



This paper appears in the book, *Emerging Trends and Challenges in Information Technology Management, Volume 1 and Volume 2*  
edited by Mehdi Khosrow-Pour © 2006, Idea Group Inc.

# Adaptive IT Education through IT Industry Participation

MSD Fernando, Dept of Computer Science & Engineering, Faculty of Engineering, University of Moratuwa, Sri Lanka,  
T: +94-11-2640383, F: +94-11-2650912, shantha@cse.mrt.ac.lk

ANW Dahanayake, Systems Engineering Section, Faculty of Technology, Policy & Management, Delft University of Technology,  
The Netherlands, T: +31-15-2784412, F: +31-15-2784811, a.n.w.dahanayake@tbm.tudelft.nl

HG Sol, Faculty of Management & Organization, University of Groningen, The Netherlands, T: +31-50-3633825, F: +31-50-3637738,  
h.g.sol@rug.n

## ABSTRACT

Information Technology (IT) education, when adaptive to the market demand, can contribute towards the development of IT in a country. The contribution of IT education to the economic growth and sustainable development of a country is seen in the quality and spread of IT industries. It has been observed that there is a gap between the IT knowledge provided by universities and the knowledge required by IT industries to improve the level of IT in many countries. Adaptive Course Development (ACD) using IT-aligned learning objects was proposed as a solution to this. A framework is required to help such a process. Proposed framework for ACD takes into account the IT capabilities of a university in IT education, the specific attributes of academic subjects demanded by the IT industries and the availability of experts in IT industry and the universities.

## INTRODUCTION

IT education soon becomes outdated if not updated. The contribution of IT education to the economic growth and sustainable development of a country comes through the quality and spread of IT industries. IT related indicators of Millennium Development Goals [1] also could be used to determine the popularity of IT within a country. With IT being a major role player in economic growth today, sustainability of IT industries is vital for sustainable development. Specifically in a transitional country, sustainability of the IT industry depends on the cooperation of universities conducting IT courses and IT industry [2]. Identifying the strengths of both parties helps bringing them together to produce adaptive IT courses through an adaptive course development (ACD) process [3]. One way to create an ACD environment is to develop a framework that facilitates the development of IT aligned learning objects that forms adaptive courses deployed through an e-learning system.

To facilitate such a framework we have produced descriptive models such as the IT Aligned Learning Maturity Model (IA-LMM) to derive the IT Aligned Capability Index (IACI) [4, 5, 6], a subject description model to derive the Learning Object Specificity Index (LOSI) with respect to what IT companies require from the universities [4, 7], and a competency model to derive the IT Competency Index (ICI) to estimate the expertise that could be used in the course development process [4, 8]. To reflect the outcome of such descriptive models in learning object attributes, a prescriptive model based learning object design and development framework is being developed.

## POTENTIAL FOR IT INDUSTRY PARTICIPATION

A survey was carried out to analyse the potential for implementing such a concept in Sri Lanka and the results were very positive [9]. Results of the survey showed that it is possible for an IT university to migrate from

a traditional academic setting to a dynamic, learning object based, ACD environment, and that IT industries will collaborate with universities in such a move [9]. The results of the survey are helpful to convince the university administration about the advantages of such a move, one which requires much thought and proper planning to avoid many issues that may arise during an organizational transformation such as that described by Bates, Collis and Moonen [10, 11]. The nature of learning objects [12] makes the task easier for IT companies to engage in the education process through continuous dynamic course development. It is also expected that learning objects can be used to provide just-in-time knowledge.

## DESIGNING AND DEVELOPING LEARNING OBJECTS

The ACD framework that involves the development of adaptive learning objects operates in several domains such as the environment analysis domain, the conceptualization and design domain, the preliminary design evaluation domain, the prescriptive design domain, the development and testing domain, and the deployment domain, as illustrated in Figure-1.

### Environment Analysis Domain

This is the start-up phase during which IT industries are selected and the subjects for ACD are decided based on the demand. Surveys such as that described in section 2 and the evaluation of indices such as IACI, LOSI and ICI are done in this phase. The results of such evaluations are then fed into the framework so that the learning object development will be suitable and usable within the surveyed environment.

### IACI Evaluation

When evaluating IACI, we considered two aspects, viz., IT infrastructure aspects and e-learning aspects based on our research findings [6]. These two aspects are evaluated using "level descriptors" to decide the level of a university with respect to IA-LMM [6]. Since we wanted to make the framework a general model, we also considered many aspects that are not directly related to IT industry participation in course development.

IT infrastructure aspects are evaluated with respect to seven "level descriptors" to evaluate the level of a university according to the IA-LMM as follows (details and reasons are omitted to make the paper short) [6].

1. Internal network infrastructure
2. External network infrastructure
3. Application services infrastructure
4. Support services
5. Accessibility facilities

6. Policy implementation
7. Infrastructure administration

E-learning aspects are also evaluated with respect to seven “level descriptors” to evaluate the level of a university according to IA-LMM as follows (details and reasons are omitted to make the paper short) [6].

1. Learner administration
2. Learning environment
3. Content development
4. Coordination and facilitation
5. Collaboration environment
6. Quality control
7. Organizational recognition

**LOSI Evaluation**

LOSI is dependent on the nature of the subject on demand and the IT companies selected to participate in the course development. Four main aspects of LOSI are listed below (details and reasons are omitted to make the paper short) [7].

1. Academic level of the subject area
2. Level of reusability observed
3. Field specificity
4. IT industry specificity

Other attributes that are considered under LOSI are interactivity type, interactivity level, learning resource types and context.

**ICI Evaluation**

ICI is dependent on the IT staff in the university and the IT companies selected. ICI is used to select competent experts needed to design and develop learning objects. The competencies are related to roles such as graphical designer, technical implementer, content provider, technical validator, educational validator, script writer, instructional designer,

subject matter expert, etc [16]. Such required competencies can be given as attributes of learning objects according to SCORM specifications [16].

**Conceptualization and Design Domain**

Preliminary design or conceptualization follows after the environment analysis domain. We follow the Content Aggregation Model proposed by SCORM [16] to conceptualize learning objects for the selected subjects as per the demand from the IT industry. This model represents a learning taxonomy neutral means that can be used by designers and implementers of instruction to aggregate learning objects to deliver a course. A collection of such learning objects forms modules, and modules form the units of a course.

Conceptualization involves content packaging, assigning metadata related to IACI, LOSI and ICI, and deciding on the sequencing and navigation schemes for learning objects of the academic subject under consideration. For example, if we take an academic subject demanded by IT industries such as Software Engineering Principles, we can outline the course structure as units and modules in this preliminary design domain. Then the type of assets to be used can be decided by appointed staff and IT industry experts for each module using an on-line framework. Then the assets have to be embedded in learning objects in a sequence agreed by the collaborating experts from the IT industries and university.

**Preliminary Design Evaluation Domain**

Once the conceptual design is in place, a better picture of the forms of media and assets used to build the learning objects will be visible. It is now important to finalize the design by re-visiting the indices derived to ensure that the final outcome will be useful and usable within our context. Hence we raise the following questions:

1. Can these learning objects be developed within the limits indicated by IACI?
2. Do these learning objects adhere to LOSI requirements?
3. Can the ICI requirements, with respect to expertise, be met to implement the designed learning objects practically?

If the answer is “no” to any of these questions, a re-conceptualization and a design step is required.

**Prescriptive Design Domain**

After the final design, learning objects have to be developed according to the IEEE LTSC standard [13] and SCORM [16] specifications. The values required for metadata are decided based on rules derived according to the output of the environment analysis domain and the conceptualization domain.

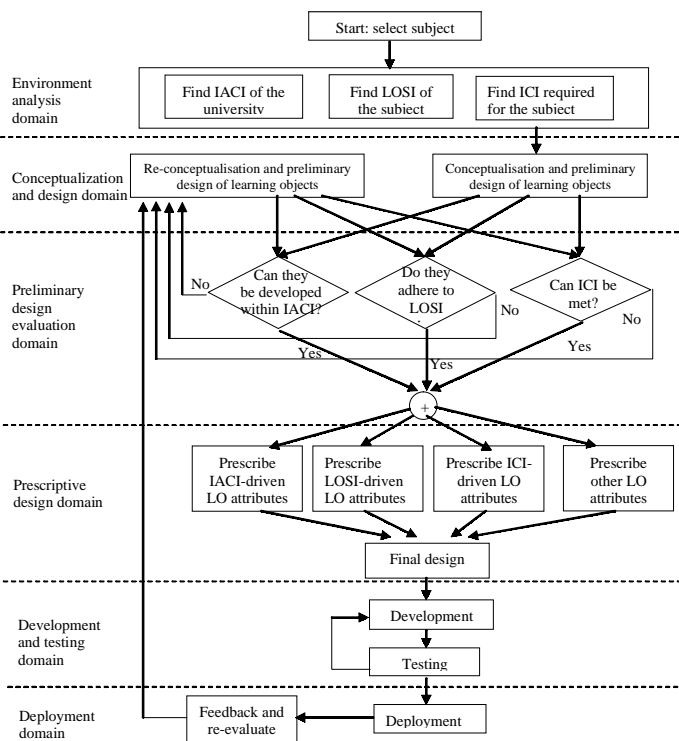
In the prescriptive design domain the framework helps us to manipulate the Learning Object Metadata (LOM) Information Model that is represented in nine metadata categories, viz., general, life cycle, meta-metadata, technical, educational, rights, relation, annotation and classification [13, 16]. These are the parent elements that behave as containers for several other child elements. Child elements will have values for the attributes that are manipulated based on the output of the phases we described before. The final design and development phases of learning objects must be supported by learning object standards [13], instructional design principles [14, 15], content development and management principles [16], etc.

**Development and Testing Domain**

Once the prescriptive design is in place it is just a matter of developing or retrieving the content assets and placing them in the right containers within learning objects. Individual asset development will be a collective task of the selected identified experts based on the requirements indicated by ICI. Actual learning content is produced during this phase.

Once the learning objects are developed they will have to be tested for proper sequencing and navigation, completeness of delivery of learning

Figure 1. Phases of ACD



experience, and other aspects such as preservation of rights, authentication requirements, delivery scope, etc., especially due to the involvement of the IT industries.

### Deployment Domain

The developed learning objects will be made available, in this phase, for the targeted learners using a learning management system (LMS). However, in our approach there is no final development since they are updated based on learner feedback and the involvement of the IT companies who will evaluate the content periodically to see whether it matches the most up-to-date developments in the IT, and then, if necessary suggest the improvements. For this iterative process to happen a feedback mechanism is required once the learning objects are deployed. This makes the cycle iterative, thus creating adaptive courses.

## CONCLUSIONS AND REMARKS

### Implications

Sustainability of IT industries is vital if the IT industry is to contribute considerably to the economic development of a country. This is possible only if the universities, who provide the intellectual resources, equip their learners with up-to-date IT knowledge. When the graduates of universities are directly employable, there is the added advantage of lower training costs for IT industries.

From the graduates' point of view, they will be competitive in the job market.

ACD also allows universities to compete in a global market. Since the academic staff will be actively involved with IT industries, a high calibre staff team will be built and their knowledge will remain up-to-date.

### Tools and the Framework

The approach requires a system that can facilitate the manipulation of metadata according to a given set of rules. These rules will be formed based on the outputs of IACI, LOSI and ICI to get the necessary attributes. It would be ideal if these rules could be automatically generated, however since we want to use existing tools for the prototype, manual template generation is used for the time being.

Multiple authors are assigned to the same subject since our idea is to get input from numerous experts in IT industries. The subject coordinator will handle the expected differences in opinion. When a particular IT industry requires a specific content, which others may not require, such learning objects will be offered as optional material.

Confidentiality and copyright issues have to be dealt carefully since competitors may be involved in the development of the same courses.

### Global Applicability

We carried out our research in a transitional country. However, this approach can be applied in any country where an IT industry – university gap exists

## REFERENCES

- [1] UN-Report (2003), "Indicators for Monitoring the Millennium Development Goals", Department of Social Affairs - Statistics Division, UNDP, New York, USA.
- [2] De Rebello, D. (2003), "What is the role for Higher Education Institutions in the UN Decade of Education for Sustainable Development?", Theme IV, International Conference on Education for a Sustainable Future, Charles University, Karolinum, Prague, Czech Republic, September 2003.
- [3] Fernando, M.S.D. (2004), "Developing IT Aligned Learning Objects for University – IT Industry Collaboration in Transitional Countries", PhD research proposal, Delft University of Technology, The Netherlands.
- [4] Fernando, M.S.D. & Dahanayake, A.N.W., (2004), "Building a Framework for Evolutionary Course Development in Transitional Countries: An IT Aligned Learning Objects based Approach", ICCE2004 - International Conference on Computers in Education 2004, Elspeth McKay, ed., Melbourne, Australia.
- [5] Fernando, M.S.D. (2004), "Measuring the Level of IT Alignment of Universities in Transitional Countries: The Concept and Theory of IT Alignment Capability Index (IACI)", internal report, Delft University of Technology, The Netherlands.
- [6] Fernando, M.S.D., Dahanayake, A.N.W., Sol, H. G., (2005), "A Holistic Maturity Model for IT Aligned University Education: IA-LMM", ICET2005 – The IASTED International Conference on Education and Technology, Calgary, Canada.
- [7] Fernando, M.S.D. (2004), "Measuring the Popular IT subject Areas in Transitional Countries: The Concept and Theory of Learning Object Specificity Index (LOSI)", internal report, Delft University of Technology, The Netherlands.
- [8] Fernando, M.S.D. (2004), "Measuring the Competency of IT Experts in Transitional Countries: The Concept and Theory of IT Competency Index (ICI)", internal report, Delft University of Technology, The Netherlands.
- [9] Fernando, M.S.D., Dahanayake, A.N.W., Sol, H. G., (2005), "Survey on IT Industry and University Collaboration for Adaptive Course Development", internal report, Delft University of Technology, The Netherlands (submitted to 2006 IRMA International Conference).
- [10] Bates, A. W. (2000), "Managing Technological Change: Strategies for College and University Leaders", Jossey-Bass Publishers, San Francisco.
- [11] Collis, B. & Moonen, J. (2001), "Flexible Learning in a Digital World: Experiences and Expectations", Kogan Page, UK.
- [12] Wisconsin (2002), "Learning Objects: What?", Center for International Education, University of Wisconsin, web reference: "[http://www.uwm.edu/Dept/CIE/AOP/LO\\_what.html](http://www.uwm.edu/Dept/CIE/AOP/LO_what.html)", accessed 24 March 2004.
- [13] LTSC (2002). "Learning Object Metadata." Learning Object Metadata Working Group, Learning Technology Standards Committee (LTSC), IEEE.
- [14] Gibbons, A. S., Nelson Jon and R. Robert (2000). "The nature and origin of instructional objects", The Instructional Use of Learning Objects. Ed. D. A. Willey, web reference, <http://www.reusability.org/read/chapters/gibbons.doc>, accessed on 24 March 2004.
- [15] Willey, D. A. (2000). "Connecting learning objects to instructional design theory: A definition, a metaphor, and a taxonomy", The Instructional Use of Learning Objects. Ed. D. A. Willey, web reference, <http://reusability.org/read/chapters/wiley.doc>, accessed 24 March 2004.
- [16] Thropp, S. E., Ed. (2004). SCORM Content Aggregation Model. Advanced Distributed Learning. Alexandria, ADL Co-Laboratory.

0 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

[www.igi-global.com/proceeding-paper/adaptive-education-through-industry-participation/32911](http://www.igi-global.com/proceeding-paper/adaptive-education-through-industry-participation/32911)

## Related Content

---

### Design of Library Archives Information Management Systems Based on Artificial Intelligence and Multimedia Technology

Ying Li (2023). *International Journal of Information Technologies and Systems Approach* (pp. 1-17).

[www.irma-international.org/article/design-of-library-archives-information-management-systems-based-on-artificial-intelligence-and-multimedia-technology/320234](http://www.irma-international.org/article/design-of-library-archives-information-management-systems-based-on-artificial-intelligence-and-multimedia-technology/320234)

### On the Transition of Service Systems from the Good-Dominant Logic to Service-Dominant Logic: A System Dynamics Perspective

Carlos Legna Vernaand Miroljub Kljaji (2014). *International Journal of Information Technologies and Systems Approach* (pp. 1-19).

[www.irma-international.org/article/on-the-transition-of-service-systems-from-the-good-dominant-logic-to-service-dominant-logic/117865](http://www.irma-international.org/article/on-the-transition-of-service-systems-from-the-good-dominant-logic-to-service-dominant-logic/117865)

### Moving Object Detection and Tracking Based on the Contour Extraction and Centroid Representation

Naveenkumar M, Sriharsha K. V.and Vadivel A (2018). *Encyclopedia of Information Science and Technology, Fourth Edition* (pp. 212-219).

[www.irma-international.org/chapter/moving-object-detection-and-tracking-based-on-the-contour-extraction-and-centroid-representation/183735](http://www.irma-international.org/chapter/moving-object-detection-and-tracking-based-on-the-contour-extraction-and-centroid-representation/183735)

### Geographic Information System (GIS) Modeling Analysis and the Effects of Spatial Distribution and Environmental Factors on Breast Cancer Incidence

Akram Gasmelseedand Ali H. Alharbi (2018). *Encyclopedia of Information Science and Technology, Fourth Edition* (pp. 3448-3459).

[www.irma-international.org/chapter/geographic-information-system-gis-modeling-analysis-and-the-effects-of-spatial-distribution-and-environmental-factors-on-breast-cancer-incidence/184056](http://www.irma-international.org/chapter/geographic-information-system-gis-modeling-analysis-and-the-effects-of-spatial-distribution-and-environmental-factors-on-breast-cancer-incidence/184056)

### Making Sense of IS Project Stories

Darren Dalcher (2018). *Encyclopedia of Information Science and Technology, Fourth Edition* (pp. 5660-5668).

[www.irma-international.org/chapter/making-sense-of-is-project-stories/184266](http://www.irma-international.org/chapter/making-sense-of-is-project-stories/184266)