

CHAPTER FIVE

DISCUSSION AND CONCLUSION

5.1 Introduction

The empirical findings of this study are discussed in detail in the previous chapter covering for the preliminary, descriptive and inferential analyses. The thesis continues the discussion to conclude the research findings, followed by the research limitations and suggestions for future works.

5.2 Key Findings

In view of the proposed research model, the dimension of individual impact on the original IS Impact model is reconciled with the IUIP theory by Ambrose, Rai and Ramaprasad (2006). With this reconciliation, the dimension is called the Individual Usage Impact dimension (that was hypothesised from the DLUIP properties) and so the proposed research model was basically an extended and revised model of the IS-Impact model. Based on the justification given in chapter three (on the purpose of reconciliation), the key findings from the extended model developed for answering the research questions of the study are discussed in the following sections.

5.2.1 Individual Usage Impact (IUI)

In achieving the first, second and third research objectives, the respective answers to the research questions were obtained via the relationships of DLUIP properties and IUI. The following section presents the discussion on the individual usage impact dimension in answering the three research questions: (1) *Is the usage for information provisioning*

model acceptable when applied in the context of digital library?, (2) Do the relationships between Digital Library Usage for Information Provisioning (DLUIP) measures and individual usage depend on the user's awareness factors?, and (3) What is the DLUIP dimension that has the largest influence on the individual usage?.

The conceptualisation of usage in the field of Information Systems has received much debate in the last three decades. However, this study conceptualised individual usage of digital libraries as usage for *information* requirements. This concept is grounded in the work of Ambrose, Rai and Ramaprasad (2006) wherein they proposed *usage* as an evolution of IS Usage. In Digital Library perspectives, the *usage* may reflect the usability of the system. In the literature, the term usability has been used broadly and means different things to different people, added with different types of evaluation to fit in with the nature of the digital library used (Razilan et al., 2011).

From the DL Success model, Individual Usage Impact for information provisioning construct was found to explain about 50% of the variance from the three hypothesised dimensions viz. breadth of content, depth of content and interaction dynamism. The $R^2 = 50\%$ might show only a moderate predictive strength of the IUI. However, the three dimensions of DLUIP showed positive relationships with the IUI construct, as identified in the theoretical frame of IUIP. Developed as a formative construct, the measures (inner model) and structural (outer model) level of assessment showed that the measures and the constructs were significant in explaining the individual usage of the digital libraries. Apart from that, the algebraic sign and magnitude of the path coefficients were as postulated in the theory. With about a moderate predictive strength shown by the initial model, the awareness factor (moderator factor) was introduced. This was a part of investigating the direct and indirect relationships of a certain endogenous latent variable, as suggested by Helm, Eggert and Garnefeld (2009) and Henseler, Ringle and Sinkovics (2009). The awareness

concept of digital library perhaps is only the beginning, as claimed by Hansen and Järvelin (2005). Nonetheless, after using *awareness* as *moderator variables*, the coefficient of determination, R^2 of the IUI construct increased to about 70%. This shows that the model fits the study data well with meaningful path coefficients (weights) with greater predictive strength as compared to the initial model. After incorporating the moderating variables, all the three path coefficients, breadth of content, depth of content and dynamism of interaction constructs yielded positive relationships with the individual usage impact construct. It should be noted that awareness construct is necessary but not sufficient condition for usage. It is related to success but has a process (rather than causal) influence on the individual impact. The results also indicated that all indicators used in measuring the individual usage impact construct were of a confidence level of 95%. There were no indicators dropped in the model due to two reasons. First, no major concerns which related to multicollinearity were aroused because all of the Variance Inflation Factor (VIF) values were found to be less than 3.0. Second, all of the indicators were of a confidence level of 95% and they were all maintained. Additionally, the indicators in the measurement model were conceptually justified (refer to Ambrose, Rai and Ramaprasad, 2006). Due to confidentiality considerations, none of the indicators were removed.

Level of awareness was seen to play a significant role in determining individual usage as it showed a high path coefficient (0.591). Pedhazur (1997) stressed that the acceptable lower limit of the path coefficient value was 0.05 but reinstated that the preferable one was above 0.10. In contrast, Chin (1998b) recommended it to be at least 0.20. However, since there is no rigid consensus with regards to this issue, this study adhered to the former.

Based on the above discussion, three research questions were answered. Firstly, awareness factors did play an important role in the relationships between the three

hypothesised dimensions (content breadth, content depth and interaction dynamism) and individual usage impact construct. In other words, the awareness factors influenced the DL usage to the extent that by moderating these factors in the model, the model's coefficient of determination increased. Secondly, all the hypothesised indicators used in the study were significant indicators in explaining the variation of the individual usage impact constructs. Thus, all indicators were considered meaningful in explaining the relationship as theorised. Thirdly, the impact of individual usage is high as the sub-model (DLUIP) was able to explain the data set by the coefficient of determination, R^2 . The value of $R^2=70.9\%$ describes that almost three quarters of the DL usage can be explained in the model (via the three constructs), and the rest of the portion would have been driven by measures not captured in the model.

5.2.2 Digital Library Success (DL Success)

Past research on assessing the success of a digital library is scarce, as mentioned in previous chapters. However this study attempts to adopt the evaluation technique by applying the revised model of IS Impact by Gable, Sedera and Chan (2008). The model is revised via reconciling the dimension of individual impact (in the IS Impact model) with individual usage for information provisioning (in the IUIP model from Ambrose, Rai and Ramaprasad, 2006). The motivation for the reconciliation is based on the justifications explained in chapter three.

This section is devoted to discussing the answers to the fourth and fifth research questions: *Is the DL Success model valid in measuring the success of academic digital libraries?* and *What is the degree of the impact of the four success dimensions on the DL Success?* Of the 37 success indicators from a-priori model by Gable, Sedera and Chan (2008), the research data set verified only 25 indicators as having impact. However, this verification did not imply that the rest were rejected indicators, but rather

the data set used in this study did not allow for their verification. Using the formative success model proposed by Gable, Sedera and Chan (2008), the model derived from this study fitted the study data well, with an explained variance of more than seventy percent. Thus this research yielded results which are in favour of the dimensions (constructs) and the relationship between the four dimensions and 25 measures (formative measurement model) proposed by Gable, Sedera and Chan (2008). Four constructs were hypothesised in measuring the DL Success viz. Individual Usage Impact, Institutional Impact, Information Quality and System Quality. Based on the successful model developed, the system quality dimension was the most influential impact of measuring DL Success with a path coefficient of 0.537, followed by information quality dimension (0.301). Surprisingly, although individual usage impact was the most important dimension, it showed a significant relationship. The same scenario was also observed with the institutional impact dimension.

The system quality dimension in the study measured how the online library resources performed from the perspectives of technical and design. The DL Success model showed the path coefficient of SQ \rightarrow DL Success with a large magnitude (0.537) and was highly significant (99%). The indicators incorporated in this dimension showed a confidence level of 95%. This showed all of the formative SQ indicators had large impacts on the success of the digital library. Pursuant with this finding, it can be stated that how the digital library is designed and how it performed technically were essential in determining its success. From the technical point of view, measures of a digital library such as being equipped with the most current information, user friendly, easy to learn, and so forth were found to be major concerns from the academic perspective. This finding is closely related to Human and Computer Interaction (HCI), where it has long been discussed in the IS literature. From the design perspective, users might find it convenient in using a particular Information System like a digital library if the interface

design is acceptable and within their preferences. Using an Information System means the users are interacting with the interface and, therefore, it should be easily adaptable. In a study by Wijesinghe, Sedera and Tan (2009), the researchers concluded that the measures used for the system quality dimension are highly relevant to the end-users. Moreover, the high influence shown by this dimension in the DL Success model might be due to its characteristics such as the interface design, functions and technicalities, which played crucial roles in shaping the users' perceptions. In addition, based on the suggestions given by respondents to the last question in the questionnaire, about half of them commented on their university's digital library. They raised the issue of unpleasant designs and dull colours which could be further improved. Furthermore, about a quarter of the responses received mentioned their dissatisfaction with the network connections within the university's vicinity. Some appealed for larger bandwidths to avoid congestion especially during the process of downloading full-text articles. Others suggested improvements in the current server used for the digital library system. In summarizing the outcomes from the proposed DL Success model and users' comments, it was apparent that the system quality clearly influenced users' perceptions. Thus, the quality of the digital library system was considered to be a vital dimension for evaluating the success of a digital library in the DL Success model.

The second highest path coefficient shown by the PLS path model was the information quality dimension. The use of information from academic users is prevalent. Hundreds of research and academic routines are ongoing each day and having high quality information is of paramount importance. Indicators postulated under the dimension of information quality were mainly concerned with the quality of the digital library output (like search results). Dealing with the requested results may contribute to the learning process where the final outcomes might play a significant part in the process. Thus, acceptance and preference of the digital library could somehow be

influenced by the benefits and quality of the outputs received from using the digital library. On the other hand, frustration might arise if users frequently ended up with no matched results, or failed to download full text versions, and so forth. Measures of information availability, currency, accuracy, ease of understanding, and so forth were found to be crucial in measuring the information quality dimension. They were shown with highly significant measures. In fact, the number of comments given by respondents on the information quality was profuse. More than half of the responses complained about the lack of resources, less high impact journals offered in the digital library and the site being infrequently updated. These were areas that needed to be improved besides the search techniques, which they claimed were quite complex. Further, respondents requested for a wider range of e-journals and more e-books. Academic users are from a variety of academic backgrounds, ranging from social science, engineering, and science to technology, as well as lecturers and students. Different academic backgrounds would require different academic online resources and this requirement has to be fulfilled everyday. Thus such online library resources as academic digital libraries should provide a wealth of categories of information that meet users' needs. Insofar as the information quality of the digital libraries is concerned, improvements needed are as indicated by the study respondents, and the DL Success model developed had shown statistical evidence of its high impact on the success of the digital libraries.

Based on the derived model, the results are still consistent with that of Wijesinghe, Sedera and Tan (2009) who found that systems quality and information quality measures are highly relevant and capable of proving better results in the Information Systems success model estimation. However, this study indicated that individual usage impact dimension did not show an important relationship in assessing the success of the digital library. The path coefficient from the individual impact of DL

Success was shown to be 0.100; it is small in magnitude but still significant at 99%. However, it showed substantial predictive strength with the three DLUIP dimensions with $R^2 = 0.709$. The IUIP theory developed by Ambrose, Rai and Ramaprasad (2006) is a contextualised measure of the Information Systems usage. Thus they emphasized the appropriateness of using this measure to evaluate its relationships with the success of the Information Systems use. In line with this, the relationship might not be meaningful in the DL Success model, but it was still significant and should be kept in the model. This was verified by the significance of the path coefficient and the formative measurements. The significance of the individual impact was apparently shown by the IUI model. All of the path coefficients from BC \rightarrow IUI, DC \rightarrow IUI and ID \rightarrow IUI were at confidence levels of 99%, 95% and 95%, respectively. Among these three DLUIP dimensions, Breadth of Content (BC) was found to be the most important indicator in influencing individual usage.

A similar finding was detected with institutional impact. The path coefficient was far below the fit index and it was significantly below the 85% confidence level. This result may be due to this reason. The IS Impact model was built under the enterprise system which implies the usage of such system was meant for companies or organisations. This measure related to the impact of the organization might be different in the context of the intention of use by individuals (that is, the use of the digital library is for personal academic needs and not using it for university purposes). In view of the different contexts, the conceptualisation of the measures of this dimension may refer to a different scenario, as compared to the enterprise system. Hence, the least important relationship between institutional impact and DL Success indicates that the academic digital library provided by the university is not for the university's academic processes. Indirectly, it represents the facility for students and academicians through which the university might gain certain benefits, such as in terms of better library processes, cost

savings, and so on. Through the results obtained, the DL Success model was assessed by focusing on the model itself in regards to the data sample. Following the process theories (Mohr, 1982), this dimension might not have had a direct impact on the success of digital libraries, but it was still necessary to maintain it in the model.

Findings from this research produced useful insights of the most important dimensions to be considered for the success of academic digital libraries. The positive impact of the 25 success indicators had been verified in the study that determined the success of academic digital libraries. The impact of the DL Success construct could be verified, but may not always be generalised to the entire student population in all higher learning institutions for the reason that the study sample used was only from the public universities. However, it can still be generalised to the population of the public universities across the country. The model's path coefficients with lower confidence levels remained to be verified by a study using larger samples. Systems Quality (SQ) and Information Quality (IQ), the two most relevant dimensions for influencing the success of academic digital libraries, should be given priority by institutions especially in the developmental stages of the digital library. Also, this research revealed that the Institutional Impact dimension was the least relevant dimension in evaluating academic digital libraries; however, it was verified as a significant construct at a lower confidence level.

The above discussion leads to the answers to the last two research questions: *Is the DL Success model valid in measuring the success of academic digital library?* and *What is the degree of the impact of the four success dimensions on the DL Success?* In view of the results obtained, all the four formative constructs with the respective hypothesised formative indicators were at a confidence level of 99% and some of the indicators were below 85% confidence level. Since the measurement model was conceptually justified, all indicators were maintained in the model, as suggested by

Henseler, Ringle and Sinkovics (2009). Thus, this study concluded that system quality, information quality, individual (usage) impact and institutional impact are all potential measures to be considered in modeling the DL Success, in the context of academia.

Findings from the study also revealed key improvements (extracted from the last question in the questionnaire) pointed out by the respondents. The key themes rendered from the written feedback are in relation to systems and information needs. This finding resembles that of Liu and Luo (2011). They revealed that the convenience and speed of information delivery are two crucial measures leading to digital library usage among undergraduate and graduate students in two universities in China. The findings of this study showed that among the crucial measures are the systems and information dimensions (results from the path model) such as the digital libraries responding rapidly (the speed), the information or data being always current, the information needed is always available, and the output is as expected, and easy to use. These measures were among the hypothesised measures and exhibited strong and moderately strong relationships with the success of the digital libraries. The measures could epitomize the concerns among the academic community requiring the latest e-journals, e-books and full-text downloadable e-journals without delay. Moreover, the availability of having such information is also vital. In addition, measures related to the digital libraries' interface design, and features and functions are also found to be important factors in the study. The last open-ended question also noted the improvements suggested for the university's networking, as respondents complained of frequent congestion and slow connection that disrupted their use of the digital libraries. To a lesser extent, the desire for more language options was also mentioned.

5.3 Discussion of Research Findings

Developing a success model for evaluating digital libraries is considered rather new and more contribution is required in this research area. It is the result of the developments in the systems' architecture that have been custom-built and deployed to the environments which they have been suited for. The past two decades witnessed the on-going research contributing to measuring the success of digital libraries. In this thesis, the attention is given to evaluate the success of academic digital libraries in accordance with the following study objectives:

1. To determine the suitability of Digital Library Usage for the Information Provisioning (DLUIP) model in measuring Individual Usage Impact.
2. To identify the effects of users' awareness in moderating the relationships between DLUIP indicators and individual usage.
3. To investigate the most influential DLUIP dimension on the individual usage.
4. To investigate the suitability of the information systems' success indicators in measuring the success of the digital libraries.
5. To determine the impact of the four success dimensions on DL Success.

In addressing these objectives, the following discussion is prepared based on the findings obtained, to answer the five research questions formulated in accordance to the research objectives. The research questions are:

1. Is the usage for information provisioning model acceptable when applied in the context of digital libraries?
2. Do the relationships between digital library usage for information provisioning (DLUIP) measures and individual usage depend on the users' awareness factors?

3. What is the DLUIP dimension that has the largest influence on the individual usage?
4. Is the DL Success model valid in measuring the success of academic digital libraries?
5. What is the degree of the impact of the four success dimensions on the DL Success?

Prior to discussing the findings that would answer the research questions, some discussions are presented on the descriptive and inferential analyses of the data.

5.3.1 Internet Access and Knowledge

Internet access provides a platform for users to use the digital libraries. The availability of the Internet connection could facilitate access to resources provided by the digital libraries, which indeed require an efficient networked infrastructure. Since the launch of the five-year ICT plan, for the years 2006-2010, Malaysia continues to deliver advanced information, communication and multimedia services. Among the prominent services are the high speed broadband, 3G (and now moving to the Next Generation Networks, NGN), Voice over Internet Protocol, VoIP and Internet telephony (Abu Hassan and Omar, 2009). In addition, International Telecommunication Union, ITU (ITU, 2010) reported that in 2009 the Internet usage statistics in Malaysia are estimated at about 65% of the country's population. Based on this high percentage, Malaysians are among the fortunate for having many options to access to, or be in, a networked environment and fostering this technology for learning activities. Opportunities to use the Internet for fulfilling academic community information needs may not be a setback in the country as compared to other less developed countries (Rosa and Lamas, 2007).

Through the rife of network facilities being provided within the campus and the university's vicinity, accessing the Internet may not be problematic for many. This study revealed that the majority of respondents accessed the Internet for the purpose of information searching from their faculties or offices, followed by from their homes and the hostels. The finding indicates that the Internet access for fulfilling their information needs is widespread and the users have many options to access the resources. The finding shows that digital library resources are in fact reachable by the academic communities in the four universities.

Another angle of research investigated is the issue of whether the Internet skills (knowledge) that users possess can help them to use the digital libraries better. Research findings indicate that more than 90% claimed that the Internet skills did help them to search for information using online library resources. This finding implies that the Internet skills and literacy play an important role in the use of the digital libraries. Hargittai's (2010) recent empirical study also found that the Internet *know-how* is associated with higher levels of Web skills.

5.3.2 Users' Awareness of Digital Libraries

For this study, awareness of Information Systems such as digital libraries is defined in two ways; firstly, the ability of the users to know about the digital library, and secondly, the ability of users to know what to do with the services and functionalities of the digital libraries, depending on the knowledge they have, or have gained, and seen or felt from the surroundings. Thus this research emphasised not only on usage awareness but also awareness of the Information Systems (the online library resources). As cautioned by Brown (1994), lack of awareness of the information resources on the Net and of the skills to locate the specific information required may lead to a low usage of the Internet. He believed that high awareness would drive high Internet usage. In this circumstance,

awareness of the digital library would indicate either a high or low usage of the system. The following discussion summarised the research findings.

From the study data, it was found that the awareness and use of the digital libraries were high among academic users. This study is consistent with a recent international study by Veeramani and Vinayagamoorthy (2010) and Shelburne (2009).

Analyses of association between level of awareness of the digital libraries and demographic profiles, the Internet usage and skills were also carried out. Age was found to be the most significant factor influencing the level of awareness. This finding confirms the study by Chu and Krichel (2003). Furthermore, there was statistical evidence of a relationship between level of awareness and the Internet usage pattern among respondents. The negative correlation between these two indicators implies that the higher the level of awareness (more familiar with the system), the higher the usage. This is in line with the findings of Brown (1994). This study's findings found that awareness factors showed evidence of an impact on the digital library usage among academic users.

Five research questions addressed in the study were answered according to the sample data used. In modeling the DL Success, the Partial Least Squares (PLS) path model was proposed. The PLS path model background started from the factor analysis, path analysis and simultaneous equation model in which these three led to the causal models. The spreading of the causal model led to the theory of Structural Equation Model (SEM) which later yielded two main approaches, Covariance Structure Analysis and PLS path model (Wold, 1982), which Fornell (1982) indicated as the second generation of multivariate analysis. The PLS path model was proposed in the study mainly due to the following reasons. Firstly, the PLS path model is SEM that is capable of analysing complex cause-effect relationships. Secondly, this approach has become increasingly popular in IS research and other disciplines like marketing (Albers, 2010).

Thirdly, the method is capable of handling both reflective and formative indicators where the data can be quantitative or qualitative (scaled or binary exogenous variables). Fourthly, the approach precludes the conditions of normality and works well with small sample sizes (Ringle et al., 2009). With these reasons, the PLS path model was applied in modeling the DL Success in addressing the study's research questions.

5.4 Library Perspectives

Textual analyses of the site interview sessions among the library personnel set in the study showed several advantages, as well as several new issues of the digital library implementation across the universities.

The implementation of digital libraries has brought a new environment to the library in providing information resources to its end users. The physical library may not be the main venue for fulfilling users' information needs as before. Some of the librarians are exposed to new work experiences to manage online library resources which require them to be re-trained. However, the main advantage of the digital library is that end-users are more independent in searching for information, they may not have to be at the library, or seek the librarians' assistance. However, it has its own main setback especially on the issues of the systems and technology. The systems and technology used in supporting the digital library sometimes fail to operate arising in users' dissatisfaction. Some of the librarians maintained that systems failure was beyond the library's control, which users find hard to understand.

The findings of this study also uncovered issues of costing and the librarians' lack of skills in managing the digital libraries. Transforming to the digital library demands a high budget, especially in procuring the systems and the hardware. Although each university has been allocated a library budget (from the university, as well as from the Ministry of Higher Education), the state of yearly-increase in subscription fees of journals alarmed the academic libraries. Academic libraries are very dependable on the

allocated budget and if any variation incurred, particularly those that imply increases in costs, they have to re-apply for either a new or additional budget. Apart from that, lack of appropriate knowledge or experience in the digital library job functions had also bothered many librarians. Some of them end up multi-tasking in their respective jobs and this directly increased their work responsibilities.

Future plans set for the digital library mainly focussed on exploring new digital library technology and improving the existing systems, as well as adding more information resources. The plans also emphasized on the collaborative efforts across universities aimed at generating inter-library loans, among other things, especially for institutional repositories. Major challenges discovered through the short interviews are financial, manpower and skills, and digital library technology. These three elements have brought librarians to new perspectives of employment as librarians, particularly in managing online library resources.

Several aspects were revealed through the interviews in supporting the DL Success dimensions that have little impact on the success of the digital libraries. Briefly, the key aspect brought up was that the academic digital libraries in the public sector were managed and run by the respective universities under the umbrella of the same body, the Ministry of Higher Education. Despite the controlled budget, limited library staff, limited digital library technology skills and similar targets for the university ranking (as extracted from the interviews), the academic digital libraries were found to be fully operational. Therefore, the measures of the institutional impact dimensions such as budget, staff and positioning of RU rankings cannot be said to have a direct impact on the success of the digital libraries. However, the measures can be further extended (in future research) to reflect the scenario of academic institutions in more detail.

In this study, the researcher has addressed five research questions. In relation to the first three research questions, the study showed that the formative Individual Usage Impact dimension was able to explain almost three quarters of the variation in the DL usage using the postulated three DLUIP formative dimensions - Breadth of Content, Depth of Content and Interaction Dynamism. Concerning the last two research questions, the results of the study showed that the formative measurement model offered an insight into the impact of the four formative dimensions (individual usage impact, institutional impact, information quality and systems quality) influencing the success of the academic digital libraries. Using the study data, the DL Success model proposed in the study is a reliable model in measuring the success of the academic digital libraries in public universities.

5.5 Research and Practical Implications

In previous sections, the researcher had discussed all of the research findings, which encompassed several key implications, for both research and practical purposes. In terms of research implications, the model may be used as a guideline in measuring the success of the academic digital libraries. Furthermore, this study assessed the pure formative measurement using partial least squares in assessing the digital libraries' success; such a model has become increasingly popular in the IS literature (Albers, 2010).

The first implication for practice purposes is that the university library's administrator, especially the Chief Librarian, should take into consideration the awareness of the academic digital library that might further induce the academic community's recognition of such system. The awareness of digital libraries among the university community can be gained through library promotions, social networks and other means that can be planned to make them become more aware of it. Information gathered from the interviews implied that all of the four universities are administering

different kinds of activities to promote their digital libraries. Promotion strategies by the academic libraries are considered helpful in promoting the usage of the digital libraries in the universities.

The second implication is that the study model and survey instruments can be used to benchmark the university's online library resources. All of the success factors are not difficult to apply as the instruments are readily adaptable.

The final implication is that the indicators used to offer practical means to drive the success of the academic digital library, thus the final model based on the verified success indicators can be used by the university, in particular the library, to evaluate the success of its digital library. This study explored the overall evaluation of the academic digital libraries, therefore the yielded success model should be capable of giving insights to evaluators on prioritizing success factors to improve their digital library services and functionalities.

The key practical implication of this research is that the success indicators hypothesised can be employed in assessing the success of digital libraries to prepare for the libraries' strategic plans based on current scenarios.

5.6 Research Contributions

The main aim of the research was to assess the overall performance of the academic digital libraries as a successful Information System, hypothesised by pure formative constructs and dimensions and using partial least squares path model in modeling the study data. Thus, this research aimed to make four main contributions in the field of Information Systems. Firstly, the DL Success model developed can be used to benchmark the overall evaluation model of the digital libraries. Secondly, as expected by academic users, the contribution is towards improving the digital libraries' overall quality as online library resources and service providers. The key success measures indicated by the proposed DL Success model, namely indicators of the systems quality

and information quality dimensions, should provide insights to the academic libraries in prioritising users' requirements so that improvements in current digital libraries (if necessary) can be achieved in order to fulfil their information needs. Thirdly, the usage of extensive knowledge acquisition among academic users would serve as a basis in understanding *what* and *why* the DL should be used. The main theme from the three postulated DLUIP dimensions concerns the users' extensive knowledge acquisition. The *what* and *why* factors should lead to the point of how useful the digital libraries are in supporting information services for the academic libraries and how well the digital libraries support the information needs of the target users. These factors could be treated as part and parcel of the success factors of the academic digital libraries. Fourthly, the proposed indicators from the four dimensions of the IS-Impact model is capable of being treated as success measures in assessing the academic digital libraries.

5.7 Future Work

In many respects efforts in this new area of study need further research. Although the proposed study model presented a higher order of the formative measurement model, an alternative model might yield different results. This study employs three first-order formative, four second-order formative and one third-order formative measurement models. The reason why only one type of measurement model was selected is because the study was not meant to test the relationships between the hypothesised constructs, but rather to use and explore the practicability of the IS-Impact model in assessing the DL Success. Therefore, the researcher calls for further research in examining alternatives to the DL Success model that can be extended by testing different orders of formative model and validating and generalising formative tests using the guidelines as found in the literature.

Although the model derived in the study fits the data reasonably well, a replicated analysis should start with all postulated relationships of all the success

indicators set in theory. This is the first study to adopt the IS-Impact model to evaluate a different application of an Information System (other than the Enterprise System). Thus, there is a need for further research to test the generalisability of the IS-Impact model, such as across different universities (public and private) in searching for the best measures and dimensions of the DL Success.

Future research is to improve the success prediction by taking into account mediating factors in the success model (for example, social norms) or to incorporate new measures for individual impact as well as institutional impact dimensions. The new measures need to be well conceptualised, operationalised and validated as the model constructs posited to be the formative dimensions of the multidimensional concept (Gable, Sedera and Chan, 2008: 400). Further, a replicate survey may be performed on different types of universities (public or private), breaking down the subjects such as considering the scholars from only graduates (or undergraduates) or to focus on specific domains of discipline in obtaining various impacts across universities. The last suggestion is important in exploring the influential usage indicators, for instance in science that might differ from the art disciplines. According to Vakkari (2008), different disciplines may have different effects on the dimensions of digital library usage.

The study may be further extended by using not only the public universities but private universities as well. The results of this study may be generalised to the public sectors but not the private sectors. Private universities are run by different managements and boards, and thus might show different results compared to those found in this study. Therefore, future research can be conducted to compare and contrast the data set from the two university sectors to contribute to the success of digital libraries.

5.8 Conclusion

This study presents an assessment of digital libraries using the Information Systems success model. It should be treated as a preliminary initiative in using a formative

measurement for assessing the success of academic digital libraries. The derived success model is developed under the theoretical framework of Gable, Sedera and Chan (2008) and Ambrose, Rai and Ramaprasad (2006). From the practical perspective, the DL Success model can be described as a novel evaluation framework for assessing academic DL. This framework can be used as a start in evaluating the success of DL. Despite allowing the prediction of the success of a digital library, universities may find it useful in exploring and examining the aspects of four dimensions namely system quality, information quality, individual impact and institutional impact in assessing and improving academic digital libraries. By establishing the contribution of each dimension, librarians or the university's library may focus on which measures to be prioritised, given a strict and limited budget and manpower skills, when designing or enhancing its digital library. Above all, systems quality was found to be the most relevant measure (which indicates the highest influence on users) and from the HCI community, it has a connection with the systems design and technical aspects. The term "design" within the HCI community means "*...the process of modeling users and systems and specifying system behavior such that it fitted the users' tasks, was efficient, easy to use and easy to learn*" (Wright, Blythe and McCarthy, 2006). The finding implies the significant impact of the interaction between human beings and the computer, and it is still a prominent measure in spite of the years of struggle to integrate the design in research and practice to fulfil users' needs.

In recent years there has been a growing upsurge of online library resources for academic users of public and private higher learning institutions. Despite millions invested in providing such Information Systems over fast changing technologies in IT and ICT, little attention has been given in evaluating its success on its targeted community.

In this study the researcher proposed and developed a novel framework in modeling the success of the academic digital libraries by taking into account four main formative dimensions, individual usage impact, institutional impact, information quality and systems quality. Furthermore, another three formative dimensions of content breadth, content depth and interaction dynamism have been brought together in discovering the impact of individual usage of using the digital library. The novel framework was drawn from theoretical grounds, defining the measures and construct in a formative mode, and making the model as a pure formative measurement model.

The developed model, DL Success, was illustrated in a case study comprising four research universities in Malaysia, based on the universities' online library resources. This research has established that for the individual usage impact dimension, the three dimensions demonstrated that all indicators and constructs (as posited in theory), played a crucial role in explaining the impact on the individual. For the whole model, the system quality dimension was shown to have a substantial impact on the success of the digital library, alongside the information quality impact. Nonetheless, both individual usage impact and institutional impact dimensions showed significant relations in explaining the variation of DL Success. The findings of the study indicated that the proposed DL Success model can be used as a sound basis for measuring the success of the academic digital libraries because it was developed based on the IS-Impact model, the most comprehensive and rigorously validated model in Information Systems evaluation (Razilan and Diljit., 2012a; Razilan, Fatimah and Diljit, 2012b, Rabaa'i, 2010; Elias and Cao, 2009; Ifinedo, 2006). While the IS-Impact model was developed with a strong analytic theory, the adoption of the model in different contexts especially in the academic digital libraries is yet to happen. Therefore, despite the results gained in this study, there is still a need to operationalise, and consequently, generalise and validate the dimensions and measures (which are beyond the scope of the

study) in the context of the digital libraries. The adoption of the IS-Impact model in the context of the academic digital libraries is proposed strongly on the basis of reusing the validated formative success measures and dimensions which was shown to have causal relationships with the overarching measure, the DL Success. The study aimed at using a robust and simple success model, and yet can be generalised.

Digital libraries do not only represent academic online repositories but are also responsible in facilitating and servicing information for extensive knowledge acquisition processes among scholars. Digital libraries provide access to collective academic resources that can be used to support the academic users in their learning and researching processes. Consequently, digital libraries have played a prominent role in bridging the scholars with the ubiquity of academic resources and by far, it is better than the traditional libraries.

Finally, the importance of individual usage of the digital library in the context of extensive knowledge acquisition should not be sidelined. Academic digital libraries are surrounded by different academic backgrounds which entail different information needs and usage. The academic communities form a sub-group of people with similar study disciplines and research interests. Thus, the DLUIP indicators should be helpful in explaining the breadth, depth and dynamics of the information they require in their academic tasks that could in turn affect the usage of the digital libraries. Based on the findings of the study, all of the success indicators play an important role in driving the success of the academic digital libraries. In line with positioning itself with the status of the Research University, the academic library should be equipped with excellent support systems such as online library resources. A deeper understanding of the necessities for such digital library systems can be gained via evaluating the systems.

The study concludes that the assessment of the performance of the academic digital libraries based on an Information Systems success model has been verified using

academic users from four public universities in Malaysia. The DL Success model proposed is based on an extended model by Gable, Sedera and Chan (2008) and Ambrose, Rai and Ramaprasad (2006). The study has verified 25 measures (out of 37) as significant measures that impact the success of digital libraries. With respect to this result, the other 12 measures have not been rejected, rather those measures cannot be verified by the study data at the point it was investigated. It should be noted that if there is a replication of such assessments, the analysis must start with all of the 37 success measures and four dimensions, with theoretically assumed relationships with the DL Success.