40.

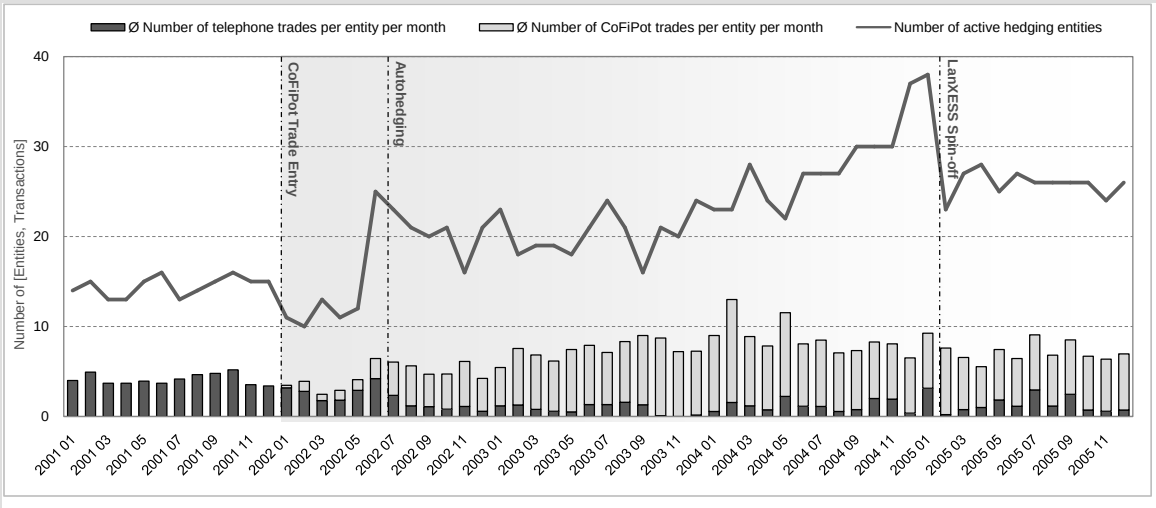


Figure 41 – *CoFiPot* vs. telephone transactions per entity; number of active entities

In summary, the analysis of the transaction data allows for important insights on the FX hedging practices of the local entities. On the one hand, the data clearly shows that the *CoFiPot* has established itself as the preferred channel for closing hedge transactions. An average of 80 percent of all transactions per month is closed either through the *CoFiPot* FX Trades Entry service or by the *Autohedging* service. This development is of particular importance with regard to the process efficiency goals – especially, if one considers the

sheer amount of *Autohedging* transactions that are closed without the necessity of any manual intervention.

Furthermore, the data underlines that the overall hedging activity has increased significantly since the introduction of the *CoFiPot* FX management services: The FX managers close more transactions per entity and month and there are more entities that do report and hedge their FX exposure. With the *CoFiPot* FX management service and the supporting promotion activities, seemingly more local FX managers have realized the need to safeguard their FX exposure and are willing to do so by the means of the *CoFiPot*. For the financial management on the group-level, this is one important insight: it outlines that by enforcing the integration of global business process, the *CoFiPot* plays one important role for Bayer Corporate Finance to address their financial management goals. With the integration of the *CoFiPot* services, the reporting and management of the group-level FX exposure "requires no-more than a few mouse-clicks" (cf. Börsen-Zeitung 2003).

8.2 Evaluation of the Corporate Portal Usage Perspective

The evaluation of the system's usage perspective is conducted by the means of a Web log analysis (aka. Web analytics). The Web log analysis consists of a set of activities that are applied by Web site operators to track and analyze their visitors' behavior. One goal is to use the gathered information for the purpose of improving the effectiveness of the Web site implementation (cf. Spiliopoulou 2000). One major facet of Web log analysis is the discipline of Web usage mining that in particularly focuses on the identification of user navigation sequences and patterns using statistical methods from data mining (cf. Spiliopoulou 2000; Eirinaki and Vazirgiannis 2003).

The Web log analysis process is subdivided into four main phases (Spiliopoulou 2000, p. 129): First the usage data has to be collected using either server Web logs or the page tagging techniques (Section 8.3.1). As this data will contain invalid records (e.g. request generated by web spiders or robots), it has to be cleaned and processed for the actual mining activities (Section 8.3.2). The result of the pre-processing phase can be used on the one hand to obtain a general overview of the usage behavior (e.g. reports on the page views, visitors, Section 8.3.3). On the other hand, more sophisticated Web usage mining techniques can further provide even more detailed insight into aspects including users' navigation patterns that help to improve the effectiveness of the information architecture design (Section 8.3.4). Figure 42 illustrates the Web usage mining process.

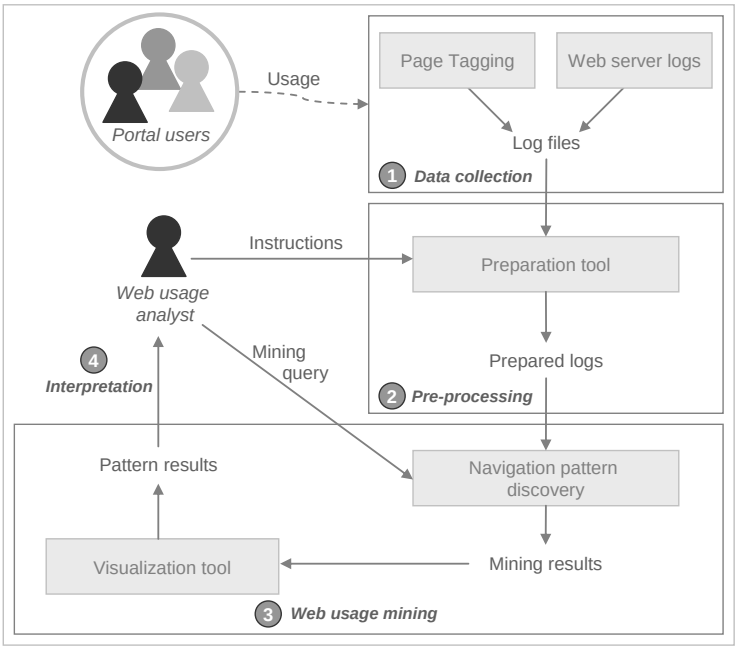


Figure 42 - Web usage mining process (following Spiliopoulou 2000, p. 129)

8.2.1 Data Collection – Web Logs and Page Tagging

In practice, there currently exist two predominant techniques for collecting Web site usage information. On the one hand the server side (automatic) recording of client interaction within the Web server logs and on the other hand the page tagging approaches.

Every request for a Web resource that is issued by a client computer is recorded in the *Web server logs*. Typically, this data is either stored in the common log file format (cf. IBM 2006) or the extended log file format proposed by the W3C (W3C_ExtendedLog 2006). The common log file format consists of the most basic Web request information. These are the remote hostname or client IP address, a string representation of the exact request, status information, information about the content transferred and the username in case the user authenticates himself. In contrast to the common log file format, the extended log file format permits a customization of the recorded information by specifying the fields that are to be recorded by the Web server. In summary, the extended log file format is designed to meet the following needs (W3C_ExtendedLog 2006):

- *Permit control over the data recorded.*
- *Support needs of proxies, clients and servers in a common format*
- *Provide robust handling of character escaping issues*
- *Allow exchange of demographic data.*
- *Allow summary data to be expressed.*

Additionally, the extended log file format introduces a number of new log fields. One example is the referrer field which represents the URL the client was visiting before requesting

the target URL. Referrer information is useful to access the effectiveness of online promotion on others referring Web sites. One further example is the user agent field that represents the software used by the client to access the Web site. Table 2 outlines a selection of the most commonly used fields in Web site log files (based on the extended web log format) together with remarks regarding their possible application.

Table 10 - Selection of fields from the extended log file format (cf. W3C_Logformat for a complete list)

Log Field	Description	Remarks
Access time stamp e.g. `2006-10-24 18:08:10`	Timestamp of the request.	Needed in order to approximate sessions/visits
IP address e.g. `192.123.50.120`	Specifies the source of a request	Analysis can be problematic if a number of clients share one IP address through a common proxy server. The IP address can provide further information including geo-location and network domains.
Method of Request e.g. `GET` or. `POST`	The method used to retrieve information. GET-request just retrieve data while POST-request can be anything	POST request – if not encrypted – can reveal further information like keywords used in search queries.
URL e.g. `/search.htm`	Exact description of the source/file that is requested	Every resource requested will be recorded. Yet, not everything is of the same relevance
HTTP status code e.g. `200` (successful)	Indicates whether the requested file was retrieved successfully	Useful for the identification of unavailable resources.
Bytes transferred	Numeric field containing the number of bytes transferred – not including the HTTP header).	Can be used to determine resource consumption. Points out possible bandwidth bottlenecks.
Referrer e.g. `www.uni-karlsruhe.de`	Specifies the URL the client was visiting before.	Is of relevance for determine the success of online portal promotion activities
User Agent e.g. `Mozilla`	Specifies the software the clients used to issue HTTP requests.	In most cases the User Agent will specify which browser is used by the clients. This information on the favourite browser is important for Web page design with regard to compatibility concerns.

There are obvious limitations of Web logs that demand for the analyst's attention. First, the data that is recorded by the Web logs is limited. In principal, all that is known from a web entry is the time of a request, the Client-IP address and the URL of the request. Although technically possible, privacy concerns usually forbid the logging of more specific data – in particular in the corporate context. Second, the recorded data is flawed with regard to the analysis purpose. For example, different clients can share one single proxy server to access the Web site. Therefore the resulting log records will share the same client IP address and it will be more complex to identify unique visitors. Web spiders or robots of Web search services scan the Web sites within a network and will consequently be responsible for a significant

amount of the web log records. These entries have to be identified and handled by the pre-processing activities.

The concerns on the accuracy of Web log file analysis and the desire to perform web analytics as an outsourced service, led to the development of a more advanced data collection method, the *page tagging*. From a technical perspective, page tagging relies on the execution of a client-side JavaScript code that aggregates a custom collection of client request information and generates a log statistic (cf. Kohavi et al. 2004). This statistic is then saved on a remote server that is used for the Web analytics tasks. Example 8.1 displays the JavaScript code that has to be added to a Web page in order to participate in the Google Analytics service (Google 2007). The first line indicates the JavaScript code that is stored on the Google Analytics server. This code is executed on the client machine and the result statistic is transferred to the server using a HTTP request.

Example 8.1 - JavaScript code for the integration of Google Analytics service (page-tagging)

```
<script src="http://www.google-analytics.com/urchin.js"
type="text/javascript">
</script>
<script type="text/javascript">
_uacct = "UA-xxxxxx-x"; /* unique identifier */
urchinTracker();        /* generates,transfers statistic */
</script>
```

In contrast to traditional Web server logs, page tagging offers the advantage of collecting more complete information on the client request. One major advantage of page tagging is that the generated statistics will usually contain information that clearly “identifies” a unique visitor regardless of whether cookies are used by the regarded Web site. A further advantage of page tagging is that the collected data is immune to corruptions due to requests by search engine Web spiders as these will usually not execute JavaScript code (cf. Kohavi et al. 2004). Yet, page tagging will not work if JavaScript is disabled by the client browser. Kohavi et al. (2004) state that about 5% of all visits belongs to this group of not recorded visits.

8.2.2 Data Pre-processing

The activities of the pre-processing phase comprise of data cleaning, identification of users, sessions as well as path completion tasks. The overall goal is to reconstruct the unique users’ activities on the Web site (Spiliopoulou, Pohle et al. 1999). Due to the discussed usual flaws and inherent limitation of log file records (e.g. incompleteness, uniqueness) the pre-processing phase has to rely on the use of heuristics for tasks like user and session identification. Cooley at al. (1999) extensively discuss the application of these in the context of Web log pre-processing. The aim of the following elaboration is to give a brief overview of the

pre-processing activities and techniques (cf. Cooley, Mobasher et al. 1999; Spiliopoulou, Pohle et al. 1999; Eirinaki and Vazirgiannis 2003).

The pre-processing phase starts with the *data cleaning* activities that eliminates log file entries which are irrelevant for the actual Web usage analysis. The usual suspects that should be filtered comprise of request for secondary resources like pictures (`*.bmp,*.gif, *.jpg`), request generated by Web spiders or robots as well as reports that could not be served and produced an error. Separating irrelevant items from the Web usage logs can rely on a collection of filter items specified by the Web log analyst. In this context, it shall be noted that some of the seemingly irrelevant records are still of interest for Web log analysis questions from a complementary perspective. For example, consider a Web designer who is interested in understanding the complexity of the Web pages served. In order to evaluate this facet, she will have to analyze all the resources attributed to a Web site (i.e. text, pictures, styles etc.). Hence, the information should be separated from the Web data used for the actual usage mining activities, but not eliminated completely.

The next task is to identify unique visitors. This is a challenging task, in particularly due to the possibility of a shared IP address (e.g. through the use of a proxy server) or users that use multiple machines simultaneously to access a Web site. The most simply approach ignores the discussed problems with shared IP addresses and considers an IP address as a clear identification of a visitor. A more advanced approach is to analyze the user agent information for one IP address as one can suspect that it is unlikely for one user to use different browsers. Of course, one limitation of this latter approach stems from the fact, that users with requests that originate from a common organization (e.g. company) will most likely use the same Web browser software due to company regulations. Hence, a more sophisticated approach as proposed by Cooley et al. (1999) is to combine the information from the access log with the referrer information and information on the site topology to identify navigation jumps. These gaps in the navigation are attributed to the browsing behavior of different users based on the assumption that if a page is not directly reachable from any of the previously visited Web site positions, a different user that shares the IP address is responsible for the request. Clearly, this method ignores cases according to which a user uses saved bookmarks for navigation.

As each visitor might visit a page more than once per day, the subsequent step is to identify Web usage sessions that represent series of requests from one user within a specified time frame. Usually, sessions are identified on the basis of reference timeframes. A common approach is to specify a timeframe of 20 to 30 minutes as a reference for session identification.

If the next request issued by a client is beyond this timeframe, the request is assigned to a new usage session. One motivation for aggregating Web usage sessions stems from the simple fact that a session is much easier to handle as a unit of measurement than for example a list of request of a whole day. Further, usage sessions carry the inherent information on a user's general Web usage behavior over the period of a day.

The use of client side caching practices (i.e. the use of Web browser's back button) will cause that actual request is not recorded by the Web server logs as it never reaches the server but is retrieved from the client's browser cache. Consequently the Web server log data will be incomplete. Hence, the task of path completion heuristics is to extrapolate these "missing" records. In principal, the techniques are similar to those of the user identification (cf. Cooley at al 1999) and rely on an aggregated analysis of Web server log, referrer data and information on the site topology. Records that are identified as probably missing records are added to the Web usage log records.

Finally, the pre-processing phase terminates with the preparation of the Web log data entries as required by the specific Web usage mining application and algorithms in the subsequent phase. In this context, Spiliopoulou (2000) proposes to modify the Web log records in such a way that they reflect the concept hierarchy – that is the Web site topology or taxonomy underlying the regarded Web pages. This is especially useful with regard to Web portals that, as dynamic Web sites in general, often rely on cryptic http-request query strings that are hard to read. As an example the following segment of URL `/default.aspx?PageId=28` can be replaced by a more readable `/Home/Team_Overview`.

8.2.3 Basic Web Log Analysis

The cleaned, aggregated and processed log files obtained from the pre-processing phase can be used for a preliminary Web usage analysis. Basic Web usage terms and metrics including information on page views, clickstreams, visits and visitors can be derived from these Web logs without much effort, using a standard Web log analysis tool. The W3C Web Characterization Activity defines these terms and metrics as follows (c.f. Haigh and Megarity 1998, W3C_WCA 1999, Eirinaki and Vazirgiannis 2003):

- **Hits** – One hit represents one client request for a server resource. The number of hits is sometimes *wrongly* taken as a measure for web site popularity. This is due to the fact that one single Web page typically consists of text, pictures and further resource components that each are requested by the client when the page is visited. Hence, while the client requests on single Web page, the result is a set of numerous sub requests that are all individually recorded in the Web logs.

- **Page View / Page Impression:** A page view or page impression is defined as the complete rendering of a Web page on the client machine requesting the page. Thus, a page view aggregates all the resource requests necessary in order to display a Web page as specified by the Web page definition (i.e. style definitions, images, scripts, etc.).
- **Clickstream:** A sequence of page views requested by a client.
- **Visit / Session**: A series of requests from the same uniquely identified client within a specific period of time (e.g. predefined session length).
- **Visitor:** The client generating requests on the web server.

Figure 43 illustrates the relationship of hits, page views and page visit. Hits that originate from the same client IP address are aggregated into groups of page views ❶. Sequences of page views ❷ that are conducted within a specific period of time are assigned to one visit ❸.

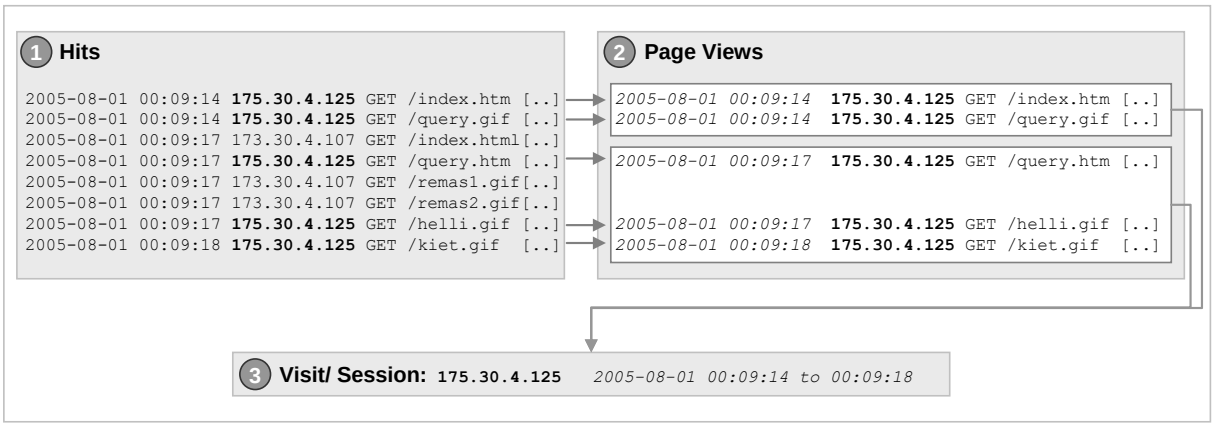


Figure 43 – Basic Web usage metrics: hits, page views and visits

For the purpose of measuring Web site usage and effectiveness, it is obvious that especially page views, visits, and number of visitors are relevant measures. In contrast, the analysis of hits only makes sense if one regards the ratio of hits versus page views, which gives an indication on the general complexity of the Web pages offered. These basic Web usage metrics are the foundation for a number of Web site performance reports and statistics the likes of visits per day, average length of a visit, visits per location and geo-segmentation or the depth of one visit.

These Web performance reports are among the basic features offered by current Web analytics packages like *Google Analytics*, and *WebTrends*.[48] These Web analytic packages provide both, pre-processing and reporting functionality. While *WebTrends* analyze Web server log files, *Google Analytics* uses data that is transferred using page tagging. Google further

[48] Google Analytics: www.google.com/analytics; Webtrends: www.webtrends.com; for an overview of Web log analytic tool suites and Web usage mining tools the reader is referred to Eirinaki and Vazirgiannis (2003).

automatically adds geo-location and Google search query data to the analysis. Using *WebTrends* one has to manually specify these additional data sources, in exchange for the freedom to specify and report custom Web performance metrics.

In summary, one major advantage of this basic level of Web log analysis is that it provides a comprehensive and easily describable set of commonly accepted Web site performance measurements. Reports that describe the development of page views over a certain period of time or the increase in unique and returning Web site visitors are easy to comprehend and communicate. This is of particular importance with regard to project management level reporting on the Web site's performance.

8.2.4 Introduction into Web Usage Mining

Web usage mining refers to the application of more sophisticated statistics and data mining techniques that aim at the discovery of interesting navigation patterns derived from the preprocessed data (Eirinaki and Vazirgiannis 2003). While the statistics obtained from Web log analysis serve a general evaluation purpose, the more complex Web usage mining tasks are conducted with the explicit purpose of improving the navigation structure of a Web sites (cf. Spiliopoulou, Pohle et al. 1999; Spiliopoulou 2000). In general terms, Web usage mining refers to a variety Web log related knowledge discovery and data mining activities including the discovery of association rules and clusters as well as classifications of users (cf. Eirinaki and Vazirgiannis 2003). In this work the focus is on the discovery of navigation patterns through the use of sequence mining activities.

Mining sequential patterns was introduced by Agrarwal and Srikant (1995) and in general addresses the challenge of discovery frequent sequential patterns from ordered item sets. In this context, the relevant terms and general concepts are defined as follows (Agrarwal and Srikant 1995, pp.3-4):

Definition 8.1: Item set

An item set a_i is a non empty set of items i with $i \in a_i$. In this work an item refers to an entry of the Web log.

Definition 8.2: Sequence

A sequence $s\langle a_1, a_2, .., a_n \rangle$ is an ordered set of item sets where a_i is an item set.

Definition 8.3: Containment of Sequences

A sequence $s_a \langle a_1, a_2, .., a_n \rangle$ is *contained* in another sequence $s_b \langle b_1, b_2, .., b_m \rangle$ if there exist integers $i_1, i_2, \ldots, i_m$ such that $a_1 \subseteq b_{i_1}, a_2 \subseteq b_{i_2}, \ldots, a_n \subseteq b_{i_m}$ holds for all items sets a_i in s_a .

Definition 8.4: Maximal sequence

A sequence is *maximal*, if there exists no other sequences that contain the sequence.

Notation: Concatenation of Sequences

The notation $z = s \cdot t$ describes *z* as a *concatenation* of the sequence *s* and the sequence *t* (Spiliopoulou 1998, p.116).

In the context of Web usage mining, a sequence refers to ordered list of Web site log entries (i.e. the items of the item set) that reflect a user's navigation pattern (Spiliopoulou 1998).[49] In analogy to sequence mining, the goal of mining navigation patterns can be described as the task to discover frequent maximal sequences of Web site requests (e.g. Agrawal and Srikant 1995; Spiliopoulou 1999).[50] The use of statistical measurements adopted from the context of rule discovery like *support, confidence* can be used as to describe and evaluate the discovered navigation patterns.

The *support* of a sequence *s* reflects the number of sequences of the form *s* that can be found in the underlying log data. With regard to two sequences *s* and *y* the *confidence* of y following s refers to the percentage of sequences that contain $s \cdot y$ among those that contain *s*. These measurements describe navigation patterns but are also useful within the actual data mining tasks as they permit the analyst to formulate conditions for data mining queries.

To facilitate the task of discovering useful navigation patterns, one can rely on Web usage mining tools like the *W*eb *U*tilization *M*iner – WUM – a tool developed and discussed by Spiloupoulou et al. (1999, 2000). WUM emerged from a research background, provides data pre-

[49] Note, that Spilipolou (1999) introduced the notion g-sequences for the application of mining navigation patterns. In contrast to the general definition of a sequence, a g-sequence explicitly introduces the notion of wildcards. This allows for a more specific definition of sequences. For an extensive discussion and application of this concept refer to the works of Spilipolou (1999) and Spilipolou et al. (1999) on Web usage mining.

[50] From the perspective of data mining problem sets, the problem of mining sequential pattern is related to the general problem of discovering association rules: As an example, the algorithms for mining sequence patterns developed by Agrawal and Srikant 1995 are modifications of the *Apriori* algorithm for discovery of association rules.

processing capabilities and the query language MINT to facilitate the discovery of sequential patterns with an SQL like query syntax. A comprehensive list of further tools for Web log analysis and Web usage mining is presented by Eirininaki and Vazirgiannis (2003).

The following case study section illustrates the use of standard Web log analysis and basic Web usage mining instruments for the evaluation of the effectiveness of the Corporate Financial Portal service offerings in terms of system usage.

8.2.5 *Case Study* Analysis of CoFiPot Web Logs

The *CoFiPot* Web log analysis is conducted on the basis of the *CoFiPot* Web log data from January 2003 to December 2005. The Web logs do not contain any information that allow for an identification of the individual portal users. Thus, for the detection of visits and visit-paths the following analysis only relies on the evaluation of the client IP address, the request's time-stamp and the data of the resources requested.

The purpose of the *CoFiPot* Web log analysis is as follows: According to the project objectives, the analysis has to foster the evaluation of the effectiveness of the *CoFiPot* usage, on the general portal level, as well as for individual services that are of interest. In this regard, one primary objective of the *CoFiPot* project is to provide services for the financial departments, worldwide. Therefore, it is of particular interest to evaluate the portal usage with regard to the different regions. Is the *CoFiPot* primarily used in Germany and Europe as one might expect with regard to the location of the Bayer head quarter? Or is it used likewise by the employees at the financial department in America and the Asian Pacific region? To answer these questions, information on the geo-location of the individual requests was added to the Web log data during the data pre-processing stage.[51]

Additionally, the mining of the visit paths for interesting usage patterns results in important insight for the evaluation and improvement of the *CoFiPot* information architecture design. In this context, one interesting aspect is the identification of groups of services that are often accessed together within on single visit. This information can for example be used to evaluate navigation designs for improving the navigation among these related services.

[51] The information is based on the geo-location information of the individual sub-networks from the Bayer network. Yet, this information is not complete. As a rule, for the analysis it is assumed that IP address ranges that could not be assigned to a geo-location are attributed to Germany. Hence, possibly more data is attributed to Germany than it is the actual case.

The results of the Web log analysis were presented and discussed at meeting of the project's steering committee. For this purpose, it is essential to select Web site performance measurements that can be clearly presented to this audience.

8.2.5.1 CoFiPot Visit Trends

From a global, portal-level perspective, the analysis of the *CoFiPot* visits allows for insights regarding the overall acceptance of the system. The visit detection is conducted on the basis of a time-based heuristic that follows the assumption for a visit session cut-off time of 30 minutes. Thus, if there are no more requests from one client for a period of 30 minutes, this is counted a visit. Figure 44 illustrates the total number of *CoFiPot* visits per month from January 2003 to December 2005.

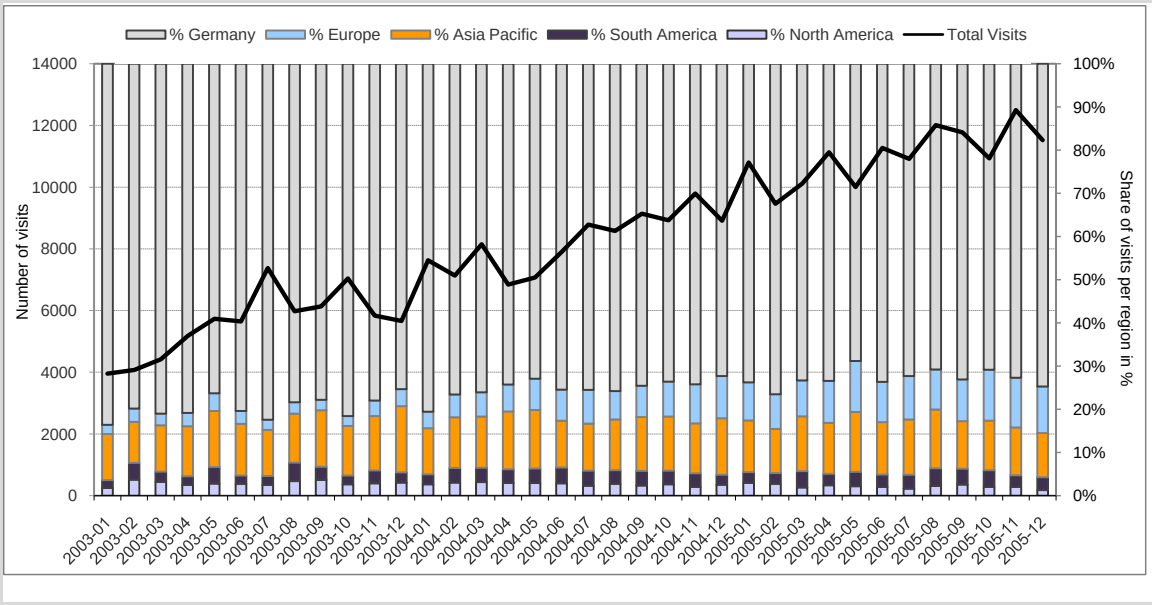


Figure 44 – Number of *CoFiPot* visits per month (prim. axis); share of visits per region (sec. axis)

Overall, there is a growth in the number of monthly visits from approx. 4000 visits detected in January 2003 to about 11500 in December 2005. The analysis of the information on the geo-location that is attributed with a visit reveals that the *CoFiPot* is visited from users worldwide. While it is not surprising that the majority of the visits originate from Germany, the percentage of international visits has increased during the regarded period from an average of 19% in 2003 to an average of 27% in 2005 (cf. Figure 44, secondary axis). Moreover, the fact that In December 2005, 31% of all *active*[52] *CoFiPot* users are in-

[52] A user is active if he has successfully signed into the *CoFiPot* at least once during the last 3 months. This approach deals with the fact that there are users that sign up for the *CoFiPot* services but don't use them. Further, users that are no longer part of the financial community and have thus not used the Portal in the previous 3 month are also excluded from the analysis.

ternational users illustrates that these users visit the *CoFiPot* nearly as actively as do the users from Germany.

The numbers show that the *CoFiPot* is particular popular within the Asian Pacific and the European financial community. In comparison, North and South America both account for a small share of the visits, due to organizational reasons. Interestingly, Figure 44 also shows that the number of visits from Europe in 2003 and 2004 is significantly lower than those from the Asia Pacific region. In fact, from an international perspective, the members of the financial community of the Asia Pacific region can be regarded as early-adopters of the *CoFiPot*. Europe, on the other hand, takes the leading role regarding the monthly growth rate of the *CoFiPot* visits, in particular in 2004. Since 2005, in absolute terms, the total number of visits per month that originate from Europe has reached the level of the Asia Pacific region.

The evaluation of the visit data provided first insights on the *CoFiPot* usage characteristics from a global perspective. Yet, this level of analysis does not explain what services account for the popularity of the *CoFiPot* globally and with regard to the individual regions. To answer this type of questions requires for a more detailed level of analysis of the *CoFiPot* usage characteristics. Thus, it is necessary to focus on the analysis of the data on the individual *CoFiPot* service level.

8.2.5.2 CoFiPot Services Level Visits and Basic Usage Path Mining

One important aspect of visit identification is that one obtains detailed information on the individual path for every visit that has been identified. This provides an important source of information on the usage behavior of the system that for example can help to identify possible shortcomings in the design of the navigation systems and the organizational structure of the navigation tree (cf. Chapter 5.2).

Example 8.2 describes a *CoFiPot* visit path which is represented by the sequence of the resource identifiers of the individual resources that have been requested sequentially within one visit. According to this example, the visitor first visited the *Exposure Monitor* followed by a series of requests of the *FX Trades* services and finally a request for the *Bayer Rates* service. In the following, the visit-path data is used as the source to answer questions on the effectiveness of the individual *CoFiPot* services offerings.[53]

[53] The following analysis is conducted using custom SQL queries against the visit path data base. Regular expressions are used to identify specific usage patterns.

Example 8.2 – Sample of a *CoFiPot* visit path

```
/Exposure_Monitor - /FX_Trades - /FX_Trades - /FX_Trades - /Bayer_Rates
```

To begin with, the occurrence of a service request within a visit path is an indicator for the actual usage of the service. For a selection of *CoFiPot* services of the major content areas, Table 11 shows the aggregated number of visits from 2005 that contained at least one request of the respective *CoFiPot* service.

Table 11 – Aggregated number of visits to selected *CoFiPot* services in 2005

***CoFiPot* Service**	**Germany**	**Europe**	**Asia Pacific**	**So. America**	**Total**
Market Focus					
- Bayer Rates	22089	2988	6048	1535	32650
FX Management					
- FX Trades	10160	4033	2595	693	18481
- FX Exposure Monitor	1662	41	123	248	2083
Financing					
- Financing Monitor	1392	154	1285	211	3032
Cash Management					
- Account Viewer	5868	1888	n/a	n/a	8555
- Cash Planning	5556	1922	n/a	n/a	8488
Knowledge Base and other Services					
- Search for Affiliates	4235	228	481	144	5088
- World Wide Contacts	512	19	25	10	566
- Documentation	1098	161	256	115	1629

The numbers show that, with the exception of the cash management services that are only available to the *CoFiPot* user from Germany and Europe, all of the regarded services are used on a global level. Furthermore, the data allows for insight on global facts and regional differences: The *Bayer Rates* module that provides information on the corporate accounting rates and that is available to the general public is, by a large margin, the most popular service. The strong focus of the *CoFiPot* on the FX management domain is reflected by the popularity of the *FX Trades* service across all regions. In comparison, there is a much lower demand for the *FX Exposure Monitor* service. With regard the *Financing Monitor,* it is interesting to observe a high demand especially from the Asia Pacific region, while in comparison the European users show less interest in this service.

This overview of the popularity of *CoFiPot* services provides a starting point for a more in deep evaluation of the usage of the individual services. By focusing on one service only, and analyzing the development of the number of visits for this service over a certain

period of time, one can find answers on controlling question concerning the effect of new service developments and extensions, or e.g. the effectiveness of service related promotion activities.

As one example, Figure 45 illustrates the development of the total number of visit for the *FX Trades* service per month from 2003 to 2005 for the different regions. The FX Trades service (cf. Chapter 8.1) was one of the first services provided by the *CoFiPot* and has been subject to a number of functional extensions over the years. Furthermore, as a core instrument of the *CoFiPot* FX management process, the FX Trades service was at the centre of a number of *CoFiPot* promotion activities, worldwide.

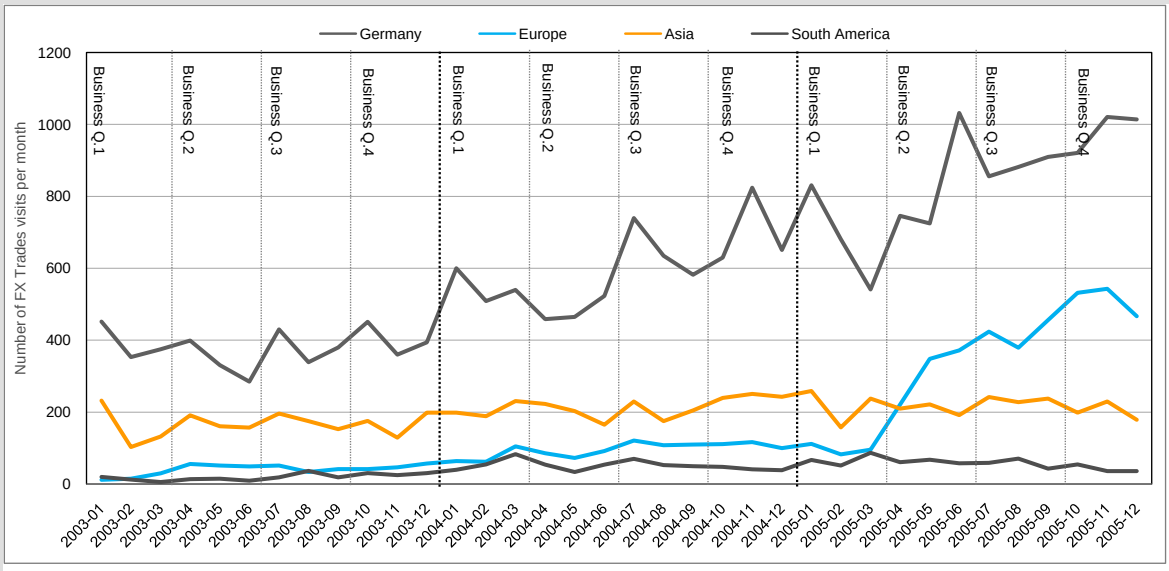


Figure 45 – FX trades visits from 2003 to 2005, for Germany, Europe, Asia Pacific, and South America

The overall development of the visits numbers shows that there is a constant level of demand for the *FX Trades* service from the Asia Pacific region and from South America. In contrast, Germany displays a steady increase in the number of monthly visits over the regarded period. Interestingly, Europe shows an especially strong increase of visits to the *FX Trades* service for the second and third quarter of 2005. This observation is of particular interest for two reasons: First, the demand for the service was relatively constant over the previous periods. And second, there have been dedicated promotion activities for the *CoFiPot* and its FX management services in Europe during the first quarter of 2005. Thus, considering the lack of information on further environmental determinants that might have had an effect on the popularity of the service, the numbers suggest that the promotion activities did have a positive effect on the service usage. Furthermore, Figure 45 also provides insights on usage trends and reoccurring patterns. For example, one pattern is the peak in the number of visits at the beginning of every business quarter. This is most evi-

dent with regard to the data from Germany and underlines the role taken by the FX Trades application with regard to the task of preparing the financial reports for the end-of-quarter closings.

Aside of these performance measures, the visit paths also allow for an analysis of the actual navigation behavior. One basic, but important measure is the depth of visit, i.e. the length of the visit path in terms of requests. In this sense, short visit paths indicate a goal oriented usage behavior, while longer visit paths usually reflect a browsing behavior. The analysis shows that 96% of the visits have a depth of five pages or smaller, thus the users use the *CoFiPot* with a specific goal in mind. A closer look at these visits further reveals that the users apply browser bookmark to directly request the service they need and do not use the navigation starting from the *CoFiPot* home page – this is indicated by a general lack of the request for the *CoFiPot* homepage within the regarded visit paths. This observation carries an important piece of information regarding the *CoFiPot* on site promotion activities (cf. Chapter 6, Section 6.3). It implies that the portal promotion team should not only rely on the *CoFiPot* homepage as the primary place for placing on-site messages.

Furthermore, the visit paths can incorporate information on relevant relationships and associations between services. For the services of a specific domain it can be interesting to study whether, which, and how often related services are requested within one single visit. Again, taking the FX management services as an example, one question is whether the *FX Trades* service requests are closely associated to *FX Exposure Monitor* requests within one single visit path that contains. This navigation pattern would reflect the FX exposure management process in the sense that the FX manager has to close FX hedging transactions using the *FX trades* service on the basis of the FX exposure level reported by the *FX Exposure Monitor*.

The result from mining the visit paths reveals that this is not the case, with an average *confidence* for this pattern that dropped from 23% in 2003, over 18% in 2004, to only 13% in 2005. With regard to the large discrepancy in the total number of visits of the regarded services, this is not a surprising result (cf. Figure 45). In fact, while the *FX Trades* service is very popular (18481 visits in 2005), the numbers of visits for the *FX Exposure* monitor show that this service is requested less frequently (2083 visits in 2005). Yet, this is not necessarily a sign for a deficit of the process efficiency. According to the numbers, the users monitor their FX hedging activities (i.e. *FX Trades* service) very frequently, while on the other hand, the FX exposure level is requested more seldom, in particularly by the international users. To some extent, this can be explained by the implementation of the *Auto-*

hedging process as described in Section 8.1. For the group of participating entities this service eliminates the need to monitor the FX exposure. Hence, for these entities, using the *FX Exposure Monitor* is no longer necessary.

8.2.5.3 Reflections on the CoFiPot Web Log Analysis Results

In summary, it can be ascertained that the Web log analysis does provide a set of appropriate measures for the evaluation of the effectiveness of Portal service offerings. For the purpose of the *CoFiPot* project controlling the evaluation activities primarily focused on measures that address the systems usage. The general analysis of the visits provides an overview on the overall popularity of the *CoFiPot*. Furthermore, the information on the visit-paths proved useful for the evaluation of the level of service usage and moreover offered information for the improvement of the design of the *CoFiPot* navigation structure.

One limitation of the *CoFiPot* Web log analysis is the lack data for the usage analysis on the individual service level. While the identified visit paths do reflect the user's navigation on the portal level (i.e. between the services), interactions within one service are not recorded in a meaningful way. As illustrated by Example 8.2, the visit paths only hold information on the fact there was a series of request for the FX Trades service but not what was requested. This is due the fact that the necessary information of the user interaction (i.e. parameters) was and could not be recorded by standard means of the Web server logs. One way to overcome this limitation is to implement application based logging mechanisms that allow for a very detailed level of usage logging (e.g. the parameters selected by the users while using a portal service).

Yet, even if the Web log analysis would rely on very detailed usage information, the information that a service or service functionality is actually used by the users does not necessarily imply that the user is satisfied with the results he gets. Of course, repeated visits indicate that the provided services are considered useful. In particularly with regard to information systems that are deployed in a specific business scenario, it is often the case that the employees have to use the system regardless of their attitude towards the system. Hence, the following sections focus on these subjective facets of system (acceptance) evaluation as a complement to the objective evaluation measures discussed so far.

8.4 Assessment of System Acceptance and User Performance Perspective

One major interest of information systems research is to determine why people accept one information system over the other. What are the reasons for the possible prevailing of products that seem clearly inferior to competing ones? Are there determinants and if so, what are these that have a significant effect on the individual's system acceptance? And finally, from a system assessment point of view: is there a perceived performance impact through utilizing the system?

The evaluation perspectives discussed so far rely on the analysis quantifiable data (i.e. hard facts - business data and Web server logs) in order to explore the tangible facets of information system success. To explore the more intangible facets, one has to conduct user interviews and surveys that are based on appropriate theoretical models for the subsequent evaluation of information system success. Following a study of DeLone and McLean (1992) information system success is extensively discussed in literature from a technical, a semantic, or an influence perspective, as well as a combination of these. The technical perspective focuses on the assessment of the features provided by an information system. The analysis of the impact of information quality is at the centre of interest of a semantic discussion on information system success. In contrast, the influence perspective addresses the effectiveness of information systems with regard to the factors usefulness, individual impact, user satisfaction and organizational impact.

The focus of the following discussion is on the system acceptance and utilization facet of information system success. The goal is to derive and define a suitable model that fosters the understanding and subsequent assessment of the utilization of a corporate portal implementation. Thus, at the center of the discussion is the *utilization focus* stream of research that predicts the utilization of information systems through the concepts of user attitudes and beliefs (Goodhue and Thompson 1995, p.214). In this work, this concept is discussed on the basis of the technology acceptance model TAM developed by Fred J. Davis (1986, 1993). Davis (1993) has strongly based his model on the theory of reasoned action (Section 8.4.1). In principal, the technology acceptance model has adapted the insights from the theory of reasoned action for the application in the field of information technology. The general concept of attitude is replaced by a combination of perceived ease of use and perceived usefulness that influence system acceptance that, in turn, influence the intention to use an information system (Section 8.4.2). Since the introduction of the model, the basic TAM has been evaluated, adapted and extended by the work of other authors, as well as Davis himself (Section 8.4.3). These further explorations of the basic models provide relevant insights for the adaptation of

this theory with regard to the development of a measurement model for corporate portals (Section 8.4.4).

8.4.1 Foundations from Sociology – Theory of Reasoned Action

The theory of reasoned actions TRA was introduced by Fishbein in 1968, yet it did not receive major attention until a rework and extension of the original work (Ajzen and Fishbein 1975). The principal idea of the TRA is that attitude can explain behavior. The theory is based on the assumption that a human is a rational being that makes systematic use of the information available to come to a decision. This process can either happen consciously or as a subconscious process.

8.4.1.1 The Concept of Attitude

Within their TRA framework Ajzen and Fishbein (1975) argue that the decision process – i.e. the behavior – can be predicted if it is possible to measure the individual's attitude towards the object in question. At the centre of this claim is the concept of attitude which is defined as follows:

Definition 8.5: Attitude[54]

> Attitude refers to "…a learned predisposition to respond in a consistently favorable or unfavorable manner with respect to a given object…"
> (Ajzen and Fisdbein 1975, p.6).

Starting from this definition, one can derive three basic assumptions that underlie the construct of attitude. First, attitude is *learned*. Second, attitude *predisposes actions* and third, actions taken according a specific attitude are *consistently* favorable or unfavorable. In this context the consistency of actions is not regarded in the sense of a strict *stimulus respond* consistency that is a subject reacts to a situation with always the exact response, but in that of an *evaluative* consistency. Evaluative response consistency is a loose definition of consistency that with regard to the favorability of actions requires that all the actions of a subject when faced with a specific object remain relatively constant (Ajzen and Fishbein 1975, p.8). The meaning of attitude as a predisposition follows the definition of consistency taken. Hence, with regard to the evaluative consistency, the predisposition does not refer to a particular (class of) behavior, but to the overall favorability of this behavior (Ajzen and Fishbein 1975, p.8). Finally, the assumption that attitude is learned reflects the observation that experiences

[54] Note, that the term object is used to address any "...discriminable aspect of the individuals world..." (Ajzen and Fishbein 1985, p.12).

of any kind towards an object influence the individual's attitude towards this object. This implies that predispositions are influenced by past experiences (Ajzen and Fishbein 1975, p.10).

8.4.1.2 From Beliefs to Intention and Behavior

Building on this understanding of attitude, Ajzen and Fishbein (1975) developed a conceptual framework to explain the relationship of the concepts belief, attitude, intentions and actual behavior. According to this framework, attitude is a mediator of beliefs and the intention to act. Beliefs that are based on knowledge and actual facts represent the information a subject has about an object. Hence, the attitude towards an object is based on the aggregated beliefs the subject holds about this object. The attitude towards an object then will result in intentions to take an action with regard to this object. Once intentions are formed the subject performs the intended actions that determine the subjects behaviors towards the object. In turn, the performed actions (i.e. behavior) and attitude determine the subject's beliefs. Figure 46 illustrate the basic conceptual framework on the relations of beliefs, attitude, intention and behaviors with respect to an object.

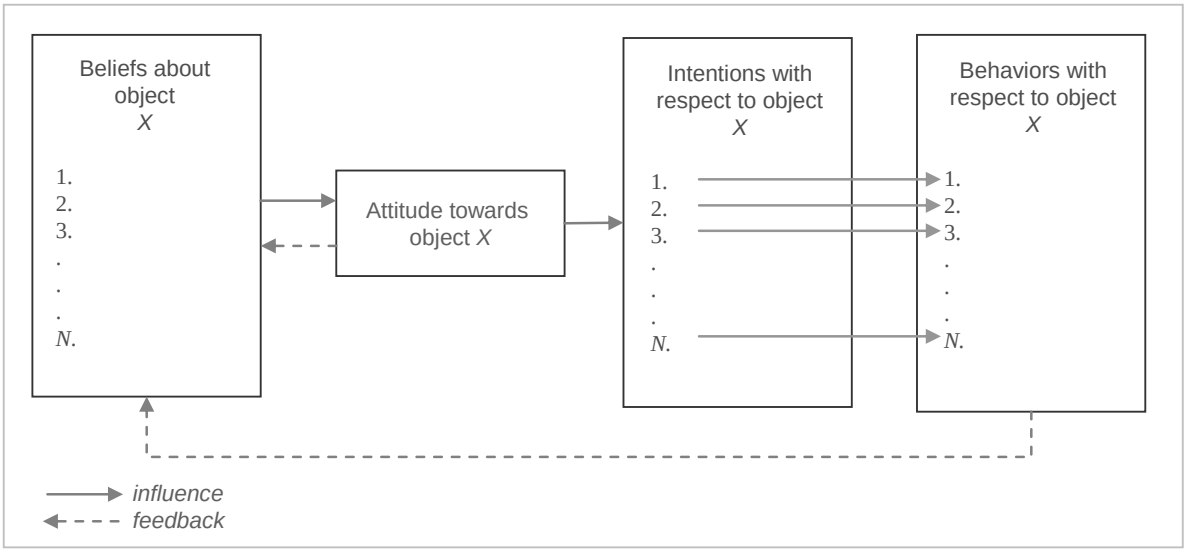


Figure 46 – Conceptual framework relating beliefs, attitudes, intentions and behaviors towards an object (Ajzen and Fishbein 1975, p.15)

Ajzen and Fishbein (1975) do not exclusively focus on attitude as a determinant of behavioral intention. The model also incorporates subjective norms as a normative component of behavioral intentions. The underlying assumption is that if one has to choose between two courses of action, the subject will choose the one that is more accepted by the social environment. The subjective norms is defined as a subject's perception of what a group of reference people think he should or should not do (Ajzen and Fishbein 1975, p.302). Combining the

subjective norm with the personal attitude leads to the central equation of the TRA (Aizen and Fishbein 1975, p.301)[55]:

$$B \sim I = (A_B)w_1 + (SN)w_2$$

where *B* is the actual behavior, *I* is the intention to perform *B* (i.e. *BI*). *SN* is the subjective norm and A_B is the attitude towards performing *B*. w_1 and w_2 are empirical weights that vary according to the kind of behavior that is to be predicted. A_B is formally described as (Aizen and Fishbein 1975, p.301):

$$A_B = \sum_{i=1}^{n} b_i e_i$$

where *b* is the belief that performing the behavior *B* leads to the outcome *i*; *e* is the person's evaluation of the outcome *i*, and *n* is the number of beliefs a person holds. Analogously, *SN* is formularized as (Aizen and Fishbein 1975, p.302):

$$SN = \sum_{i=1}^{n} b_i m_i$$

where b_i stands for the normative belief and m_i reflects the motivation to comply with the normative belief with regard to a referent *i* – where *n* is the number of referents. Figure 48 illustrates the conceptual framework underlying the complete TRA. Attitude and subjective norms are determined by the respective beliefs and influence the behavioral intention. Thus, the subject will perform the intended behavior if the following requirements are met (Ajzen and Fishbein 1975, p.292):

First the intention and behavior have to match in the specificity of action, target, context and time-frame. Second, the intended behavior must be under the subject's control. It is important to nota, that following the TRA, behavioral intentions *BI* completely mediate the actual behavior in the sense that no other construct has a significant effect on actual behavior over the *BI* (e.g. further validated by Davis et al 1989). Finally, the actual behavior causes a feedback for the subject's beliefs.

[55] In this context, it is noteworthy that Ajzen and Fishbein (1985, p.308) consider attitudes and social norms the only factors that directly influence behavioural intention. Other possible factors that are considered to have an influence on the subject's intention do this indirectly through either of the two constructs as external variables. In this sense, attitudes as well as social norms serve as mediators between additional influencing factors and intentions.

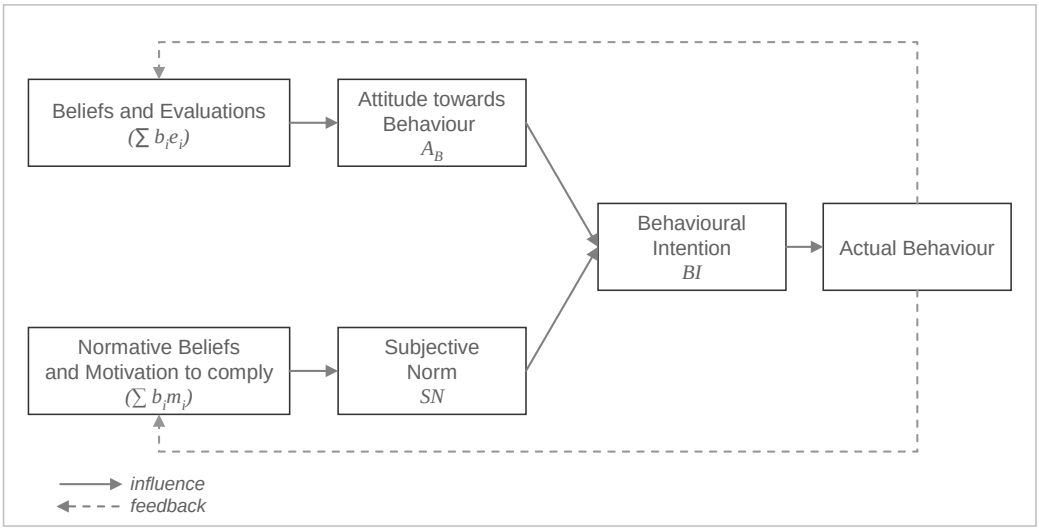


Figure 47 – Conceptual framework for prediction of intentions and behavior (Aizen and Fishbein 1985, p.16)

8.4.1.3 Conceptual Limitations and Extensions of the TRA

The TRA has been applied and incorporated by a wide variety of research settings on a variety of subject areas (Davis et. al, 1989). For instance, it has proved to be able to predict the consumer intentions and behavior quite well (Sheppard, Hartwick et al. 1988) and has also been prominently applied within the utilization research stream of information systems research (Goodhue and Thompson 1995, p.214). Yet, there are constraints that have to be considered in the application of the conceptual framework due to the generality of the theory.[56] Following Sheppard et al. (1988), the TRA predicts "any voluntary act, unless intent changes prior to performance or unless the intention measures do not correspond to the behavioral criterion in terms of action, target, context, time-frame and/or specificity" (Sheppard et al 1988, p.325, based on Ajzen and Fishbein 1975, 1980). While the latter two constrains can be addressed in practice through a careful execution of the research study, it is the first constraint that poses a challenge for the application of the theory. This is due to the fact that in practice there are situation where a subject wants to perform a specific behavior however is restricted due to some reason that is beyond the subject's sphere of influence. Consequently, Ajzen and Fishbein (1980) introduced the theory of planned behavior TPB as an extension of the general TRA that incorporate the construct of perceived behavioral control as a third antecedent of *BI*. Perceived behavioral control refers to the individual's perception of whether or not the prerequisites for an intended behavior are met or not (Aizen and Fishbein 1980). For instance, if the subject attributes a high level of difficulty to an intended behavior, it is less likely that this behavior will be executed.

[56] The reader is referred to Sheppard, B. H., J. Hartwick, et al. (1988) for an overview of applications of the TRA and a discussion of the limitations.

It shall be noted that for the practical application, the basic TRA model does not specify the specific beliefs that are connected to a particular behavior (Davis, Bagozzi et al. 1989, p.984). Hence, one has to identify those beliefs that are of operative relevance for the behavior under investigation. This question has been addressed by Davis (1989) and his technology acceptance model for information systems.

8.4.2 User Acceptance of Information Technology

With the technology acceptance model TAM, Davis (1989) provides a conceptual framework to explain the adoption or rejection of information technology. As acknowledged by Davis (1989), the TAM is an adaptation of the TRA for modeling the user acceptance of information systems. Hence, the TAM shares the general statement that information system acceptance is based on the behavioral intention to use the system that in turn is based on the attitude towards this intention.

8.4.2.1 The Constructs of Perceived Usefulness and Perceived Ease of Use

In contrast to adapting the generic construct of attitude as assumed by the TRA, Davis (1989b) introduces the *perceived usefulness* and *perceived ease of use* as the two distinct constructs relevant for the behavioral acceptance of an information system.

- **Perceived usefulness** *PU* is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" which "follows from the definition of the word useful" (Davis 1989b, p.320). In terms of the TRA a highly rated perceived usefulness corresponds to a positive use-performance relation that leads to a favorable attitude towards using the system. In practice, *PU* is aggregated by forming a number of different performance-related beliefs about the utilization of the system in question. These comprise of beliefs about the impact of system utilization on productivity, quality, and efficiency with regard to a specific tasks within the subject's responsibility (e.g. Davis 1989b).
- **Perceived ease of use** *EOU* refers to "the degree to which a person believes that using a particular system would be free from effort" (Davis 1989b, p.320). Effort is considered a limited resource that has to be allocated to the activities a person is responsible for. Hence, the construct of perceived *EOU* addresses the situation where a user's intention to use a system due to the system's usefulness is outweighed by the effort that is considered necessary to use the application. In general, the assumption holds that a system that is easier to use than another system is more likely to cause a favorable intention to use the system, all other factors being equal. System characteristics that are discussed to

influence the perceived *EOU* include general characteristics (e.g. response time, stability), system support (e.g. organizational support, documentation), information quality characteristics (e.g. terminology, structuring), and facets of user interface design (e.g. Davis 1989b).

8.4.2.2 Foundations of the Technology Acceptance Model

Following the TRA, TAM postulates that the actual system usage is directly determined only by the behavioral intention to use. However, in contrast to the argumentation followed in the TRA, the BI is not only determined by the attitude towards system utilization (A) but also by the perceived usefulness PU:

$$AU \sim BI = A + PU$$

The $A \rightarrow BI$ relationship follows the argumentation taken in the TRA. The additional $PU \rightarrow BI$ relationship is based on the idea, that in an organizational setting, the people establish their intentions towards behaviors based on the perceived job performance impact attributed to this behavior (Davis et al. 1989, p.986). In this sense, the $PU \rightarrow BI$ relationship reflects a postulated positive performance-reward relation. Further, TAM postulates that attitude *A* is defined by *PU* and *EOU* (Davis et. al 1989, p.986-988):

$$A = PU + EOU$$

This relationship follows the TRA in the sense that attitudes towards behavior are based on the relevant beliefs with regard to the *PU* as well as the *EOU*. The $PU \rightarrow A$ relationship acknowledges for the fact that the perception of positively valued outcomes do contribute to an increase of the favorability of the attitude towards the particular behavior to achieve these outcomes (cf. Davis et al 1989, p.988). The $EOU \rightarrow A$ relationship is meant to reflect the intrinsic motivation facets of *EOU*.

Finally, *PU* and *EOU* are considered distinct but related constructs as *EOU* is hypothesized to have a direct influence *PU*. This relation is based on the assumption that efforts saved due to improved *EOU* will also have an effect on the performance, thus in these cases *EOU* does influence *PU*.[57] In addition to the influence from *EOU*, *PU* is affected by external variables *EV*, while *EOU* only is only influenced by *EV* (Davis et al. 1989, p.988):

$$PU = EOU + EV$$
$$EOU = EV$$

The external variables EV represent everything beyond the internal beliefs, attitudes and intentions, incorporated by the TAM. These include general system characteristics (e.g. in-

[57] It shall be noted, that this relationship was not included in the original work on the TAM (Davis 1986) but was later added by Davis et al. 1989 due to the above reasoning and acknowledging empirical work on the association of these two constructs (cf. Davis et al. 1989, p.988).

formation quality, user interface design) but also facets like individual differences, situational constraints, or organizational settings. The TAM assumes that every factor (i.e. external variable) that has an influence on the intention to use a system is mediated to the construct of *PU* and *EOU* hence, every external factor that is theorized has to be mapped to either of these constructs. Figure 48 illustrates the relationships of *EV*, *PU*, *EOU*, *A*, and *BI* as postulated by the TAM.

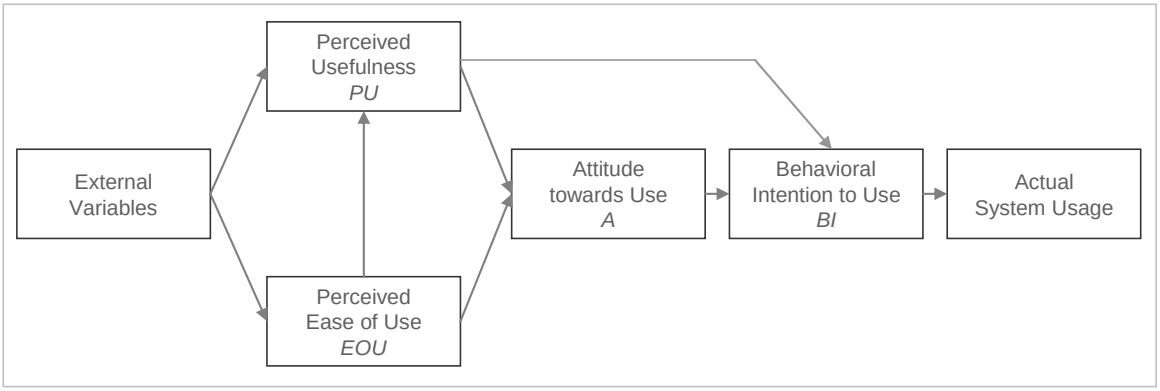


Figure 48 – Schematic view on the original task technology fit model (Davis, Bagozzi et al. 1989, p.985)

8.4.2.3 Theory Validation, Revisions, and Extensions

Davis (1989b) tested his model on two sample cases: first, an evaluation of *PU* and *PEOU* of electronic mail and a file editor and second, a study on the prospective acceptance of two graphics systems. Yet, in both studies the results were not as expected. He failed to show the postulated direct effect of *PEOU* on the intention to use the systems. However, he could observe cases where *PEOU* has an effect on the *PU* which results in an indirect effect on *BI*. Consequently, the *EOU* relation was added to the following revision of the theory, especially as a further longitudinal experiment provided additional evidence (cf. Davis et al. 1989). In contrast to the first two studies, Davis et al. (1989) evaluated the prospective intention to use of a word-processing system before the actual introduction of the software, and 14 days later after the subjects have worked with the system. The data showed two results: First, *PU* and *EOU* have a direct influence on *BI* while the role of attitude as a mediator of beliefs intentions is less pronounced then postulated (Davis et al 1989, p.993). Consequently, attitude was removed from later discussion of the TAM. Second, the direct effect of *EOU* on *BI* disappeared after the subjects have used system with EOU now causing a significant indirect effect through usefulness (Davis et al 1989, p.996, further evaluated by Szajna 1996). Therefore, a split of the TAM was proposed with a model for the pre-implementation phase and the post-implementation phase respectively. These insights are of particular interest for this work, as not only do we want to evaluate user acceptance before the actual introduction of a corporate

portal, but the evaluation of the after the system is introduced is of equal importance as it can provide the crucial implications on further system refinements.

Since its introduction, the TAM has been applied, modified and extended on various subjects of system utilization and acceptance research. Due to the generality of the TAM, a number of these research has focused on the identification of external determinants of the *PU* and *EOU* for specific research objects (e.g. Hong, Thong et al. 2001). On the other hand, research tries to incorporate additional constructs that have an influence on the BI for the purpose of increasing the validity of the original model (e.g. Venkatesh and Davis 2000). As an example, Vanketesh et al (2003) attempted to unite the major determinants of acceptance of different theories. As a result, the authors identified four major classes of determinants that have a direct influence on the intention to use information technology. Consequently, in addition to the PU and EOU, social influence (e.g. social norms) and facilitating conditions (e.g. organizational and technical infrastructure) are incorporated in an extended TAM (Vankatesh, Morris et al. 2003).

In the context of this work, the interest is on developing a suitable model for the evaluation and interpretation of the acceptance of corporate portals. Hence, the following section focuses on the identification of the relevant external factors of the *PU* and *EOU* with regard to the intention to use a corporate portal. The elaboration is based on the revised version of the general TAM.

8.4.3 Evaluation of Acceptance and Performance Impact of Corporate Portals

The previous discussion on the acceptance of information systems laid the basis for a research model on the determinants of user acceptance and performance impact of corporate portals. The aim of this research model is to provide a sound framework for the evaluation of these intangible facets of corporate portals. At the core, the model is a combination of the TAM constructs and the constructs of user satisfaction with the system as discussed in the DeLone and McLean D&M model for information system success (D&M IS success model, DeLone and McLean 1992). These constructs are modeled as immediate antecedents of the *individual performance impact*.

The original TAM is usually applied during the early system introduction phase, thus is particularly interested in evaluating the determinants of the *potential* intention to use the system. This facet is of relevance for initial introduction of corporate portals and portal services. Yet, with regard to portal controlling and evolution the research subject is a corporate portal that is already in use. Consequently, the portal controlling and evaluation has to regard the

individual performance impact that with regard to the literature relates to a mix of task effectiveness, efficiency and quality (Goodhue and Thompson 1995, p. 218).

The following sections outline the relevant model constructs and underlying hypotheses that lead to a measurement model for the evaluation of corporate portals. The model is validated by the *CoFiPot* case study as presented in the subsequent sections.

8.4.3.1 External Determinants of TAM Constructs and User's Satisfaction

The consideration of external factors as determinants of the TAM constructs and satisfaction allows for a better understanding of these constructs. External factors like system responsiveness that influence the perceived ease of use are easier to grasp than it is the case with intangible aspects like the system's usefulness. Hence, from a portal management perspective, insights on the effects from these external factors are important hints for improving the system. Following the discussion in literature (e.g. DeLone and McLane 1992, Hong, Thong et al. 2001), the information quality and general system quality are identified as the primary external determinants of the user's acceptance and satisfaction with information systems.

- **Information Quality**

A core functionality of a corporate portal is to provide users access to the requested information. In this regard, the quality of the information provided is a major factor that influences the users' perception on the usefulness of the system as well as the level of satisfaction that results from using the information provided.

In the literature, information quality is usually described according to a number of desired attributes including timeliness, correctness, relevance, and presentation among most commonly cited (e.g. DeLone and McLean 1992;). While information quality characteristics like correctness and relevance can be clearly assigned to have an influence on the perceived usefulness, clarity of presentation and formatting are related to the perceived ease of use. Hence, with regard to the measurement model, information quality is assumed to positively attribute to the TAM constructs as well as to the aspect of satisfaction.

Hypotheses 1: Influences of Information Quality

H1a: Information quality will have a positive influence on the perceived ease of use.
H1b: Information quality will have a positive influence on the perceived usefulness.
H1c: Information quality will have a positive influence on the satisfaction and the system's value rating.

- **System Quality**

System quality incorporates all the measures that relate to the corporate portal from a systems engineering perspective. In the context of corporate portals technical measures of system

quality include the server response time, reliability, but also facets of the information architecture like consistent terminology, and navigation. In addition to these technical facets of system quality, more general aspects like the support provided for using the portal services is also one important facet of the overall system quality.

Lately, the discussion on system quality also addressed the facet of service quality, as information system are more and more regarded as service providers (cf. DeLone and McLean 2003). From a corporate portal perspective, service quality incorporates facets like service responsiveness, reliability and relevance of the service output. In the context of the measurement model, service quality is assumed to be a subset of the system quality. Thus, the system quality is assumed to positively attribute to the TAM constructs as well as to the aspect of satisfaction.

Hypotheses 2: Influences of System Quality

H2a: System quality will have a positive influence on the perceived ease of use.
H2b: System quality will have a positive influence on the perceived usefulness.
H2c: System quality will have a positive influence on the satisfaction and value rating.

8.4.3.2 Antecedents of Performance Impact

The direct antecedents of the individual performance are at the heart of the measurement model. On the one hand, these are the TAM constructs of perceived usefulness and ease of use. On the other hand, user satisfaction has a positive influence on the individual performance, according to the argumentation taken in the D&M IS success model. It is noteworthy to mention that in the D&M IS success model the author refer to the construct of use in terms of actual usage (DeLone and McLean 1992), instead of the intangible constructs proposed by the TAM. Yet, in the context of corporate portals which by definition address a wide range of users with *heterogeneous* job-background, only relying on the actual use as a system performance indicator is of little meaning. For example, a manager will probably request a specific set of portal services only occasionally, while an account might access information services more frequently according to his job requirements. Clearly, in these cases actual usage measures (e.g. visits to the portal) say nothing about the users' attitude towards the system simply because the absolute figure can't be compared across users with a different job background. This is the reason for this research model to focus on the general attitude towards the system as reflected by the TAM constructs.

- **Perceived Ease of Use**

For corporate portals, ease of use is critical for the overall system success. Corporate portal services have to be designed in a way that they provide the user with a straight forward and intuitive usage experience. This is important because, unlike it is the case with traditional applications, corporate portals will not be able to rely on throughout user training to have the users familiarize with the system. Hence, corporate portals and their services have be easy to understand and to use. For the research model, following the original TAM hypotheses, perceived ease of used is assumed to positively relate to individual performance and perceived usefulness. As a system that is easy will create a more satisfying usage experience, it is further assumed that perceived ease of use also relates positively to the users satisfaction.

Hypotheses 3: Influences of Perceived Ease of Use

H3a: Perceived ease of use will have a positive influence on the individual performance.
H3b: Perceived ease of use will have a positive influence on the perceived usefulness.
H3c: Perceived ease of use will have a positive influence on the user satisfaction

- **Perceived Usefulness**

Davis argumentation on perceived usefulness being one important precursor of the intention to use a system has been supported by a variety of empiric IS research studies on this subject (e.g. Hong 2001). The same will also hold through for corporate portals that will only be successful if the individual portal services provide the users with a useful information output. In this context, it shall be noted that the research model does differentiate between the usefulness of the corporate portal as a whole and that of the individual portal services. From a user's perspective that is actually meaningless. The services, the user interacts with will determine the usefulness of the corporate portal concept. Clearly the overall usefulness level will be affected by "weak" services, yet from a portal management perspective this stresses the importance of realizing a homogenous level of service usefulness across all services. For the research model, it is assumed that the perceived usefulness positively influences the individual performance as well as the user satisfaction.

Hypotheses 4: Influences of Perceived Usefulness

H4a: Perceived usefulness will have a positive influence on the performance.
H4b: Perceived usefulness will have a positive influence on the user satisfaction.

- **User Satisfaction with the System**

User satisfaction with the system relates to the opinion of the users that is derived from them using the portal. Hence, user satisfaction covers every aspect that has an influence on the

(successful) usage experience. This includes the external system, service and information quality characteristics as well as the affected perceived ease of use and usefulness. In a meta-study on measures of information system success, DeLone and McLean (1992) identify that in fact user satisfaction is "most widely used single measure of IS success" (DeLone and McLean 1992, p.69). Hence, with regard to the research model, it is assumed that satisfaction has a positive influence on the individual performance.

Hypotheses 5: Influences of User Satisfaction

H5: Satisfaction with the system will have a positive influence on the individual performance.

8.4.3.3 Measurement Model

Figure 49 describes the measurement model for the evaluation of the individual performance impact of corporate portals. Following the above argumentation, the model takes into account the external factors information quality and system quality that are assumed to have an effect on the TAM constructs and the user satisfaction. These intangible constructs that relates to the users acceptance of a system are in turn hypothesized to have an influence on the individual performance. With individual performance as the key system success measure, the model is clearly targeted toward the evaluation of corporate portals that are already in use. In this regard, it is distinct from the traditional application of the TAM that focuses on the evaluation of the system during the introduction phase.

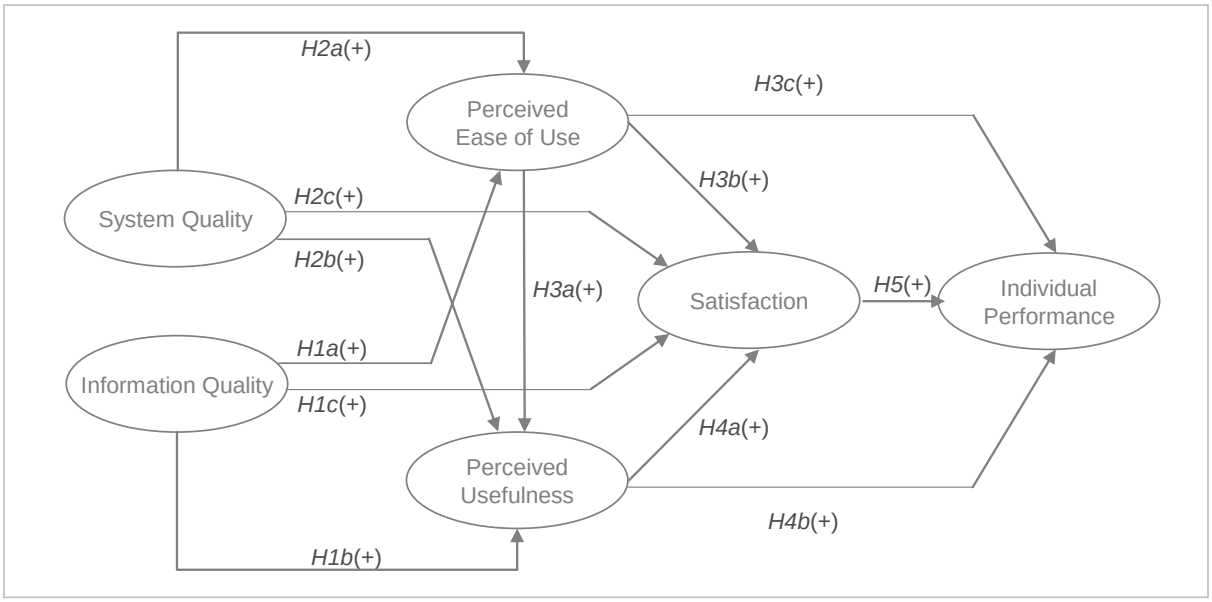


Figure 49 – Measurement model for the assessment of the impact of corporate portals on individual performance

The following case study section applies the developed measurement model for the evaluation of the acceptance and performance impact from using the CoFiPot. The results do not

only validate the measurement model but also generate generalizable insights on the determinants of acceptance and performance impact from using corporate portals.

8.4.4 *Case Study* Acceptance and Performance Impact of the CoFiPot

This section elaborates on the assessment of the user acceptance and individual performance impact through using the *CoFiPot*. The evaluation is based on the measurement model developed in the previous section. The study was conducted on the basis of an online *CoFiPot* user survey. The target of the survey was two-fold: First, to obtain direct user feedback on important system characteristics and second, to use the data to evaluate the validity of the hypotheses underlying the research model and to come up with a valid measurement instrument for future system assessments.

8.4.4.1 Research Setting and Data Collection

The data for the model validation is based on a survey among the registered *CoFiPot* users. The survey was conducted as an online questionnaire. The survey addressed 338 active *CoFiPot* users in total. The users were informed and asked for participation through an e-mail. One and a half week before closing the survey, e-mail reminder was issued. In summary, the survey was conducted from 08.12.2005 to 13.01.2006. Every registered *CoFiPot* user could only participate once. Of all *CoFiPot* users that were addressed, 144 participated in the survey which equals a response rate of 43.3% taken the number of active *CoFiPot* users as a basis. After elimination of invalid data sets (e.g. data sets that contained only "don't know" as an answer to all questions) 135 sets of answers remained.

The restriction on registered *CoFiPot* users implies that all survey participants do have experience in using the system – of course, with a variety in the level of individual usage experience. The data set not only contained positive or negative answered, the sample also included skeptical and negative responses that further support the validity of the sample.

In addition to the sections that directly relate to the research model, the questionnaire also contained sections with general questions including job characteristics, work location, and the option to leave general comments to the *CoFiPot* team. Finally, the respondents were given the chance to provide suggestions and comments to the *CoFiPot* team. As a matter of fact, most of these comments and critical suggestions provided valuable hints on current system short-comings and possible extensions.

For reasons of transparency, the final results of the *CoFiPot* survey were made available to the *CoFiPot* users with the corresponding comments and answers from the *CoFiPot* team on the suggestion and criticisms (cf. Appendix B).

8.4.4.2 Measurement of the Model Constructs

Each of the latent[58] constructs underlying the research model was measured with at least two indicators. Each of these indicators was represented by one survey question. The questions asked the respondent to agree or disagree with statements on a five-point Likert scale ranging from "*strongly agree"* to "*strongly disagree"*. Respondents could skip a question by selecting *"don't know"*. All statements were formulated such that the "strongly agree" refers to a very positive rating. The indicators for the different constructs were defined as follows:

- **Information Quality**

To measure information quality, the *CoFiPot* users were ask for their opinion on the timeliness (*Infq_1*), applicability and relevance (*Infq_2*), presentation (*Infq_3*) and reliability (*Infq_4*) of the *CoFiPot* information services. These are standard measures for information quality also used in related IS research studies (e.g. DeLone and McLean 1992, p.64).

Table 12 – Indicators of information quality

Indicator ID	***CoFiPot* provides information that…**
Infq_1	is up to date.
Infq_2	I can directly apply to my tasks.
Infq_3	is well formatted and clearly present.
Infq_4	is reliable and of high quality.

- **System Quality**

The system responsiveness (*Sys_RESP*), the consistency and cleanliness of the navigation (*Sys_NAV*), the clarity of the terms used throughout the *CoFiPot* services (*Sys_TERM*), and the quality and usefulness of the *CoFiPot* support (*Sys_SUP*). This selection of indicator is not exhaustive, but is based on the most relevant system characteristics from the *CoFiPot* management perspective.

Table 13 - Indicators of system quality

Indicator ID	**Generally speaking...**
Sys_RESP	*CoFiPot* responds promptly to my requests.
Sys_NAV	the navigation is clear, consistent and intuitive.
Sys_SUP	there is sufficient support to help me understand and use *CoFiPot*.
Sys_TERM	I understand all the terms used throughout *CoFiPot*.

[58] A construct is latent if it is not directly observable. Latent constructs are operationalized through indicators.

- **Perceived Usefulness and Ease of Use**

The indicators of perceived usefulness and perceived ease of use are adapted from Davis' study on the TAM. Indicators of ease of use focused on how easy it is to understand and use the *CoFiPot* and the services in general (*EOU_1*,.., *EOU_4*). The perceived usefulness indicators focused on whether the *CoFiPot* provides any help for the preparation of report (*USE_1*), collaboration (*USE_2*) and the routine tasks (*USE_3*).

Table 14 – Indicators of Perceived Usefulness and Ease of Use

Indicator ID	In terms of *CoFiPot*'s ease of use/ Using *CoFiPot*…
EOU_1	it is easy for me to learn how to interact with the portal.
EOU_2	I can easily find out what I can do with the portal.
EOU_3	I can easily understand the content of the reports.
EOU_4	it is easy for me to use *CoFiPot* reports.
USE_1	helps me in preparing my own reports.
USE_2	makes working together with my colleagues easier.
USE_3	helps me fulfil my routine tasks.

- **User Satisfaction with the System (Value Rating)**

User satisfaction as a response to the output obtained from the CoFiPot services is measured straight forward by asking the respondent for their overall satisfaction rating with the results they get from the CoFiPot usage (Satisf_1). Further the individual's value rating is a second indicator for the user satisfaction (Satisf_2).

Table 15 – Indicators of user satisfaction and system value

Indicator ID	Overall…
Satisf_1	I am satisfied with the results I get from *CoFiPot*
Satisf_2	*CoFiPot* is an important and valuable tool for my job.

- **Individual Performance**

Individual performance is measured with three indicators that assess the *CoFiPot* impact on the work speed (*Perf_1*), the quality of the tasks conducted (*Perf_2*), and the quality of decision making (*Perf_3*) related to the *CoFiPot* service results.

Table 16 – Indicators of individual performance impact

Indicator ID	Using *CoFiPot*…
Perf_1	I can carry out my work faster.
Perf_2	I can improve the quality of my work.
Perf_3	I can make better (well-informed) decisions.

8.4.4.3 Results of Descriptive Analysis

A descriptive analysis of the data was conducted before evaluating the measurement model. The *CoFiPot* survey also asked for the respondent for background information including the work region and information on their job profile.

Figure 50 shows that 43.1% of the respondents are from Germany, 28.5% from Europe, 18.8% from the Asia Pacific region, 6.3% from North America including Canada, and 3.5% from South America. With regard to the job background, 31.9% of the respondent stated that they conduct a management function, 25.0% are accountants, 10.4% are controllers, 2.8% are analysts, and 29.9% didn't specify a job profile. The participation from *CoFiPot* users of different work regions and job backgrounds supports the validity of the survey results.

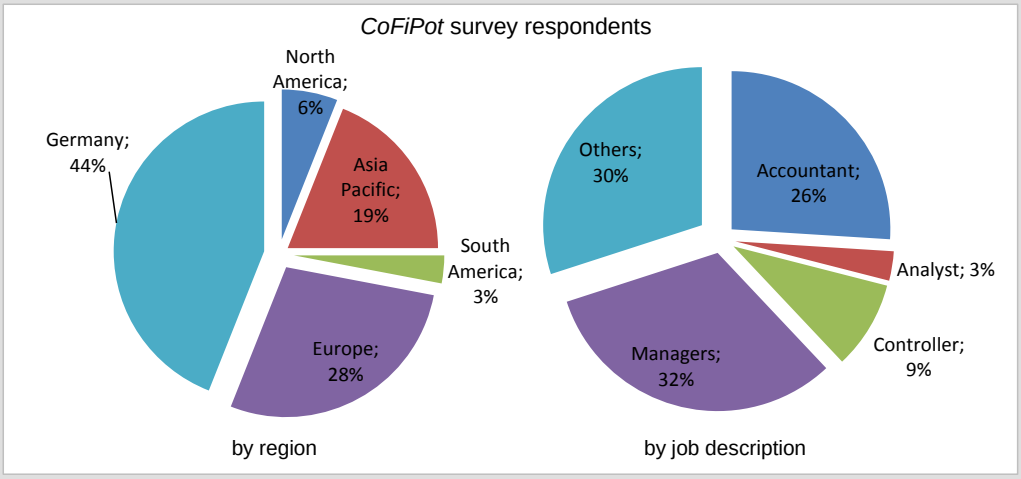


Figure 50 – *CoFiPot* survey respondents by region and job description

Tests for differences between the responses of users from different locations (Appendix C, Table C1 & C.1b) and different job backgrounds (Appendix C, Table C.2 & C.2b) show no significant differences between the respective groups, with regard to the indicator responses.[59]

Overall, the descriptive analysis showed that the *CoFiPot* received good ratings (cf. Table 17). All measurement indicators received a positive score of "strongly agree" or "agree" with a support of at least 50% of the responses. On the other hand, negative ratings the likes of "disagrees" or "strongly disagrees" account only for a small percentage of the responses. Moreover, indicators receiving a high percentage of "neutral" ratings overall

[59] The Kruskal-Wallis test was applied to test for differences between the respective groups ($p \leq 0.01$). Note, that the large discrepancy in the sample sizes of the compared groups may have affected the results, in particular with the small sample size of the North and South American groups. Dropping these two groups from the comparison results in significant differences among the remaining groups for the responses on the Perf_1 and the Infq_2 indicators. In this regard, further applying the Mann-Whitney U tests revealed that users from the Asia Pacific region rate these two indicators significantly lower than do the users from Germany.

(e.g. *Sys_Term*, *Use_1*, *Use_2*) indicate that there is room for improvements with regard to the *CoFiPot* characteristic in question.

Table 17 - CoFiPot survey result: table of response frequencies

Indicator	*Strongly Agree*		*Agree*		*Neutral*		*Disagree*		*Strongly Disagree*		*Total*	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	μ	σ
Infq_1	38	28,54	83	60,14	15	10,88	1	0,82	1	0,82	1,88	0,68
Infq_2	38	28,54	88	55,80	19	13,88	3	2,18	1	0,82	1,93	0,85
Infq_3	23	16,68	84	53,62	31	22,46	8	5,80	2	1,45	2,22	0,84
Infq_4	22	16,06	82	59,85	30	21,90	2	1,46	1	0,83	2,11	0,80
Sys_Nav	18	12,41	81	59,12	31	22,63	8	5,11	1	0,83	2,23	0,86
Sys_Resp	33	24,44	81	52,59	18	13,33	11	8,15	2	1,48	2,10	0,91
Sys_Sup	22	16,42	61	45,52	35	26,12	15	11,19	1	0,85	2,34	0,91
Sys_Term	16	11,68	61	44,53	45	32,85	14	10,22	1	0,83	2,44	0,86
EOU_1	11	8,33	83	55,30	38	28,03	11	8,33	0	0,00	2,36	0,85
EOU_3	15	11,36	88	65,91	24	18,18	5	3,89	1	0,86	2,18	0,80
EOU_2	9	6,88	85	58,25	35	26,82	12	9,16	0	0,00	2,38	0,85
EOU_3	10	8,85	68	51,94	43	33,33	9	6,98	0	0,00	2,40	0,83
Use_1	9	8,09	55	43,31	58	44,88	6	4,82	0	0,00	2,48	0,80
Use_2	12	9,45	60	48,24	50	39,38	4	3,15	1	0,89	2,39	0,84
Use_3	14	10,61	81	53,89	43	32,58	4	3,03	0	0,00	2,28	0,69
Satis_1	11	8,46	90	69,23	28	21,54	0	0,00	1	0,88	2,15	0,59
Satis_2	22	16,89	80	53,44	34	25,95	2	1,53	3	2,29	2,19	0,81
Perf_1	12	9,16	80	53,44	43	32,82	4	3,05	2	1,53	2,34	0,85
Perf_2	12	9,16	84	56,49	40	30,53	4	3,05	1	0,86	2,30	0,81
Perf_3	13	10,08	66	51,16	46	35,66	4	3,10	0	0,00	2,32	0,80

Looking at the individual indicator items, the indicators of information quality receive particular high ratings for timeliness (*Infq_1*) and relevance (*Infq_2*). The system quality receives good ratings for the responsiveness (*Sys_Resp*) and the navigation architecture *Sys_Nav*, while the numbers indicate that the terminology (*Sys_Term*) used throughout the *CoFiPot* should be revisited for terms that are difficult to understand. The indicators of the perceived ease of use and usefulness suggest that concerning the understandability (*EOU_5*) and interaction (*Use_1*) with the *CoFiPot* reports there is still room for improvements. These insights are supported by corresponding user comments that ask for more training and explanation on using the *CoFiPot* reports. Still, the satisfaction ratings show that overall, the *CoFiPot* users are satisfied with the results they get from the portal (*Satis_1*) and consider the portal an important and valuable tool for their job (*Satis_2*), with both supported by at least 85% of the respondents. These results are likewise reflected by the individual performance ratings (*Perf_1, Perf_2, Perf_3*).

Although, the data shows that the respondent do give *CoFiPot* good ratings overall, the descriptive analysis does not provide any insights on the correlations between the items. In fact it is not even proven whether the survey items are of any relevance at all to the mea-

surement of the individual performance, beyond the theoretical foundations. For the purpose of improving the *CoFiPot*, it is interesting to see which items do have an influence on the individual performance impact and satisfaction, and to what extend? To answer these questions, the following sections focus on the analysis of the causal research model underlying the *CoFiPot* survey.

8.4.4.3 Data Analysis: The PLS Approach to Structural Equation Modeling

In order to test the causal relationships as hypothesized by the measurement model, the data analysis relies on the partial-least-square PLS approach to structural equation modeling (SEM). Structural equation modeling techniques are referred to as second generation data analysis techniques that in contrast to first generation statistical tools like regression, allow for a comprehensive analysis of multiple independent and dependent constructs simultaneously (Gefen, Straub et al. 2000, p.2).

In principal, there are two distinct SEM model approaches, the covariance-based LISREL approach and the variance-based PLS technique. [60]

LISREL and PLS differ fundamentally in their statistical objective (cf. Gefen et al. 2000). The goal of the LISREL covariance-based SEM approach is to confirm the hypothesized research model given the sample data. On the other hand, the objective of the PLS approach is to show "high R^2 and significant t-values" (Gefen et al. 2000, p.22) for the hypothesized relationships and reject the null-hypotheses of no effect.

Consequently, with regard to the application of the SEM models in research practice, the covariance-based LISREL approach is suitable for a confirmatory context with a strong underlying theory that is to be tested. In contrast, the variance-based PLS approach is used if there is no strong theory underlying the research model, thus an explorative approach is more suitable. Yet, this is not a definite distinction, as PLS is also be applied for a confirmatory analysis, in particular for those circumstance where the strict requirements for the application of LISRELS are not met by the study characteristics (cf. Bliemel et al. 2005).

The LISREL approach usually relies on the maximum likelihood method for estimation, which implies an assumption on the multivariate normal distribution of the underlying data sample. Further, LISREL requires a large sample size, in particularly when dealing with ordinal date scales as it is the common case with surveys (cf. Jöreskorg 2002). In contrast, the PLS approach developed by Wold (1974) poses no assumption on the distribution

[60] In the context of this work, following the practice in literature, the LISREL approach and term is used as a synonym for covariance-based SEM. In contrast PLS is used as a synonym for variance-based SAM techniques.

characteristic of the data sample. For the sample size, a rule of thumb requires the actual size to be at least ten times the number of items in most complex construct (Gefen, Straub et al. 2000) – thus, the PLS allows for small sample sizes. One further distinct characteristic of the PLS approach is that it allows for the modeling of formative measures that cause the latent construct whereas LISREL is limited to reflective measures that describe a latent construct (Figure 51;cf. Bliemel et al. 2005). Yet, the less restrictions of the PLS techniques comes at the cost of a lack of measures for the evaluation of the model fit, hence PLS is also labeled by World as a "soft modeling" approach that is, as stated above, first and foremost suitable for explorative research settings.

The characteristics and intentions underlying the *CoFiPot* research model favor the PLS approach for the following reasons: First, there is no assumption on the data sample to be multivariate normal distributed. Second, the small sample size with regard to the ordinal measurement scale restricts the application of the LISREL approach. Lastly, in literature, TAM constructs are mainly used to measure the pre-introduction attitude to use a system. In contrast, this study focuses on the post-application phase and aims at explaining the variance of the target constructs. According to this explorative research intention, the PLS approach is more suitable.

The subsequent elaboration focuses on the mechanisms and interpretation of the PLS approach. For a detailed discussion on the LISREL approach, the reader is referred to Jöreskop (2002) and Diamantopoulos (1994). Gefen et al. (2000) provides a comprehensive comparison of the two SEM model approaches.

The PLS model approach incorporate two components of a causal model: the measurement model and the structural model (cf. Figure 51). The measurement model (outer model) describes the reflexive or formative relationship between the observed indicators x, y and the underlying exogenous ξ, and endogenous η latent variables, respectively. On the other hand, the structural model (inner model) describes the relationships between the latent variables with the path coefficients γ_j indicating the relative strength of their relationship (Gefen, Straub et al. 2000, p.14). $\delta, \varepsilon, \zeta$ denote residuals of the corresponding inner- and outer models.

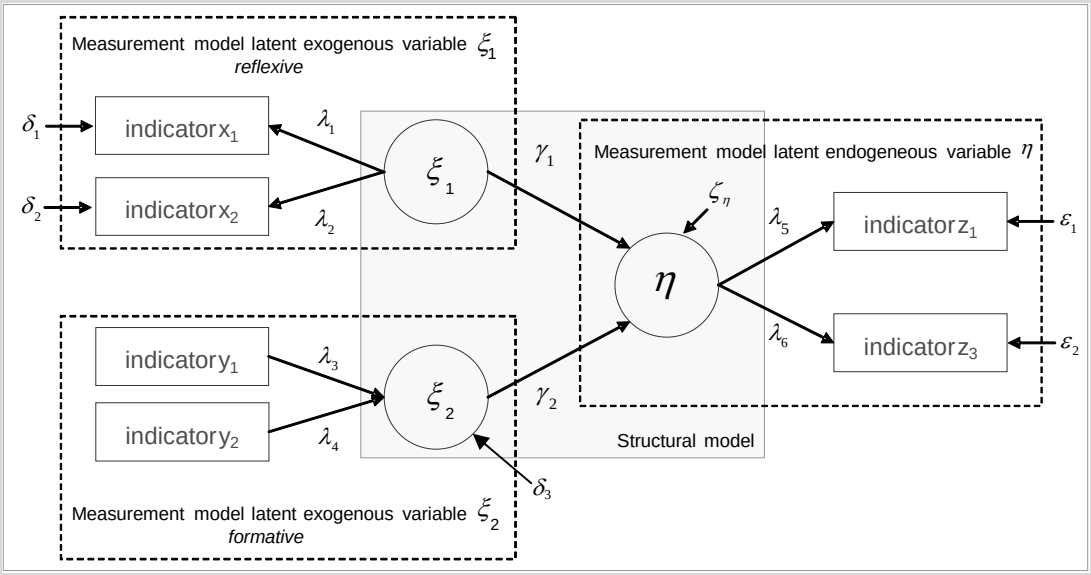


Figure 51 – Relationship between measurement and structural model in a PLS Model[61]

The basic PLS algorithm for estimating the unknown model parameters (i.e. latent variable scores, path coefficients γ_i, indicator loadings λ_i) follows a three stage procedure (Lohmöller 1989, p.29-30): In the first stage, the latent variables are estimated as weighted aggregates of their indicators. The weights are obtained by least squares methods that minimize the variances of the residuals following an iterative procedure. Following the estimation of the latent variables, the path coefficients of the structural model and the measurement model are estimated by ordinary-least-square estimation. Finally, the third stage estimates the means and the location parameters of the indicators and latent variables.

The evaluation of the PLS model estimates is performed according to a two step procedure. First, the measurement model is tested for construct validity that is to which extend the indicators measure the construct they are supposed to measure. For this purpose, the convergent validity and reliability, as well as the discriminant validity are evaluated using techniques and measurements from factor analysis[62] (Gefen, Straub et al. 2000; Livari 2005). The forecasting relevance is assessed on the basis of the Stone-Geisser's Q^2 of communality. The measurement model is considered to provide the necessary level of predictive relevance if the Q^2 obtained for a construct is greater than zero. Second, the structural model is evaluated based on the coefficient of determination R^2 of the latent variables and the significance of the path estimates.

[61] e.g. http://www.pls-ansatz.de ,03.04.2007
[62] Measures from factor analysis are only applicable for reflective measurement constructs. For the evaluation of the estimation quality of formative constructs, the reader is referred to Chin (1998).

Table 18 summarizes the measures for the assessment of the measurement and the structural model as proposed by literature for the PLS approach (cf. Chin 1998; Hulland 1999; Gefen, Straub et al. 2000; Ringle 2004;Garson 2006).

Table 18 – Measures for the evaluation of PLS estimation results
(cf. Chin 1998; Hulland 1999; Gefen, Straub et al. 2000; Ringle 2004;Garson 2006)

Model Component	Evaluation of	Thresholds and Interpretation
Measurement Model	Item loadings	Individual items loadings should be greater than 0.8, which is equivalent for the item explaining at least 50% of the variance (i.e. reflexive relationship) t-value > 1.96
	Internal consistency	Cronbach's Alpha > 0.60 for explorative, > 0.80 adequate for confirmative purpose
	Internal consistency	Average Variance Extracted AVE > 0.50
	Discriminant validity	Average variance shared between construct and respective measures ($\sqrt{AVE}$) greater than for any other construct.
	Predictive relevance	Stone Geissers Q2 of communality > 0
Structural Model	Path coefficients	Significant path coefficients > 0.10
	Latent constructs R^2	R^2 >0.19 week results R^2 >0.33 average results R^2 >0.68 significant results
	Predictive relevance	Stone-Geisser's Q2 of redundancy > 0
PLS Model	Overall model fit	No established metric available for PLS

8.4.4.4 PLS Model Analysis of CoFiPot Survey Research Model

The analysis of the research model was conducted according to the following process: First, the measurement model was evaluated to assess whether the relationships between the indicators and the respective latent research model is confirmed by the sample data. Second, the hypotheses underlying the structural model were assessed. Note, that the usual third step of evaluating the model fit was omitted due to the current PLS analysis limitations in this regard (i.e. the lack of appropriate and established goodness-of-fit measures, cf. above section). The data analysis was conducted with SmartPLS 2.0. [63]

- **Evaluation of Measurement Model**

Table 19 outlines the main results from the PLS estimation of the measurement model.[64] With one exception, all indicator factor loadings clearly exceed the required threshold of 0.80, thus ensures that more than 50% of the indicator variance accounts for the underlying latent construct. For the *Sys_Resp* indicator, the analysis determined a factor loading of only 0.48. Actually, *Sys_Resp* did not load well on any of the examined constructs. Con-

[63] Version used: SmartPLS 2.0 M3: www.smartpls.de.
[64] Note, that the relationship between indicators and the underlying latent constructs was assumed *reflexive*, for all latent constructs.

sequently, following the common research practice, this indicator was dropped from the further analysis.

Table 19 - PLS analysis, results from measurement model analysis

Latent Variable	Indicator	Loading	T-Value	Internal Consistency	AVE	Q^2
-	-	*>0.80*	*>1,96*	*>0.80*	*>0.50*	*>0*
Information Quality	Infq_1	0.822	19.806	0.853	0.695	0.482
	Infq_2	0.825	22.666			
	Infq_3	0.803	23.314			
	Infq_4	0.883	36.325			
System Quality	Sys_Nav	0.889	15.599	0.846	0.663	0.319
	Sys_Sup	0.842	28.409			
	Sys_Term	0.811	15.352			
Perceived Ease of Use	EOU_1	0.896	18.595	0.864	0.583	0.299
	EOU_2	0.821	12.899			
	EOU_4	0.834	9.823			
	EOU_5	0.801	14.864			
Perceived Usefulness	Use_1	0.841	20.550	0.838	0.854	0.488
	Use_2	0.882	31.356			
	Use_3	0.881	35.154			
Satisfaction	Satis_1	0.886	26.829	0.869	0.812	0.381
	Satis_2	0.915	62.024			
Individual Performance	Perf_1	0.880	33.116	0.849	0.869	0.511
	Perf_2	0.915	50.831			
	Perf_3	0.833	23.331			

For every latent construct, the internal consistency (reported by the cronbach alpha) is greater than the required threshold of 0.80. The average variance extracted AVE is a further measure of the internal consistency. Again, for all constructs, the AVE is greater than the required 0.50. In summary, the findings support the convergent validity of the measurement model.

The correlation matrix of the latent variables and the indicators provides first insights that support the discriminant validity of the measurement model. Every indicator is stronger correlated with the respective target indicator than with the others. To further validate this preliminary result, the $\sqrt{AVE}$ of every construct is compared the correlations between the constructs. In case of a high discriminant validity, the $\sqrt{AVE}$ should be greater than the respective construct correlations (i.e. fulfilling the Fornell-Larker criterion, cf. Garson 2006). This is the case for every construct (Appendix C, Table C.4.) Finally, the Stone-Geisser's Q^2 of communality show that the measurement model provides the necessary level of predictive relevance for the individual constructs.

The results from testing the convergent and discriminant validity underline the construct validity of the measurement model. In other words, the chosen indicators measures the un-

derlying constructs as assumed by the model. Further, the measurement model provides the required level of the predictive quality.

- **Evaluation of Structural Model**

Figure 52 depicts the primary results from the analysis of the structural model. With regard to the path validity, the path coefficients of the structural model are larger than the required 0.10 for all, but three relations: the relation between *system quality* and *perceived usefulness*, *system quality* and *satisfaction*, and *perceived ease of use* and *individual performance* are smaller than 0.10 and found insignificant. The significances of the paths (t-values) were determined by a bootstrap re-sampling procedure based on 500 samples (cf. Chin 1998).

The analysis of the structural model shows that satisfaction and perceived usefulness have a direct significant influence on individual performance (*H4b*, *H5*). The analysis does not support the hypothesis that perceived ease of use has a direct influence on individual performance (*H3c*). Still, there is a significant moderating effect from perceived ease of use found on perceived usefulness and satisfaction (*H3a*, *H3b*). Further, the there is a significant moderating effect from perceived usefulness on satisfaction (*H4a*).

For the external constructs, the analysis shows that the information quality has a significant influence on perceived ease of use, usefulness, and satisfaction as hypothesized (*H1a, H1b, H1c*). On the other hand, it is interesting to see that system quality has a strong influence on perceived ease of use (H2a), but there is no significant effect on perceived usefulness, and satisfaction (*H2b*, *H2c*).

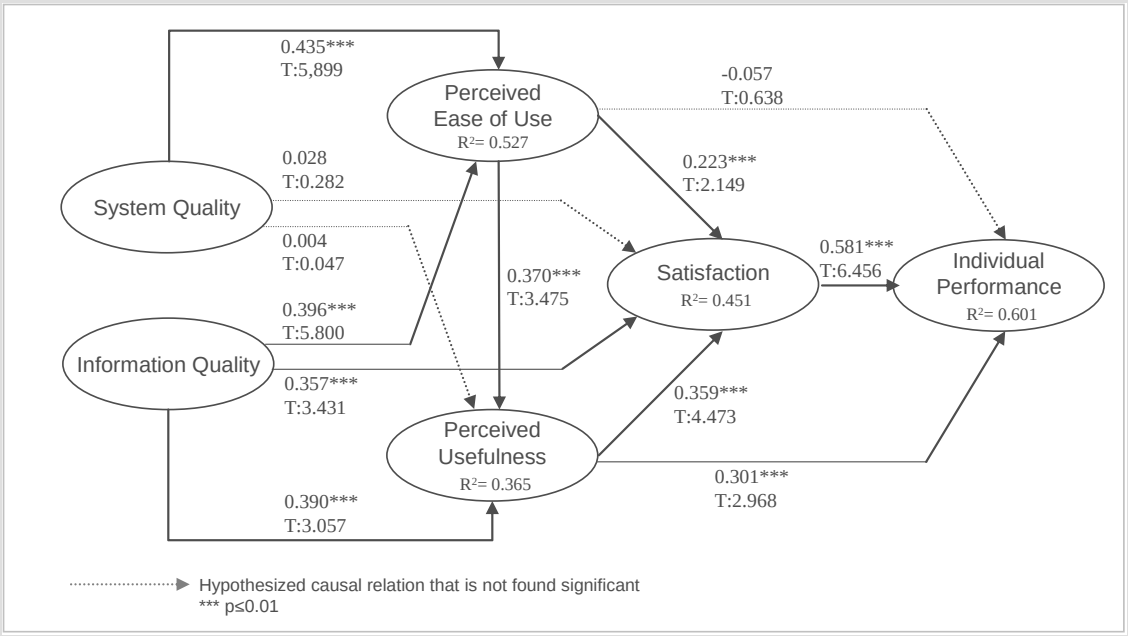


Figure 52 – Results from the analysis of the structural model

The reported R^2 for the endogenous latent variables is used to examine the model validity. The numbers show, that the research model explains a considerable amount of the variance in *perceived ease of use* (R^2 = 0.528) and *individual performance* (R^2 = 0.601). Further, the model explains an above average amount of the variance of perceived usefulness (R^2 = 0.365) and *satisfaction* (R^2 = 0.451). The computed Stone-Geisser's Q^2 of redundancy shows that the PLS model provides the necessary level of predictive relevance (Appendix C, Table C.5).

8.4.4.5 Reflection on Acceptance, Satisfaction, and Performance Impact of the *CoFiPot*

The target of the *CoFiPot* survey was to evaluate the acceptance and satisfaction of the *CoFiPot* user. Further, the focus was on the question whether by using the corporate portal, the users do experience a performance impact with regard to the quality, efficiency, and effective of their work.

To examine these intangible determinants of information system success, the developed measurement model takes into account the constructs of perceived ease of use and usefulness from the TAM, and the construct of satisfaction as discussed in the DeLone-McLean model of information system success. These constructs are hypothesized as direct antecedents of the target measure, individual performance. Further, the model takes into account the information quality and the system quality as external determinants.

Major constructs of the measurement model have been subject to previous research. Still, distinct characteristics of the *CoFiPot* case and design intentions underlying the model required an explicit evaluation of the model validity. The TAM constructs are mainly applied in a pre-implementation phase to predict the intention of using the system. Yet, in the context of the measurement model, the TAM constructs are incorporated with the intention to predict the individual performance of a system that is already in use. One further reason for the necessity to test the validity of the model is the corporate portal as the research subject. This follows the observation that literature on the evaluation of IS success relies on systems for E-mail and word-processing (Davis 1998), or in digital libraries in more recent studies (Hong et. al. 2001) as research subjects: i.e. information systems that offer a clear scope of application. In contrast, a corporate portal offers a variety of services that each addresses a different purpose. Yet, the users perceive the portal as *one* information system, although they are usually referring to one particular *CoFiPot* service (or set of services). From their perspective, it is the *CoFiPot* that supports them with the management of their FX transactions, not the FX trades service. Thus, from a research perspective,

it was interesting to see whether the regarded IS success determinants and their postulated relationship also apply to this type of information system.

The measurement model was evaluated using the PLS approach to SEM. The analysis showed that the measurement model is able to explain 60% of the variance of individual performance impact. In terms of effect strength, the satisfaction has the strongest impact on the individual performance, followed by the perceived usefulness. Interestingly, the analysis revealed that the perceived ease of use has no significant effect on the individual performance. This finding confirms the results from previous studies on the TAM, that usually fail to show a direct effect from perceived ease of use on the intention to use, in particular with regard to the post implementation phase (e.g. Davis, Bagozzi et al. 1989; Szajna 1996, cf. Section 8.4.2.3). For the *CoFiPot* users, the perceived ease of use has no immediate relevance on the individual performance, but does have a significant mediating effect on satisfaction and perceived usefulness. Seemingly, the *CoFiPot* users already have gained enough experience using the system that they incorporate facets of the system's ease of use in their perception of the system's usefulness and satisfaction. In other words, service design decisions that affect the ease of use of the system will have a strong influence on the perceived usefulness and satisfaction and in turn on the individual performance.

With regard to the external system characteristics, the information quality not only received high ratings from the survey respondents, but in terms of the measurement model, shows a significant direct effect on the two TAM constructs as well as the satisfaction. In contrast, for the system quality, the PLS analysis shows a significant direct effect of system quality only on the perceived ease of use of the system. Hence, the *CoFiPot* users seem to regard the general system quality characteristics (e.g. response times, quality of navigation systems) first and foremost as determinants of the perceived ease of use.

In summary, the *CoFiPot* survey showed that according to the measured constructs, the *CoFiPot* received high ratings overall from the respondent. The PLS model analysis supports the validity of the measurement model and provided important insight on the relationship of the regarded determinants of individual performance. Furthermore, from a project management perspective, a measurement model has been obtained that can be used for future assessments of the *CoFiPot* or other corporate portals.

8.5 Chapter Summary

As a corporate portal implementation in general addresses different business and organizational objectives simultaneously, this requires for a multifaceted approach towards the evaluation of the information system. In principal, it makes sense to evaluate corporate portal implementations from three distinct perspectives:

First, the business performance evaluation focuses on those project objectives that allow for an objective measurement either on the basis of established performance measures, or by custom measures that are defined accordingly. In either way, in order to accommodate for the multitude of services incorporate by a corporate portal, it is advisable to partition the portal service portfolio into smaller sets of services that focus on the same business purpose and analyze these sets separately. Thus, in the context of *CoFiPot* project evaluation, the business impact on the FX management practices was regarded separately, as were the other financial management domains that are addressed by the corporate portal.

The second perspective focuses on the usage of the system. Techniques and measures from Web (log) analysis provide important quantifiable insights on the system use in terms of visits to the system and the actual service requests. Relevant performance measures that are easy to comprehend and communicate to project executives are visit trends with regard to different regions either from a global, portal-level perspective or more detailed, for individual services. The latter is in particular interesting for monitoring the acceptance and effectiveness of promotions activities of newly introduced portal services. Furthermore, the Web log analysis is among the only alternative that provides objective measures for insights on the more intangible benefits that stem from corporate portals like fostering community building, and knowledge dissemination.

The evaluation of a corporate portal implementation is not complete without considering the users' opinion towards the system. In this work, the focus is on evaluating whether the users experience a positive performance impact from using the corporate portal. Furthermore, with regard to future improvements, it is interesting to determine the effect of external corporate portal characteristics on the regarded endogenous performance constructs. Consequently, this work presents and discusses a measurement model for the evaluation of corporate portals. The model is derived from the Technology Acceptance Model and extends this with the constructs of satisfactions and performance impact as discussed by models on information system success. The measurement model was validated on the basis of a global *CoFiPot* user survey. As a result, the survey results provided not only on overview of the current users' attitude

towards primary system characteristics, but, furthermore, also outlined the nature of the relationships between external *CoFiPot* system determinants and the regarded performance constructs. These are important insights that can be incorporated into subsequent *CoFiPot* engineering cycles.

Chapter 9

Concluding Summary & Outlook

Like their Internet counterparts, corporate portals take a central role within the Intranet. Corporate portals offer the employees a personalized single point of access to the relevant information and services dispersed across the Intranet. The corporate portal services access the data and selected functionalities of corporate information systems that are connected by means of the Intranet technology. The services wrap the functionality and expose it to a larger target audience in an intuitive and understandable manner, therefore leveraging the investment of the associated systems. In particular for knowledge and reporting intensive business functions such as financial management on a global scale, a corporate portal provides means to address the information management challenges within the organization. Moreover, depending on the application scenario, corporate portals provide means to integrate internal and external business processes, to foster collaboration, or to strengthen corporate communities.

Yet, in order to live up to these promises, it is not sufficient to select and deploy a corporate portal application. This will just provide the Web application framework that supports the most fundamental portal-specific use cases. It is the portfolio of services that ultimately defines the business value of a corporate portal implementation. These services have to be carefully designed, implemented, and integrated with regard to the actual business context.

It is crucial to understand that a corporate portal project has to follow an iterative software development process that is based on a series of substantial evolutions that address the portal as well as the portal services. Aside from these project management specific challenges, one has to consider further the requirements of a heterogeneous target audience. The design and implementation of corporate portal components and services that can be used intuitively relies on a careful selection of expertise, instruments, and practices. These include expertise in de-

sign and development of Web information systems, experience in the area of systems integration, expertise in the reengineering of business processes, and proficiency in the design of intuitive Web user interfaces. Moreover, experience in the organizational integration of the corporate portal implementation is required.

With the objective to address the complexity of conducting a corporate portal initiative, this work developed and elaborated an engineering approach that describes the main stages of a corporate portal project from the project initiation to the controlling of the project objectives that defines the outline for subsequent evolution cycles. In principal, corporate portal initiatives have to be regarded as large-scale service engineering projects that are conducted within a corporate environment. Hence, this work represents a step toward understanding and addressing the challenges of this software engineering and project management scenario.

Following the identification and discussion of the challenges related to the engineering of corporate portals, the main contribution of this work is to develop a model that fosters the systematic development of corporate portals. This model consists of an engineering process model that in particularly addresses the notion of system evolution in the context of corporate portal projects. Moreover, for each of the engineering stages, the author develops and elaborates models, techniques, and innovative instruments to support the relevant tasks and activities. This work provides important insights from a theoretical as well as a practical perspective on the development of corporate portals, whereas the latter is based on the insight from conducting the Corporate Financial Portal project in cooperation with the Bayer AG.

9.1 Concluding Summary of this Work

Chapter 1 briefly introduced into the subject of developing corporate portals and outlined the primary objective of this work that is the development and discussion of an engineering approach for the design, implementation, introduction, and operation of corporate portals. To achieve this objective, three research questions were raised and answered in the course of this work. Furthermore, Chapter 1 also briefly described the background of the case study that provided the relevant insights and experiences that complemented the theoretical discussions of this work.

I. Assessment of Research Subject

Chapter 2 elaborated the characteristics and the main fields of application of corporate portals. Starting from the discussion of the general portal concept, the relevant literature was reviewed for a definition and description of a corporate portal. There are a number of different corpo-

rate portal definitions, with most of them describing the concept in the context of a specific field of application. Unsurprisingly, this contributes to a diffuse perception of the main concept that underlies corporate portals. Thus, in order to foster the understanding, Chapter 2 described a framework for the categorization of corporate portals and outlined the core functions and services that are commonly associated with a corporate portal implementation. Finally, a discussion of the potential benefits from the implementation of corporate portals closed the introduction into the subject of corporate portals.

II. A Method for the Engineering of Corporate Portals

As corporate portals can be applied to a range of different fields of application and often have to perform distinct business objectives, a corporate portal initiative is subject to technical, functional, and organizational design and implementation challenges as they are identified in Chapter 3. Motivated by these challenges, the literature was reviewed for relevant and proven approaches that support the design, development, introduction, and operation of corporate portals. Yet, the review revealed that the current approaches do not address the interdisciplinary design challenges as identified in this work.

The general Web engineering approaches lack the discussion of the information systems and organizational integration requirements that are inherent to a corporate portal implementation. Furthermore, there is currently a lack of more general discussions on the characteristics of Web application projects conducted in a corporate context. On the other hand, the corporate portal specific approaches tailor the techniques on specific applications of corporate portals, focus their discussions on specific engineering stages only, or provide a high-level overview that lacks the theoretical and practical foundations.

Consequently, Chapter 3 developed and elaborated a method for engineering corporate portals that consists of a process model describing the main engineering stages and their relationships, a role model that describes the interaction of the involved parties, and a brief overview of instruments and mechanisms for the project controlling. Moreover, the corporate portal engineering process model outlined the structure of the remaining work.

III. Embodiment, Applicability, and practical Relevance of Method Constituents

Chapter 4 described the activities of the *business analysis and project alignment stage*. The objective of the business analysis is to identify the business problems and to assess whether there is a substantial benefit from pursuing a corporate portal project; and if so, to derive business objectives that clearly outline the business purpose of a corporate portal. Subse-

quently, the business alignment activities define the set of long-, mid-, and short-term strategies to implement the project objectives.

The *CoFiPot* project underlined the importance to conduct a business analysis as a limited pilot project that involves workshops, discussions, and interviews with representatives of the potential target groups. One important lesson learned is that this early involvement of the potential end-users not only ensures the development of a set of business objectives that addresses the users' needs but also fosters the general visibility of the project. With regard to the project governance, the establishment of a steering committee of high-level executives that supervised the progress of the project and furthermore provided the necessary organizational backing of the project decisions and activities, as well as strengthened the project visibility.

Chapter 5 elaborated the activities of the *design and implementation stage* from two perspectives. On the one hand, the discussion focused on the description of the characteristics and functional relationships of the core components of the corporate portal application architecture, the integrations architecture, and the information architecture.

Current corporate portal application architectures are usually structured according to a reference model that consists of a Web application skeleton, the portal server, and the repository of portal services that are invoked and integrated by means of a common portal service API. This modular design that separates the main application components fosters the flexibility for future extensions especially with regard to a growing development team. The evolution of the *CoFiPot* application architecture from the initial monolithic design to the current modular architecture that implements the discussed reference architecture is based on these flexibility prospects and requirements.

The integration architecture describes the integration approach and instruments that the corporate portal services have to implement in order to connect to the underlying systems. In the context of the *CoFiPot* project the integration scenario was determined by a large number of different information systems that had to be integrated. Consequently, a many-to-many integration architecture was implemented that reduced the number of direct connections and provided the required level of flexibility and scalability for future integration requirements.

The information architecture defines a set of components and design concepts that help users on their way through the portal content. In contrast to the often complex user-interfaces of traditional enterprise information systems, one strength of Web applications and thus corporate portals is to offer the required functionality in a comprehensible and intuitive manner. The lesson learned from the *CoFiPot* project is that the design and implementation of the in-

formation architecture follows an iterative process that to some extend will rely on a try-and-error approach. In this sense, the establishment of a limited number of re-occurring user-interaction patterns, the consistent use of technical terms, and the application of personalization mechanism to reduce the user interaction complexity has proven to be important success factors that determine acceptance of the portal services.

Aside from the discussions focusing on the corporate portal components, Chapter 5 also evaluated software development process models according to their applicability for the distinct portal development scenarios. As supported by the *CoFiPot* project-experience, a Waterfall development model proved best suited for the development of core portal components with a clearly specified set of functional and technical requirements. Contrarily, the development of *CoFiPot* services benefited most from an incremental development model that incorporates user-involvement.

Chapter 6 described the *roll-out stage* of a corporate portal implementation as a three step procedure: first, the deployment of the new version, second, the end-user training and learning activities, and third, the promotion of the new developments. The deployment of a new corporate portal implementation does not have to deal with questions on distribution, or versioning as it is the case with traditional software applications. Although the deployment can be conducted by means of a simple installation of the new version on the portal application server that overwrites the current installation, this work argued that this procedure is not appropriate for business critical applications. In the context of business critical services, as it is the case with the *CoFiPot* services, the deployment procedure has to allow for functional tests and final approval of the developments within the live business environment. Thus, Chapter 6 described the current *CoFiPot* deployment procedure that consists of the installation of the *CoFiPot* on a deployment site that operates in the live environment, final tests and system approval on the basis of this deployment site, and the subsequent release of the new version.

Following the deployment procedure, the latest developments have to be introduced to the end-users, generally by the means of end-user training and learning activities. However, this work argued that for corporate portals, the need for dedicated end-user training has to be more of an exception than a rule. With regard to the large number of users worldwide, training initiatives would require a lot of resources. Moreover, one primary idea of a corporate portal is to provide services to a broad range of different users. To achieve this goal, the design of the corporate portal services has to ensure the right level of functional complexity and intuitive usability as it has been discussed in Chapter 5.

Hence, by following the design philosophy "to make difficult things seem simple", the *CoFiPot* and the majority of the *CoFiPot* services are introduced without dedicated end-user training activities. The remaining occasional user training requirements were addressed by a training mechanism that relied on the concept of peer support and relies on experienced *CoFiPot* users that provide direct support for their colleagues. Furthermore, Chapter 6 addressed the selection of promotion activities that are required in order to strengthen the visibility and acceptance of a corporate portal project within the target groups. It was argued that the promotion activities are not restricted to the roll-out of a corporate portal implementation, but have to be repeated during the operation of the system in order to realize a significant impact.

Chapter 7 focused on *the management and maintenance activities* that are required to guarantee the proper operation of the corporate portal and the incorporate services. From the functional perspective, it is argued that in order to reduce the management complexity, distinct management responsibilities have to be defined for the corporate portal and the offered services. In the context of the *CoFiPot* project, one proven practice was to delegate functional management responsibilities of key services to experienced portal users with the required professional background knowledge. These management users functioned as the first contact and support for the users. Further, they were responsible for supervising the service quality with regard to timeliness, accuracy, and applicability.

From the technical perspective, Chapter 7 elaborated the need for a system of suitable performance metrics and mechanisms to supervise the operating state of the corporate portal and the services on an ongoing basis. Ideally, these instruments are integrated into the corporate portal framework as it is the case with the *CoFiPot* implementation. Moreover, this work motivated the implementation of service monitoring mechanisms on the individual service level.

Chapter 8 addressed the *evaluation of corporate portals* from three distinct, but interrelated perspectives: the business objectives, the system-usage, and the users' system acceptance. The evaluation of the business objectives that are attributed with a corporate portal implementation is based on quantitative and qualitative performance measures as defined by the project steering. Yet, the challenge lies in the multitude of possibly distinct business objectives addressed by the various corporate portal services. As exemplified by the analysis of the business impact of the "*CoFiPot* FX Management" services, this work proposed to divide the portfolio of corporate portal services into smaller sets of services that focus on the same business purpose and to evaluate these sets separately.

The evaluation of the system's usage on the basis of Web log analysis techniques and measures provides quantifiable insights on the popularity of corporate portal offerings and usage patterns. With regard to the CoFiPot usage evaluation, visit trends for different regions from a general portal-level perspective and more detailed, for individual services, were discussed as performance measures that proved easy to comprehend and communicate to the *CoFiPot* project executives.

Finally, measurement models that allow for the evaluation of the users' attitude towards the system were elaborated. The discussion focused on models that enable the evaluation whether the users experience a positive performance impact from using the corporate portal. With regard to future improvements, it was furthermore interesting to determine the effect of external corporate portal characteristics on the regarded endogenous performance constructs. Consequently, a measurement model was derived that extended Davis's Technology Acceptance Model with the constructs of satisfactions and performance impact as discussed by the models on information system success. The measurement model was validated on the basis of a global *CoFiPot* user survey. As a result, the survey results provided not only on overview of the current users' attitude towards primary system characteristics, but, furthermore, outlined the nature of the relationships between external *CoFiPot* system determinants and the regarded performance construct. Table 20 offers an overview on the main lessons learned according to the stages and activities of the portal engineering process as elaborated throughout the course of this work.

Table 20 – Selection of lessons learned for the main stages of the corporate portal engineering process

Stages	Tasks & Activities	Selection of Lessons Learned
Portal Business Alignment Stage Analysis & Strategy **Chapter 4**	Business & Requirement analysis	▪ Perform technology assessment, including overview of portal technology, vendors (Ch. 4.1.1) ▪ Evaluate the corporate portal business potential by means of a business process analysis, based on key characteristics including process structure, information management requirements, and organizational determinants (Ch. 4.1.2) ▪ Explore sound business purposes and goals following an iterative process (Ch. 4.1.3)
	Technology Assessment	
	Identify of key business requirements	
	Define business cases and primary business goals	
	Define portal strategy	▪ Define long term strategy according to overall project goals (i.e. the main portal vision) ▪ Mid-term strategies address the design and implementation of portal content areas ▪ Short-term strategies define portfolio of service developments for one content area
	Align and define set of corporate portal strategies - short-term strategies - mid-term strategies - long-term strategies	
	Project governance	▪ Establish a democratic steering committee of high level management executives (Ch. 4.2.1) ▪ Define suitable quantitative & qualitative measurements for the main project targets (Ch. 4.2.3) ▪ Regular steering committees for the controlling of portal strategies and major evolution cycles
	Verify, agree on project targets	
	Agree upon project direction (i.e. portal strategies)	
Portal Development Stage Design & Implementation **Chapter 5**	Design of corporate portal components	▪ Main portal application architecture components should be physically separated to foster development flexibility (Ch. 5.1.3) ▪ Implement business objects based integration layer to foster re-use/flexibility for portal development and integration requirements (Ch. 5.1.2) ▪ Information architecture according to the mantra "make difficult things seem simple" (Ch. 5.1.3)
	Design portal application architecture	
	Design information architecture	
	Design integration architecture	
	Implementation	▪ Implementation of core portal application components following structured approach (Ch. 5.2.1) ▪ Implementation of portal services benefits from user involvement; iterative process (Ch. 5.2.2)
	Implement evolutionary prototype	
	Tests & approve prototype	
Portal Introduction Stage Deployment & Rollout **Chapter 6**	Deployment of portal/portal applications	▪ Determine time-slots for deployment process based on Web usage analysis (Ch. 6.1.1) ▪ Deployment procedure should address final system tests and sign-off requirements (Ch. 6.1.2) ▪ Deployment procedure involves coordination with the corporate IT department.
	Define deployment process	
	Deployment of new portal version	
	Final sign-off of new developments & going live	
	Rollout	▪ Simple services do not require dedicated training and learning (Ch. 6.2.1), end-user training based on peer-training approach (Ch. 6.2.2) ▪ Promotion activities based on appropriate mix of corporate communication channels (Ch. 6.3.3)
	Define rollout activities	
	Promotion of new developments	
Portal Online Stage Operation, Evaluation & Controlling **Chapter 7 & 8**	Operations	▪ Portal level management and support provided by project team and IT department (Ch. 7.1.1) ▪ Delegate portal service level management to experienced and motivated users (Ch. 7.1.2) ▪ Technical maintenance should be integrated into portal administration components (Ch. 7.2)
	Provide portal support	
	Portal maintenance	
	Portal management	
	Evaluation	▪ Business impact evaluation according to project success metrics (Ch. 8.1); major evolution cycle ▪ Web log analysis for evaluation of general system usage (Ch. 8.2); minor evolution cycle ▪ User acceptance, satisfaction and determinants evaluated with developed measurement model (Ch. 8.3); minor and major evolution cycle
	Evaluate business impact	
	Evaluate system usage	
	Evaluate user acceptance	
	Controlling	
	Process evaluation results	

9.2 Reflection on the Implications of the Case Study Set-up and Results

Literature argues that qualitative case study research offers distinct advantages over quantitative research approaches (Silverman 1998). A particular strength of qualitative research is that it is able to focus the "actual practice" (Silverman 1998, p.3) and capture "a deeper understanding" (King 1996, p.174) of the organizational research context. On the other hand, case study research is also subject to criticism starting from the concerns regarding the validity of the methodological basis upon which to conduct the research, to the criticism of delivering subjective, biased results (cf. Yin 1989, pp.40-41; Lee 1989, pp.34-35). As these general criticisms may also apply to the results and insights reported from the Corporate Financial Portal project, this section discusses the quality of the case study set-up and results according to the criteria construct validity, internal validity, external validity, and reliability.[65]

The *construct validity* addresses the common criticism concerning the possible subjective selection of the case study data. Hence, the construct validity demands the definition of a set of operational measures that are to be applied within the data collection and the composition of the case study reports. To address the construct validity one tactic is to rely on multiple sources of evidence during the data collection stage (Yin 1989, p.41). As described in Chapter 1 the *CoFiPot* case study sections are composed on the basis of data from documentation, researcher notes, structured interviews, and a user survey. Moreover, the key results and insights derived from the interviews and the user survey were discussed for further validation of the case study data. As one example, interviews were conducted with the key members of the project steering, and the results of these interviews were in turn discussed and presented within the meetings of the steering committee.

The requirement for *internal validity* applies for causal studies and the validity of causal statements, only (Yin 1989, p.43). The *CoFiPot* case study follows an explorative approach that focuses more on descriptions and explorative insights, rather than on the validation of causal hypotheses. Therefore the demands for internal validity do not apply to the *CoFiPot* case study reports.

The *external validity* deals with the question whether and to what extend the findings of a case study research are generalizable beyond the actual cases. The questioning of the external validity is a major criticism of case study research. Yet, Yin (1989, p.43) argues that the criticism is founded on a misperception of the concept of generalization in the context of case

[65] The reader is referred to Eisenhardt 1989; Yin 1989; Klein and Myers 1999 for discussions on research tactics, principles, and methods to deal with the common criticisms in the context of case study research.

studies. In contrast to quantitative research like surveys that rely on the assumptions of statistical generalization, case study research is based on analytical generalization that "sets the results in the context of a broader theory" (Yin 1989, p.44). Analytic generalization is achieved through replication of the case study results. The reported *CoFiPot* case study results benefit from the fact that the observation time-span of five years allowed for the replication of major results. Within the project runtime, more than 60 *CoFiPot* services have been developed, deployed, and introduced. Furthermore, the *CoFiPot* application framework has undergone two major revisions. The case study reports discussed in Chapter 4 to Chapter 8 represent the aggregated insights of the design, implementation, roll-out, and management activities conducted.

The *reliability* criterion demands that the results of the case study research can be replicated on the same case by repeating the course of actions taken within the original research study. To satisfy the reliability requirements, literature suggests the use of a protocol of the case study research, and further the implementation of a case study data base that allows other researchers to review the reported results (Yin 1989, pp.98-99). This works reports the questionnaire used for the structured interviews with the *CoFiPot* experts. Furthermore, the *CoFiPot* user survey structure, the questions, as well as the quantitative and qualitative results of the user survey are reported and allow for the replication of the evaluation results.

Of course, due to privacy concerns and disclosure agreements, not all of the documentation that was used can be freely reported in this work. Yet, researchers with legitimated access to the Bayer's Corporate Finance documentation will be able to follow the course of argumentation taken in this work by analyzing the documentation of the financial systems landscape, development documents, protocols and presentations of the meetings of the project steering, project presentations, and data on financial transactions as referred to throughout the case study sections.

9.3 Outlook

The objectives of the corporate portal engineering method developed and elaborated in the course of this work was to outline the main stages of a portal engineering process and discuss the relevant methods and instruments to foster the major activities of the portal engineering stages. The method was developed as the result of a synthesis of theoretical reflections and the major insights from conducting the Corporate Financial Portal project.

Five years into the Bayer's corporate financial portal initiative and after a number of major portal evolution cycles, the *CoFiPot* project is on the verge of a major transition that is triggered first by the objective to extend the scope of the portal to accommodate for a completely new content area for a new group of users (corporate taxation) that need to be integrated. Second, by the required changes to the project team that has to accommodate for an increased number of - locally dispersed - portal engineers whose actions need to be coordinated. And third, by the potential of Web 2.0 technology (in particular community tools and rich-user interfaces) that shall be incorporated into the existing design concepts in a meaningful way. These triggers pose a number of challenges that need to be addressed and incorporated in future iterations and extensions of the corporate portal engineering method that was developed in this work.

Appendix

Appendix A - *CoFiPot* Expert Interviews

Appendix A.1 - Overview *CoFiPot* Interview

- The *CoFiPot* Interviews were conducted in German. The interviews took around 60 minutes and were recorded,
- In total, 8 Interviews were conducted: five expert users and three high level management executives (including the director of the corporate finance center).
- The respondents were free to skip those questions that they did not want to or could not answer.
- The summary of main interview results is available at: www.iw.uni-karlsruhe.de/*CoFiPot*/expert_interviews.pdf

Appendix A.2 - *CoFiPot* Interview Handout

Universität Karlsruhe (TH)
Institut für Informationswirtschaft und -management
- Informationsbetriebswirtschaftslehre (IW) -

Corporate Financial Portal – Erfahrungen & Erkenntnisse

Leitfaden Interview

Vielen Dank für Ihre Teilnahme an diesem Interview.

- Das Ziel dieses Interviews ist die Aufarbeitung von Erkenntnissen und Erfahrungen, die Sie in den letzten fünf Jahren direkt oder indirekt mit dem Corporate Financial Portal gemacht haben.
- Fragen, die Sie nicht beantworten wollen werden ausgelassen.
- Wesentliche Erkenntnisse aus diesem Gespräch werden ein wichtiger Teil meiner Dissertation zum Thema Corporate Financial Portals sein.
- Dieses Interview wird etwa 60 Minuten in Anspruch nehmen.
- Das Gespräch wird auf Band aufgezeichnet werden.
- Ich möchte Sie hiermit auch um Erlaubnis bitten Teile des Gesprächs in meiner Arbeit anonym zu zitieren.

Name _____
Positionsbeschreibung _____
Datum _____

Teil 1: Vorstellung des Gesprächspartners

Frage 1.1
Bitte stellen Sie sich kurz vor und skizzieren Sie Ihre Tätigkeit bei Bayer Finanzen.

- Wie lange arbeiten Sie schon für Bayer Finanzen?
- Für welche Abteilung sind Sie verantwortlich?
- Welche Kernaufgaben hat Ihr Bereich zu erfüllen?

Teil 2: Motive & fachliche Anforderungen an ein Finanz-Informationssystem

Frage 2.1
Skizzieren Sie bitte aus Ihrer Sicht die Motivation für die Einführung eines zentralen Informationssystems für Finanzen.

- Haben externe Faktoren eine Rolle gespielt? Wenn ja, welche?
- Welche informationslogistischen Herausforderung(en) galt es zu bewältigen?
- Existierten weitere Motive für die Einführung einer zentralen Informationsplattform?

Frage 2.2
Sie finden im Folgenden eine Auflistung von möglichen funktionalen und fachlichen Anforderungen an ein Informationssystem.
Können Sie bitte beurteilen wie wichtig Ihnen diese Anforderungen grundsätzlich erscheinen? Können Sie eine Aussage darüber treffen, ob die Umsetzung im Corporate Financial Portal gelungen ist?

Funktionale und fachliche Anforderungen	Bedeutung für ein Finanzinformationssystem						Umsetzung im Corporate Financial Portal				
	Sehr wichtig				ohne Bedeutung		nicht gelungen				sehr gelungen
Zugriff über das Intranet (jederzeit, überall)	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Personalisierung (Nachrichten, Gestaltung, etc.)	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Standardisierung von Informationen, Berichten	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Sicherheit, Zugriffsbeschränkung	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Abbildung u. Optimierung von Geschäftsprozessen	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Standardisierung von Prozessen	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Unterstützung des Berichtswesens	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Unterstützung der Zusammenarbeit & Koordination	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐

	Sehr wichtig				ohne Bedeu-tung		nicht gelun-gen				sehr gelun-gen
Workflowunterstützung	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Ergonomie & Bedienbarkeit	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Änderungs-Flexibilität (neue Prozesse, Datengrundl. etc.)	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Multimodaler Zugriff (Blackberry, Palm etc.)	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Benutzergruppenmanage-ment	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Unterstützung bei der strategischen Entschei-dungsfindung	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Weitere _____	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐

Teil 3: Berichtswesen

Frage 3.1
Skizzieren Sie bitte kurz den Prozess der Berichterstellung vor der Einführung des Corporate Financial Portals.

- Welche Herausforderungen ergaben sich bei der Erstellung von Berichten?
- Wer hat Berichte nachgefragt?
- Wie war das Informationsbedürfnis der Gesellschaften?
- Gab/Gibt es regelmäßige Berichtstermine?
    - Wenn „ja“: Wie häufig? In welchen Intervallen?

Frage 3.2
Können Sie abschätzen, wie viel ___% ihrer Arbeitszeit Sie bzw. Ihre Mitarbeiter mit folgenden Tätigkeiten vor 5 Jahren verbracht haben?
Können Sie zudem abschätzen wie die Verteilung heute wäre, wenn immer noch die damaligen Gegebenheiten bestünden?

Tätigkeit	**Vor 5 Jahren**	**Heute aber mit den damaligen Gegeben-heiten**
Datenerfassung		
Datenverarbeitung & -integration		
Datenaufbereitung		
Datenanalyse		

Frage 3.3
Wie wichtig sind Ihnen die folgenden Anforderungen an das Berichtswesen?
Für wie gelungen erachten Sie die Umsetzung der folgenden Anforderungen an das Berichtswesen im Corporate Financial Portal?

Funktionale Anforderungen an das Berichtswesen	Bedeutung für Finanzinformationssystem						Umsetzung im Corporate Financial Portal				
	sehr wichtig				ohne Bedeutung		nicht gelungen				sehr gelungen
Personalisierung der Berichte	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Variabler, bedarfsgerechter Detaillierungsgrad (Drill-Downs)	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Integration v. Berichten	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Geschwindigkeit der Auswertung	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Aktualität der Daten	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Korrektheit der Darstellung	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Anwendbarkeit der Information	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Standardisierung der Berichte	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Ansprechende Gestaltung	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Verständlichkeit der Darstellung	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
On-demand Verfügbarkeit	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Standardisierung der Berichtsprozesse	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Nachvollziehbarkeit der Ergebnisse	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐
Weitere _____	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐

Frage 3.4
Wie beurteilen Sie insgesamt die Qualität der Berichte, die durch das Finanzportal angeboten werden?

mangelhaft	ausreichend	befriedigend	gut	sehr gut
☐	☐	☐	☐	☐

Frage 3.5
Wie sehr variiert die Qualität der bereitgestellten Berichte (Darstellung, Zugänglichkeit, Informationsgehalt) im Corporate Financial Portal?

gar nicht		durchschnittlich		sehr stark

☐	☐	☐	☐	☐

Frage 3.6
Können Sie quantifizieren, wie viel __% der von Ihnen benötigten Berichte durch das Portal abgebildet oder unterstützt werden?

Unter 20%	20-40%	40-60%	60-80%	mehr als 80%
☐	☐	☐	☐	☐

Frage 3.7
Können Sie abschätzen, wie viel ___% ihrer Arbeitszeit Sie bzw. Ihre Mitarbeiter mit folgenden Tätigkeiten heute verbringen?

Tätigkeit	**heute**
Datenerfassung	
Datenverarbeitung & -integration	
Datenaufbereitung	
Datenanalyse	

Frage 3.8
Haben Sie insgesamt den Eindruck, dass Sie jetzt Entscheidungen auf Basis besserer Informationen treffen?

Trifft nicht zu				Trifft voll und ganz zu
☐	☐	☐	☐	☐

Frage 3.9
Haben Sie insgesamt den Eindruck, dass Sie jetzt im Ergebnis bessere Entscheidungen treffen?

Trifft nicht zu				Trifft voll und ganz zu
☐	☐	☐	☐	☐

Teil 4: Workflowunterstützung und Geschäftsprozesse

Frage 4.1
Schildern Sie bitte kurz die Bedeutung des Portals in Ihrem Tagesablauf bzw. Tagesgeschäft.

- Wie häufig nutzen Sie das Portal?
  - [mehrmals täglich, täglich, mehrmals die Woche, wöchentlich, etc.]
- Zu welchem Zweck nutzen Sie das Portal?

Frage 4.2
Wenn man das Corporate Financial Portal abschalten würde, dann würde dies Sie bei der Erfüllung Ihrer Aufgaben…

nicht beeinflussen	kaum beeinflussen	beeinflussen	erschweren	sehr erschweren
☐	☐	☐	☐	☐

Frage 4.3
Gibt es Tätigkeiten, die Sie ohne das Portal nicht mehr erbringen könnten? Nennen Sie bitte Beispiele!

Frage 4.4
Fallen Ihnen spontan Geschäftsprozesse innerhalb ihres Tätigkeitsbereichs ein, die direkt oder indirekt durch das Finanzportal beeinflusst worden sind?
Bitte vergleichen Sie bei Ihrer Beschreibung die Situation vor 5 Jahren mit der Situation wie Sie sie heute vorfinden.

- Kurze Beschreibung des Prozesses
- Besonderheiten (z.B. Grenzüberschreitend, besonders langwierig, etc.)
- Häufigkeit
  - [mehrmals täglich, täglich, mehrmals die Woche, wöchentlich, etc.]
- Durchlaufzeit
  - [Minuten, Stunden, Tage, etc.]
- Manueller Aufwand
  - [manueller Zeitaufwand in % der Durchlaufzeit?]
- Qualität des Prozesses
  - [Fehlerrate, etc.]
- Welche direkte oder indirekte Rolle spielte das Portal?
  - Prozess wurde abgebildet
  - Prozessschritte wurden verändert, Prozess wurde optimiert

Teil 5: Strategische Entscheidungsfindung & -Flexibilität

Frage 5.1
Haben Sie die Erfahrung gemacht, dass Entwicklungen im direkten und indirekten Umfeld des Finanzportals eine Auswirkung auf strategische Entscheidungsfindung und Flexibilität hatten?

Trifft nicht zu				Trifft in hohem Maße zu
☐	☐	☐	☐	☐

Frage 5.2
Wenn Sie die Erfahrung gemacht haben, dass

- Erläutern Sie bitte kurz Ihren Standpunkt!
- Welche Entwicklungen/Erfahrungen waren ausschlaggebend?

Frage 5.3
Wie beurteilen Sie die Bedeutung der folgenden Entwicklungen auf die strategische Entscheidungsfindung & Flexibilität?

	Sehr wichtig	wichtig	weniger wichtig	unwichtig	ohne Bedeutung
Verfügbarkeit neuer Reports	□	□	□	□	□
Einführung von Management Reports	□	□	□	□	□
Verbesserte Flexibilität bei Geschäftsprozessen	□	□	□	□	□
Steigerung des Automatisierungsgrad	□	□	□	□	□
Mehr Zeit für Datenanalyse	□	□	□	□	□
Bessere Sensibilität für die Umsetzbarkeit neuer Ideen und Anforderungen	□	□	□	□	□
Weitere_____	□	□	□	□	□

Teil 6: Zusammenarbeit in der Organisation

Frage 6.1
Beschreiben Sie bitte kurz wesentliche Aspekte der Zusammenarbeit in der Organisation Finanzen (unabhängig vom Finanzportal).

- Welche Kommunikationsmedien werden genutzt?
- Wie wichtig und wie aufwendig gestaltet sich die Koordination?
- Welche Prozesse, Tätigkeiten erfordern besonderen Koordinationsaufwand?

Frage 6.2
Wie sehr prägen folgende Aspekte die Zusammenarbeit innerhalb der Organisation Finanzen? Wie beurteilen Sie den Einfluss des Portals auf diese Facetten der Zusammenarbeit?

- Können Sie ihre Beurteilung anhand von Beispielen erläutern/kommentieren?
- Welche Eigenschaften/Ausprägungen des Portals kommen hier zum Tragen?

Zusammenarbeit	Determinanten der Zusammenarbeit						Einfluss durch das Corporate Financial Portal				
	Sehr wichtig				ohne Bedeutung		Kein Einfluss				großer Einfluss
Persönliche Kommunikation	□	□	□	□	□		□	□	□	□	□
Austausch von Dokumenten	□	□	□	□	□		□	□	□	□	□
Koordination der räumlichen Distanz	□	□	□	□	□		□	□	□	□	□
Koordination von zeitlichen Unterschieden	□	□	□	□	□		□	□	□	□	□

Weitere _____	□	□	□	□	□		□	□	□	□	□

Frage 6.3
Insgesamt hat die Zusammenarbeit in der Organisation Finanzen durch das Portal …

Nicht profitiert	Kaum profitiert	profitiert	verbessert	sehr verbessert
☐	☐	☐	☐	☐

Teil 7: Projektmanagement & -organisation

Frage 7.1
Können Sie bitte rückblickend skizzieren, welche Aspekte des Projektmanagements und der Projektorganisation prägend für den Projekterfolg waren/sind?

Frage 7.2
Wie wichtig waren/sind Ihrer Meinung nach die folgenden organisatorischen Maßnahmen für den Projekterfolg? Wie gut hat das Projektmanagement diese berücksichtig?

Funktionale Anforderungen an das Berichtswesen	Bedeutung für Finanzinformationssystem						Umsetzung im Corporate Financial Portal				
	Sehr wichtig				Ohne Bedeutung		nicht gelungen				sehr gelungen
Einbindung der Anwender	□	□	□	□	□		□	□	□	□	□
Orientierung an den Bedürfnissen der Anwender	□	□	□	□	□		□	□	□	□	□
Transparenz bei der Priorisierung von Projekten	□	□	□	□	□		□	□	□	□	□
Flexible Teilprojektstruktur	□	□	□	□	□		□	□	□	□	□
Flexibilität bei Änderungen der Pipeline	□	□	□	□	□		□	□	□	□	□
Schrittweise Einführung (Portal, Anwendungen)	□	□	□	□	□		□	□	□	□	□
Zeitmanagement	□	□	□	□	□		□	□	□	□	□
Ansiedlung des Projekts in der Fachabteilung	□	□	□	□	□		□	□	□	□	□
Aufhängung des Projekt *Unterstützung von „oben“*	□	□	□	□	□		□	□	□	□	□
Regelmäßige Steering Committees	□	□	□	□	□		□	□	□	□	□
Kooperation mit Universität	□	□	□	□	□		□	□	□	□	□
Weitere _____	□	□	□	□	□		□	□	□	□	□

Appendix B - *CoFiPot* User Survey

Appendix B.1 - *CoFiPot* User Survey Structure & Results

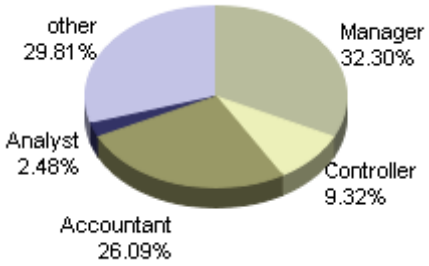
Corporate Financial Portal

- *CoFiPot* User Survey Results -

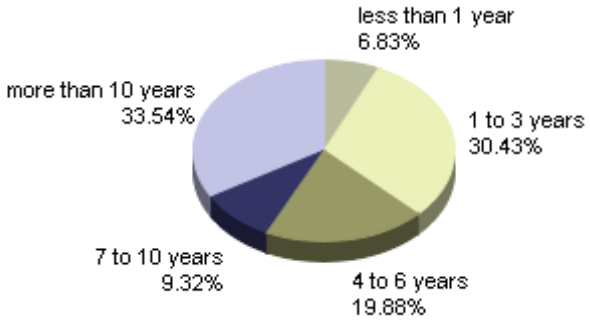
< Back to *CoFiPot*

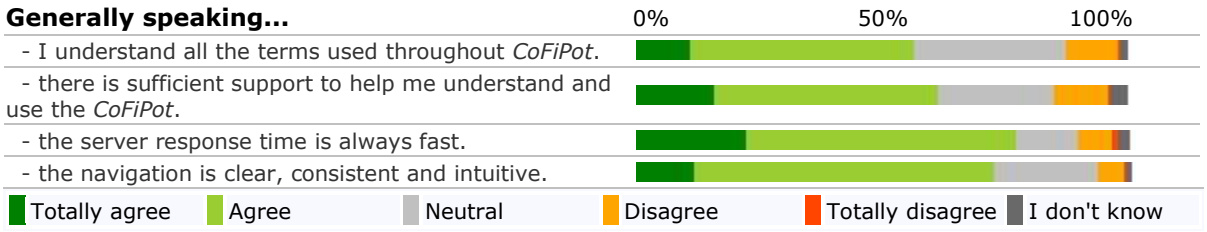
The first *CoFiPot* Survey is now closed. The following results are based on feedback from 161 users. Thank you very much for your participation!

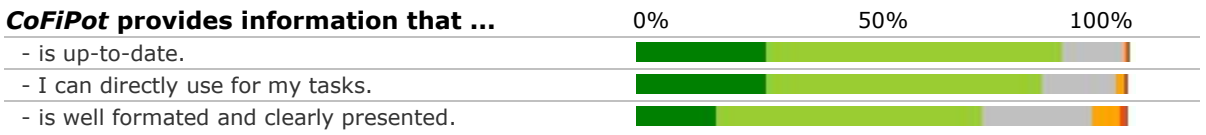
I'm working for Bayer as a ...

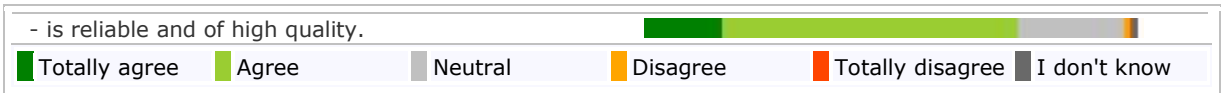


I've been working for Bayer for...

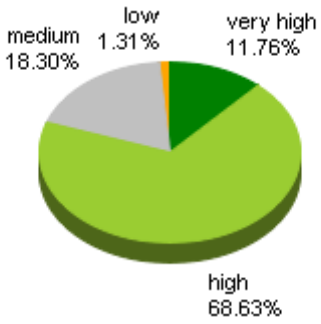


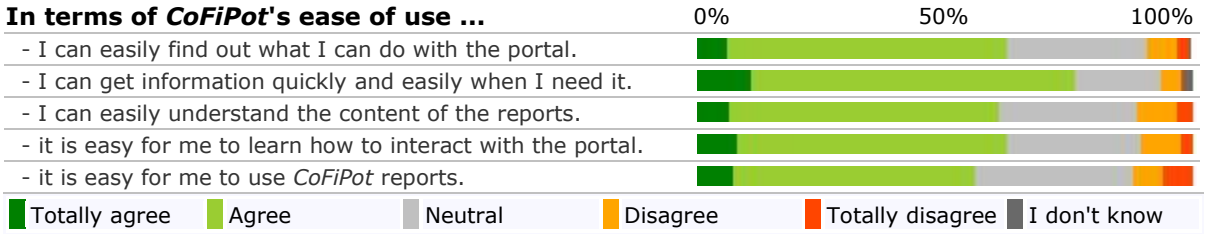


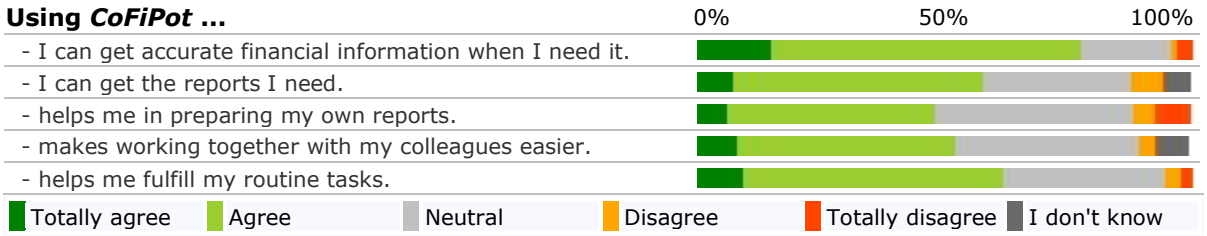


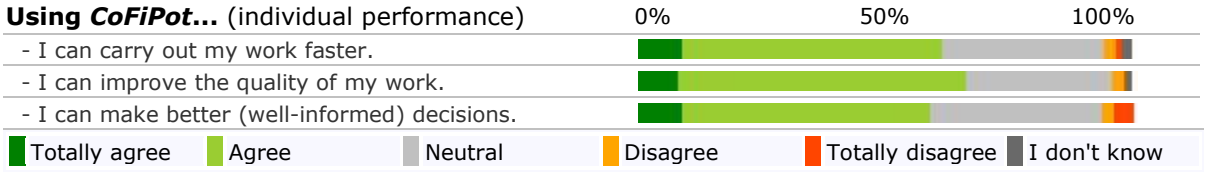


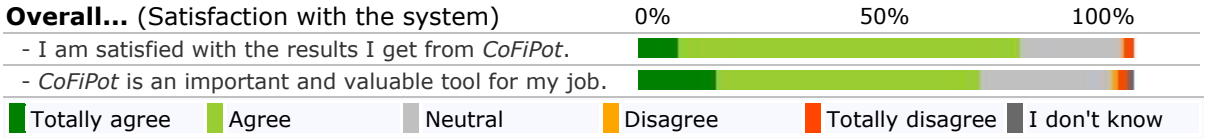
Overall, how would you rate *CoFiPot*'s quality?



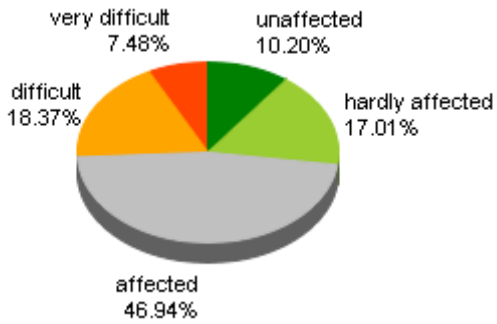




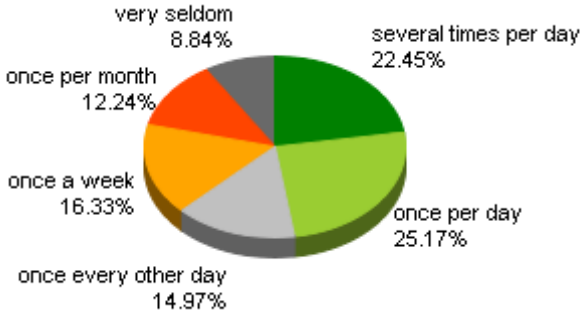




Without *CoFiPot*, carrying out my work would be...



How often do you use *CoFiPot*?



User comments

Some of the survey participants provided us with valuable remarks. Below you'll find a categorized list of representative remarks along with our comments. If you feel like an issue you rose has not been touched upon thoroughly enough, please contact us directly at support.fi@bayer-ag.de.

Ease of use and training

Your remarks:

- *More intuitive*
- *Define terms*
- *More clarity*
- *Training / overview of what is possible*
- *An explanation for every report on how to interpret the output shown.*
- *Table of contents*
- *Receive a training on the various functions of the portal*
- *More explanatory also for non financial professionals*

Our comments:

> One of the aims of *CoFiPot* is the reduction of complexity of the underlying systems. Although the average rating for ease of use (2.35) is not too bad, it is the worst rated category in the survey. That means there is room for improvement. When we create new portal modules, we try to build them to be intuitive and self-explanatory. Based on user feedback we review existing modules and revamp them if necessary. This way we are able to limit the training effort to the very minimum. For some modules it works, for some--more complex ones--it apprently doesn't. When introducing new processes like "NewKred reporting" or "Financial planning" we conducted workshops to familiarize the users with the underlying tools. The feedback to those workshops was very positive. Some users suggested similar

workshops about *CoFiPot* in general. As a first measure to tackle the issues at hand we will conduct presentations of *CoFiPot* in the upcoming F&A Managers Meetings. One of possible outcomes of those presentations will be follow-up training sessions in selected regions or countries.

More data sources & data quality issues

Your remarks:

- *A better update of our internal account with Bayer AG*
- *Include more information like Tax Issues, Balance Sheet Data of the Bayer-Entities*
- *Include commodity price chart (e.g. oil or benzol) on front page, together with USD and share price*
- *More information concerning direct contact partners for each topic*
- *More planning information for more countries*

Our comments:

When we started the *CoFiPot* project we would never expect it to be where it is now. With limited resources we have integrated many internal and external applications thus creating a common platform many consider crucial for their daily work--almost 75% of the survey participants stated that their daily work would be at least affected if there was no *CoFiPot*. Still, we don't feel like sitting back and relaxing. Quite the contrary. Our development pipeline seems to be never ending. We have already initiated a new project to extend the scope of *CoFiPot* to tax-related applications and data. We will also work to include more accounting information.

Functionality

Your remarks:

- *Information of bank statements could be sorted by amount*
- *Include account balances on sumary sheet in NewKred for entity or bank group*
- *Update NewKred Format to include liquidity position*
- *I use the NewKred monitor (Accounts) in Treasury. But it takes so much time to enter all the data. Current procedure is that we have to fill the data in one account and save, update, confirm update, close and click another account with same ways until we finish the last account. But if all the accounts are shown in one page without so many clicks and enter the data all together and after finishing the data input of all accounts and save, update and close then we can reduce much time.*

Our comments:

Most of your suggestions are already in our pipeline. That means they will be included in one of the future releases. By the way--currently we are working on a issue tracking system. Soon you will be able to report bugs, feature requests, etc. directly through the portal. Each reported issue will be filed, commented on and added to the development pipeline if applicable. For each module you will be able to see what has changed in the previous releases. That should increase the transparency of our development process.

Response times

- *Increase server performance / (possibly CNB speed)*
- *Better performance*

Our comments:

Performance is crucial for augmenting user acceptance. Therefore it has always been in our focus. Our performance rating of 2.09 indicates that we're still on the right track. However, with growing number of modules, users, data sources and higher and higher volumes, it gets more and more difficult to find the perfect mix between performance and functionality. Furthermore, there is one factor we cannot influence directly--the speed of your local network. For some users network speed might be the bottle neck. That is why we always try to reduce the amount of data being sent over the wire. To sum it up--if performance can be improved with reasonable effort, we will improve it.

Marketing

Your remarks:

- *A little bit more marketing among affiliates*
- *Easier to find via myBaynet*

Our comments:

So far we have concentrated more on developing *CoFiPot* than on promoting it. Our main "marketing instrument" so far has been word-of-mouth advertising. When we look at how many users we have reached, it's actually amazing how successful that instrument has been so far. Still, user feedback and the survey show that there is room for improvement--apparently quite a few users are not aware of the existence of some functionalities. We have tried to address that issue by means of our newsletter. However, as other things kept us more than busy and because we had the feeling that only few actually read the newsletter we gave it up for the time being. We will consider reviving it. Furthermore we plan to add more information about available modules and functionalities.

Last but not least: Bone-crunching criticizm

- *That CoFiPot disappears*
- *I would like to abolish this tool.*

Our comments:

Ouch. Such comments were very rare--as a matter of fact there were only two. Still, we're taking them very seriously--although we're well aware that we won't be able to achieve 100% user satisfaction.

Appendix C - PLS Results

Table C. 1 – *CoFiPot* survey, descriptive results with regard to work location of the respondents

Measure	***Asia Pacific**^{A}*		***Europe**^{E}*		***Germany**^{G}*		***N. America**^{N}*		***S. America**^{S}*	
	μ	σ	μ	σ	μ	σ	μ	σ	μ	σ
Infq_1	2.04	.61	1.98	.86	1.84	.64	1.88	.68	1.80	.84
Infq_2	2.20	.65	1.93	.85	1.86	.80	2.00	.50	2.40	.55
Infq_3	2.32	.85	2.22	.91	2.21	.83	2.11	.93	2.00	1.00
Infq_4	2.24	.66	2.08	.89	2.05	.68	2.22	.68	2.20	.84
Sys_Nav	2.18	.86	2.24	.88	2.22	.80	2.22	.44	2.40	1.68
Sys_Resp	2.24	1.01	2.00	.63	2.04	1.02	2.33	.81	2.40	1.52
Sys_Sup	2.32	.80	2.44	.92	2.25	.98	2.50	.86	2.40	1.14
Sys_Term	2.40	.81	2.39	.86	2.45	.90	2.88	.64	2.20	1.30
EOU_1	2.33	.86	2.28	.55	2.38	.86	2.58	.53	2.80	1.10
EOU_2	2.40	.81	2.39	.86	2.46	.85	2.29	.86	2.20	.45
EOU_4	2.38	.82	2.23	.58	2.46	.83	2.43	.89	2.60	.55
EOU_5	2.42	.83	2.31	.58	2.41	.89	2.58	.89	2.60	.89
Use_1	2.65	.81	2.53	.80	2.36	.82	2.43	.53	2.60	.55
Use_2	2.84	.62	2.32	.84	2.26	.88	2.29	.49	2.80	.45
Use_3	2.65	.65	2.18	.68	2.14	.80	2.43	.53	2.80	.45
Satis_1	2.36	.49	2.05	.46	2.09	.69	2.14	.38	2.85	.50
Satis_2	2.40	.65	2.15	.88	2.05	.86	2.14	.38	3.25	1.26
Perf_1	2.68	.63	2.33	.80	2.14	.80	2.58	.89	2.85	.50
Perf_2	2.52	.88	2.31	.66	2.13	.69	2.58	.89	2.85	.50
Perf_3	2.48	.81	2.24	.68	2.25	.80	2.58	.89	2.50	.58

Table C. 2b – Kruskal-Wallis-Test statistics for group differences according to work locations

	Infq_1	*Infq_2*	*Infq_3*	*Infq_4*
Chi-Square	5,26681328	12,9758184	1,14701498	2,52178833
df	4	4	4	4
Asymp. Sig.	0,26099971	0,01139456	0,88674281	0,64073855
	Sys_Nav	*Sys_Resp*	*Sys_Sup*	*Sys_Term*
Chi-Square	2,1354362	1,87076955	0,50543388	2,69708711
df	4	4	4	4
Asymp. Sig.	0,71086519	0,75951241	0,97296984	0,60972443
	EOU_1	*EOU_2*	*EOU_4*	*EOU_5*
Chi-Square	2,69963004	1,39161223	5,11924745	1,20126594
df	4	4	4	4
Asymp. Sig.	0,60927935	0,84565153	0,27527935	0,87789015
	Use_1	*Use_2*	*Use_3*	*Satisf*
Chi-Square	4,36038302	1,84380987	3,05598428	10,9941185
df	4	4	4	4
Asymp. Sig.	0,35942488	0,76445808	0,54850067	0,02663019
	Value	*Perf_1*	*Perf_2*	*Perf_3*
Chi-Square	10,2219057	11,9136393	9,9479725	3,17451289
df	4	4	4	4
Asymp. Sig.	0,03685109	0,01800515	0,04131326	0,52905736

The Kruskal-Wallis-Test showed no significant difference between the groups, with $p \leq 0.01$

Table C. 3 – *CoFiPot* survey: descriptive results according to respondents' job background

Indicator	***Accountant*** ^{AC}		***Analyst*** ^{AN}		***Controller*** ^{C}		***Manager*** ^{M}		***Other*** ^{O}	
	μ	σ	μ	σ	μ	σ	μ	σ	μ	σ
Infq_1	2.14^{*O}	.60	2.25	.50	1.68	.49	1.84	.83	1.80	.56
Infq_2	2.03	.62	1.50	.58	1.93	.80	2.05	.89	1.85	.68
Infq_3	2.46	.82	2.00	.82	2.40	.84	2.20	.93	1.98	.88
Infq_4	2.31	.63	2.50	.58	2.28	.59	2.08	.89	1.88	.66
Sys_Nav	2.38	.60	2.50	.58	2.40	.84	2.09	.88	2.15	.84
Sys_Resp	2.20	.63	2.25	1.26	2.20	.94	2.05	1.00	2.00	1.01
Sys_Sup	2.63	.83	3.00	1.15	2.36	.93	2.24	.96	2.13	.92
Sys_Term	2.50	.66	3.00	.82	2.68	.98	2.32	.93	2.38	.88
EOU_1	2.52	.62	3.25	.96	2.31	.63	2.38	.82	2.15	.84
EOU_2	2.44	.61	2.85	.96	2.46	1.13	2.40	.95	2.35	.66
EOU_3	2.33	.65	2.00	.00	2.23	.83	2.19	.86	2.00	.69
EOU_4	2.58	.81	2.25	.50	2.62	.96	2.30	.88	2.24	.68
EOU_5	2.64	.80	2.68	.58	2.54	.66	2.38	.85	2.14	.59
Use_1	2.52	.58	2.85	.50	2.50	.68	2.52	.81	2.34	.81
Use_2	2.59	.61	3.00	.82	2.28	.65	2.48	.81	2.08	.88
Use_3	2.33	.65	2.50	.58	2.38	.88	2.40	.66	2.05	.82
Satis_1	2.21	.65	2.25	.50	2.38	.51	2.19	.51	1.98	.64
Satis_2	2.35	.85	2.25	.50	2.31	.85	2.26	.80	1.92	.82
Perf_1	2.44	.89	2.00	.00	2.23	.83	2.50	.68	2.16	.82
Perf_2	2.41	.84	2.25	.50	2.15	.55	2.40	.83	2.13	.80
Perf_3	2.36	.65	2.50	.58	2.23	.83	2.31	.82	2.30	.84

Table C. 4b – Kruskal-Wallis-Test statistics for group differences according to different job backgrounds

	Infq_1	*Infq_2*	*Infq_3*	*Infq_4*
Chi-Square	8,13927973	5,51082318	9,54717422	8,41603023
df	4	4	4	4
Asymp. Sig.	0,08660739	0,23877975	0,0487869	0,07747373
	Sys_Nav	*Sys_Resp*	*Sys_Sup*	*Sys_Term*
Chi-Square	5,86420626	3,42858449	7,39097416	6,59771587
df	4	4	4	4
Asymp. Sig.	0,20952155	0,48881997	0,11661408	0,15873668
	EOU_1	*EOU_2*	*EOU_4*	*EOU_5*
Chi-Square	8,62112323	3,75967083	7,25517998	9,81383502
df	4	4	4	4
Asymp. Sig.	0,07129964	0,43950672	0,12300211	0,04368313
	Use_1	*Use_2*	*Use_3*	*Satis_1*
Chi-Square	1,93977558	5,32519288	1,90187572	5,54360596
df	4	4	4	4
Asymp. Sig.	0,74683485	0,25552778	0,75380041	0,23592299
	Satis_2	*Perf_1*	*Perf_2*	*Perf_3*
Chi-Square	7,47094535	4,79603762	4,93175102	0,4157078
df	4	4	4	4
Asymp. Sig.	0,11299733	0,30887264	0,29437223	0,98117078

The Kruskal-Wallis-Test showed no significant difference between the groups, with $p \leq 0.01$

Table C. 5 – Correlations of indicators and latent variables (factor loadings)

Indicator	*Perceived Ease of Use*	*Individual Performance*	*Information Quality*	*Satisfaction*	*System Quality*	*Usefulness*
EOU_1	0.8959	0.2932	0.4833	0.4416	0.6405	0.4490
EOU_3	0.8208	0.5952	0.5426	0.6353	0.3414	0.5150
EOU_4	0.8345	0.2510	0.3829	0.4009	0.4882	0.2855
EOU_5	0.8005	0.2430	0.4581	0.4010	0.5259	0.4095
INFQ_1	0.4560	0.3885	0.8222	0.4992	0.3858	0.4655
INFQ_2	0.4608	0.5801	0.8246	0.6098	0.3220	0.4888
INFQ_3	0.5885	0.3528	0.8028	0.5298	0.5168	0.4024
INFQ_4	0.5813	0.3880	0.8829	0.5384	0.5203	0.4218
PERF_1	0.4624	0.8899	0.4694	0.6844	0.2563	0.6112
PERF_2	0.4318	0.9150	0.4645	0.8013	0.2866	0.5663
PERF_3	0.3608	0.8335	0.3982	0.5588	0.1628	0.5350
SYS_NAV	0.5348	0.2488	0.5188	0.410	0.8895	0.2950
SYS_SUP	0.5384	0.2421	0.4554	0.4221	0.8423	0.3805
SYS_TERM	0.4941	0.1682	0.2922	0.3235	0.8106	0.2894
Satis_1	0.6130	0.5849	0.5962	0.8865	0.4033	0.5314
Satis_2	0.5368	0.8445	0.5842	0.915	0.4524	0.6483
USE_1	0.4996	0.4985	0.4383	0.4801	0.3164	0.8412
USE_2	0.5260	0.5800	0.4658	0.6094	0.4316	0.8819
USE_3	0.4313	0.6130	0.4853	0.6154	0.2845	0.8812

Table C. 6 – Correlations of latent variable; diagonal show square root of average variance extracted (AVE)

$\sqrt{AVE}$	*Perceived Ease of Use*	*Individual Performance*	*Information Quality*	*Satisfaction*	*System Quality*	*Perceived Usefulness*
Perceived Ease of Use	0.863					
Individual Performance	0.489	0.886				
Information Quality	0.624	0.508	0.833			
Satisfaction	0.634	0.843	0.654	0.901		
System Quality	0.642	0.282	0.524	0.4864	0.814	
Perceived Usefulness	0.558	0.652	0.530	0.6586	0.398	0.868

Table C. 7 – Stone Geisser's Q2 of redundancy

Total	*Q2*
Ease of Use	0.2995
Individual Performance	0.5114
Information Quality	0.4821
Satisfaction	0.3813
System Quality	0.3199
Usefulness	0.4884

Appendix D – CoFiPot Screenshots

Figure D. 1 – CoFiPot Screenshot 2001

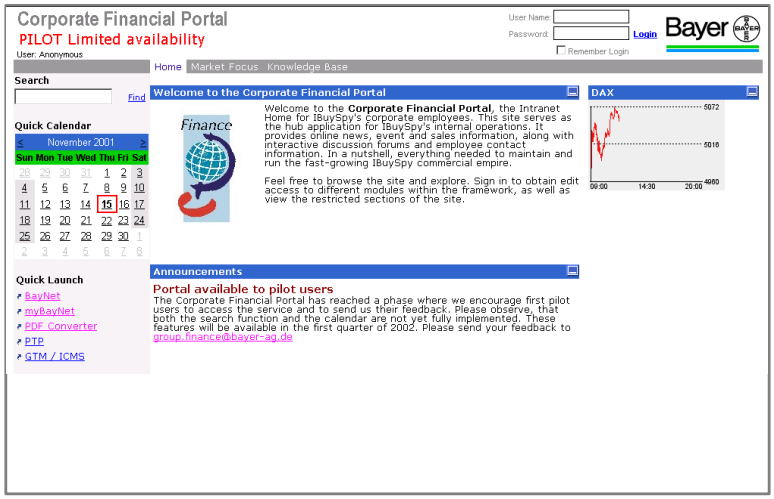


Figure D. 2 – CoFiPot Screenshot 2003

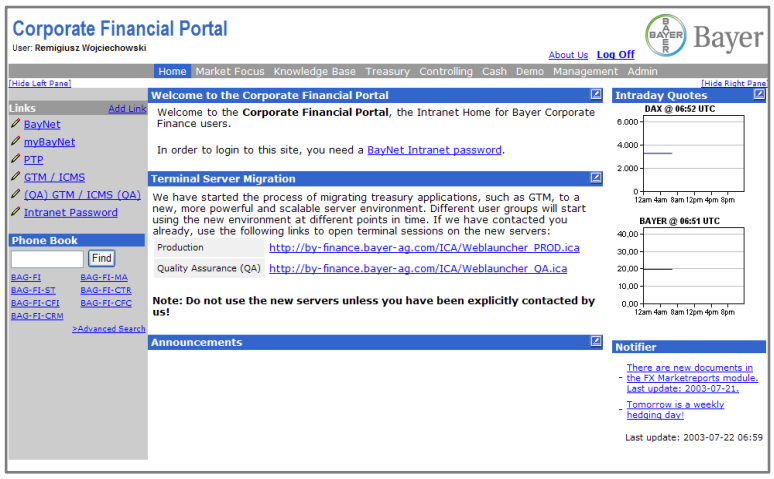
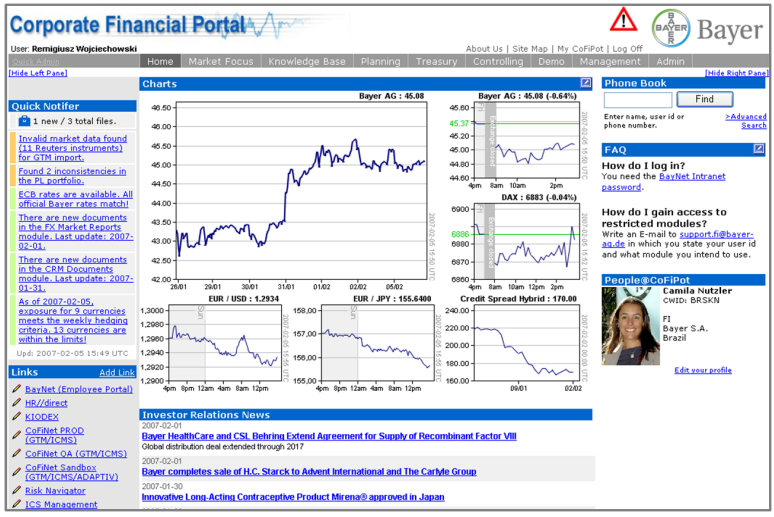


Figure D. 3 – CoFiPot Screenshot 2007



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