DECISION SUPPORT TECHNIQUES IN ADAPTIVE LEARNING SYSTEMS

Enn Õunapuu
Department of Informatics, Tallinn University of technology
Raja 15
Estonia 12618, Tallinn

Jelena Nuzhnaja
Department of Informatics, Tallinn University of technology*
Raja 15
Estonia 12618, Tallinn

ABSTRACT
The Internet has radically changed the way in which we learn and teach. E-learning systems are often not addressing fundamental business objectives and are not being rigorously evaluated. E-learning is being approached as a technical solution rather than a business solution. In this paper we investigate and implement a methodology for web service execution measurement from an educational organization perspective. In the nearest future a lot of web services will exist in the web and it will be common that we have to choose one or some from them. For example, in the case of tutorial systems we have to choose among various tutorial services according to the profile of the learner. In this case we need a regular component for the multi-criteria decision analysis of the learner profile. This component can be adaptive and have also some learning features.

KEYWORDS
Adaptive e-learning system, web services, software agents, decision support component, balanced scorecard.

1. INTRODUCTION

In the past, applications were built by integrating local system services such as database systems and development tools. That model was very flexible in providing access to a rich set of development resources and precise control over how the application behaved; however, although it was error prone, it was costly and time consuming. To get real results every enterprise creates its own system and component reuse is manifested, but not really used.

Today, complex distributed applications are being constructed that integrate existing applications and services from all over their networks (Aalst 2001; Afuah et.al. 2001; Allen 2001; Chappel 2001). The service itself is structured as n-tier application with such tiers as business entities, data entities, and facades (Banerjee 2001). This enables developers to focus on delivering business value.

This paper describes a solution to the web services choice from the set of the similar web services from the performance measurement perspective of educational organization.

2. DECISION SUPPORT IN ADAPTIVE LEARNING SYSTEMS

E-learning systems are often not addressing fundamental strategic objectives and are not being rigorously evaluated. E-learning system is being approached as a technical solution rather than a business solution.
In our project we handle the e-learning system as a powerful solution for achieving strategic objectives of the University and measure the impact of the system implementation on the performance of the University both in monetary and non-monetary way.

The overall aim of the University is to be the most attractive and successful educational and scientific institution. To achieve this aim the University should attain the following objectives:
- to have outstanding academic personnel;
- to perform high-level scientific research work;
- to establish efficient, innovative and appealing studying/training process;
- to have talented students and community support;
- to use University resources in most effective and efficient way.

For measuring the e-learning system’s performance and its influence on the overall performance of the organization we use Balanced Scorecard Approach (Kaplan 1996), which aligns e-learning system to organization’s strategy and its key objectives, and measures performance.

Next we shall see how BSC looks like for the initiative of the adaptive e-learning system implementation and how to measure the impact of this initiative on the University performance.

2.1 BSC for Adaptive e-learning System

According to the BSC methodology the impact of the implementing any information system (here: adaptive e-learning system) on the University performance can be measured in four different ways: (1) IT system quality improvement (i.e. ISO 9126); (2) academic and support processes’ efficiency and effectiveness improvement, (3) growth of constituents satisfaction; (4) better cost performance.

2.1.1 People and Technology Perspective

The overall objective in this perspective is to build open standards-based, language/platform independent modern IT solutions, which are easy to develop and maintain, able not only to support academic and support processes, but also drive process change, and which do not need narrowly specialized IT stuff. Here we measure broadness of functionality (incl. business process management, BPM), ease of integration, standards support, flexibility, performance of the solution. Adaptive E-learning system based on web services and software agents is characterized by ease of integration, flexibility, manageability, standards support and built-in functionality of BPM.

To implement the e-learning system academic personnel must be educated in e-learning skills. For the year 2006 we have the target of 80% of academic personnel to use e-learning system. To achieve the target user manuals must be ready and training done by the beginning of January, 2006.

2.1.2 Process Perspective

The strategic objective for us in process perspective is to maximize the efficiency, effectiveness and quality of academic and support processes in the organization. For academic processes we expect the following benefits from e-learning system implementation:
- training process effectiveness: relative to full instructor-led training adaptive e-learning saves 35-45% in training time;
- studying process quality: performance increase by 10-15%.

2.1.3 Constituents Perspective

By implementing the e-learning system we intend to improve first and foremost the access to learning, which will call forth the rise of retention rates.

The targets set for 2006 are: retention rates rise 25-60%; satisfaction with learning consistency increases by 50%. The academic achievements and quality will be measured by number of articles and citation index. Because of more effective resource distribution between training and scientific research, and better quality of studying process achieved by implementation of the e-learning system we predict some impact of the e-learning system implementation on this indicator. However, due to the long-term nature of this relationship, no targets are set for this indicator for the year 2006.
2.1.4 Resource Management Perspective

In this perspective we want to achieve the maximum efficiency of the budget resources in use. Within this perspective of BSC we calculate Total Cost of ownership (TCO) of e-learning system.

We assume, according to cause and effect relationship (Öunapuu & Nuzhnaja 2005), that there are mainly three factors that drive TCO: 1.) technology; 2.) people; 3.) processes.

In our TCO model we include the following costs: cost of knowledge (IT stuff training and consulting); cost of infrastructure; cost of the development process: design of the web service, implementation, test, deployment, network cost, as XML traffic is heavier than binary traffic; cost to make web service public; cost of maintenance, which consists of systems and personnel costs derived from Activity Based Costing (ABC) model.

In the resource management perspective we set the target of TCO reduce by 20%.

2.2 Instructional Support System Architecture

The foundations for creation of intelligent e-learning systems is developed in (Duval 2003).

The basic units of intelligent e-learning system architecture are web services. Some services are supported by service agents (Öunapuu & Nuzhnaja 2005).

Using services as described here provides you with the following benefits:

- Independent management. This means that you can move or duplicate your services with no adverse effects on the system. Duplication of services allows you to scale out.
- Technology independence between consumer and provider. Interoperability is improved, enabling diverse systems to easily communicate and share information.
- Standards based. Services are based on the use of standards-based technologies such as SOAP, HTTP, and XML (Banerjee et al. 2001). This means that you are not limited to using only one vendor’s products.

The services-based architecture provides a model for software that is designed for integration and designed for change.

Agent-based instructional support system guides the instructional process to treat each student individually. Each course includes number of tests; each test consists of groups of questions. The system provides continuous reporting of progress.

In system many services interact with each other: questionnaire service, instructional service, test analysis service, teacher service, logging service and student service. The information agent manages these interactions.

2.3 Decision Support Component

Our goal is to find the best web service among multiple offerings. Business can advertise their offerings in repository servers. Since these repositories have straight access methods (i.e. the find service and get service detail methods), intelligent mechanisms can be developed for their analysis. Decision support component represent a possible solution for the problem. In this component the multi-criteria analysis methods are
implemented. In this approach, we consider service execution statistics, service availability statistics and consumer preferences as input for the multi-criteria analysis techniques. An overview of multi-criteria analysis techniques is done in (Saaty 1994).

3. CONCLUSION

The proposed methodology provides component-based extensibility, allowing to manage educational information systems. It provides web services and agent based connections for integrating functional subsystems. The XML, WSDL and SOAP are the communication vehicles for the functional systems. The methodology is used to create the educational system for Estonian Business School and successfully explored a college year. The simplified integration promised by Web services poses some potentially drastic changes for IT departments. Not all of these changes can be so easily managed. Let us try to analyze some pros and cons of this solution.

Pro: The potential for cost savings with an out-of-box interoperable solution can be considerable. After some of the major implementation debacles of the last few years, most companies understand the value of a short implementation time.

Pro: The interoperability across platforms, applications, and programming languages is the second positive feature of the methodology.

Con: Web services require a rethinking of systems - if not a redesign. For enterprises to succeed at Web services, they need to embrace the concept of SODA (services-oriented development of applications). SODA requires developers to work with dynamic modules of services rather than static code.

ACKNOWLEDGEMENT

This research work was supported by ESF Grant 6202.

REFERENCES