Automation of Information Processes

Krasimira Stoilova, Todor Stoilov, Zlatka Ivanova

Abstract: *Technologies for integration of e-content is considered. Such integration is useful for generation of new e-learning content, for actualization and extension available one. The automatic search and integration of e-content is a tendency, which is widely used for the domain of information services. The paper addresses technological tools which can be used for automation of information processes. Standards and their implementation in workflow technology stack is classified and discussed. It has been found a set of tools, which respect standards and makes in a common sequence the development of workflow solutions.*

Key words: *Web Services, Workflow Technology, Modelling and Execution of Information Processes.*

INTRODUCTION

The integration of parts of e-learning content is the current practice for the development of new or modification of existing e-learning lessons. Potential benefits are expected in automating parts of this process in searching and integration of different components of e-content and e-services, addressing the domain of e-learning. The framework under which the automation of information processes is developed is the concept of the Service Oriented Architecture (SOA). SOA is a natural extension of the object oriented software and it applies modular approach to integrate content and virtual environment. Thus, in such a way independence across hardware and software tools has been achieved, which is very important for the design of e-learning content. SOA was also launched as a model for integration of business processes in a distributed system environment. The most important implementation of SOA is Web services. They allow implementation of the principles of automation in business processes and e-learning. This extension of Web services is known as workflow technology. The paper analyses the technological requirements and standards for the implementation of Web services. It has been identified the software development tools, which can link in a common sequence the development of automatic solutions for the integration of e-content and e-services. Software tools and standards, applied for the implementation of automation in information processes are chosen.

SERVICE ORIENTED ARCHITECTURE

The term SOA was introduced to stress the meaning of information services and their application for the management and automation of information processes. SOA accepts the virtual environment as a place, where information, program and computer services are offered, nevertheless the used underlying technology of implementation [2]. The information services in SOA are implemented as loosely coupled services, which interact on the basis of user interface, instead of program level. Thus, an integration of information services in more complicated application is achieved, which complex service was not existed till now [2]. The idea of SOA is not new and it is an extension of the concept of Object Oriented programming, where distant invocation of program code is a powerful technology. The concept of SOA makes functional extension of the technologies Remote Method Invocation (RMI) and Common Object Request Broker Architecture (CORBA), where in distant way distributed program code is invoked. SOA applies this model in relation to information services, not only for program code. The concept of SOA assumes information services as "black boxes", which do not depend on the execution of specific programming codes and technologies. This model allows data to be exchanged between various information services and new more complex services to be composed as a combination of available more simple ones.

NEW PHENOMENON IN E-LEARNING - WEB SERVICES

Wide popular implementation of SOA is Web Services Architecture [10]. The data exchange between distributed information processes in the virtual environment is the core of Web services. The concept of Web services is based on service based computing performed from different dispersed hosts in the global network [8]. A popular definition of service is given in [1]: "...a service is an active program or software component in a given environment that provides and manages access to a resource that is essential for the function of other entities in the environment". We have to mention that the resource has a different meaning - from a piece of hardware (hard disk) to a kind of software (math library). The Web service is a service over a computer network and it is accessible using standard Internet protocols (HTTP) using broad applied standard formats (XML) [4, 5]. The necessity causes the Web services to become a new perspective in the computer industry. Web services combine the best aspects of component-based development and the Web [8]. The Web services represent functionalities that can be easily reused without knowing how the service is implemented (like components). The service is an application that can be accessed through a programmable interface. In the past clients accessed these services using a tightly coupled, distributed computing protocols, such as DCOM, CORBA or RMI. As these protocols are effective for building applications, they limit the flexibility of the system [5]. Practically, Web Services are powerful mechanism for integrating information resources.

Web services take the best features of the service-oriented architecture and combine it with the Web. The Web supports universal communication, using loosely coupled connections. The resulting technology eliminates the usual constraints of DCOM, CORBA or RMI. Thus, Web services support Web-based access, easy integration and service reusability.

TECHNOLOGICAL ARCHITECTURE OF WEB SERVICES

The Web services are implemented with a set of software technologies: XML, SOAP, HTTP, WSDL, Workflow, Fig.1.

XML (eXtensible Markup Language) is a tag based language for the formalization, formatting and structuring the information exchanged between Web services.

SOAP (Simple Object Access Protocol) is a XML based protocol for the formalization and specification of the exchanged information between Web services.

WSDL (Web Services Description Language) is a XML based language for the formalization, description, specification of parameters, attributes, interfaces of the Web services. WSDL is used by programs and allows them to understand how to invoke a web service, what are input parameters needed, which are the output data, what type of interfaces their Web service applies. Technological descriptions of WSDL can be found in [3, 11].

UDDI (Universal Description Discovery and Integration) is a standard devoted to the publication of the services in a register, describing the functional capabilities of Web services. This standard disseminates and makes a common catalogue for publishing the available Web services in a virtual environment.

Although Web service can support any communication protocol, the most common is SOAP over either HTTP or HTTPS. Good presentations of Web services are given in [3].

On the top of the technology stack of Web services is the Workflow technology. It is applied for the description of the relations, sequence of operation and logical conditions, under which Web services are executed. The formalization of this logic is performed using available standards for service modelling and specification as BPEL (Business Process Execution Language) and XPDL (eXtandable Process Definition Language). Examples of

software products, which deal with the WSDL formalization are: JBoss Application Server from JBoss ; Glassfish of Sun Microsystem ; EJB 3, which is the most distributed editor for Java applications.

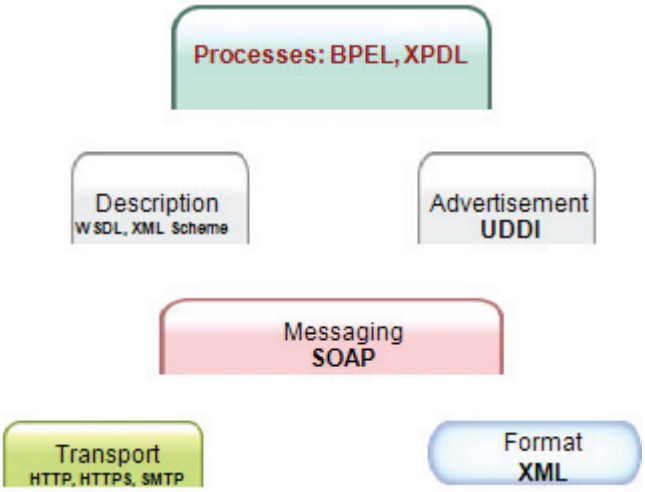

Fig.1. Technological architecture of Web services

Fig.2 represents the sequence of operation for Web Services, related to the set of technologies applied. The Web service provider registers a service in the UDDI directory. The Web service client searches an appropriate service from the UDDI directory and finds from it the input point for the WSDL service description and invocation. All formalizations are done according to XML standard and the communications between the services are performed by SOAP protocol.

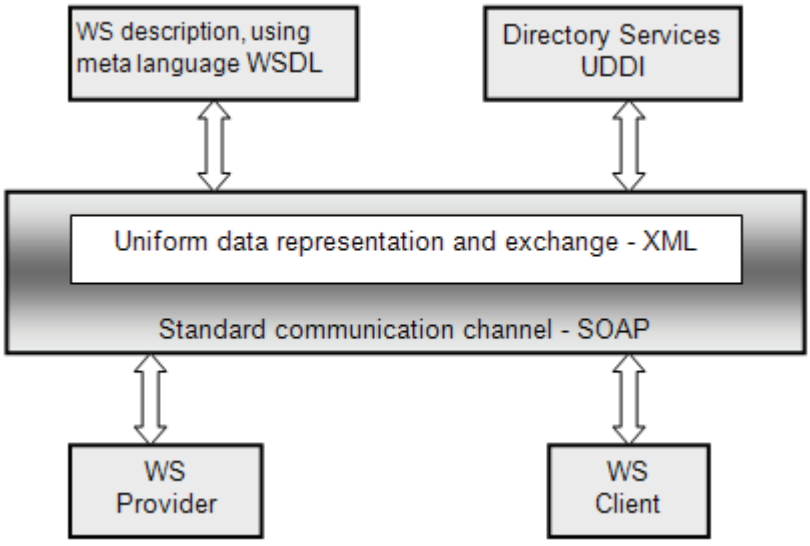

Fig.2. Sequence of utilization of Web services

WORKFLOW TECHNOLOGY

The business process management systems developed in the late 1980s enable the automated coordination of activities, data and resources. This coordination is formalized in a workflow model [13]. The architecture of workflow management systems can be separated in a modelling environment and execution environment [7]. Workflow

Management Systems are a mature technology for automating and controlling business processes [6]. One definition of workflow comes from the Workflow Management Coalition [12]: "Workflow is the computerized facilitation or automation of a business process, in whole or part". A general task of the development of the workflow system is the implementation of principles of the automatic control in business systems. These systems do not consist of pure technical components and integrate both human and human-computer activities. Thus, the implementation of the automation will benefit the exploitation of the business (e-learning) systems.

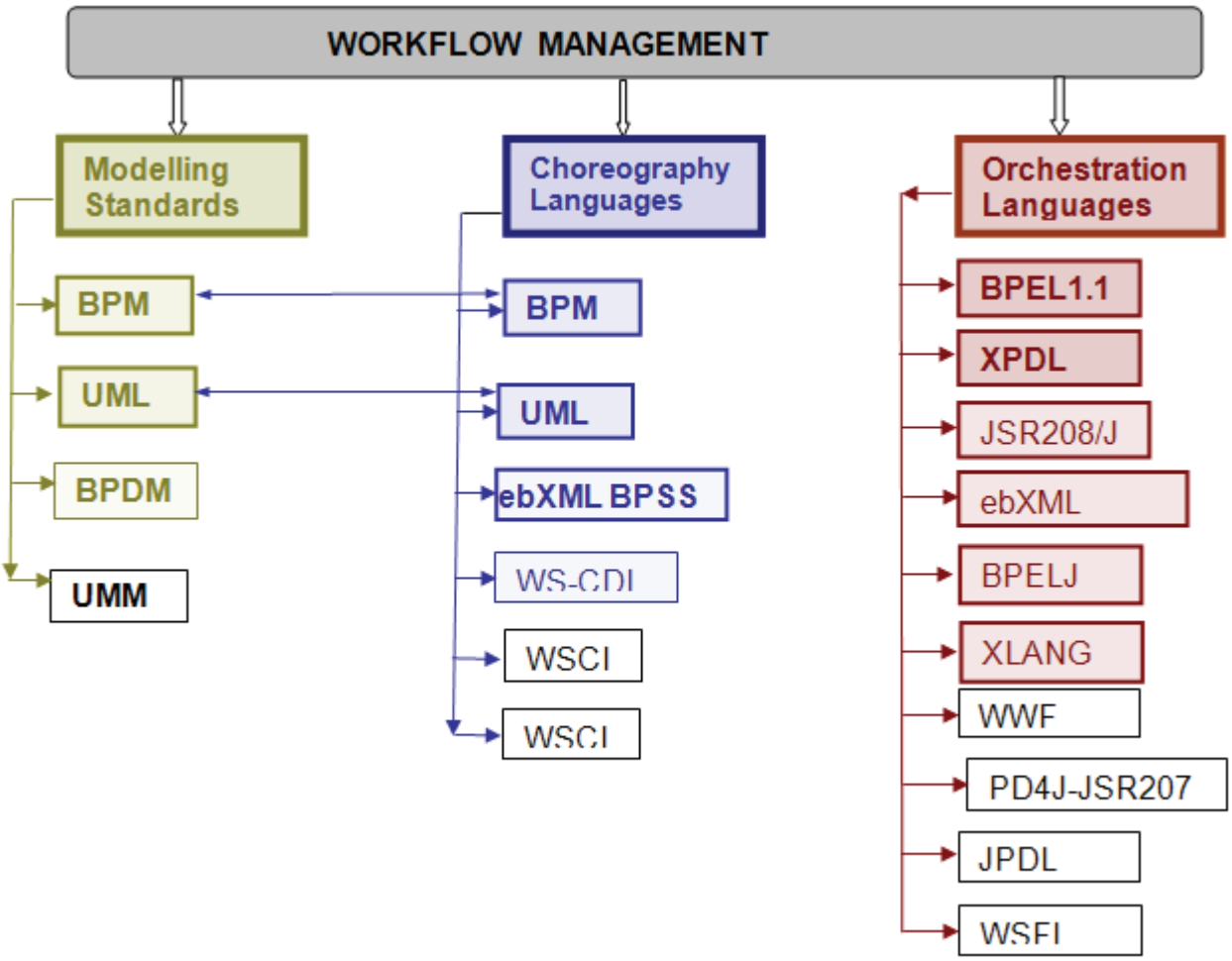

Fig.3. Hierarchy of the formal languages for workflow modelling and execution

The Workflow technology is implemented by two sequential stages: modelling of the business process and execution of the model. The modelling stage is named "choreography" of the workflow. It defines the sequence and the conditions under which the different information services exchange messages for achieving the business target. For the case of Web services, both originated by automatic programs or human machine interface each information process has to be defined in advanced before its execution. Thus, the logic of the business process is defined and structured on the stage of the business modelling. Using a functional correspondence with the software technology, on the stage of workflow modelling the "program" for the Web services is designed. However, the programming of the workflow is performed on higher logical level and it is realized as a composition of Web services, executed in a predefined sequence. On the second stage the workflow choreography is executed. And the term "orchestration" is applied for distinguishing from the stage of "choreography".

For the formalization of these stages, different languages for modelling and execution are developed. The target is both these workflow stages to be based on common standards by means to achieve technology independence for the underlying information services. Representatives of languages for workflow modelling (choreography) are: BPSS (Business Process Specification Schema); WS-CDL (Web Services Choreography Description Languages); BPML (Business Process Modeling Language). Representatives of languages for workflow execution (orchestration) are: BPEL (Business Process Execution Language); XPDL (XML Process Definition Language); BPELJ (BPEL for Java); jPDL (Java Process Definition Language).

Example of the software products, which implement the different stages of the Workflow technology, is given in Fig.4. These products have been used by the authors for the development of a platform for virtual Internet service providers [15] and they can be applied also for e-learning systems

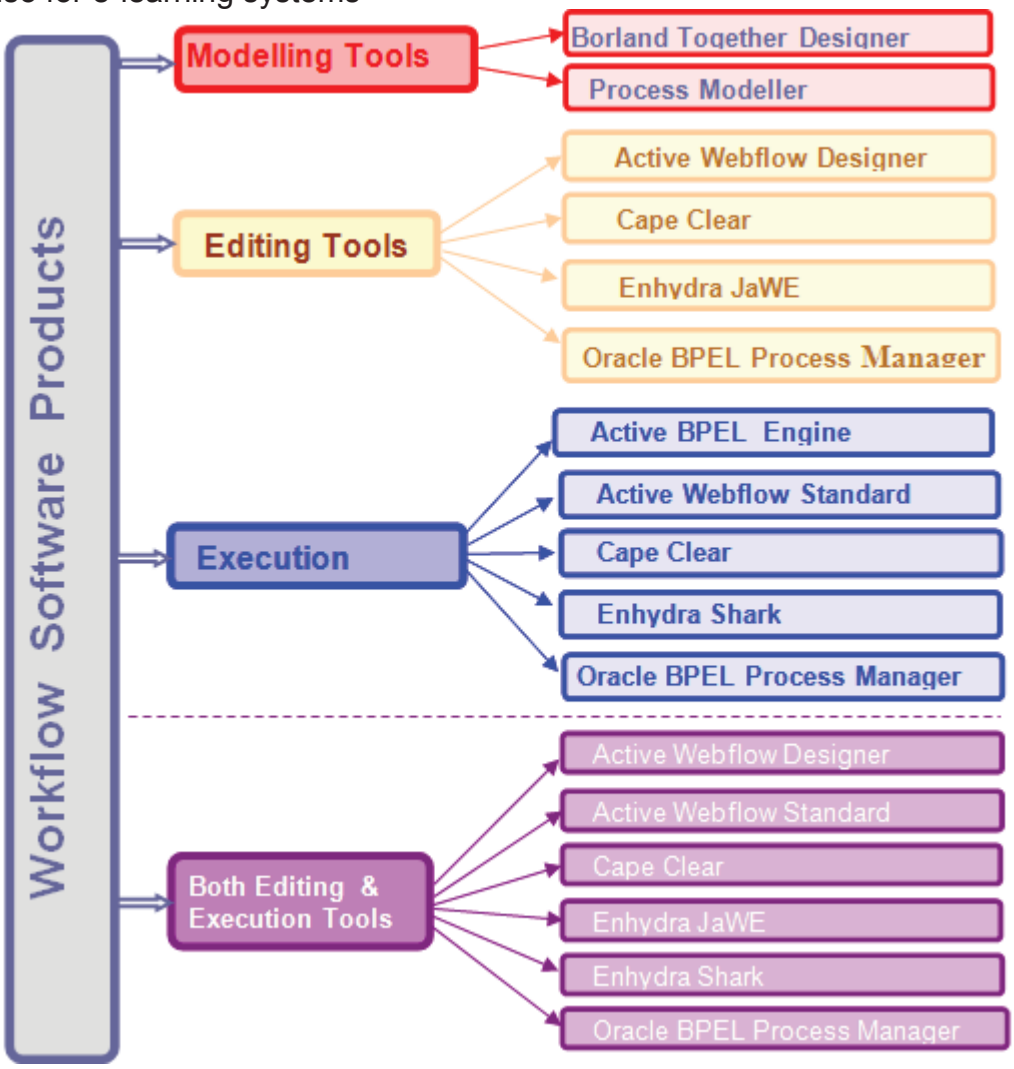

Fig.4. Software products which implement the Workflow technology

CONCLUSION

An analysis of the technology stack used for the automation of information processes is performed. The software tools which implement the different stages in the integration of e-content and e-services in a common sequence are found. Thus, automatic management of information processes is achieved, which gives potential for the development and

integration of workflow solutions. The workflow technology is regarded as a technological background for the implementation of automation in information and e-learning processes.

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