Paper

Comparative analysis of models and platforms for the e-learning portals

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Abstract— The main basic functions of portal systems have to be implemented by the functionality of it platform. The technological platform of portal should be complied with the specified requirements. The basic set of services and components of e-learning portal contains five components for: services performance, user services, data management, portal adaptors, web infrastructure. The paper presents the detailed outcomes of well-known platforms analysis, discusses the advantages and disadvantages of mentioned systems and gives recommendations for customers in making a choice among these platforms.

Keywords— portal systems, services, components, technological platforms.

1. Introduction

The technological platform for development and support of system of e-learning portals is the software-hardware complex that allows establishing and maintaining the portals for different purpose and architecture and provides the accomplishment of the following functions: execution of the applications, possibilities for team-working, content management services, user administration, control and management of the productivity, knowledge management, support of the communications, personification, profiling, search, ensuring of security, standard www-access to the portal.

The technological platform of the e-learning portal should comply with the following requirement to provide the effective, dependable and flexible working:

- Conformity with international standards for open systems including standards for development, maintaining and documentation.
- Presence of advanced technological tools for integration with other applied systems and database management systems (DBMSs).
- Adaptability, tools for tuning of portal for functional requirements of specified university/institute or educational system, solution transfer technologies between the platforms.
- Scalability depending to the users' amount, stored data volumes, data exchange intensity, etc.

2. Requirements to the basic set of components and services

The technological platform, which has been selected for development of the e-learning portal, has to include the basic set of services and components. These requirements allow us to develop the portal with any architecture without delays and big financial resources due to ready set of prepared services and components.

The basic set of the services and components has to include five main elements: the component of presentation services, the component of user services; the component of information management; the component of portal adapters; the web infrastructure component [1]. Lets give the brief overview of mentioned items.

2.1. Component of presentation services

Presentation services allow users to manage the view of portal user interface and allows portal to dynamically accommodate the content presentation and navigation system to the device possibilities, which control the user access. Two different types of user interface are supported: *voice interface* (at the second stage of development) and *data interface*. The set of devices for establishment of the connect to the portal has to include desktop and portable computers with any web browsers, personal digital assistant (PDA), wireless devices – mobile phones and electronic pocket books. The portlet environment (services for personalized portal views [1]) and packing services permit user to decide what content type is "eligible" for used device because not all applications are available for all devices.

2.2. Component of user services

Component of user services helps users to find necessary information and people; to define what applications and data are needed for user; to collaborate with other users.

Personalization services (services of user personal portal) bring the content (data, applications and expert knowledge) into accord with necessities of concrete user. User may define the rules of preferable content view as part of his own *profile* for managing of this process. Afterwards the user may change the profile settings. Besides, the portal can change its settings dynamically on the basis of collected data set concerning the functioning of the applications and

user's behavior (so called *click stream*). The usage of common filtering (of logical output) and rules allows the portal to use only important information for view personification and facilitation of the end-user working.

Security services (permission' control and authorization) give users the single-authorization access to all allowed content (applications, information and expert knowledge). Security services also guarantee the inaccessibility of the portal data and applications for those users who have not enough permission to access these objects.

Access services give users an access to information and applications by means of portal adapters and uniform resource locators (URLs).

Search (meta-search) **engines** compose the ideal interface for searching for the needed content at the internal and external sources simultaneously.

Publication services (informational services) support both automatic and manual publication. In case of manual publication the users with required permission may publish the content for shared working with other users. It includes office documents, materials for discussion groups, knowledge, external information (URLs, real-time news), rules, expert knowledge and transactions. At the publication new materials is included in the appropriate category of the portal *informational catalogue*.

Subscription services allow users to take out a subscription to interesting informational channel whereupon they will receive the notifications concerning new information or changing existing one at the selected topics. The subscription mailing may be carried out according to the *schedule scheme* or at *event coming.*

Delivery services (delivery service) manage the delivery of content to the subscribers (users and applications) according to the delivery politics. The content delivery may be implemented into the format, which corresponds to device (PC, pocket PC, smart-phone) or application that represent the given information.

Collaboration support services (interactive interaction services) give the tools for collaboration. With help of these tools users inside and outside the company can interoperate with each other and use content jointly. Document circulation services allow users to define:

- processes which have to be executed by these users;
- processes that have to be started in case of subscription, decision or personalization rule is true.

2.3. Component of information management

Informational management services include several items.

Informational catalogue (moderated catalogue of educational resources) is the method for searching for the information and applications accessible through the portal. The catalogue contains the links (metadata) to the content items grouped by topics. It indexes the structured and non-structured information, applications and other objects. Informational catalogue is often the determining factor for choice of the solution for development of the portal. It may be implemented as usual filesystem with the basic set of functions or as database with its rich possibilities.

Content layout manager contains the services for content systematization and grouping. Information collectors, which start after the user request or according to the schedule, "look through" the web sites and collect metadata about applications. New and updated content is transferring to the content layout manager, which takes the information into the appropriate section of informational catalogue.

Rules catalogue – rules are defined and processed by means of *rules editors*, which include to the personification, subscription and documents circulation management. The rules are stored at the rules catalogue and divided into the set of types:

- personalization rules manage the users access to the information blocks;
- content layout rules combine the interlinked data for facilitation of the work;
- decision-making rules manage the automatic decision-making, recommendations distribution and processes execution;
- subscription rules are intended for information delivery according to the schedule and to the request.

Event manager is responsible for job starting on the basis of rules, which are defined in the rules catalogue. The rules can start the actions such as report generation, e-mail delivery, operational transaction start, etc. At event coming the event manager notify the specified user or device and deliver the informational package with the help of delivery services and/or accomplish the other automatic actions.

Repository of shared information (the bank of educational objects) is the logical repository that is used for management of informational content created and published by common worked users.

Content unification manager is responsible for the integration of the application components and content (voice information and data) for delivery through the usual and wireless communication lines. This manager is carried out by personalization services.

2.4. Component of portal adapters

Portal adapters grant access to the wide range of information. To provide the interactions between applications, data and users the portal contains the adapters, which carry out the functions of interface between different informational systems and formats. Adapters may be supplied as the product for development of the portal, purchased at the specialized company or developed on one's own [3]. There are several types of adaptors to connect with different types of content.

Database (DB) adapters and files – application program interfaces (APIs) of DBs and files, which grant access to

the data stored in different sources of structured information (customers' DBs, analytical information of BI and OLAP systems).
Adapters of knowledge instruments (BI) – API for access to the knowledge instruments, analytical software packages and knowledge portals BI.
Content management adapters – API for access and management of content management systems, which store non-structured commercial information (pictures, audio, video, etc.)
Adapters for application integration allow granting access to the package applications and old computer systems. This kind of adapters also includes modules for transaction management support.

2.5. Web infrastructure component

Application development tools include tools, portal components and application components, which can be used jointly with software development tools (web design instruments, rules editor and JavaBeans environment).
Administration and productivity control tools designed for portal systems administrators. It gives them possibilities for management of users and their groups, system productivity, content management (updating and synchronization) and system analysis. Administration tools should be integrated with other management instruments organizing the common framework for systems' management in the organization. Productivity control tools include caching tools, service distribution tools, and workload analysis tools.
Web applications server is the standard component of web infrastructure, which supports integration of corporative web applications [2]. The web applications server has to:

- support of several API applications and API servlets, JSP, JavaBeans, EJB, Corba, etc.;
- contain the HTTP server (Apache, Netscape or Microsoft IIS);
- provide the synchronous and asynchronous transaction management.

3. Comparative analysis of most well known portal platforms

The solutions of the most well-known and trustworthy portal development companies have been selected. For comparative analysis the following approaches were accomplished: questionnaire design, expert evaluations, experimental installation of portal platforms.

3.1. Hummingbird enterprise information portal (EIP) 5.0

Hummingbird company has developed the server of portal that provides the dependable access to the structured and non-structured information and applications [3]. Hummingbird portal is established at the entirely open architecture that allows setup and tuning it easily. Practically Hummingbird presents at the market the first *metadata portal*. Hummingbird CAP server provides the unified and secure access to the multitude heterogeneous catalogue services. CAP protocol delivers from the necessity to develop the specific code for providing of the interface with each catalogue service.
The main portal component is the Java-based platform-independent server, which delivers the set of tools and information required for user to perform his tasks. Inside organization Hummingbird portal increases the effectiveness of the work of analytics, managers and mobile users. Hummingbird EIP also consolidates the communications between organizations with the use of "business-business" transactions and e-commerce.
Advantages: EIP demonstrates the excellent characteristics for development of the corporate portals.
Disadvantages: the scalability, security, modularity, flexibility in decision-making is provided insufficiently.

3.2. X-Ware technological platform

X-Ware technological platform is the integrated package of software solutions designed for development and support of large distributed systems. Three-level architecture of technological platform allows connect up any quality of the external modules to the kernel ("shared bus"). These modules may be located at any ex-territorial area and processes the data at various formats and based at the different software-hardware platform. System kernel may be developed as group of distributed modules.
The main attached modules of X-Ware platform:

- content management module (provides content producing and updating, its formatting, editing and remote management);
- "stager" module (responsible for continuous development and updating of web resources);
- geo-targeting module (provides the ability for geographical localization of remote user and giving him information in accordance with his location);
- catalogue management module (designed for forming of the hierarchic structures of URLs for the usage at the universal search engine or geo-targeting module);
- search engines (include two modules: incremental search engine (for immediate indexing) and universal search engine (for periodical indexing).

Advantages: X-Ware-based systems have abilities for integration with the majority of well-known products with open API interface, and with the applications with DCOM or CORBA technologies. These systems have opportunities for connecting with customers' existing informational resources and can be transferred between different platforms and OS [4].

Disadvantages: this package isn't distributed as "box version", it is recommended to use it as custom-built product.

3.3. IBM WebSphere portal

IBM WebSphere portal is the integral part of WebSphere software platform. This platform is designed for:

- access granting for all categories of users, devices and settings options;
- integration and automation of all business processes;
- development and management of the applications.

Three classes of IBM WebSphere solutions are complied with these functional sections.
Functional framework and tools – planning, development and management of the applications. WebSphere application server, MQ package for message exchange and the most modern development tools form the powerful basis for the platform. This foundation and tools help customer to give necessary functions for Internet working, allow to develop and use of web services, provide the connectivity with scaled community of WebSphere users.
Business integration – providing of the compatibility with internal business processes. WebSphere business integrator as integral part of WebSphere package facilitate the establishment of applications and business processes including solutions for supply chain management (SCM) and integration of existing processes with web [5].
Customers' services quality – content personalization and access granting for all categories of devices. These WebSphere products are responsible for exact settings of portal in accordance with cistomers' requirements and provide wide possibilities for access of customers, business partners and ex-territorial branches.
Advantages: powerful flexible system; large repository of objects; containing of portlets for educational portals.
Disadvantages: high cost; labour-intensiveness of application development

3.4. Oracle 9i Application Server Portal

Oracle 9i Application Server has wide abilities for publishing web services and applications in Internet. One can develop web services on the basis of the modern technologies, including Java languages (with the standard J2EE), XML, PL/SQL. JDeveloper and Forms Developer as the parts of Oracle Internet Developer Suite package allow development and setup of application in the close connection with Oracle 9i Application Server.
With use of Oracle 9i AS portal and its portlet technology one can develop personified portals with one-time authorization. This action facilitates the access to the services content and provides the necessary security level. New e-business application – Webtop – delivers the personified information to different users' groups, increases their productivity and supplies with necessary data [6].
Oracle portal package can be presented as three distinct but interlinked modules: in fact, portal components, tools for development and common administration of the site and integrated tool for development of web applications based on Oracle DBMS.
Oracle portal applications consist of three different types of components:

- forms are designed for information input by use of text fields, multiply choice controls, flags, drop-down lists and dialog windows;
- reports display DBMS information in HTML, Text or Microsoft Excel formats;
- diagrams show the information in graphical mode;
- hierarchy display data with subordination status (e.g., organizational charts).

Advantages: powerful upcoming system; well-designed development tools; extensive additional abilities.
Disadvantages: too expensive system; there are few educational portlets.

3.5. Microsoft SharePoint Portal Server 2001

Microsoft SharePoint Portal Server 2001 is the flexible solution for development of portals that facilitate the search, shared working and publishing of information.
SharePoint Portal Server allows create the powerful work-ready portal systems. It consolidates main functions for document circulation management such as extraction of the necessary documents and its return to the repository, documents' profiles and shared publication. Users can create the special working area of SharePoint Portal Server that may implement project planning and document management and sharing. Electronic panels node of MS SharePoint Portal Server executes the functions of centralized access point to the information from different sources. At the same time it provides the security of used documents [6]. External data sources may be used as working areas of SharePoint Portal Server, MS Exchange Server 5.5 shared folders, local and network filesystems.
Microsoft SharePoint Portal Server special features:

- access facilitation to the business information (indexing of most important data sources; supporting of security settings for Windows and Exchange server);
- close integration with Microsoft Office products and Windows Active Desktop (abilities for extraction and returning of the documents, version control);
- effective solutions for development and enlargement of the portal (portal interface built at the basis of electronic instrumental panels allows its extension by use of webcomponents; standardized portal platform on the basis of XML, WebDAV, ADO/OLEDB and CDO standards).

Advantages: powerful complex solution oriented exclusively to the own MS-platform.
Disadvantages: there are no specified portal solutions for educational tasks; unsatisfactory parameters of security, dependability, control, support of standards.

3.6. Freeware and problem-oriented software

At analysis of different portal systems one should pay attention to the numerous solutions of freeware and shareware products, supported by groups of enthusiasts. As examples Zope [7], PHP-Nuke [8], MetaDot Portal Server [9] may be examined. These products can't be recommended as the federal-wide (nation-wide) solutions. They may be established as the school or university platform only.
There are several software products responsible for carrying out distinct useful functions: WebCT [10], Lotus LearningSpace [11]. Such kind products can be integrated to the portal as the "independent" application but not as the basis for it [12].
Advantages: free of charge; simple installation and usage; originality of solutions.
Disadvantages: absence of high-quality documentation; no guarantees; numerous errors and defects.

4. Conclusions

X-Ware platform may be recommended to the development of distributed system of educational resources' catalogue in accordance with common search engine and rubricators of educational portals system in case of brining to collaboration manufacture company.
IBM WebSphere platform is the best choice among well-known and supported products for educational portal system. It complies with complex requirements and supports the integration of existing resources into a single whole. Its usage may be combined with X-Ware implementation for distributed catalogues.
Oracle products may be recommended for realization of distinct portal modules responsible for data storing and processing.
Freeware products (Zope, PHP-Nuke, etc.) are intended for faculty-level or university-level projects.
The most important factor for the choice of the platform for portal is the presence of manufacturer's experience of working with the given platform.

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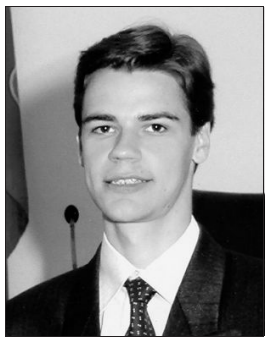

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