



INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

A Strategic Decision-Making Framework For E-Learning System: Based on Strategic Planning Process and ISO 9126 Model

Wanwipa Titthasiri, Asst. Prof. Dr.

Department of Computer Science, Rangsit University, Thailand

wanwipat@gmail.com

Abstract

Although the adoption of e-learning system is widespread and the much research considered many excellent tools and techniques to invest in purchasing or developing them in house, there is lack of theoretical framework for planning, developing, and improving the processes supporting strategic decision-making of e-learning system with quality. This paper proposes the concept of strategic planning and ISO 9126 quality model as useful tools for a framework that encourages the development of effective e-learning system independent of technical, managerial, and pedagogical structures. The author provides the examples of outcomes of each phase applying this framework. Quality management and well plan under the software engineering principles are based on 'error prevention', while the evaluation of system after implementation style is based on 'error correction' [8]. This proposed framework is based on this idea and be expected to be used as a basis for a strategic decision-making to inform e-learning system purchase decision, avoiding costly mistakes.

Keywords: Strategic planning, ISO 9126 model, Benchmarking, e-learning system, quality model

Introduction

Necessary to the success of the online educational era, higher institutions must evolve to accommodate and keep pace with new e-learning system. It is found that stimulating innovations in pedagogy and management through computer usage are necessary and needed to focus. Realizing this, almost universities have already begun to adopt e-learning. But to accomplish this, e-learning system must provide an effective engine to drive online study or e-learning.

A such engine's role in supporting e-learning activities focused on both administrative and academic area in each classroom. This engine is popularly known as a software-Course Management System (CMS) or Learning Management System (LMS). It is a core of an e-learning system, designed to enable educators with minimal technology of expertise to design, create and deliver e-learning content as well as measure the results of e-learning courses [13]. Much of research on e-learning has

focused on the study of its adoption and evaluation. There is little attention paid to a strategic decision-making of an efficient CMS for e-learning system. Nevertheless, to accomplish an e-learning system, not only do e-learning system have a CMS with high quality, hardware and infrastructure must be designed to support the system; but also e-learning initiatives and to adopt an institutional approach in order to fully integrate all of the necessary considerations, such as pedagogy, politics, cost, and so on. In addition, work in [11] also concluded that ISO 9126 supports strategic decision-making activities, avoiding costly mistakes. Therefore, it is recognized the need for a clear vision and integrated strategy for e-learning that is reflected by environmental scanning in strategic planning process.

Literature on ISO 9126 quality model was reviewed to identify quality characteristics for evaluating quality of software product-CMS. But to

accomplish what author has stated upon, strategic planning process is also needed to consider.

The purpose of this paper is to establish a theoretical framework applying strategic planning process and ISO 9126 quality model. The blended of them is believed that this framework would be a process of sufficient flexibility to guide the initiative or improvement of e-learning system with the independent of technical platforms, organizational structures, culture, pedagogical and institutional business. This framework named as 'A Strategic Decision-Making Framework for E-learning System', It is based on the idea of 'error prevention' instead of 'error correction'.

Review of Litatures

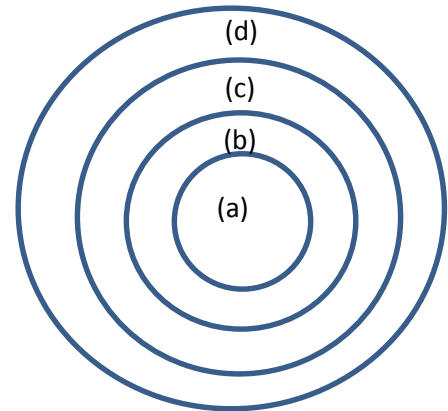
E-Learning System

To provide an understanding of e-learning system, it is divided into two words: 'system' and 'e-learning'. The first word 'system' is defined [18] that "A system is a set of interacting or interdependent components forming an integrated whole." The word 'e-learning' is defined [3] that "E-learning is a new educational concept by using the internet technology. It deliveries digital content, provides a learner-oriented environment for the teachers and students." In addition, to understand of e-learning, seven facets of the concept are examined: concepts, technologies, content, psychologies, human factors, business, and management [10]. Marshall and Mitchell stated [9] that e-learning requires a balancing of tension between technical, organizational and pedagogical considerations.

In this paper, it is concluded that e-learning system can be defined as a system comprising four components: (a) technologies and tools, (b) pedagogy, (c) people, and (d) business and management. (see Figure 1)

Figure

Figure 1: The structure of an e-learning system



The figure 1 shows a structure of e-learning system, appearing like a circle with many circles. Each circle represents each component of the e-learning system. The innermost circle is a core component representing a technical factor including hardware, network, and software. Most of software in e-learning system is considered as a CMS. It is a set of tools for instructors and students including class rosters, content creation, real-time chat, bulletin board. The CMS tools also focus on all aspects of teaching, learning and teacher-student interaction. Some of CMS include WebCT, Blackboard. Some of U.S. institutions have developed open source projects such as CourseWorks, CHEF and Stellar. Some also developed their own small-scale CMS [16]. CMS is considered as an important core supporting on all aspects of teaching-learning process. It focuses on both database and teaching-learning activities. Therefore, the quality of CMS reflects the success of e-learning system. The next circle is concerned with pedagogy including education, teaching, learning, and psychological theories underlying e-learning, The third circle is concerned with people who are stakeholders including administrators, IT staff, instructors as well as students. And the outermost circle is concerned with business and management. It is business strategies introducing e-learning and all aspects of it such as organizational structure, politics and economics. These are to sustain e-learning's growth.

As the structure of e-learning system, the innermost circle is only technical factor and the rest

ones are non-technical factors, including human, educational, and managerial and political factors respectively. The structure shows that both hardware and CMS are the core component supporting the rest components in the e-learning system. Mall [8] stated that “Software presents a host of problems to the customers: software products are difficult to alter, debug, and enhance; use resources non-optimally; often fail to meet the user requirements; are far from being reliable; frequently crash; and are often delivered late.... In not very distant future, hardware prices would become insignificant compared to software prices.” To accomplish what Mall stated, CMS as a core software is strongly considered in term of quality for a successful e-learning system.

ISO 9126 Quality Model

The International Organization for Standardization (ISO) was founded in 1946. ISO has defined a set of ISO and ISO/IEC (standards related to software quality). But ISO 9126 was originally developed in 1991 to provide a framework for evaluating software quality. It is believed that this is more adaptable and can be used across many systems, including e-learning systems [4]. The ISO 9126 consists of four parts : ISO/IEC 9126-1: quality model, ISO/IEC TR 9126-2: external metrics, ISO/IEC TR 9126-3: internal metrics, and ISO/IEC TR 9126-4: quality in use metrics. Hu, Loeffler and Wegener [5] stated that “The part 1 describes a 2-part quality model for software product: a) internal quality and external quality, and b) quality in use. For internal and external quality, six characteristics (functionality, reliability, usability, efficiency, maintainability and portability) are specified and each characteristic is subdivided into several sub-characteristics.... As supplementation to part1, the remaining three parts (technical reports) provide a suggested set of software quality metrics from perspective external quality, internal quality and quality in use, respectively.”

In this paper, only ISO 9126-1 part would be used as criteria for developing CMS software of e-learning system without any measurements. ISO 9126 sets out six quality characteristics, and these six characteristics are further subdivided into a number of sub-characteristics. (see Table 1)

Table :

Table 1 ISO 9126 characteristic and sub-characteristics
Source: Abran, A., Khalifi,A.,and Suryn,W., (2003). [1]

Characteristic	Sub-characteristic	Explanation
Functionality	Suitability	Can software perform the tasks required?
	Accurateness	Is the result as expected?
	Interoperability	Can the system interact with another system?
	Security	Does the software prevent unauthorized access?
Reliability	Maturity	Have most of the faults in the software been eliminated over time?
	Fault tolerance	Is the software capable of handling errors?
	Recoverability	Can the software resume working and restore lost data after failure?
Usability	Understand-ability	Does user comprehend how to use the system easily?
	Learnability	Can user learn to use the system easily?
	Operability	Can user use the system without much effort?
	Attractiveness	Does the interface look good?

Table 1 (continued)

Characteristic	Sub-characteristic	Explanation
Efficiency	Time behavior	How quickly does the system respond?
	Resource utilization	Does the system utilize resources efficiently?
Maintainability	Analyzability	Can faults be easily diagnosed?
	Changeability	Can the software be easily modified?
	Stability	Can the software continue functioning if changes are made?
	Testability	Can the software be tested easily?
Portability	Adaptability	Can the software be moved to other environment?
	Installability	Can the software be installed easily?
	Conformance	Does the software comply with portability standards?
	Replaceability	Can the software easily replace other software?
All characteristics	Compliance	Does the software comply with laws or regulations?

These characteristics and sub-characteristics represent a detailed model for evaluating any software. Table 1 described the first part of quality model. The second part is quality in use characteristics that are modeled with four other

characteristics: effectiveness, productivity, security, and satisfaction. It is believed by author that the ISO 9126 quality model is quite complete to use as criteria for initiative or improving an e-learning system with high quality.

A Strategic Planning and Benchmarking

Strategy Management Group at Balanced Scorecard Institution [14] defined that “Strategic planning is an organizational management activity that is used to set priorities, focus resources, strengthen operations, ensure that employees and other stakeholders are working toward common goals, establish agreement around intended outcomes/results, and assess and adjust the organization’s direction in response to a changing environment.” There are many different frameworks and methodologies for strategic planning. However, many frameworks stand on some basic phases: (a) environmental analysis, where an understanding of the current status of environment is developed, (b) strategy formulation, where high level strategy is developed, (c) strategy execution, where the high level plan is translated into action plans, and (d) evaluation, where ongoing refinement and evaluation occur [12].

In strategic planning process, analyzing the organization’s external and internal environment is important activity aiding in the implementation of organization’s strategy. The SWOT analysis is a business analysis technique that its process involves identifying the strengths and weaknesses of the organization, and opportunities and threats present in the market that it operates in. The first letter of each of these four factors creates the acronym SWOT. SWOTs can be used to guide strategy at the very highest level but they can also be tied to a specific business objective [15].

Furthermore, benchmarking technique is also considered, along with the strategic planning and ISO 9126. It is the process of comparing one’s business processes and performance metrics to industry bests or best practices from other industries. The examples of typical benchmarking methodology: identify problem areas, identify other industries that have similar processes, identify organizations that are leaders in these areas, survey companies for measures and practices and visit the best practice companies to identify leading edge practices. Benchmarking can

be categorized into many types. However, in this paper, performance and product benchmarking are applied. It is focused on the process of designing new products or upgrades to current ones. This process can sometimes involve reverse engineering which is taking a part competitor product to find strengths and weaknesses [19].

Results and discussion

A Strategic Decision-Making Framework For E-Learning System

Based on the literature, it is found that much of research on e-learning have focused on its adoption and evaluation, but little attention paid to how to have a good plan and quality management for an e-learning system, do exists. Having a good plan/framework reflects on 'error prevention'. It should be better than done and then evaluation, based on 'error correction'. According to this reason, the need exists for additional support to develop a strategic decision-making framework for developing of an e-learning system.

This section presents the concepts of a strategic decision-making framework designed to assist IT staffs or educators in developing an e-learning system. The proposed framework is drawn from the literatures of e-learning system, strategic planning, ISO 9126 quality model standard and benchmarking technique. This framework would enable developers to understand where they are now (i.e., what exists), to plan where they want to be, and to understand how e-learning system has been successfully implemented.

A strategic decision-making framework for e-learning system is composed of four phases, including (a) organizing an e-learning developing team, (b) defining strategic issues/system specification, (c) deciding an e-learning system, and (d) implementing and evaluating. (see figure 2)

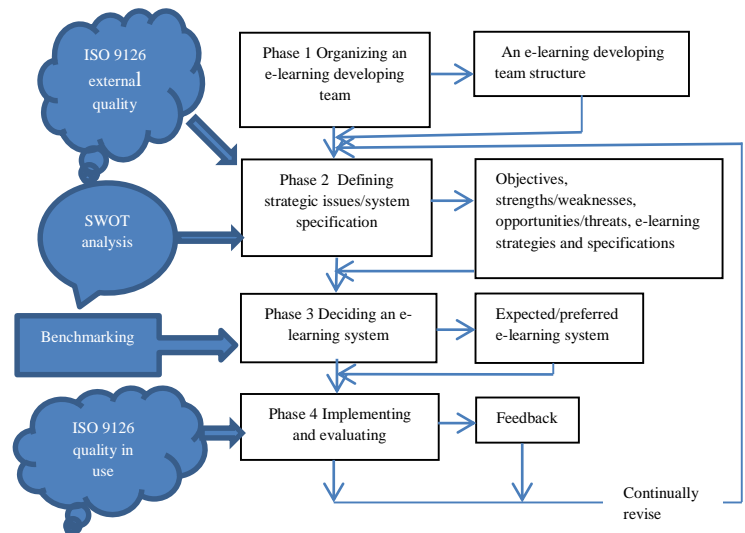
Phase 1 Organizing an E-Learning Developing Team

Based on the structure of e-learning system, technologies and tools is the core component and e-learning is a subset of IT institutional department. The structure of system further indicated that pedagogy is also important component. It is therefore recommended that this team should be composed of vice-president for IT as chairman, vice-president for academic, vice-president for administrative, senior faculty and IT staff

representatives, and external consultants. The aim is to provide a forum for discussion of needs, new educational paradigm, IT problems, and review of institutional policies.

Figure:

Figure 2 A Strategic Decision-Making Framework For E-Learning System



Based on the literature, it is found that e-learning system's functions could be classified into three major areas: (a) technologies and tools, (b) education, and (c) management. The technologies and tools part is considered as a core part of e-learning system. The education part is thought to be appropriately developed under the management. Therefore, this e-learning developing team should have two subgroup teams: (a) an e-learning managerial group, and (b) an e-learning IT group. An e-learning managerial group should be responsible for three components of e-learning system including pedagogy, people, and business and management. An e-learning IT group should be responsible for a core component – technologies and tools, supporting the first group. However, in choosing members for each group, it is important to identify individuals with background knowledge of IT and education, working experience in university, and influence of a key stakeholder. In addition, a secretary should be appointed to serve on each group. These two working groups should inspect the campus and other campuses, compare existing IT, and envision future trends.

Phase 2 Defining Strategic Issues/System Specification

The purpose of this phase is to evaluate the current status of environment that affects e-learning using SWOT analysis, and to define users' requirement for e-learning system using ISO 9126 external quality. Therefore, this phase should be started with SWOT analysis. SWOTs is used to guide strategy and then be tied to a specific business objectives. SWOT analysis is composed of the internal analysis and the external analysis. The internal analysis of a university should include its culture, expertise, resources. Strengths and Weaknesses are considered to be internal factor. Strength has a positive implication but weaknesses place university at a disadvantage. The external analysis include market-students, social, economic, and political environment that university operates in. Moreover, it includes university's partners, competitors, and government. Opportunity and Threats are considered to be external factor. Table 2 shows an example of SWOT analysis for developing an e-learning system.

Table :
Table 2 An Example of SWOT analysis for e-learning system

	Helpful	Harmful
Internal origin	Strength (+) Positive cash flow University Reputation Efficient administration Good physical infrastructure, network Having vital skill people	Weakness (-) Outdated hardware High staff turnover Inefficient process Key person leaving Inability to take outside advice
External origin	Opportunity (+) Change of technology (new technology) Improved supply arrangement Social development	Threat (-) Price rises from vendors Loss of significant students Emergence of new competitors

The result of SWOT analysis will be different for every institution. It suggests other strategy options. For example: capitalizing on opportunities that play to strengths, deciding which weaknesses need to be addressed as a priority, and protecting institution against threats [2]. In addition, teamFME [15] suggested that there are two simple methods, referred to as 'matching' – match strengths to opportunities to gain competitive advantage, and 'converting' – convert threats or weaknesses into a managerial number.

Data obtained from SWOT analysis would be used to describe what and how the current status of e-learning and its related environment are operating, determine user needs, and decide how e-learning with IT can be applied to fulfill these needs. SWOT analysis could be conducted by surveys, observations, existing records, and brainstorming with various individuals at various location.

According to the core component of e-learning system, technologies and tools part is an important base dictating a successful e-learning system. An important one of this part is CMS - software engine to drive e-learning - , based on the literature. In order to have a quality of software, ISO 9126 would be used as a guideline determining the characteristics of preferred CMS. Based on ISO 9126 standard model, the characteristics of software accompanied with the result of SWOT analysis, are used to build strategic objectives for developing e-learning system. And then the strategic objectives is translated into operational strategies for developing, as shown in Table 3.

Table :
Table 3 An Example of the operational strategies for e-learning system

Strategic areas	Tasks/Considerations
1. Technologies and Tools Hardware/Network Strategies	-What will be the minimum specifications of function and capacities of hardware? -Will the Internet be useful for administrators, instructors, staffs, and students? -Will users off-campus use e-learning system with the same quality and quantity as their peer on campus? -What type of network security should be provided? -What maintenance of hardware is provided by vendors? -Does the existing hardware/network enrich the e-learning environment? Or Is it outdated?
Software (CMS) Strategies	-Should the institutions develop their own system or buy them? -How does CMS meet users' requirements? -How does CMS match with ISO 9126 model? -Can either vendors or IT staff maintain and support CMS implementation? -What CMS is presently in use? And What is the obstacle of its using? -How is the relationship with vendors? -How easy is it to transfer CMS to another environment?

Table 3 (continued)

Strategic areas	Tasks/Consideration
2.Pedagogy	
Curriculum Strategies	-What curriculum is appropriate to be e-learning? -How to design/adjust curriculum for e-learning? -How much students/target in the online curriculum?
Resource Strategies	-Are the function of content creation available in the CMS and easy to use? -How to set up the rule/procedure/standard for resource creation? -How can the institution provide training to students/instructors on how to use CMS effectively? -Is reusable intellectual property identified and catalogued for reused? -Is student usability of the resources regularly assessed?
Course management Strategies	-Is CMS support course management? -Can be CMS linked with information system of the institution? -How should the security be installed in CMS?
3.People	
Student/Instructor development Strategies	-How can the institution provide training to students/instructors on how to use an e-learning system? -What technical support can be provided to maximize the use of hardware/software? -Is the students/instructors competent to benefit from training? -How much e-learning system is needed by end users?
IT staff recruitment Strategies	-Can the institution hire a full-time IT professional staff? -How can the existing IT staff be maintained?
4.Business and Management	
Business and marketing Strategies	-Will efforts be made to promote the concept that e-learning can play a positive role in institution? -What mechanism will be used to design advertisement of e-learning within the institution? -What research will be done to compare and analyze the prices of the e-learning system to be purchased? -How to have a good relationship with vendors? -How to create an efficient administration? -How is an established student base in e-learning? -What and how is the institutional competitor? -Are strategies to address student needs, reflected in university plan?
Financial Strategies	-What should be done to ensure that the institution allocates sufficient budget to support e-learning? -How can the institution sell/upgrade outdated technology? -How to manage the license cost? -How to have a good relationship with the bank? -What research will be done to compare and analyze the price of hardware/software to be purchased?
Management Strategies	-How will the e-learning system developing team structure be organized? -How will policies and procedures be developed? -How to prepare and manage e-learning team to operate on e-learning effective? -How to promote e-learning in the institutions? -Is organizational audits of e-learning performance regularly conducted?

Table 3 presents some examples of tasks, based on the SWOT analysis and users' requirements.

The first output of phase 2 is e-learning strategies under the SWOT analysis and then these strategies are translated into operational strategies, as shown in table 3. Finally, the operational strategies are considered, accompanied with the characteristics defining in ISO 9126 model. The e-learning system specification is developed appropriately with the institution

Phase 3 Deciding an E-Learning System

The purpose of the third phase is to decide an e-learning system. The operational strategies and the characteristics of quality provided by ISO 9126, are considered by the e-learning system developing team. They produce an e-learning system specification as an output of phase 2. To decide an e-learning system, they consider this system specification to decide a CMS – e-learning system's engine - using benchmarking technique. They could do a survey of CMSs in the market and provide a basis of comparison of different systems, based on system specification. Table 4 demonstrates an example of benchmarking of e-learning system using e-learning system specification. Each row represents functional and non-functional specification and each column is for each e-learning system engine. The intersection of each row and column is a value of score with weight (x), given by the evaluation of e-learning developing system. Total scores (xx) are compared and the CMS comes with the highest score would be chosen as a preferred e-learning system.

Table :

Table 4 An Example of a summary of e-learning specification

CMS Tools e-learning system specification based on ISO9126, SWOT.	WebCT	Blackboard	CourseWork	CHEF	Stellar
Functional Specification					
Functionability					
-course information	x	x	x	x	x
-teaching materials	...	...	...	...	...
-assignments					
-class discussion board					
-class chat room					

Table 4 (continued)

CMS Tools e-learning system specification based on ISO9126, SWOT.	WebCT	Blackboard	Coursework	CHEF	Stellar
-roster -calendar -instructor's tools -test -course statistics, etc.....					
<u>Non-Functional Specification</u>					
Reliability					
-backup/recovery	x	x	x	x	x
-statistic of error	...	...	...	...	...
-security					
-product site references, etc.....					
Usability					
-user friendly interface	x	x	x	x	x
-training time, etc....	...	...	...	...	...
Efficiency					
-7 days 24 hrs operating	x	x	x	x	x
-system response time	...	...	...	...	...
-IT staff knowledge, skill, etc..					
Maintainability					
-software license/upgrade	x	x	x	x	x
-vendor support, etc....	...	...	...	...	...
Portability					
-platform supports	x	x	x	x	x
-system installation, etc...	...	...	...	...	...
Institutional management					
-financial support	x	x	x	x	x
-manager support	...	...	...	...	...
-relationship with vendors, etc..					
Total Score	xx	xx	xx	xx	xx

Phase 4 Implementing and Evaluating

Implementation is to use the system and to know what has been and is being accomplished. ISO 9126 quality in use is used to evaluate the system. It

[http:// www.ijesrt.com](http://www.ijesrt.com)

is the end users' view of the quality of the software product, when it is used in a specific environment and a specific context of use. Quality in use is determined by a set of four characteristics: effectiveness, productivity, safety, and satisfaction [7]. This phase is important for implementation and ongoing review/evaluation with comments and discussion of strategies and system specification. There should be a timeline for continuous monitoring and for feedback and after evaluation, it should be required to consider how the system can be maintained or improved.

This framework is designed to support a strategic decision-making for an e-learning system. The framework is based on ISO 9126 model, SWOT analysis, and benchmarking as the literature. It is intended to provide guidance for institution in developing or improving on e-learning system.

Conclusion

Based on the experimental research [17], it is found that there is no difference on learning between traditional and e-learning. Moreover, the enrollments in e-learning programs increase in every year and be also realized that the internet becomes the dominant means of teaching-learning process under CMS/LMS – e-learning's engine. It is recognized that a modern learning – e-learning – is a necessary policy of most university, offering a form of online degrees in a high competition world marketplace.

To accomplish the e-learning, not only do students and instructors need to become more highly computer literate, the administrators must understand and strong support in management, but also CMS must be modernized and qualified, and hardware and network designed to create an interface between the campus and the worldwide community. Moreover, environment should not be ignored. Therefore, this study propose a guideline to develop e-learning system using the concept of strategic decision-making with SWOT analysis in term of management, ISO 9126 standard model for qualified CMS as an engine of e-learning system, and benchmarking for comparison in the last step. Since people often lack real understanding of a quality of e-learning system and how to strategic plan, concept of strategic

planning accompanied with ISO 9126 quality model should be introduced in e-learning system development. Primary tasks will be to define the university's relationship with its environment, define e-learning strategies and identify e-learning system specifications. These specifications determine the preferred e-learning system. Additionally, e-learning system developing team should recognize that this proposed framework must be implemented and continually revised.


In conclusion, this study should be useful for developers to adjust or develop their own e-learning system's development. Since it is found that most of institutions did not employ an environmental assessment as a part of their e-learning system development, SWOT analysis could serve as a baseline. Furthermore, ISO 9126 model is often used to evaluate software in e-learning system, but this framework proposes the idea of 'error prevention', instead of 'error correction'. This means ISO 9126 model is used to be a standard specification for having a software engine with high quality before implementation. Finally, for e-learning system developing team, who need to make decision regarding which system to buy, this framework provides a possible metric for comparison of the various product available on the market without non-technical factors mistakes. Therefore, this framework is expected to be useful for institutions where are intended in developing new e-learning system with a high quality and enhanced user satisfaction.

References

1. Abran, A., Khelifi, A., Suryan, W., Swffah, A. "Usability Meanings and Interpretations in ISO standards," in *Journal of software Quality*, VOL 11, NO. 4, p.325-338, 2003.
2. BHP Information Solutions, "SWOT Analysis", <http://www.bhprintsolutions.co.uk>
3. Chengzhi, "Introduction to E-learning", <http://www.chengzhi.net/english/>
4. Chua, B.B. and Dysan, L.E., "Applying the ISO 9126 model to the evaluation of an e-learning system", <http://www.ascilite.org.au/conferences/perth04/procs/pdf/chua.pdf>
5. Hu, W., Loeffler, T., and Wegener, J., "Quality Model based on ISO/IEC 9126 for Internal Quality of MATLAB/Simulink/Stateflow Models" in the *IEEE International Conference on Industrial Technology (ICIT)*, Athens, Greece, 2012.
6. ISO/IEC 9126-1: 2001(E) : *Software Engineering-Product Quality-Part1:Quality Model*, ISO/IEC Std., 2001.
7. ISO/IEC 9126-4: 2003 : *Software Engineering-Product Quality-Int'l Std Quality in use Metrics*.
8. Mall, R., "Fundamentals of Software Engineering", 2nd ed., 2006, PHI, New Delhi.
9. Marshall, S., and Mitchell, G., "An E-learning Maturity Model", <http://www.utdc.vuw.ac.nz/research/cmm/publications.shtml>
10. Philips, J.A., "e-learning" <https://peoplelearn.homestead.com>
11. Quirchmayr, G.S. Funikul and Chutimaskul, W., "A Quality Model of E-Government Scrives Based on The ISO/IEC 9126 Standard" in the *Proceeding of International Legal Informatics Symposium IRIS*, (2007).
12. Rowley, D.J., Lujan, H.D., and Dolence, M. G., "Strategic change in colleges and universities", 1997, San Francisco, CA: Jossey-Bass Publishers.
13. Solemon, B., and Sulaiman, R., "Rapid-E-Learning Content Management Systems" (RE-COMS) in the *International Journal of Computing and Information Services*, VOL.4, NO.1, 2006.
14. Strategy Management Group, "Strategic planning basics", <http://www.balancedscorecard.org/>
15. Team FmE, "SWOT Analysis: Strategy skill", <http://www.free-management-ebooks.com>
16. Technopedia, "Course Management System-CMS", <http://www.technopedia.com/definicion/6651/course-management-system-CMS>
17. Titthasiri, W., "A Comparison of traditional and e-learning : experimental approach" in the *International Journal of Information Technology and Computer Science (IJITCS)*, VOL.12, NO. 3, 2013, <http://www.ijitcs.com>

18. *Wikipedia, Study Item : "System"*
<http://www.en.wikipedia.org/wiki/system>
19. *Wikipedia, Study Item : "Benchmarking"*
<http://www.en.wikipedia.org/wiki/benchmarking>

Author Bibliography

	<p>Wanwipa Titthasiri, Asst.Prof., Dr. Department of Computer Science, Rangsit University, Thailand. Email: wanwipat@gmail.com</p>
---	--