FIDIS

Future of Identity in the Information Society

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Summary

This document describes the internal and external FIDIS web-portal system, focussing on the technical aspects of its development, the used tools, and the general structure.

The objective of this document is to give a broad overview of the technologies and software products used to build this portal system. Furthermore its internal structure will be described.

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0.2	02.10.2004	Finalised structure of the document.
0.5	06.11.2004	Added screenshots of the website and the internal portal.
Ongoing editing		
1.00	01.12.2004	Final release
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Foreword

FIDIS partners from various disciplines have contributed as authors to this document. The following list names the main contributors for the chapters of this document:

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1 Executive Summary

Looking at today's research community in Europe, more and more research projects are conducted cooperatively, connecting several European organisations (universities, governmental agencies, SMEs etc.) into large research networks. Such projects tend to be complex in their underlying mechanisms. Apart from the various management issues that need to be addressed, the communication and the scientific exchange between the researchers is the most crucial factor for the success of such a research network. This factor is even more important, if the research teams are scattered across the continent.

The focus of this deliverable is the description of the of the TYPO3-based web-portal system for the European research project FIDIS ("Future of Identity in the Information Society"). As its main focus, the FIDIS network of excellence (NoE) jointly conducts research on a number of identity related research topics and issues whilst managing the internal coordination and integration, as well as dissemination of the knowledge to the public. The web-based portal and the public website are the key facilitators of these functions. Accordingly, the primary objective is to ensure the availability of an IT-infrastructure in order to fulfil communication and coordination of the different working groups within FIDIS.

2 Introduction

2.1 Scope

This document, created in the context of the Workpackage 1 of the **FIDIS Network of Excellence (NoE)**, documents the development and the technical structure of the internal portal and the external public website.

As its main operation, the FIDIS NoE will jointly conduct research on a number of identity related research topics and issues while looking at the internal coordination and integration as well as the promotion of knowledge to the public. The web-based portal and the public website are the key players to facilitate these functions. Accordingly, the primary objective of this Workpackage is to ensure the availability of an IT-infrastructure in order to fulfil communication and coordination of "Joint Activities" and Workpackages. It is therefore a prerequisite before the actual NoE operation and research can take place.

2.2 The Structure of this Document

This document is structured in the following 4 main parts:

- Chapter 1 – Contains the introduction of this deliverable.
- Chapter 2 – Specifies the technical aspects and the selection process of the software.
- Chapter 3 – Describes the structure of the internal and external FIDIS website.
- Chapter 4 – Future development steps for the system.

3 The System: Hardware and Software

3.1 Introduction

As the first step in the process of building the FIDIS web-system, different content management systems (CMS) were evaluated. This chapter should give an overview of the technology and the parameters that led to the choice of the used systems.

3.2 Content Management Systems (CMS)

In general, CMS allow end-users (typically authors of some sort) to provide new content in the form of articles or multi media assets (*content*). The articles are typically entered as plain text, perhaps enriched with markups, such as bold, italic (*structure*) to indicate where other resources, such as pictures or other file-types should be placed (*layout*).

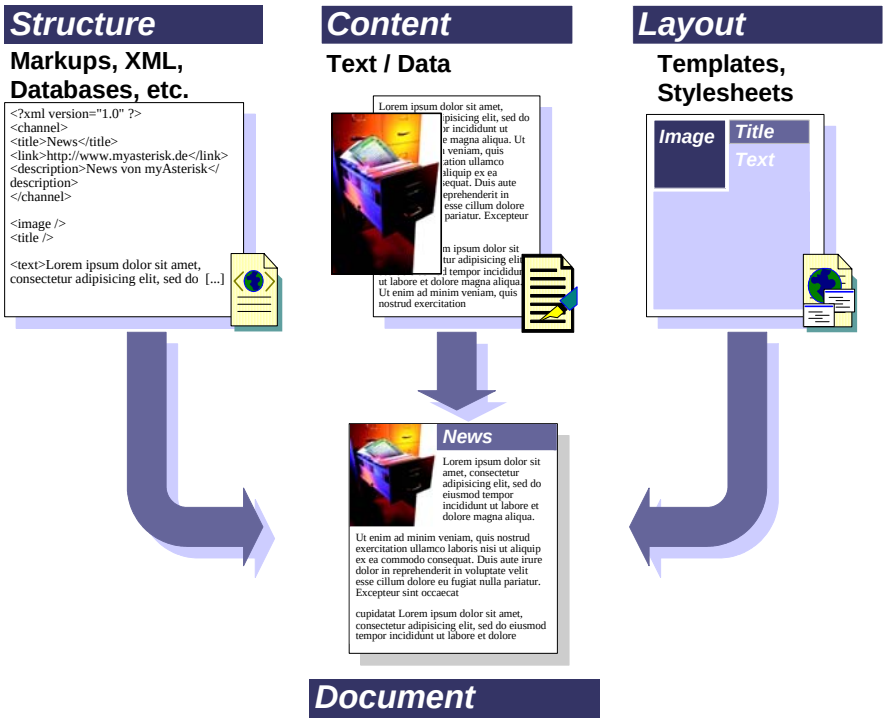


Figure 1: Structured Content.

The system then uses rules to style the article, which separates the display from the content. This has a number of advantages when trying to get many articles to conform to a consistent "look and feel". The system then adds the articles to a larger collection for publishing, combining the content, the structure and the layout (Figure 1). Figure 2 gives an overview of the different components of a typical CMS architecture:

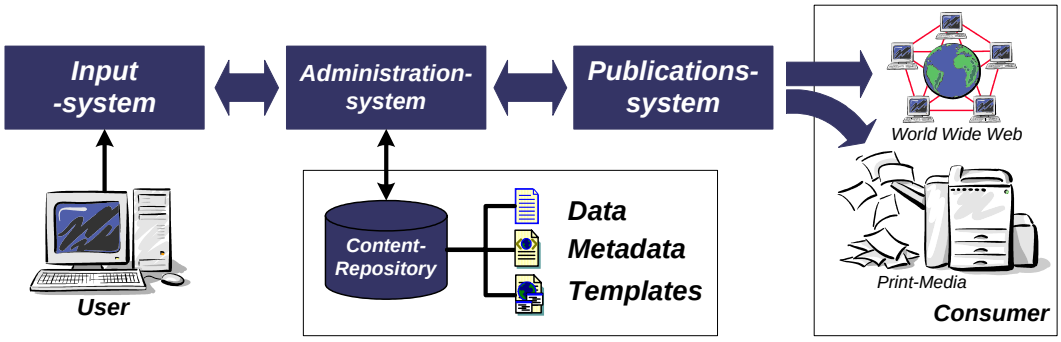


Figure 2: Architecture of a CMS

3.3 CMS Selection Process

In the initial phase of the development of the website and the portal system, several CMS were evaluated for their functionality, their usability and the needed prerequisites for the installation of such a system. Table 1 summarises the results of the market study:

Product	Manufacturer	Comments
SharePoint Portal[1]	Microsoft	• Portal system for mid-size workgroups • High prerequisites for the used Hardware • Integration of Microsoft Office products • Less flexible – Users are bound to MS Windows and the MS Internet Explorer • Needs additional software for public website
eRoom[2]	Documentum	• Powerful JAVA-based application server system • Very flexible, customisable and powerful solution aiming on collaborative workflow management • High prerequisites for the hardware – Needs separate servers for the database, the content repository, and the JAVA-based application server (e.g. JBOSS or Tomcat or Web-Sphere). • Complex installation process • Most expensive solution, due to the fact that know-how has to be acquired from external consultants.
Zope/Plone[3]	Open-Source	• Python-based application server • Very flexible and customisable • Needs special runtime environment to operate (Python) • Free of charge
Php-Groupware[4]	Open-Source	• PHP-based groupware solution, especially designed for technical purposes, such as software development or technical engineering groups. • Powerful user management • No support for external websites • Free of charge

[1] http://www.microsoft.com/sharepoint/

[2] http://www.documentum.de/

[3] http://www.plone.org/

[4] http://www.phpgroupware.org/

TYPO3[5]	Open-Source	• PHP-based content-management framework • Highly customisable, flexible, and powerful system that can be tailored for any purpose • Standardized API for extension development. At the moment, there are more than 200 extensions available. • Does not need special a special software/hardware environment – a standard Computer, running Apache, MySQL, and PHP is sufficient. • Offers integration of Microsoft Office and OpenOffice files • Integrated and easy to use user/user-group management for setting access permissions • Very active project, excellent documentation and ongoing development.

Table 1: Summary of the evaluated CMS.

Based upon the results of this market analysis, TYPO3 was chosen as CMS solution for the internal and extern website of the FIDIS NoE, offering the best mixture of flexibility and customisability. Furthermore, this solution offers the best integration for the internal and external website, using only one software system (see Figure 3).

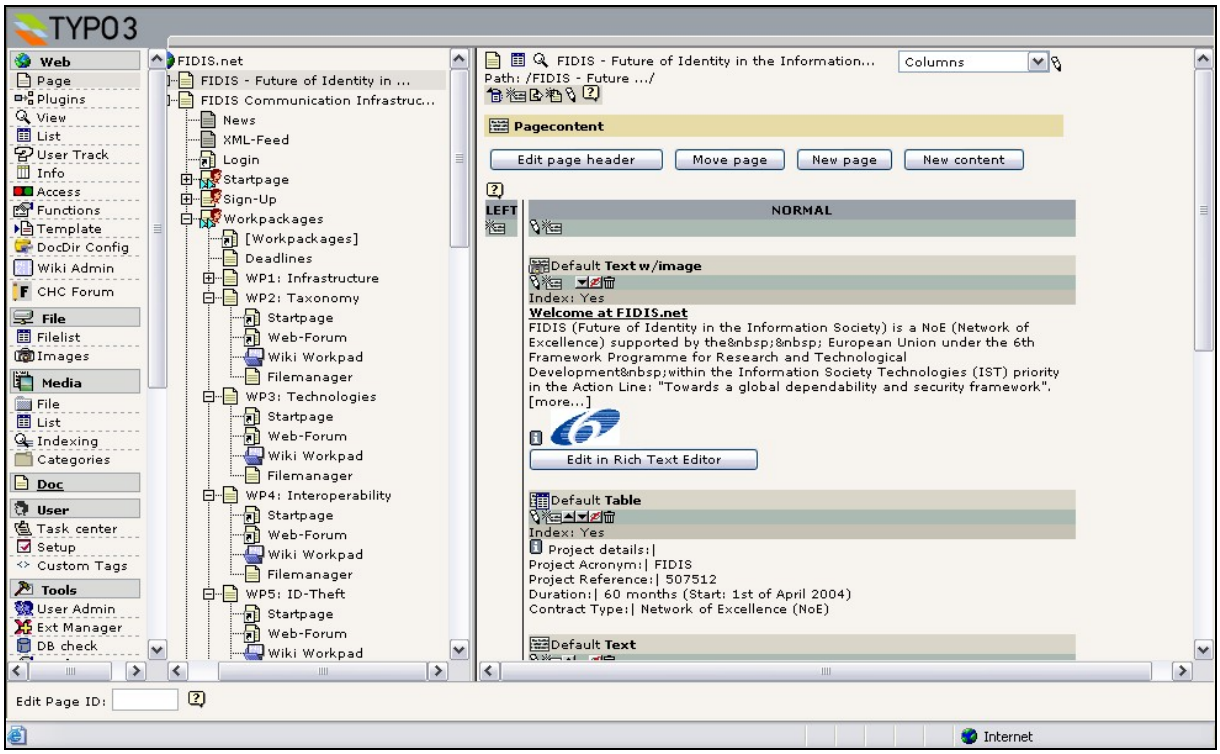


Figure 3: TYPO3 Backend System.

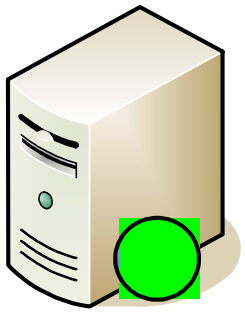
More information about TYPO3 and its features can be found at http://www.typo3.com or http://www.typo3.org.

3.4 Server Selection Process

Although being modest with its demands in regard to the used hardware, a dedicated server with a high-speed Internet connection is necessary to operate a TYPO3 installation. In order

[5] http://www.typo3.org

to keep administration (e.g. backup of files) and maintenance efforts (e.g. the installation of security updates) minimal, an external service-provider was chosen to host the actual hardware. The system running, the FIDIS communication infrastructure, offers the following feature:



- ***Intel Pentium IV 1,8 GHz Processor*** (dedicated machine)
- ***Memory:*** 1024 MB RAM
- ***Storage:*** 20 GB of hard-disk storage for files
- ***Application Server:*** PHP5, Perl
- ***Web-Server:*** Apache
- **Database Server:** MySQL
- **Operating System:** Debian Linux

Nevertheless, the service-provider offers facilities to backup the uploaded files, administrate the web-server, administrate the email-lists, and the access permissions for the directory-structure.

3.5 Used Access Management and Security

In order to secure the communication for the internal portal, an encrypted SSL/TLS connection is established. Moreover, the internal portal is secured by a user/password schema that restricts the access to the internal areas. This user/user-group access mechanism is an integrated part of TYPO3.

3.6 Communication Requirements & Prerequisites

In the initial step of building the needed infrastructure, we analysed the general prerequisites in order to get an overview of the needed technical facilities and the general prerequisites of the web-site. In this process, we identified the following basic characteristics, which the system had to meet:

- ***Communication within the research network:*** Being the crucial success factor, the communication between the researchers in the network had to be enabled. Therefore, a comprehensive web-based portal, supported by several mailing lists for different teams and functional groups, was needed in order to provide efficient communication.
- ***Self administration:*** With the help of the portal, members should be able edit their own contact information as well as define their memberships to different research groups, such as certain jointly executed research activities.
- ***Document management:*** The system should allow cooperative editing of reports, publications and other publishable material as another core functionality. The portal should also provide the required functionality to cover a coordinated and cooperative editing process for documents and other working materials.
- ***Content management for external internet portal:*** The system should be able to provide administrative functions that allow the researchers to edit and manage the content and information visible to internal and external stakeholders.

- ***Workflow management:*** Conducting cooperative research within a research project is mainly realised by cooperatively discussing and evaluating ideas and publications. With the help of workflow management and predefined processes, the creation of publications and ideas can be facilitated in a structured and formalised way.

4 The Structure of the FIDIS Website

4.1 Introduction

The communication system itself can be divided in two main parts (cp. Figure 4):

- The external FIDIS website at http://www.fidis.net, providing information for the public, such as event calendars, deliverables, and message boards.
- The internal FIDIS portal at http://internal.fidis.net, providing efficient communication within FIDIS community. Moreover, the system helps facilitating and integrating the collaborative research efforts done by the FIDIS NoE.

4.2 The Public Website

This platform aims onto the public, offering information about the FIDIS NoE to external stakeholders. Here, information about FIDIS related public events and press related material, such as descriptions of the consortium partners, can be found. Most important, the website will serve as a place for the distribution of the research results:

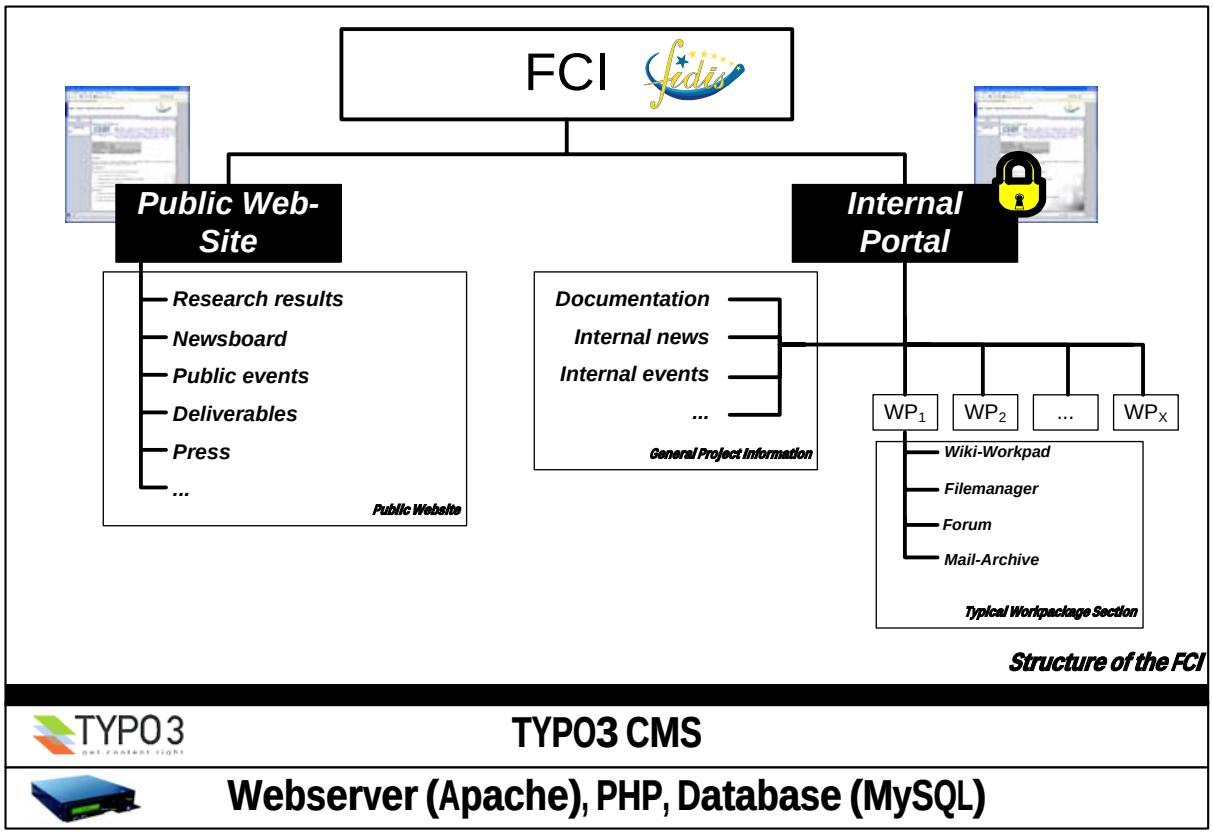


Figure 4: Structure of the FIDIS website.

In a future development stage of the website, a newsletter facility will be available to the public, helping to keep external stakeholder updated about ongoing research efforts, press releases of FIDIS and events (see chapter 4 for details).

Figure 5: The external FIDIS Website.

4.3 The Internal Web Portal

The main platform to provide efficient communication within the FIDIS NoE is a comprehensive internal web-based portal. The following functional areas are already implemented for being part of this system:

- **Communication within the FIDIS NoE:** The main platform to provide efficient communication within the FIDIS NoE is a comprehensive internal web-based portal supported by several mailing lists for FIDIS teams and roles.
- **Self administration of FIDIS members:** With the help of the portal, FIDIS members can edit their contact information and define their memberships to different FIDIS teams, such as certain jointly executed research activities.
- **Document management:** The cooperative editing of papers and publications is another core functionality of the Internal Internet Portal. The portal will provide the needed functionality to cover a coordinated and cooperative editing process.
- **Content management for external internet portal:** To manage the content and the information visible at the FIDIS external internet portal, the internal portal will provide administrative functions that allow FIDIS members to edit the information displayed at the external portal.

The portal stores and provides all information necessary to coordinate and integrate the common activities. While the portal is more or less waiting for FIDIS members to access information, the mailing list actively inform FIDIS members and keep them up to date.

With the help of the portal and mailing lists, workflow management for auditing papers and ideas will be implemented. The cooperative conducting of research within a JA is mainly realised by cooperatively discussing and evaluating ideas and papers.

The leading idea about the portal implementation is to ensure distributed responsibility for the content management. Only that approach guarantees, that content is current and up-to-date. For that reason, a content management system is the underlying infrastructure to provide the needed flexibility. Each NoE researcher will be able to directly edit content within a specific and self-contained area of the FIDIS portal.

4.3.1 General Structure

The internal portal of the FIDIS communication infrastructure is a secured area (password protected), only allowing registered users to access these pages. Furthermore, the access to the different parts of the internal portal is protected by a user/user-group scheme, only allowing users of certain groups to enter their specific areas of the website. Figure 6 shows the start-page after logging into the portal. Here, the latest news of the FIDIS NoE are available to the users.

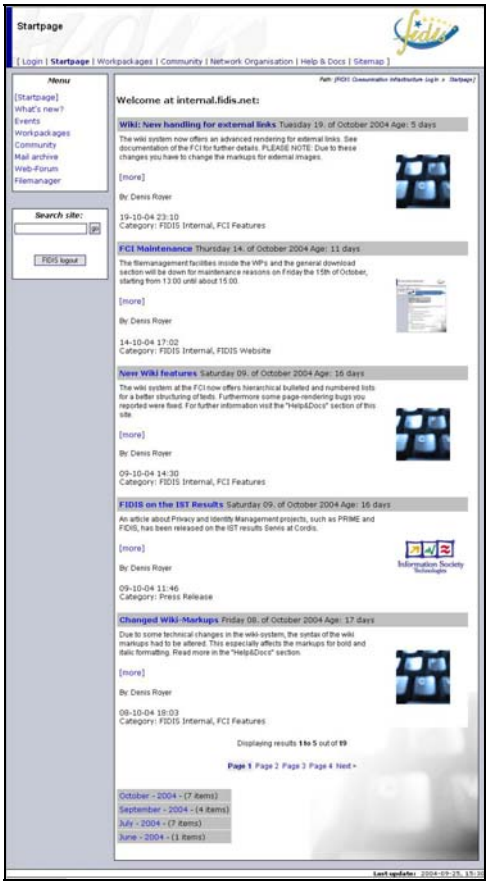


Figure 6: The Starting-Page of the internal FIDIS Portal.

The structure of the website can be divided in the following main-parts:

- Workpackages
- Community
- Network Organisation
- Documentation

4.3.2 Mailing Lists and Responsibilities

Apart from the internal website and the information available there, the communication within the NoE is supported by several mailing lists for FIDIS teams and roles. Currently the following mailing lists are available:

- **fidis@fidis.net** – Mailing list for all FIDIS members

- **ja-board@fidis.net** – Mailing list for the JA-Board
- **fidiscoord@fidis.net** - Mailing list for the FIDIS co-ordinators
- **wp*XX*@fidis.net** – Mailing lists for the different Workpackages
- **phd@fidis.net** – Mailing list for the PhD student activities (e.g. workshops, etc.)
- **wp-admins@fidis.net** – Mailing list for the Workpackage administrators.

While the development and the general maintenance of the infrastructure is managed centralised by WP1, we had to learn that split responsibilities were needed to maintain the individual Workpackage sections. Every individual Workpackage operates differently in its usage of the offered tools, how research tasks are organised, and what information has to be filled into the Workpackage sections. By keeping the maintenance and the editing centralised, the workload and the mean reaction time would have been considerably higher.

Based on this notion, a decision was made to announce a so called "Workpackage administrators" for every working group within the research network. Meeting the structure of FIDIS project best, these people are trained on the TYPO3 system and its usage. However, this also means that the underlying processes (e.g. adding content, style-guides, etc.) have to be documented more rigid. Without doing this, it would have been difficult to have a common look and feel or a common way of structuring information. Therefore, in a future development step, we will introduce the internal TYPO3 workflow management system, which will be available in an upcoming release of this software package[6].

4.3.3 Workpackages

As presented in Figure 7, a typical Workpackage consists of different working tools, enabling researchers to share their ideas and thought in a collaborative working environment. The main focus for the development was to integrate all features in one workspace, allowing even inexperienced people to use the system. While the technical aspects are handled by the WP-Admin or WP1, the content and the structuring of the information is handled by each individual Workpackage. The offered tools should help to facilitate the information exchange and the research done inside a Workpackage.

Figure 7: Typical Configuration of a Workpackage Section.

- ***Startpage*** – This is the entry-point, where general information of the Workpackage is presented. This can include e.g. a schedule for the deliverables, a general description of the Workpackage and its work, etc.
- ***Web-forum*** – A web-based discussion forum system, allowing its users to organize their ideas in terms of categories, conferences, threads, and posts. Moreover, the posted messages are sent via email, when a user subscribes to the forum-system (see Figure 8).

[6] Cp. [Royer05].

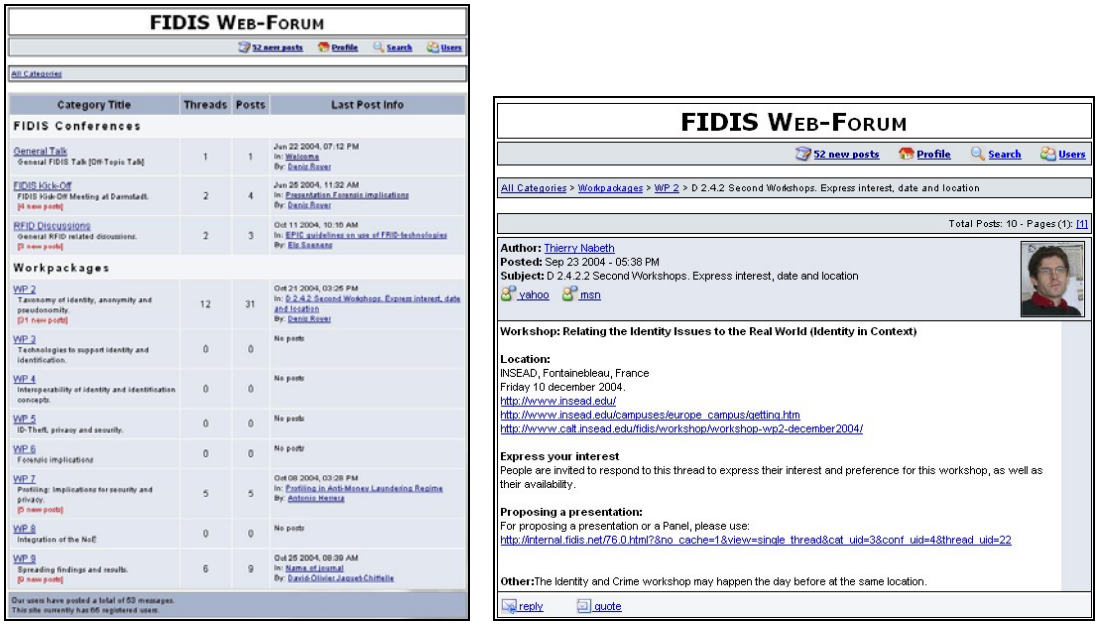


Figure 8: Web-Forum – Overview of the existing Discussion Conferences and a single Message posted on the System.

- ***Wiki Workpad*** – A "*WikiWikiWeb*" enables documents (e.g. deliverables, general information, etc.) to be written collectively in a simple markup language using a web browser. Because most wikis are web-based, the term "*wiki*" is usually sufficient. A single page in a wiki is referred to as a "*wiki page*", whiles the entire body of the pages, which are usually highly interconnected, is called "the wiki". One of the defining characteristics of wiki technology is the ease with which pages can be created and updated. Figure 9 shows the source-code and the rendered view of a typical wiki-page.
- ***Usage of the Wiki***: Looking at the requirements for the FCI (cp. chapter 3.6), the wiki system offers the best way to share and cooperatively edit documents using web-based technology. One of the success stories, which can be named in this context, is Wikipedia[7], a project that intensively uses this technology. Looking at the dissemination plans of the FIDIS NoE, there are plans by some of the Workpackages (e.g. WP2, etc.) to make the wiki public (cp. chapter 5.2).

[7] See www.wikipedia.org for details.

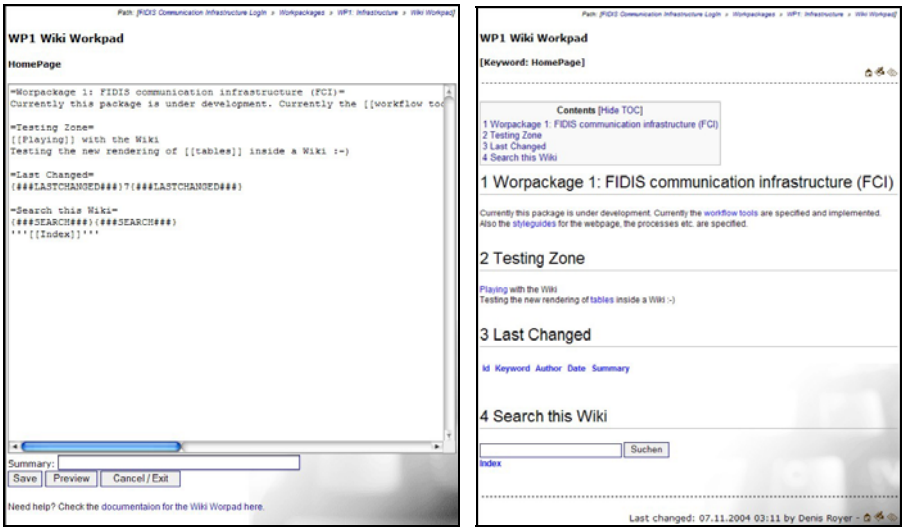


Figure 9: Wiki-page in editor mode and resulting HTML[8] output (including automatic linking and table of contents).

- ***Filemanager*** – The web-based "filemanager" enables users to manage a local file repository and exchange their files. This works similar to a filemanager available in most operating systems. Most important, it offers the possibility to store files in a private folder, only visible to the users having the specific access permissions (e.g. for a certain Workpackage), while other folders are open to all users.

4.3.4 Community

The community section of the internal website functions as a place for general FIDIS relevant information, such as upcoming and past events, mail archives, or the account information of each individual user (see Figure 10):

Figure 10: Structure of the Community Section.

- ***Events*** – Within this section, all relevant information about upcoming and past events of the FIDIS NoE are available. Moreover, the portal users can announce their own events, in order to inform other FIDIS researchers in the network (see Figure 11). This can be done by simply filling out an online form that transmits the data into the database of the CMS.

[8] ***HTML*** – Hypertext Markup Language → http://www.w3.org.

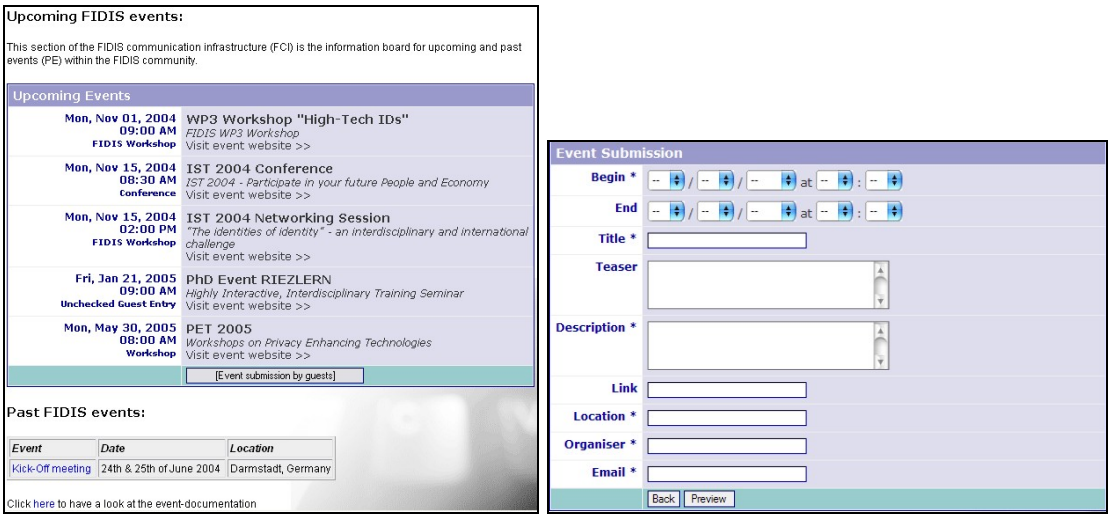


Figure 11: Event Manager – Upcoming Events and Event Submission.

- ***Mail Archive*** – The mail archive of the internal FIDIS portal collects the emails written on the fidis@fidis.net list, organising them into message threads for easier and faster access. This offers the users a centralised point for displaying and searching the message history, even if emails are locally lost.
- ***FIDIS Directory*** – The directory serves as an internal address book, displaying the address information, the portal users entered for their sign-up.

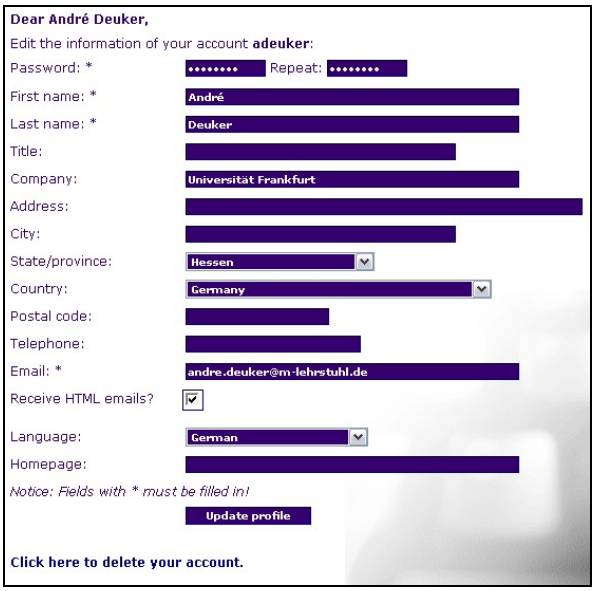


Figure 12: Example of editing User-Information on the internal Website.

- ***Manage Your Account*** – Working hand in hand with the FIDIS directory, this part offers the possibility for users to change and edit their address information, entered at the sign-up (Figure 12). This feature helps to keep all addresses, etc. up-to-date.
- ***Web-Forum & Filemanager*** – These parts are additional links to simplify the access to the forum and file-repository of the internal portal. Here, documents such as deliverables, shared documents, or templates (logos, presentations, word-files, etc.) can be downloaded.

- ***Photos*** – Here, photos of past FIDIS events can be shared and accessed by the internal users. This part of the website is organised as a photo gallery.

4.3.5 Network Organisation

A NoE as a smart and flexible but relatively small FP6 instrument needs lean management and organisation. Therefore, as much of the decisions making, steering and controlling as possible will be done using non formalised and cooperative coordination mechanisms. By encouraging overlapping teams working on JAs, informal coordination can easily take place and information can thus be spread through the whole network.

In order to support this approach, the internal portal system helps to distribute the information of the "Research Plenary" and the "Joint Activity Board" to all FIDIS members. By doing this, a centralised place for announcing important events and documents is created.

4.3.6 Documentation

Last but not least, all documentation concerning the "Financial Guidelines" or the general usage of the presented tools is available in the "Help & Docs" section (Figure 13):

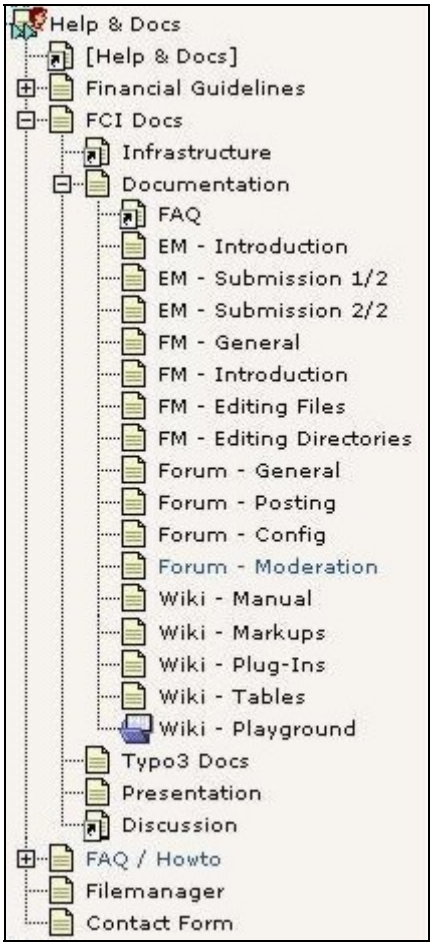


Figure 13: Structure of the Documentation Section.

- ***Financial Guidelines*** – This section especially deals with the financial and accounting issues of FP6 projects. Here, the users of the portal can access all necessary documents, such as the "*Financial Guidelines*" or the needed forms for the audit.

- ***FCI Docs*** – In section, one can find detailed information about the basic tools of this infrastructure, for example a description of the "*Filemanager*", the "*Web-Forum*", or the "*Wiki Workpad*". Furthermore, information about the used Content Management System (CMS) "TYPO3" and its usage is provided in the "TYPO3 Docs" section. This especially aims toward the administrators of the website and the portal system. Finally, the "Presentation" section gives an interactive introduction of the general concepts of a CMS and its advantages in everyday work.
- ***FAQ / How-To*** – Here, a collection of frequently asked questions (FAQ[9]) and short manuals (How-To[10]) is created, to simplify everyday work with the portal system or the financial guidelines.
- ***Filemanager*** – This section is an additional link, simplifying the access to the file-repository of the internal portal. As described earlier, all documents such as deliverables, shared documents, or templates (logos, presentations, word-files, etc.) can be downloaded here.
- ***Helpdesk*** – A helpdesk is an information and assistance resource that troubleshoots problems with computers and similar products. For the users of the internal website this facility offers an easy way to contact the administrators of the portal for support (Figure 14).

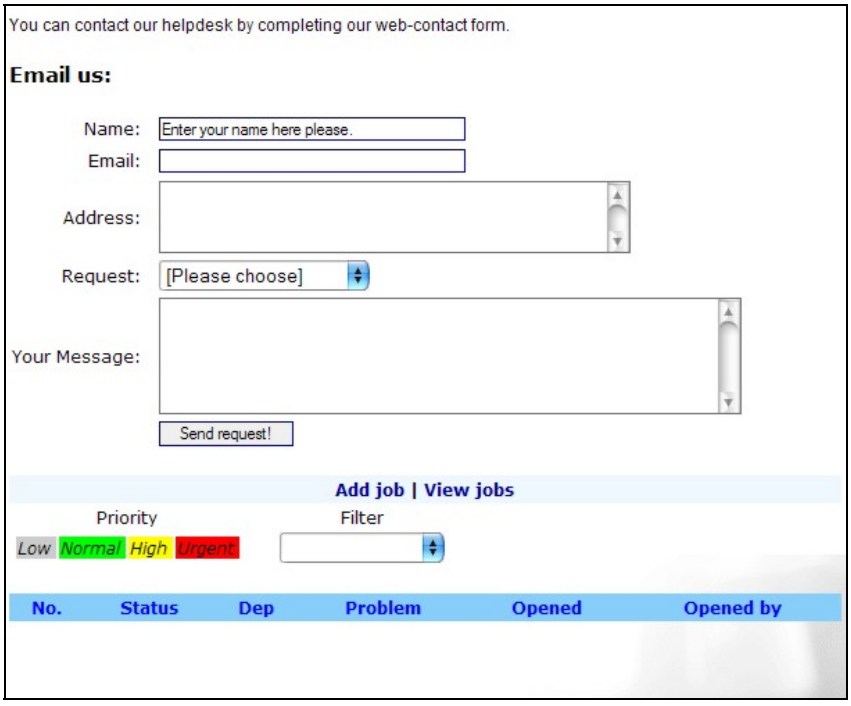


Figure 14: Helpdesk System.

[9] A FAQ is a document containing a series of questions and answers all pertaining to a certain topic.

[10] A how-to is an informal, often short, description of how to accomplish some specific task. They are generally meant to help non-experts, and may leave out details that are only important to experts, and may be greatly simplified from an overall discussion of the topic.

4.4 Statistics of the System

For the development process and the maintenance of the website and the internal portal, some performance parameters are monitored. This is done, to provide information for optimisations of the system. Figure 15 and Table 2 show some of the results:

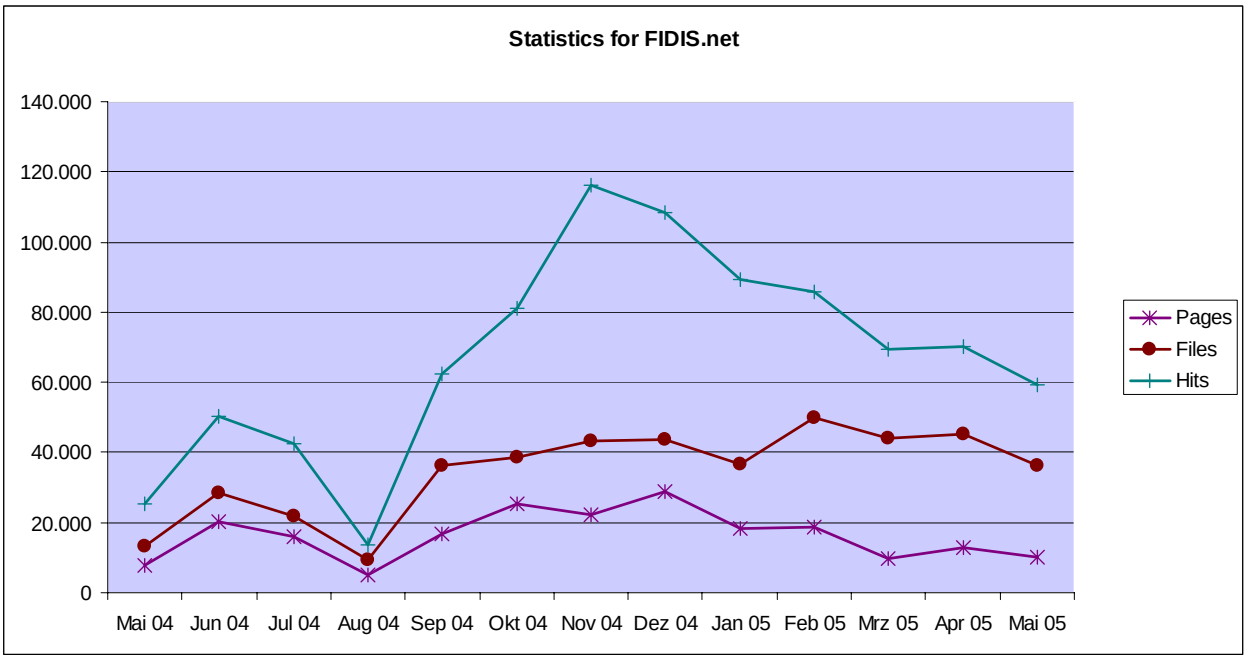


Figure 15: Usage Statistics of the FIDIS.net Website[11].

The increasing numbers of ”Hits” indicates an active usage of the website by its users, while the stable development of the “Files” and “Pages” value show the success of the continues optimisations of the systems. For a better understanding of the terms used here, the following definitions were created:

- “***Hits***” represent the total number of requests made to the server during the given time period (month, day, hour etc.).
- “***Files***” represent the total number of hits (requests) that actually resulted in something being sent back to the user. Not all hits will send data, such as “*404-Not Found*” requests and requests for pages that are already in the browsers cache.
- “***Sites***” is the number of unique IP addresses/hostnames that made requests to the server. Care should be taken when using this metric for anything other than that. Many users can appear to come from a single site, and they can also appear to come from many IP addresses so it should be used simply as a rough gauge as to the number of visitors to your server.
- “***Visits***” occur when some remote site makes a request for a page on your server for the first time. As long as the same site keeps making requests within a given timeout

[11] Statistics generated by “Webalizer” Version 2.01 at http://www.fidis.net. Webalizer is a fast, free web server log file analysis program. It produces highly detailed, easily configurable usage reports in HTML format, for viewing with a standard web browser. Read more at http://www.mrunix.net/webalizer/.

period, they will all be considered part of the same "*Visit*". If the site makes a request to your server, and the length of time since the last request is greater than the specified timeout period (default is 30 minutes), a new "*Visit*" is started and counted, and the sequence repeats. Since only pages will trigger a visit, remotes sites that link to graphic and other non-page URLs will not be counted in the visit totals, reducing the number of false visits.

- "Pages" are those URLs that would be considered the actual page being requested, and not all of the individual items that make it up (such as graphics and audio clips). Some people call this metric page views or page impressions, and defaults to any URL that has an extension of .htm, .html or .cgi.

Month	Daily Avg				Monthly Totals					
	Hits	Files	Pages	Visits	Sites	KBytes	Visits	Pages	Files	Hits
01 May 2004	1.057	558	326	13	189	167.204	318	7.824	13.404	25.391
01 June 2004	1.678	946	681	27	439	553.504	833	20.457	28.388	50.349
01 July 2004	1.367	707	516	27	496	353.577	854	15.998	21.918	42.389
01 August 2004	438	306	165	27	523	171.099	844	5.118	9.496	13.602
01 September 2004	2.081	1.211	554	35	758	602.822	1.078	16.628	36.357	62.455
01 October 2004	2.616	1.241	812	49	918	764.157	1.533	25.197	38.482	81.103
01 November 2004	3.877	1.447	736	59	1.034	825.231	1.796	22.086	43.420	116.338
01 December 2004	3.497	1.413	929	67	1.185	1.305.834	2.088	28.813	43.804	108.409
01 January 2005	2.886	1.187	590	77	1.407	1.173.383	2.405	18.299	36.825	89.495
01 February 2005	3.061	1.776	663	82	1.081	1.490.284	2.304	18.584	49.730	85.711
01 March 2005	2.237	1.424	312	87	1.043	1.224.796	2.719	9.693	44.154	69.348
01 April 2005	2.345	1.511	432	85	997	1.003.734	2.553	12.965	45.334	70.373
01 May 2005	1.910	1.170	332	79	853	888.700	2.451	10.305	36.283	59.212
Totals						**10.524.325**	**21.776**	**211.967**	**447.595**	**874.175**

Table 2: Detailed figures of the current system usage.

5 Future Work

5.1 Introduction

From a software-development cycle's perspective, as illustrated in Figure 16, the development of the FIDIS website and the internal is finished (launch) and the whole system is now in its maintenance cycle. Nevertheless, constant development is necessary, in order to enhance the usability, the integration of the tools, and most important the presented content.

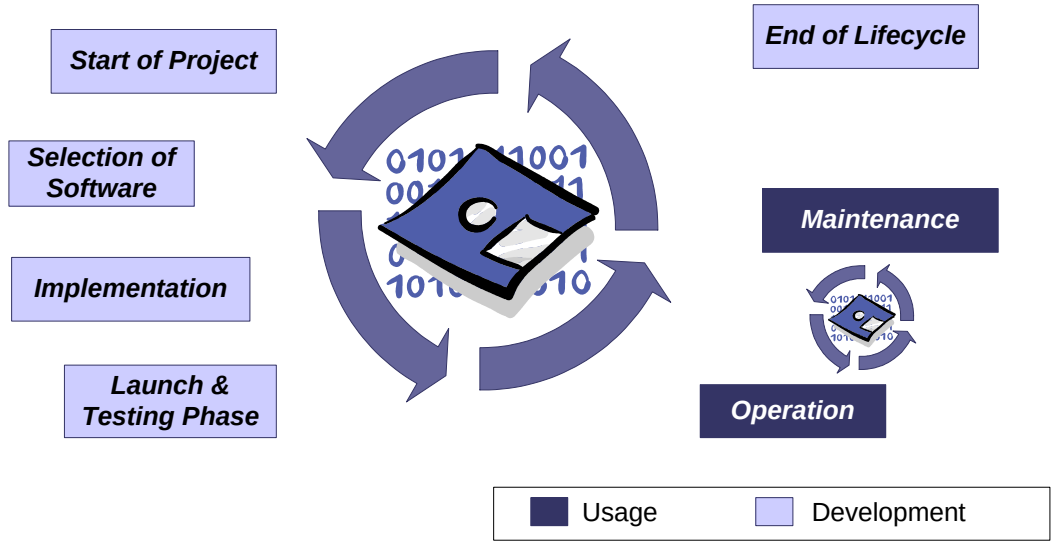


Figure 16: Spiral development cycle[12].

5.2 Information System

There will be an on-going effort to disseminate knowledge acquired within FIDIS beyond the network. The website will be external with facilities that will make available information about FIDIS, about European identity management systems, some of the final work products, general information on each JPA, a collection of real-life stories related to identity issues, and an agenda with information about specific events. So far, the following additional features and improvements have been identified for the dissemination of FIDIS results on the website and on the internal portal:

- ***FIDIS Journal*** – Being part of Workpackage 9, the efforts of creating a journal on identity management can be facilitated by using a web-based system. Therefore, the FIDIS website could be used as a platform to host an electronic version of the journal.
- ***Newsletter system for external stakeholders and the public*** – For an efficient means of informing external stakeholders and the public about the ongoing research within the FIDIS NoE, a web-based newsletter system will be installed. Depending on the

[12] The spiral model is a development model combining elements of both design and prototyping-in-stages, in an effort to combine advantages of top-down and bottom-up concepts. It was first described by Barry Boehm in 1988 [Boehm88].

preferred topic the subscriber is interested in, a customised newsletter will be created and sent via email.

- ***Advanced Wiki Workpad*** – Being the focal point of exchanging ideas and results, the wiki system will be enhanced in many ways. These enhancement especially focus on the usability (e.g. a system to find differences in different versions of a wiki-page) or the export of the results into other data formats (e.g. text-files, XML, etc.) for further editing. Moreover, a "wiki-viewer" will be created, that serves as a read-only version of the wiki.
- ***Deliverables library*** – A library for the dissemination of the research results (e.g. deliverables) will be created in a dedicated public download repository on the public website.
- ***Database integration*** – As part of its objective to become a reference point for discussions between all actors involved in Identity issues in Europe, the NoE will also build a database on identity management systems, related projects and initiatives. The geographical scope is Europe but relevant activities outside of Europe will also be recorded. Relevant interoperability, technical and strategic initiatives as well as European Commission funded projects and initiatives will also be included. The existing different ID systems in Europe will be collected and analysed and a suitable taxonomy will be produced. Currently, different ways of integrating this database on identity management are researched. Therefore a TYPO3 extension will be created that seamlessly plugs into the developed system for better usability.

6 Bibliography

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