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Survey on IT Industry and University Collaboration for Adaptive Course Development

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ABSTRACT

The contribution of Information Technology (IT) to the economic growth and sustainable development of a country is indicated by the quality and spread of IT industries and IT education in universities. The gap between the knowledge provided by the university and the knowledge required by the IT industry is a concern. As a solution, Adaptive Course Development (ACD) that could result from the collaboration of IT companies with the universities conducting IT courses was proposed. In our former work, a framework was proposed to develop IT aligned learning objects that are to be deployed on an e-learning platform to implement ACD. This process takes into account relevant subject areas, availability of experts, openness of IT companies, IT course curriculum, etc. The survey described in this paper reveals the potential for ACD in a transitional country. Similar situations may exist in developed countries as well.

INTRODUCTION AND BACKGROUND

Information Technology (IT) being a major contributor for the economic growth and the sustainable development of a country today, quality IT education is vital. Effects of the IT education is indirectly seen in the IT related indicators of Millennium Development Goals [1]. However, the quality of IT education is directly indicated by the quality and spread of IT industries. Therefore, cooperation of universities delivering IT education with IT industry becomes important [2].

Over the recent years, a growth in IT industries has been observed in many transitional countries. However, for its sustainability, we highlighted the need of Adaptive Course Development (ACD) that requires collaboration of IT industry and universities offering IT courses [3]. It was observed that the university – IT industry collaboration in many transitional countries does not go to the level of course development and research based collaboration using the expertise at both ends. It also has been observed that many universities in transitional countries do not have an IT-aligned learning environment, which is also essential today for competitive advantage, to facilitate such collaboration. Therefore, IT-aligned course development processes that can create innovative and adaptive learning material through such collaborations are hardly seen [3]. Creating a framework that enables both university and IT industry to utilise their expertise and research capabilities in the course development may solve the problem. Hence we started working on such an architectural framework to design and develop innovative and adaptive learning material using adaptive learning objects. We have published the initial concepts on building this framework for ACD (which we then named as Evolutionary Course Development or ECD) [4].

To support ACD we have worked on several descriptive models such as IT Aligned Learning Maturity Model (IA-LMM) that can be used to derive IT Aligned Capability Index (IACI) [5, 6], a subject description model to derive Learning Object Specificity Index (LOSI) with respect to what IT companies require from the universities [7], and a competency model to derive IT Competency Index (ICI) to estimate the expertise that could be used in the course development process [8]. We use inductive-hypothetic research strategy proposed by Sol [9] according to which we started with a problem case study and presented the empirical situations using descriptive models and now in the process of defining a prescriptive model to arrive at an implementation to provide a solution to the situation. We also borrow the ideas of case based research proposed by Yin [10] in our endeavours.

This paper describes a case study carried out in Sri Lanka among IT companies and a department of a university that conducts IT courses, to analyse the potential of implementing ACD.

Description of the Survey

The survey was conducted among twelve IT companies that were identified as potential ACD partners. They already had relationships built with the selected university. Out of the twelve companies, nine were application software developers for sectors such as banking, administration, business, infrastructure, etc., and the remaining three had their main business in other fields but with an involvement in IT.

Objective of the Survey

Main objective was to investigate the potential for ACD in a university that had links with IT companies. The following aspects were considered for this:

1. Specific areas of interest of IT companies
2. Openness of IT companies to involve in ACD
3. Capacity of IT companies to assign experts for ACD
4. How well the existing IT courses of the selected university relate to the production and development processes of IT companies, and what changes and improvements do the IT companies expect the university to introduce
5. How ACD could be used for the dynamic improvement of IT courses

Survey Methodology

The survey was carried out during a first semester (end of September 2004 to January 2005) of the selected university. Instead of having interviews and questionnaires, the survey was conducted by getting the companies to participate in offering a course in the third year (level-3) of a four-year undergraduate course. The reason to use this course was its flexible nature that allows the active participation of companies. Fifty-six students registered for the course, and each student was expected to work with one IT company. Main actors were the mentors

from the IT industry and the academic staff who conducted the selected course. Companies were expected to propose a requirement for an industrial software project and to assign one or more mentors to provide guidance and expertise in relation to necessary training on software tools, use of specific algorithms, programming techniques, developing conceptual designs, etc. They were also expected to carry out periodic reviews. The task of the academic staff was to maintain the academic quality, guide the students through software engineering principles, improve the project scope if necessary and evaluate the progress.

Administration and coordination of the course, report submission, provision of guidelines and necessary material were done through e-learning. However, it also involved physical interactions between the students, mentors from IT companies and the academic staff for planning, demonstrations and assessments.

Response of the Companies

Out of the twelve companies, two companies responded positively than expected. One of them who were a software developer for corporate sector applications in USA and Europe initially agreed to provide four mentors to impart technical know-how. Many training sessions were arranged, and when the course was on its way, more supervisors and technical assistants were assigned to mentor the students. Plans were also set out to work with them on a long-term ACD project using learning objects in future.

The other company, whose main business is to develop educational software and e-learning content for foreign markets, agreed for collaborative research in learning object development and to sponsor a team of students to do a project on the same, in addition to the involvement in this course.

Six more companies, making it a total of eight, cooperated in conducting this course successfully. They provided requirements for software projects, initial guidance, one or more mentors and monitored the progress in their capacity until the end of the semester. Management of these six companies did not voluntarily give any commitment to involve in ACD on a continual basis. However, it is anticipated that there will be a positive response if invited.

Two other companies were interested but due to many reasons they could not involve at the start of the semester. It was a requirement from the university that if a company involves with this particular subject it had to be from the beginning to the end of the semester. However, one of them has been sponsoring scholarships and equipment for computer laboratories in the recent years. Later the management of this company had several discussions with the university and expressed their willingness to involve in ACD in the area of Software Quality Assurance.

Only two companies did not give a positive response.

Academic Participation through Projects

The aim was to motivate the companies to offer something that will benefit them in turn. Instead of requesting them to provide content for an inflexible course, they were asked to propose software projects that require academic knowledge. Expertise and knowledge acquired by IT companies were to be imparted to the undergraduates through these projects. Some companies offered more projects where they had more mentors, enrolling a higher number of students. The following are few projects offered and mentored by them.

- Web based auction site
- Dynamic content manager
- Mail filtering and notification system
- Leave tracking system
- Time tracking system
- Online library system
- Voice XML interpreter
- Web Applications and Services Platform (WASP) server plug-in for Java Integrated Development Environment
- Open Travel Architecture (OTA) compliant web service for insurance booking
- Open source implementation of web services eventing for Apache Axis
- Network traffic analyser with MIB browser

Table 1. *Academic subjects of interest by the selected sample of 8 companies*

Academic subject area of interest	No. of companies interested
Software engineering principles	8
Programming for web based applications	6
Database designing and management	3
Multi-tier architecture	3
Web services concepts and development	2
Servlets	1
Network communications programming	1
Prototyping	1
Component based development	1
IT services for telecommunications	1
Application development for network administration	1
Software Quality Assurance	1

Students had to learn or work on requirement gathering, problem analysis, preparation of requirement specification, software engineering principles, prototyping, programming language skills (Java, C++, C#, Perl, PHP, etc.), multi-tier architectures, database designing and management, servlets, use-case modelling, object-oriented designing, server-side scripting, testing principles (unit, component and integration testing), session management principles, server-side validation, parsing principles, thread handling, etc. They also had to read and understand technical documents, standards and specifications, and carry out the implementation on appropriate development platforms.

Based on the feedback of the companies, their demand for related academic subjects is summarised in Table 1.

ANALYSIS OF THE SURVEY

The following is an analysis based on the results of the survey. We try to find the reasons for the response of IT companies, what we can expect from them for ACD in future, their subject preferences, current IT university education, and how it could be improved to contribute more for the sustainability of IT industry.

Response of IT industries

Our observation is that the majority of IT companies that require university graduates are software developers in many transitional countries, except for few that have expertise in advanced digital technologies. This may be due to the availability of expertise, and lower capital requirement, training costs and labour charges. Considering Sri Lanka as a case, we have carried out the survey to find out what type of IT industries would open the door for ACD, different technologies and techniques they use, and other interests of those companies. Majority of the IT companies that we selected for our sample were software developers. In fact, there are many small and medium-scale IT companies that were not considered.

In the sample of twelve companies, two companies responded at a level beyond what was expected, six adhered to what was expected, two showed the interest though did not involve, and only two gave no response. This shows the interest and the requirement that many IT companies have to engage in university course development. One reason for not responding was that it was not very clear to them what was expected to do in this course. Involvement in ACD is influenced by external factors such as the openness and understanding of both parties to each other, and the long-term mutual benefit that each party will get [3].

Subject Preferences

Although most of the selected IT companies were software developers, their target customer bases do not overlap very much. It is not quite accurate to say that this sample gives a snap-shot of IT industry in Sri Lanka, because the basis for our selection was the relationships that the selected university already had with the respective companies, which we thought as important for the success of ACD.

Analysis shows that all companies are interested in software engineering principles. The reason can be, not a market trend, but the necessity of software engineering principles for any software project, and hence it becomes a common subject of interest. Therefore, it is preferred to have a wider involvement of IT companies in the ACD process for this subject. However, copyright, ownership, neutrality and confidentiality issues become complicated.

Second most preferred subject is programming for web-based applications, which has become popular due to the widespread of Internet in the business community and the possibility of cross platform deployment. The discussions revealed that the research input of academics is required in the areas such as efficiency, security and reliability of web-based software.

Database designing, management and multi-tier architecture related theories, concepts and programming techniques are at the third level of preference. The demand is from the companies who develop applications for corporate environments. It has a moderate specificity [7] where some company specific inputs are required in specialised areas. Therefore, this type of courses should consist of common modules and company specific modules separately.

Due to the new trend of web services based development, two companies are interested in this area. Currently many aspects of web services are at research stage, with respect to their security, efficiency, robustness, etc. Few companies specialise in web services based development and they carry out many research activities that can be enhanced through ACD.

Rest of the subject areas of interest are servlets, network communications programming, prototyping, component-based development, IT services for telecommunications, application development for network administration, and software quality assurance. Some of these are highly company specific while some are not, but do not show a higher demand in the selected sample of companies.

IT Education in Universities

It is observed that curricula of several academic institutes who conduct IT courses in Sri Lanka mainly focus on software designing and development, with an emphasis on web based applications. However, many graduates are recruited as programmers, and the IT companies need to provide extensive training to make them suitable for advanced projects. This shows that though the course designers tend to think that the current courses meet the demand because they cover software development including web based applications, the content delivered to the undergraduates do not properly match the real need of the IT industry. Only a handful of undergraduates become competent in software designing, architecting and engineering. Knowledge on efficiency, robustness, reliability and quality required for mission critical applications seem to be not up to the standard. Therefore only a few IT companies who have such expertise are able to deliver products for large commercial organizations such as banks, stock exchanges, infrastructure providers (such as telecom companies), etc. It is observed that many tenders are awarded to foreign IT products by large commercial organizations due to the inability of the local companies to meet the requirements. This raises the question of sustainability of the growth of IT industry.

Few universities in Sri Lanka, including the university selected for this survey, maintain links with the IT industry. However, from the results of the survey as given in Table 2, we can observe that dynamic improvement of the courses is required even in such a university. "Comments" column of Table 2 indicates the areas that needs improvement according to IT company expectations. It is also an indication of what they can provide through ACD. To preserve confidentiality, actual companies are replaced with company types based on their target market and named as Type-1, Type-2, etc.

Table 2. *Areas where the university concerned need to improve according to IT company expectations*

Company type	Knowledge provided by the company	Comments
Type-1	• Deployment of servlets • Deployment through CORBA • Use of tomcat server, JDBC, MSDN libraries • Working with SQL server • Use case modelling • Testing: Unit, component, integration • SMS messaging • Writing COM objects • Concept of "event sinks"	• University requires further improve the contents on servlets, use case modelling and testing principles. These are covered in the curriculum, but the company needs it at a deeper level. * • Company expects the students to have an in-depth exposure to JDBC/ODBC/SQL at level-3. Currently they get it only at level-4. *
Type -2	• Integration testing • Leave management • Application level trace logging • Dynamic database management	• Leave management is project specific and hence it does not need to be in the curriculum. * • University needs to improve on testing principles. • Dynamic database management is covered at level-4, but the company requires it at level-3. *
Type -3	• .NET • UML • Business logic testing • Integration testing • Session management	• University needs to improve on testing principles, UML and session management principles. • Students are expected to acquire .NET knowledge by themselves.
Type -4	• VXML • Parsing • Component based implementation	• Company expects knowledge in parsing and component-based implementation principles. These are usually covered at level-4. * • Use of VXML is specific to this company.
Type -5	• Knowledge on WASP server • Web services principles and WSDL • Knowledge on OTA • Java thread handling • Travel industry based software	• University needs to improve on Java thread handling. • The rest are company specific. *
Type -6	• Web services principles • SOAP, XML and XML parsing • Event based parsing • WSDL • Evolutionary prototyping • Familiarity with MIME standard	• University needs to improve on principles of web services, SOAP, XML, WSDL, parsing principles, prototyping and MIME. • The rest are company specific. *
Type -7	• Knowledge on SNMP and MIB	• Knowledge on SNMP and MIB is covered in the curriculum at level-4. *

CONCLUSIVE REMARKS

This type of surveys motivates universities to migrate from a traditional academic setting to a dynamic, learning object based, ACD environment. The results are helpful to convince the administration about the advantages of such a move, that requires much thought and proper planning to avoid many issues described by Bates, Collis and Moonen [11, 12]. Nature of learning objects makes the task easier through just-in-time knowledge, as well as continuous dynamic course development expected through ACD [13].

The analysis eliminates the fear of lack of support from the IT industry and makes it possible to venture into the actual development of adaptive courses. This development will attract more IT industries as it could be seen by the comments given in Table 2.

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