Agile Content Development

Seree Chinodom
Department of Computer Science, Faculty of Science,
Burapha University, Chonburi, Thailand
Email: seree@buu.ac.th

Sirirat Mutchimadilok
Learning Technology Laboratory
Faculty of Informatics, Sripatum University
Bangkok, Thailand
Email: sirirat.mu@spu.ac.th

Abstract

In the expanding e-business market of selling SCORM-based content on-line, the cost of producing e-Learning content must be further optimized. The traditional Analysis Design Develop Implement Evaluation (ADDIE) model is shown in this paper to be inadequate compared to the new Agile Content Development (ACD) based on effort equations formulated for each model and industry statistical content development based on ADDIE and ACD.

Key words: e-Learning development methodology, SCORM content, ADDIE, agile content development.

1. Introduction

The advent of e-Learning and the development of Sharable Content Object Reference Model (SCORM) [1] for standardization of content and LMS enables the possibility of selling SCORM-packaged content on web. The e-Learning package development in conformance with the SCORM standard is more secure and run in a web-based application environment. Unlike the CAI package that runs on PC which is prone to copy illegally, the e-Learning package running at run time is harder to copy hence making the commercialization of content possible. Now it is a matter of how to produce the content with the lowest cost and highest learning value. In this paper, we will show that The ACD is much better than the traditional ADDIE model.

In producing the e-Learning content, the first step is to take the content in textual form and perform the segmentation of textual content into small chunk called frames. The segmentation process so far is a manual process. Kwaying [2] proposed an algorithm to automatically perform the segmentation of textual input into each frames based on the structural information of the text file. This automatic content segmentation algorithm would have positive ramification for the content industry. Other researches include the use of UML to model some aspects of e-Learning [3]. Van Rosmalen Authoring a full life cycle model in standard–based, adaptive e-Learning. Educational Technology & Society [4] proposed a model for creating self-adaptable content based on predefined measurement of successes. Marshalls and Michell, G. [5] attempted to apply CMM model to e-Learning development. However, it is just an initial exploration, no solid elaboration is provided. Barugue, L.B. and Melo, R.N. [6], modified the ADDIE to include the learning theory resulting in a new methodology called ISDMELO [7]. The Agile development concept from software was applied by Chun, A.H.W [8] and proposed the Agile Teaching and Learning Methodology (ATLM), which emphasize the speed of delivery both for teaching and learning

In this paper, the Agile methodology from software development area is used as the basis for defining the ACD. It will show that the ACD is a better model for e-Learning lesson development than the traditional ADDIE model in terms of man-month usage.

The ADDIE model consists of five steps as follows

- Analysis : finding the scope, requirements of the content and user analysis.

elements of a frame including the voice lecture script.

- Implement: install the content on the LMS (Learning Management System)
- Evaluation : find out if the content has any deficiency in terms of learning and technical deficiencies.

The ADDIE model requires that all the content (paper or digital) for creating the e-Learning lesson, which must be gathered completely in hands to produce the story board. After the story is approved then the content production can begin. This includes the production of all the multimedia elements, interactive elements and voice lecture. The application of ADDIE would result in many rework of the prototype frames due to many factors such as incomplete lesson gathering, incomplete story board, misinterpretation of concept animation, etc The rework might occurs in many rounds resulting in increase in effort (man-month). This event is similar to the software development based on the Water Fall Model. Consequently, for software development, many methodologies are proposed such as the Iterative and Incremental Development, rapid prototyping, spiral model, the XP model which is the precursor to the Agile model and other notable model such as Feature Driven Development and Adaptive Software Development.

2. Agile Content Development

The heart of the e-Learning development using the agile technique is to use simple rules conformed with the project's nature and employs simple rules for team to communicate and collaborate The concept is derived from Cockburn [9] on the issue of Agile software Development.

The ACD team consists of

- Content Developer
- Customer
- Quality Assurance Officer
- Project Monitor
- Programmer

Roles of Team Members

Content Developer

Content Developer will work with the content owner, first, to segment the content into frames and then design the presentation based on Instructional Design principles and define the requirement specification for producing the multimedia elements.

Customer

Normally, the customer of the content development team is the professors. In ACD, the professors must have sufficient time to work with the content developers to define, develop, test the e-Learning frames.

Quality Assurance Officer

This person is responsible for checking the textual correctness, runtime interaction, run time reports, color, and position of frame elements, copy right information, usability, and the report produced by the system.

Project Monitor

This person will be responsible for all the deliverables, scheduling, performing complexity information gathering such as the number of multimedia elements, the number of engaging frames, the number of frames, etc.

Programmer

The programmer is needed for producing content packaging based on the SCORM modification of the manifest file, the development of Action Script and Java Script for simulation frames.

The ACD Methodology

There are 6 phases in ACD showed in figure 1as follows.

1. Content Discovery phase

The ACD team will work with the customer to obtain all contents, and then perform content segmentation.

2. Requirement Specification phase

Here, the developers will work with the customer on various aspects of creating the lessons based on sound instructional design practices, and also provide the screen look and feels, the navigation styles, the production design styles, esthetics as baseline design for discussion.

3. Iteration content development phase

The iterative component of ADC is based on dual developer principle similar to the dual programming concept. Here one of the developers will concentrate on designing the content frames while the other developer will develop the multimedia elements for use in the frames. Each iteration will involve a fixed number of frames. At the end of the iteration, the frames will be reviewed and corrected. Then the final frames will be integrated into existing accepted frames.

4. Review of the e-Learning Frames phase

The frames that have been completed so far (including the current iteration) will be jointly reviewed by the customer, if any unsatisfactory comment occurs, those frames will be corrected immediately and the corresponding functional specification will be updated. This review process will be carried out for customer.

5. Construct the SCORM Packaging phase

For this step, the approved content will be packaged with metadata based on the SCORM standard. The packaged content is now ready to run on any SCORM compliance LMS.

6. Production phase

This step is to produce the final commercial packaging with user manual and installation guide.

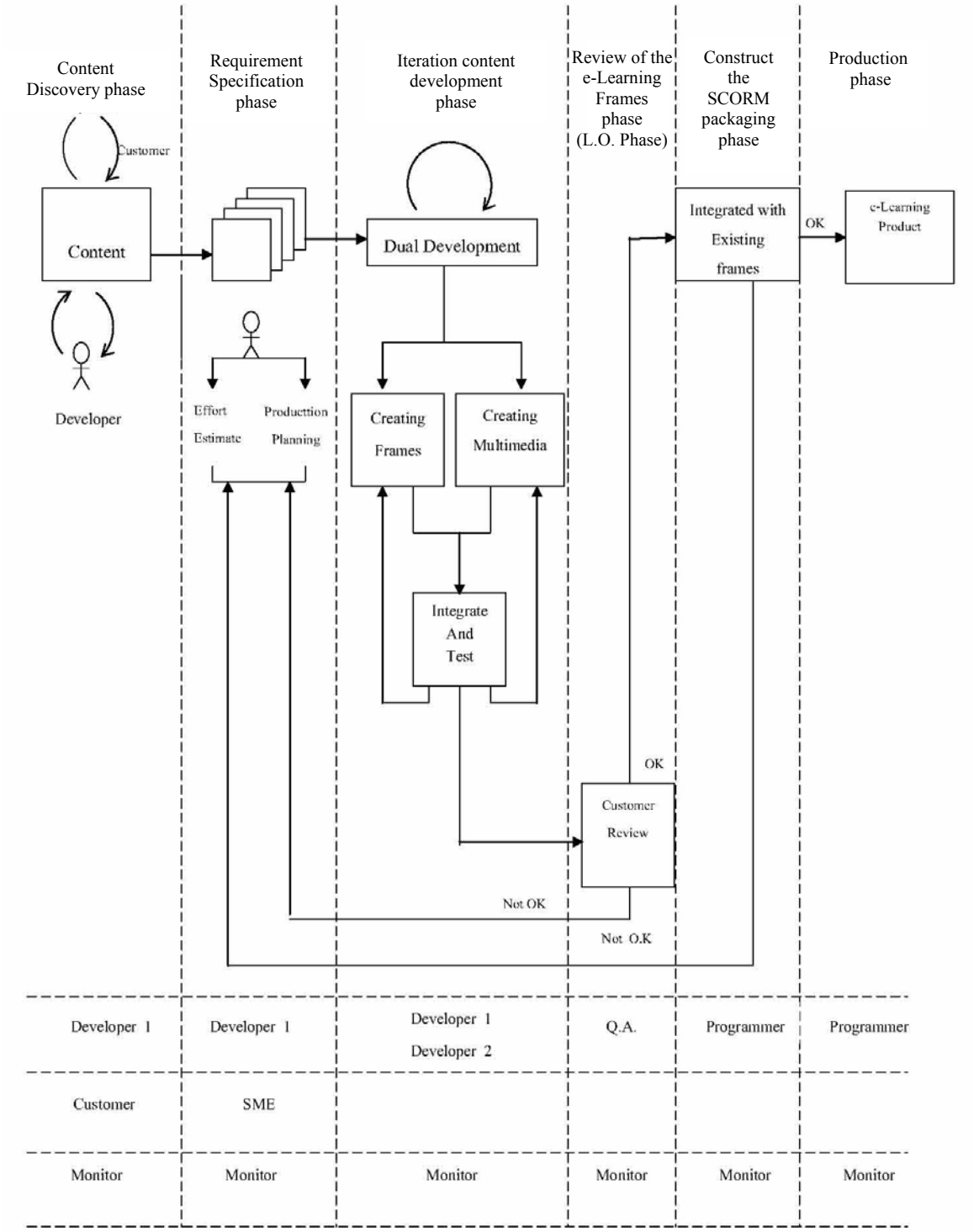

Figure 1 The ACD Model.

3. Comparisons

Comparing the ADDIE model with the ACD model, we will use the effort equation. The effort is defined as the man-month needed to produce n frames of e-Learning contents.

Assumption

1. The content is provided, no authoring needed.
2. The cost of correcting text in a frame is negligible.
3. The effort of customers in reviewing the content would not taking into consideration since only the effort of the developers will be accounted for.
4. Has tool to convert PowerPoint frames into flash or HTML frames.

The Effort Model

In formulating the effort equations for both the ADDIE model and the ACD model, the following variables will be defined.

- A is the effort used in developing n frames of e-Learning content using the ACD model.
- E is the effort used in developing n frames of e-Learning content using the ADDIE model.
- S is the effort per frame in developing the storyboard for the ADDIE case
- S_1 is the effort per frame in developing the storyboard for the ACD case.
- n is the number of e-Learning frames
- m is the number of multimedia elements
- p is the number of interactive elements that has to develop using action script.
- M is the average time for developing one multimedia element.
- P is the average time for developing one interactive element
- C is the time needed to combine one frame to the existing frames.
- c_i is the number frames need correction at round i for the ADDIE case.
- r_i is the number of frames need correction at the iteration i for the ACD case.

In The ADDIE model, after the n frames of e-Learning content are developed and then reviewed by the customer, assume that c_1 frames need to be corrected for the first round. After the correction and review again, assume that c_2 frames need to be corrected for round 2. This process continues until round k, $c_k = 0$ which means that the customer has no further comment. The e-leaning content then can be delivered.

In general , $n \geq c_1 \geq c_2 \geq c_3 \geq \ldots \geq c_i \ldots c_k = 0$ the functional behavior from the variables $c_1, c_2, c_3, \ldots c_j$ will be a monotonic decreasing function. From the statistic collected from developing e-Learning for 50 university subjects, with frames ranging from 250-600, and the development process is the ADDIE model [6], it is reported that only two rounds of corrections are required to finish the work in which the first round has in the average 60% frames need some form of corrections., while in the second round, the number of frames needing correction is reduced to only 20%. For the third iteration, if any, most are spelling and formatting correction. Hence,

$c_1 = 60\%$
$c_2 = 20\%$
$c_3 = 0\%$

Now, we can form the effort equation for the ADDIE model as follows.

$$\begin{aligned} E &= nS + nD + mM + p\,(P + M) \\ &\quad + M\,(0.6\,m + 0.2\,m) \\ &\quad + P\,(0.6\,(p+m) + 0.2\,(p+m)) \\ &\quad + nC \\ &= n\,(S+D) + 1.8\,(mM + pM + pP) \end{aligned}$$

From the data collected report, when applying the ACD model, the customer usually work closely with the team for 3 iterations. The number of frames need correction after the first review in each of the iterations is reduced in this order 60%, 40% and 20%, respectively. In the average, there are no corrections for the 4 iterations since the customer is convinced that so far the delivered content meet the expectation. For the ACD model, assume that j iterations are needed. Each iteration will develop n_i frame, I = 1 to j . Let A_{ni} be the effort of developing n_i frames. Then,

$$A_{n1} = n_1\,(S_1+D) + 1.6\,(m_1M + p_1M + p_1P)$$
$$A_{n2} = n_2\,(S_1+D) + 1.4\,(m_2M + p_2M + p_2P)$$
$$A_{n3} = n_3\,(S_1+D) + 1.2\,(m_3M + p_3M + p_3P)$$
$$A_{ni} = n_i\,(S_1+D) + C_i\,(m_iM + p_iM + p_iP)$$

$$A = A_{n1} + A_{n2} + A_{n3} + \sum_{i=4}^{j} A_{ni}$$

$$\begin{aligned} &= (n_1 + n_3 + n_3)\,(S_1+D) + [1.6\,(m_1+p_1) \\ &\quad + 1.4\,(m_2 + p_2) + 1.2\,(m_3 + p_3)]\,M \\ &\quad + (1.6\,p_1 + 1.4\,p_2 + 1.2\,p_3)\,P \end{aligned}$$

$$A = n\,(S_1+D) + [\,(1.2/j) + 1\,]\,(mM + pP + pM)$$

Assuming that $S=S_1$ and j is very large

$$A = n\,(S + D) + (mM + pP + pM)$$

From the ADDIE model,

$$E = n\,(S + D) + 1.8\,(mM + pP + pM)$$

Then,

$$\begin{aligned} E - A &= 0.8\,(mM + pP + pM) \\ &= 0.8\,(mM + p\,(P + M)) \end{aligned}$$

Hence, we can conclude that the development of e-Learning lesson using the ADDIE model would expense more effort than using the ACD. In particular, in using the ACD model, it can result in

saving the corrections of all the multimedia and interactive elements. This should be noted that the conclusion is valid only if in the down stream iterations, the user has no additional new requirements.

4. Conclusions

The expansion of the e-business of e-Learning content dictates a lower cost production imperative. While the ADDIE model is just as fundamental as the waterfall model for software development, the need is to find better approaches to develop the e-Learning content. We have devised effort equations with some industrial data to show that the ACD model has a lower effort than the ADDIE model for e-Learning content development. Hence, the agile approach to e-Learning development based on the ACD model as described clearly warrants serious consideration for adoption in the content industry.

5. References

[1] ADL, 2007, "Advanced Distributed Learning - Sharable Content Object Reference Model" [Online], Available URL: http://www.adlnet.org, [Aug, 2007].

[2] Kwangying, Automatic Content Segmentation, Ph.D Dissertation, SWU, Bangkok, Thailand, 2006.

[3] Ana Cavalli, Stephane Maag, Sofia Papagiannaki and Georgios Verigakis Get/ Institut National des Telecommunications, A Testing Methodology for an Open Software e-Learning Platform.

[4] Van Rosmalen, P., Van Es, R., Passier, H., Poelmans, P., & Koper, R., Authoring a full life cycle model in standards-based, adaptive e-learning. Educational Technology & Society, 2006, pp 72-83.

[5] Marshall, S. J., & Mitchell, G., E-learning Process Maturity in the New Zealand Tertiary Sector. In proceedings of EDUCAUSE in Australasia 2005 Auckland, New Zealand.

[6] CHUN, Andy Hon Wai, The Agile Teaching/Learning Methodogy and its e-Learning Platform, 2004, In Lecture Notes in Computer Science-Aduances in Web-Based Learning, Volume 3143, Springer-Verlag Heidelberg, pp. 11-18.

[7] Baruque, Lucia Blonder, Rubens Nascimento Melo, R.Marques S. Vicente, The Various Stages of an Instructional Systems Development Methodology for e-Learning Modules, PGLDB'2003, PUC-Rio,Rio de Janeiro-RJ, Brazil, pp. 40-50,2003

[8] Sugrue, B., Performance-Based Instructional Design For E-Learning Performance Improvement-Volume 41-Number 7.

[9] Alistair Cockburn, Agile Software Development (Paperback), 2001, Addison-Wesley Professional, pp 256.