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Critical success factors for institutional repositories implementation

Fatemeh Lagzian and A. Abrizah
Department of Library & Information Science, Faculty of Computer Science & Information Technology, University of Malaya, Kuala Lumpur, Malaysia, and
Mee Chin Wee
Department of Information Systems, Faculty of Computer Science & Information Technology, University of Malaya, Kuala Lumpur, Malaysia

Abstract

Purpose – This paper aims to explore the critical factors that contribute to the success of institutional repositories worldwide. Previous research indicates that there is little agreement surrounding what constitutes a successful institutional repository.

Design/methodology/approach – Possible key factors were extracted from literature review and responses from expert panels. A web-based survey questionnaire forming a total of 69-item statements was developed. The questionnaire, when pilot-tested, was found highly reliable. The questionnaire was then distributed to 322 institutional repository managers, who are representative of the population, via the OpenDOAR email distribution service. Data collection ended in four months, once the sample volume of usable questionnaires reached 295, which is 91.6 per cent response rate.

Findings – The results of the factor analysis indicate the possibility of 46 variables under six factors being important for the success of institutional repository implementation. These six factors are "Management", "Services", "Technology", "Self-archive Practices", "People" and "Resources".

Practical implications – This study has empirically tested and consolidated the factors which are important in institutional repository implementation worldwide and documented them as critical success factors.

Originality/value – It also frames questions about the possible value of developing some guidelines or standards related to success factors to be able to monitor the deployment of institutional repositories.

Keywords Academic libraries, Critical success factors, Institutional repositories, Digital library framework, Enterprise architecture

Paper type Research paper

Introduction

In the past decade, institutional repositories (IRs), a type of digital library, have grown to be a common topic of interest for researchers, developers and users from a broad range of disciplines. To deploy IR projects successfully, the organizations need to know

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the key factors for their successful implementation. The key factors can be critical success factors (CSFs), a phrase which is simply defined as "factors" that are "critical" to the "success" of the organization (Caralli, 2004). The search for CSFs in organizations and business ventures began in the 1960s (Fortune and White, 2006). Daniel (1961) was the first to develop the concept of CSFs. A decade later, Rockart (1978) popularized and refined the concept of CSFs. Since then, the concept has been used extensively to help business organizations implement their strategies and projects. Rockart (1978, p. 85) defined CSFs as "the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization" and he reinforced that the areas of activity "should receive constant and careful attention from management".

Despite the importance of CSFs in organizational endeavours, there is a lack of knowledge about CSFs for ensuring successful implementation for digital library and IR projects, as well as how CSFs can be used to evaluate the success of such systems. As of 15 May 2012, there are 2,875 digital repositories in the world registered with the Registry of Open Access Repositories (http://roar.eprints.org). These repositories differ widely from just a few thousand items to over 45,000 research documents. Jain (2011) indicated that, in spite of all the obstacles to successful implementation, IRs have been increasingly recognized as a vital tool for scholarly communication, an important source of institutional visibility and a viable source of institutional knowledge management. As a new, emerging digital library initiative area, however, requirements and evaluation criteria for successful IRs have not yet been established (Palmer *et al.*, 2008). There has been no comprehensive study on the success factors of IRs in the library and information science context, as such, no investigation of the factors in some real-life contexts of IR activities. In addition, successful IR projects are hard to come by as very few managers, as depicted in the literature, are willing to share their secrets.

Literature review

The success factors in digital and IR implementation have been subjected to a limited amount of prior research. The earliest by Shearer (2003) identified ten possible success factors for the IR projects of the Canadian Association Research Libraries: archiving policies, disciplines advocacy activities, copyright policies, content type, staff support, quality control, publicities, software, use and organizational culture. Westell (2006) proposed eight input indicators for measuring IR success in Canada: mandate, integration with planning, funding model, relationship with digitization centres, interoperability, measurement, promotion and preservation strategy. Thibodeau (2007) proposed a five dimensions framework based on the open archival information system reference model to evaluate the success of digital repositories: service functionalities, orientation, content coverage, collaboration and state of development. Markey *et al.* (2009), who conducted a comparative case study of five IRs in colleges and universities, argued that success should be measured by both internal (i.e. content, services) as well as external factors (i.e. staff, community). Proudman's (2007) analysis of the European DRIVER research project resulted in CSFs required for populating repositories and their services, namely: management and organization; content and services; infrastructure and technical; policy; advocacy; and organizational networks. Cassella (2010) proposed a set of performance indicators to assess IR success. She came up with 14 internal

indicators and three external indicators which may help IR managers to demonstrate their repositories' cost-effectiveness and success.

There have been a few surveys and case studies that led to discussions on the specific conditions that make an IR successful. Researchers primarily cite content recruitment (Shearer, 2003; Bell *et al.*, 2005; Ferreira *et al.*, 2008) and services (Thibodeau, 2007) as key factors. Previous research has shown that the success of a digital repository lies in its acceptance by the target audience (Dahlan *et al.*, 2006; Shen *et al.*, 2006; Thong *et al.*, 2002) and sustained funding for its long-term viability (Westell, 2006). Other key factors which may lead to successful IR implementation are that the repository:

- is community-driven and community-focused (Gibbons, 2004);
- facilitates scholarly communication and archiving (Kim, 2010; Xia and Sun, 2007);
- is technically easy to use and regularly used (Kim, 2010; Zuccala *et al.*, 2008);
- provides a safe, long-term home for materials (Lampert and Vaughn, 2009);
- has institutional support and dedicated staff (Westell, 2006); and
- has a robust technological infrastructure (Palmer *et al.*, 2008).

Management commitment and support are vital for successful IR implementation to ensure preservation and maintenance, IT infrastructure, digital rights management and institutional mandate (Jain, 2011; McCord, 2003; van Westrienen and Lynch, 2005; Suleman, 2007). Cullen and Chawner (2012) emphasized that setting up a repository is a major undertaking for an institution, and it requires a commitment of financial and staff resources to ensure success in both the establishment and the maintenance of the repository.

Russell and Day (2010) considered the importance of content as the critical factor as well affected repository implementations. Dorner and Revell (2012) wrote that if IRs are to be successful, library managers must not only ensure that content is being input into the repositories, but also that they are being promoted to library users as valuable information resources. Chavez *et al.* (2007) and Ramirez *et al.* (2010) believe that services that add value to the content support a successful IR.

The literature also highlighted that a successful IR requires self-archiving practices among their users. Kim (2010) identified that perceived self-archiving culture (such as concerns about copyright, extra time and effort and technical ability) is a significant factor that motivates or impedes self-archiving practices. Xia and Sun (2007) stressed the importance for success factors such as number of deposits and authors' attitude on self-archiving, as well as usage assessment. Starkman and Earwage (2008) emphasized that staff participation and collaboration in submission are key factors to create open access. According to Dorner and Revell (2012), librarians have critical roles to educate users with copyright and other intellectual property rights issues, so that these facilities are compliant with such rights (Tripathi and Jeevan, 2011). Jain (2011) also emphasized the provision of clear policies on ownership, copyright issues, mandatory deposits and encouraging academics to self-archive, and stated that all these can be successfully done through comprehensive promotion and publicity of the benefits of an IR to all stakeholders. However, in general, there is little agreement surrounding what constitutes a successful IR, as has been concluded by Markey *et al.* (2009). As there has been little empirical study on the use of CSFs in IR projects, this study aims to address

this gap by ascertaining factors that are critical to its IR being available for use, as well as the strategies and conditions that advance and influence IR development.

Methodology

This study used a quantitative exploratory research design to identify, analyse and describe factors contributing to the success of IR implementation worldwide. The following research objectives have been formulated:

- To identify a list of potential success factors for the implementation of IRs.
- To identify a set of CSFs for IRs that contributes to their successful implementation.

A web-based questionnaire was developed, comprising 69-item statements culled from the literature and verified by 21 participants in an elicitation study conducted earlier. These participants, comprising IR managers and researchers from 13 countries, responded to a list of questions regarding the success factors and obstacles in the implementation of their IRs. For the purpose of convenience, we grouped the item statements into the five dimensions of the Digital Library Enterprise Architecture (Abdullah and Zainab, 2008), namely: motivation, people, resources, time and location and services. These dimensions were used in our prior study (Lagzian *et al.*, 2013) which postulates that successful deployment of a digital library and repository implementation may depend on this set of success factors. Each statement identifies the importance of a particular variable regarding the IR, using a five-point scale ranging from not important (1), of little importance (2), moderately important (3), important (4) and extremely important (5).

A pilot survey involving 96 IR practitioners was conducted prior to the administration of the actual survey. This is a valid response from 300 IRs listed in the Ranking Web of World Repositories (RWWR), available from http://repositories.webometrics.info. The pilot survey was needed to gain insight into the signifiers of success in IR projects listed in the RWWR and to help detect and remedy a wide range of potential problems with the instrument. It also ensured that appropriate questions are being asked and the right data are being collected. The pilot study showed the preliminary estimates of the reliability of the construct measurement. All 69 items achieved a Cronbach's alpha score of 0.965. This suggests that the items have relatively high internal consistency. The Kaiser – Meyer – Olkin (KMO), which measures sampling adequacy, has a value 0.614. A value of 0.5 and above is suggested as appropriate. Bartlett's test of sphericity is used to examine the hypothesis that the variables are uncorrelated in the population. The Bartlett's test of significance level is 0.0000. As such, factor analysis is a suitable statistical method to meet the objective of this study.

A random sampling method was adopted in the actual survey and the unit of analysis is the individual IR listed in the Open Directory of Open Access Repositories (*Open*DOAR, available at: www.opendoar.org). *Open*DOAR is an authoritative directory of academic open access repositories that takes the initiative to harvest repositories around the world and assign metadata to allow categorization and analysis to assist the wider use and exploitation of these repositories. As such, it is able to present an overview on the current status of the development of digital repositories around the world. As of 20 October 2012, *Open*DOAR listed over 2,217 repositories worldwide. To

obtain a sufficient number of samples to generate a 95 per cent confidence interval, the web-based questionnaire was distributed to the sample size representative of the respondents (i.e. the IR managers). The sampling formula by Krejcie and Morgan (1970) requires a sample of about 322 respondents out of the total population (of 2,217 repositories) with a confidence level of 95 per cent. Data collection ended after four months and the sample volume of usable questionnaires reached 295, which is a 91.6 per cent response rate. The questionnaire was distributed via the *Open*DOAR e-mail distribution service. This service allows researchers, service providers and repository administrators to contact all repositories or a bespoke selection of repository administrators listed on this site. However, some of the repositories listed in *Open*DOAR lack e-mail contact addresses, others may have chosen to opt out of this service or employ spam filters that may negate contact efforts which may not guarantee successful contact with the repository staff.

Findings

The study describes the CSFs for IRs. The 295 respondents who participated in this study are mainly from Europe (111, 38.3 per cent), followed by North America (63, 24.1 per cent), Asia (49, 16.5 per cent), Oceania (29, 10 per cent), South America (27, 9 per cent) and Africa (14, 4.8 per cent). They are generally managers cum librarian (118, 40.1 per cent) from universities (245, 83.1 per cent). Regarding work experience, most of the respondents (110, 37.3 per cent) have worked in the library for one to three years, and the majority (165, 56 per cent) reported having a Master's in Library and Information Science (MLIS) degree. Most reported performing the role of collection management and stewardship of collections (187, 63.4 per cent); followed by persuading authors to participate in self-archiving (151, 51.1 per cent); and understanding of software and giving training to authors (146, 49.4 per cent). More than half (173, 58.6 per cent) of the respondents, the majority coming from Europe and North America, reported implementing their IR using the DSpace software, followed by E-prints (46, 15.6 per cent).

The relationship between the importance of an item statement and the success factor associated with each statement is assumed to be reflective. The 69-item statements which present the success factor were ranked based on the mean value. The mean of 42-item statements is more than 4.0 (important and extremely important), which indicates that the majority of the respondents are agreeable on the importance of these variables. The mean of 26-item statements is more than 3.0, which indicates that on average more respondents feel that these items are moderately important. Only 1 item statement received a mean about 2.0 which indicates that most of the respondents tended to disagree that the success of an IR is dependent on this factor. The standard deviations of 9-item statements are more than 1.0 which indicates a large dispersion of agreement on the importance of these variables among the respondents.

Before conducting the factor analysis on the actual data set, KMO and Bartlett's tests were carried out again. The KMO value and the Bartlett's test of significance level are 0.913 and 0.0000, respectively. Again, factor analysis has been confirmed as the appropriate statistical method for the current study. As such, factor analysis with principal components analysis was conducted on the data. The varimax rotation method was used. A minimum of two runs is normally required for factor analysis. In the first run, factors should be extracted for eigenvalues of 1 or greater. After rotation, it

is necessary to check the meaningfulness of the factors extracted, and only meaningful factors should be retained for further rotation. If a certain variable is not significant, in other words, if the factor loadings have a value of less than 0.4, then it is considered that the variable is unimportant to ensure success in IR projects.

Of the 69 items or variables, 7 variables have lower value less than 0.4, and 16 variables were considered insignificant because they loaded on more than two factors and are not relevant to both. Therefore, these 23 variables have been removed before further analyses. Therefore, the findings indicate the possibility of 46 variables (from a total of 69) under six factors being important for the success of IR implementation. The 46 variables that compose the CSFs for IR implementation are shown in Table I.

The six constructs extracted from the factor analysis were named "management" (Factor 1), "services" (Factor 2), "technology" (Factor 3), "self-archive practices" (Factor 4), "people" (Factor 5) and "resources" (Factor 6). Five factors are exactly matched with the defined factors in the different parts of the questionnaire based on the Digital Library Enterprise Architecture for which the questionnaire was developed. The other factor (self-archive practices) has close relationships with these factors. For example, self-archive practice is considered as the subset of the management, people and resources factors.

A reliability coefficient (Cronbach's alpha) was computed to estimate the reliability of each factor. Table II presents the reliability statistics for each factor which indicate that the items form a scale that has reasonable internal consistency reliability. The combined alpha value for all the items is 0.950 which are above the threshold value 0.7, which indicates that the factor analysis conducted is correct and suitable for testing. People has a lower level of reliability (0.672), however, it is kept for further analyses as the alpha value is close to 0.7. Therefore, 46 statements regarding the CSFs in IR implementation were classified into six dimensions, namely: management, services, technology, self-archive practices, people and resources.

Discussion and conclusion

This study argues that it is necessary to identify the key success factors influencing the implementation of IRs worldwide from the perceptions and experiences of diverse people who have played different roles in IR development. The results of this study indicate that a total of six factors from the 46 attributes were confirmed by factor analysis, namely, "management", "services", "technology", "self-archive practices", "people" and "resources". All six factors were significant for interpretation.

The people and resources factors received the highest mean value in terms of importance. Simons and Richardson (2012) pointed out that identifying how best to prepare and support the repository staff is vital to the success of repository services, as IRs continue to evolve and mature. Content recruitment is a success factor because it literally is the core of the IR (Markey *et al.*, 2009), and a critical mass of material is necessary to generate both additional content recruitment and end-user activity. Mackie (2004) wrote that librarians have to take a proactive role in garnering content for their repositories and work towards a sustainable approach to ensure success. Shearer (2003) wrote that there is a strong indication that the nature and amount of advocacy activities done by the librarians and management on campus will contribute to the success of an IR. Shearer, who defined IR success as "use", opined that the success of an IR will ultimately be determined by the use of the

Rank[a]	Item no.	Item statement	Component 1	2	3	4	5	6
1	45	The IR makes available freely accessible full text documents						0.438
2	6	Top management shows a strong level of commitment and support	0.653					
3	9	Librarians/middle management accept the responsibility for successful implementation	0.523					
4	15	The IR is intuitive and easy to use		0.603				
5	10	Librarians/middle management conduct effective procedures for successful implementation	0.520					
6	13	The IR staff understands what users really need in addition to taking a particular approach to understanding user information needs		0.643				
7	24	The IR system makes available the number of downloads and views of full text files		0.402				
8	40	IR staff undertake success in IR and conduct IR activities correctly					0.422	
9	16	The IR is stable and has adequate and sufficient documentation for users to follow		0.536				
10	41	The IR Staff understands how the IR systems work (technical competence)					0.410	
11	7	The institution locates sufficient funds to ensure IR success	0.617					
12	14	The IR provides a user-friendly and understandable interface because it acts as the librarian of the IR		0.642				
13	42	The IR accurately describes the content of the digital object itself completely (descriptive metadata)						0.638
14	44	The institution digitizes contents to suitable formats as per the requirements i.e. archival formats for preservation both long term as well as short term						0.545
15	1	The institution understands the importance of IR and its relation to organizational objectives	0.760					
16	5	The institution has an appropriate IR advocacy policies and program	0.670					
17	39	The IR and the institution must be prepared for technology obsolescence					0.476	

Table I.
Rotated component matrix

(*continued*)

Rank[a]	Item no.	Item statement	Component 1	2	3	4	5	6
18	18	The institution establishes the IR to provide access to electronic resources and make scholarly materials available for the future		0.526				
19	31	The IR system promotes broad access to digital resources by applying Open Archives Initiative Protocol (vital)			0.423			
20	12	The IR has the ability to demonstrate usage of repository content, expanding the use of the digital library and efficient use of materials		0.679				
21	22	The institution implements IR software/platforms and standards with an international perspective (flexibility, modularity, integration with different kinds of digital library)		0.424				
22	37	Authors or copyright owners are aware of publishers' policies relating to self-archiving by posting research work in the IR				0.436		
23	20	The IR system has a fast browsing speed to encourage people to use it more		0.480				
24	4	The institution and its community (academics and librarians) see IR as a top priority	0.682					
25	36	Authors and copyright owners voluntarily contribute scholarly content				0.572		
26	43	The IR uses metadata schemas (Dublin Core, MARC, METS, MODS), focusing on chapters, pages or other sub-document divisions (structural metadata)						0.630
27	38	The institution installs and runs new equipment and web-based software that will support the IR system					0.549	
28	3	The institution establishes and implements specific IR goals and policies	0.699					
29	2	The organization has a strategic master plan for digital preservation and IR	0.737					

(*continued*)

Table I.

Rank[a]	Item no.	Item statement	Component 1	2	3	4	5	6
30	23	The IR has search techniques and strategies, suggestions for search terms, supportive/helpful design for the completion of the task, a clear and understandable search result page		0.417				
31	30	The IR system transmits metadata between the repository and other library systems			0.477			
32	34	Individuals in the institution make broad and voluntary participation through self-archive or depositing records/documents				0.711		
33	8	The institution promotes the cultural environment within the organization that there must be a high amount and quality resources in the IR	0.607					
34	35	The institution expands self-archiving culture and provides posting works on a publicly accessible website				0.707		
35	33	The institution convinces authors to self-archive				0.776		
36	28	The institution increases the amount of bandwidth that is normally available to the system, to facilitate the number of people who are simultaneously using the same resource			0.492			
37	19	The IR systems share information about updates, latest usage figures, etc. with the users		0.480				
38	17	The institution establishes the IR as a scholarly communications system and as the system for publishing		0.528				
39	46	The IR system mines resources (content and metadata) from other digital repositories, faculty and departmental websites						0.433
40	32	The institution provides one ubiquitous (available everywhere) link to a form that sends an email to the "help" account (read by multiple people) and provides widespread posting of that email address			0.410			
41	21	The institution seeks out new user populations to develop the IR community		0.442				

Table I. (*continued*)

Rank[a]	Item no.	Item statement	Component 1	2	3	4	5	6
42	11	The institution has sustainability strategies that the IR must adopt to be self-sufficient	0.495					
43	25	The institution mirrors the content available on the system to other servers, reducing the overhead on the system or increasing the overall network throughput to the system			0.655			
44	27	The success of the IR depends on the institution's decision to run with using open source software			0.535			
45	26	The IR system provides applications and reference and information service in several official languages, with bilingual staff in designated locations			0.586			
46	29	The success of the IR depends on the institution's decision to run with using commercial software			0.482			

Notes: [a] Re-ranked based on the mean value of each factor; extraction method: principal component analysis; rotation method: varimax with Kaiser normalization; MARC, machine readable catalogue; METS, metadata encoding and transmission standards; MODS, metadata object description schema

Table I.

Factor	Cronbach's alpha	Cronbach's alpha based on standardized items	Mean score	*N* of items
Management	0.906	0.907	4.093	11
Services	0.886	0.890	4.050	13
Technology	0.763	0.765	3.476	8
Self-archive practices	0.824	0.822	3.942	5
People	0.672	0.671	4.137	4
Resources	0.709	0.725	4.120	5

Table II.
Reliability statistics for each factor

full-text resources within. Gibbons (2004, p. 14) commented that the "recruitment of content, not technology, is the greatest barrier to success" as an indication of the importance of full-text materials to populate an IR to signify its success.

Consistent with the findings of this study is the importance placed on management support. Barwick (2007) and Jain (2011) emphasized that a clear sign of management support is an important success factor to ensure the sustainability of IRs. The current study also reported the following "self-archiving practices" attribute as having high importance in the successful implementation of IRs: easy submission of adequate and updated content; and a clear copyright management statement for the resources. Copyright restrictions have been cited as reasons why authors are reluctant to submit their works in open access repositories (Crow, 2002) which will affect the input activities of an IR. The lack of mandatory provisions in the policies of institutions or funding organizations to deposit the research output into IRs

is another frequently cited reason which will impede successful deployment of this infrastructure (van Westrienen and Lynch, 2005).

The current study has identified that "technology" is a critical factor; however, it received the lowest mean value in terms of importance. Markey *et al.* (2009) indicated that a signifier of success against the goals of a library is how well the chosen technology fulfils the purpose of the IRs. Chan *et al.* (2005) provided an in-depth description of how librarians of the Hong Kong University of Science & Technology (HKUST) repository partnered with their systems colleagues to ensure that the university has a technology that fully supports Unicode. The librarians evaluated the IR software based on criteria such as database structure, interface, search capabilities, special features, software requirements, Chinese, Japanese & Korean (CJK) support, speed and reliability and export options. Giesecke (2011) also noted that libraries involved in the creation of IRs need to get the support of information technology units for a system that meets their requirements.

In terms of this study, functional attributes of the IR, such as availability of IRs in several languages and use of commercial software, are perhaps necessary but not sufficient for success. Barton and Waters (2005), in their research about creating an IR, listed some requirements for the IR software systems including support for multiple languages in the search and user interface. However, this option is a technical feature which is used for evaluating the IR software systems and not the success of its implementation. This research finding on the use of commercial software supports Giesecke (2011), who indicated that choosing a commercial software program can limit the number of technical staff needed and may limit the amount of customization that can be done.

This study has empirically tested and consolidated the factors which are important in IR implementation worldwide and documented them as CSFs. It also frames questions about the possible value of developing some guidelines or standards related to CSFs to be able to monitor the deployment of IRs. This study may help libraries and other IR start-ups to understand what sources and services they need to develop to make their applications successful in an already very populated network. To improve the chance of success, they need to understand and pay close attention to a number of key CSFs; first, to self-archiving practices and, second, to management, as revealed in this study. Identifying and discussing the CSFs of IRs can also influence the success of digital libraries, as the former are a type of digital library system. Both researchers and practitioners in the field of digital libraries and open access initiatives may value the results of this study, as it may help them to develop a more efficient implementation programme of digital library and IR, and to plan how to set priorities that will help ensure desired levels of performance, as well as desired resources and services characteristics.

While this study does provide useful information, further investigation in this area is also warranted. The study population was restricted to only the 2,217 repositories registered in the *Open*DOAR. The sample should be extended to repositories not registered in *Open*DOAR known to future researchers. A wider sample is needed to study the relationships between the importance of the success factors and the actual performance of the IRs to further test the CSF approach and the Digital Library Enterprise Architecture dimensions used in this study. Future research also needs to take into consideration the limitations of this study such as the inability to translate the survey questionnaire into other languages. This may somehow affect the comprehensibility or participation in the survey. Further studies also may serve to explain why certain groups of IR managers (e.g. by country, position, years of

experience, level of education and field of study) differ in their responses to some attributes that they perceived as important in IR implementation.

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About the authors

Fatemeh Lagzian is a PhD candidate from Iran attached to the Department of Library and Information Science in the Faculty of Computer Science and Information Technology, University of Malaya, Kuala Lumpur. Her research interests include digital libraries and institutional repositories.

A. Abrizah is an Associate Professor at the Department of Library and Information Science, Faculty of Computer Science and Information Technology, University of Malaya, Kuala Lumpur. She graduated with a BSc in Environmental Engineering from Temple University, Philadelphia in 1988, and obtained her MLIS degree in 1998 and PhD in 2007 from the University o f Malaya. She has authored many conference and journal papers related to digital libraries and open access repositories. She is the Editor of the *Malaysian Journal of Library and Information Science*, and a research fellow at the Malaysian Citation Centre, Ministry of Higher Education Malaysia. A. Abrizah is the corresponding author and can be contacted at: abrizah@um.edu.my

Mee Chin Wee is a Lecturer in Information Systems at the University of Malaya, Kuala Lumpur, Malaysia. She holds a PhD and her research interests include computers in education, computer managed instruction, computer assisted assessment, online collaborative tools, barriers and critical success factors for the use of computer in education, and data visualization techniques. She has published a number of papers related to these areas.