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The Evaluation of Data Warehouse and Business intelligence for Quality Assurance of Education Institutes in the Northern Region, Thailand.

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บทคัดย่อ

งานวิจัยนี้มีวัตถุประสงค์เพื่อประเมินประสิทธิภาพของระบบสารสนเทศประกันคุณภาพการศึกษาของสถานศึกษาในเขตภาคเหนือ โดยใช้ตัวบ่งชี้และเกณฑ์การประเมินประสิทธิภาพระบบสารสนเทศของสถานศึกษา เพื่อให้มีประสิทธิภาพและประสิทธิผลสอดคล้องกับความต้องการของสถานศึกษา กลุ่มตัวอย่างของการวิจัยคือผู้บริหารสถานศึกษา ครู และนักเรียน เครื่องมือที่ใช้ในการเก็บข้อมูลเป็นแบบประเมินที่มีเกณฑ์ 6 ระดับ วิเคราะห์ข้อมูลด้วยการวิเคราะห์ความถี่ ร้อยละ ค่าเฉลี่ยเลขคณิต ส่วนเบี่ยงเบนมาตรฐาน และค่าความแปรปรวน นอกจากนั้นได้มีการทดสอบข้อมูลโดยใช้ One Way ANOVA และทดสอบเปรียบเทียบพหุคูณโดยวิธีการ Shceffe' ผลการวิจัยพบว่าผลประเมินในภาพรวมของระบบ DWBIS มีค่าเฉลี่ย 3.87 ระดับดี และจากการวิเคราะห์ความแปรปรวนเพื่อทดสอบค่าเฉลี่ยของโรงเรียนขนาดใหญ่ กลาง และเล็ก พบว่าผลประเมินมีความแตกต่างกันตามขนาดของโรงเรียนอย่างมีนัยสำคัญทางสถิติ เมื่อทำการทดสอบข้อมูลโดยใช้ One Way ANOVA ที่ระดับนัยสำคัญ .05 และพบว่าค่าเฉลี่ยของผลประเมินด้านประสิทธิภาพของระบบสารสนเทศฯ ของผู้บริหารสถานศึกษาไม่มีความแตกต่างกัน ในขณะที่ค่าเฉลี่ยของผลประเมินของครูและนักเรียนมีความแตกต่างกัน อย่างไรก็ตามเมื่อทดสอบเปรียบเทียบพหุคูณโดยวิธีการ Shceffe' พบว่าค่าเฉลี่ยผลประเมินด้านประสิทธิภาพของระบบสารสนเทศฯ ในกลุ่มตัวอย่างแต่ละกลุ่มไม่มีความแตกต่างกัน ทำให้ผลลัพธ์ของการวิจัยดังกล่าวมีความสอดคล้องกับสมมติฐานการวิจัย โดยประโยชน์ที่ได้จากงานวิจัยครั้งนี้สามารถช่วยให้โรงเรียนที่สนใจในการปรับปรุงกระบวนการประกันคุณภาพของโรงเรียนที่ใช้ระบบDWIS มีข้อมูลเชิงประจักษ์และแนวทางปรับปรุง ระบบDWISให้มีประสิทธิภาพและประสิทธิผลสอดคล้องกับความต้องการของสถานศึกษา

คำสำคัญ: ธุรกิจอัจฉริยะ คลังข้อมูล ระบบสารสนเทศ การประเมินประสิทธิภาพ ระบบประกันคุณภาพ

Abstract

The objectives of this research were to study the performance evaluations in Data Warehouse and Business intelligence System (DWBIS) of education quality assurance among schools in the northern region of Thailand. This project was used for identifying evaluation indicators and criterias to assess system efficiency which compliance with targets of education institutes management, and study consequences and provide recommendations regarding usage of DWBIS in schools. The samples were selected by purposive sampling method; samples included school directors, teachers and student. Data collection tools consisted of the 6-scale evaluation form that was analyzed by using frequency, percentage, arithmetic mean, and standard deviation as well as inferential statistics including One-way Analysis of Variance (One-way ANOVA) and Scheffe's pairwise analysis. The average score of DWBIS is 3.87 was considered as good. Analysis of variance is used to test the mean of DWBIS of large, medium and small schools by using F-test and one-way ANOVA. All results have shown that the performances of DWBIS in various school sizes were relatively different at .05 significance level and researchers have tested all data One Way ANOVA at significant level of 0.05. The results of the experiment have shown that the average of information system performance of school directors was not significantly different. On the other hand, both teachers and students were different. However, by using the Shceffe' multiple comparisons, it has been found that the average of the information system performance of each group was not different. These results have corresponded to the research hypothesis. The benefits of this research can be applied to school that interest to improve their DWIS quality assessment system. By having an empirical data to improve and guide that DWIS system can give efficiency and effectiveness accordance with the requirement of educational institution.

Keywords: Business Intelligence, Data warehouse, Information System, Performance Evaluation, Quality Assurance System

Introduction

The decision support systems are highly efficient for enhancing the value of service information, certain studies have emphasized the significance of information-value offerings in Business intelligence Systems (Popovic, Hackney, Coelho & Jaklic, 2014) and the Information technology system is one of key factors that enhance capabilities and potential of education institutes. Information technology management is about integration of relevant factors and processing of data to facilitate retrieval and distribution to related persons, with the objectives to support decision making in management, operation, control, analysis, and organization structuring to ensure efficiency (Laudon & Laudon, 2014). Information system is the data that are systematically compiled to deliver values for users (Turban, McLean &. Wetherbe, 2002; Laudon & Laudon, 1999). Organization requires knowledge in terms of awareness and understanding about information system and its applications to support works (Stair & Reynolds, 1999). Quality assurance of

education reflects efficient educational management. Executives of institute are obliged to identify management direction, thus requiring data and information to facilitate thorough decisions for optimum alternatives. Therefore, Information is essential for organization as data will be retrieved for processing and analysis to ensure suitable and timely decision of management. The resulting performance enhancements (Chuang & Lin, 2015). Suitable evaluation structure should be applied for information system management project. Widely-accepted evaluation structure should include assessment of environments or input, and output of project (Madaus, Scriven, & Stufflebeam, 1983). The types of data used by schools for decision making or improvement have been catagorised in a variety of ways. At a basic level data can include both qualitative and quantitative forms (O'Brien, McNamara, O'Hara & Brown, 2019). Hardy argues that accountability processes in schools are increasingly linked with "processes of quantification of educational outcomes" as opposed to providing more detailed and qualitative accounts of student learning which may better reflect the broader purpose of schooling, beyond a concern to raise test results (Hardy, 2015).

The Data warehouse and Business Intelligence System (DWBIS) has been developed in the year 2015 and has been applied in 26 schools in the northern region of Thailand under the Memorandum of Understanding (MOU) of Phayao University with 26 schools in the northern region. The evaluation of DWBIS aims to evaluate the performance over the past 3 years (2016-2018). Information systems improving the performance of information system is one of the most important tasks for satisfaction and mixed sustainability-resilience framework for evaluating Information systems is proposed in this study in order to enhance their performance from a mixed sustainability-resilience view (Haghighi & Torabi, 2018). The evaluation of DWBIS efficiency for quality assurance of education among education institutes in the northern region is divided into 2 parts which are Part 1 – System testing which consists of Alpha Stage and Beta Stage, and Part 2 – Evaluation of DWBIS efficiency of education institutes, which consists of Input, Process, Outputs, and Impact. Questionnaires of this research have been tested in terms of validity and reliability in various circumstances (Cronbach, 1963).

Objectives

To evaluate performance of DWBIS for quality assurance of education among education institutes in the northern region and to study impacts of information system and identify evaluation indicators and criteria to assess quality of education institutes in the northern region. This is an evaluation of the DWBIS used in the years 2016-2018.

Research Hypothesis

1. Performance of information system operation is directly related to size of education institutes.

2. Impacts of information system is directly related to performance of education institutes.

Research Methodology

Population and samples, Non-probability sampling is used to select samples according to qualifications as system users and testers (Niyamangkoon, 2003) and samples are also selectively recruited by using Purposive Sampling from 26 schools in the northern region, which include 26 managements, 52 teachers and 52 students. For Beta Stage testing, 20 technical specialists are selected.

Evaluation scope is divided into 2 parts which are Beta Stage test to test performance of system by technical specialists, and performance evaluation of DWBIS for education institutes to assess impacts of information system and develop evaluation indicators to quality criteria. Such indicators include Input, Process, Outputs, and impacts of system. 26 schools are selected and evaluated by 20 specialists in terms of performance against targets of management. Index of relationship of indicator and objective of information system and management policy of schools is 0.75 - 1.00.

Development of criteria, researcher has gathered information from various sources and synthesized evaluation indicators and criteria. These criteria have been validated by 5 specialists.

Data collection tools, the data collection process are analyzed based on evaluation criteria which include questionnaire, scale. For the 1st set of questionnaire, Alpha and Beta system test include Functional, System Design, Performance, Reliability, and Usability. For the 2nd set of questionnaire, evaluation of DWBIS includes the interview about respondents' profiles, general information of schools such as location, size and classes, number of students and teachers evaluation of information system performance, problems and recommendations of evaluators.

Validation of data collection tool, Questionnaire is validated by specialists and qualified persons. Each question and evaluation criteria will be processed by using index of item objective congruence and adjusted based on recommendations of specialists. Data collection process, Researcher collects data by using questionnaire. For management, researcher collects data by using in-depth interview. For management, teachers and students data are gathered by using questionnaire. An alternative approach to the estimation of information theoretic measures is considering the recorded data as continuous variables (Darmon, 2016) The Data analysis this process is divided into (1) General analysis from questionnaire which applies frequency, arithmetic mean, and percentage (2) Analysis from scaled questionnaire which applies arithmetic mean and standard deviation (3) Information system performance analysis which applies arithmetic mean and standard deviation; results are analyzed by using 6-scale criteria, from the worst to the best (4) Statistical Correlation for hypothesis testing, which include One-way ANOVA and Pearson correlation. The analysis of variance (ANOVA) identifies significance of effects of different factors on the response variable. ANOVA utilizes a regression model to fit the experimental data and establishes statistical significance of factors and their interactions (Raz, Kenley & DeLaurentis, 2017).

Research Findings

Development of DWBIS efficiency for quality assurance of education among education institutes in the northern region has been established based on SDLC. There are 10 modules of DWBIS functions that fulfill requirements of all sample groups which consist of basic data management for school, adjustment of criteria or indicators in computer, record of performance against quality criteria and indicator, management of performance and data of output, analysis of data to support decision making of management for quality assurance of education, reporting of evaluation results, evaluation by committee, self-evaluation, user management, reporting of results and presentation of Self/Check Assessment Report (SAR/CAR). The DWBIS screen captures as shown in figure 1.

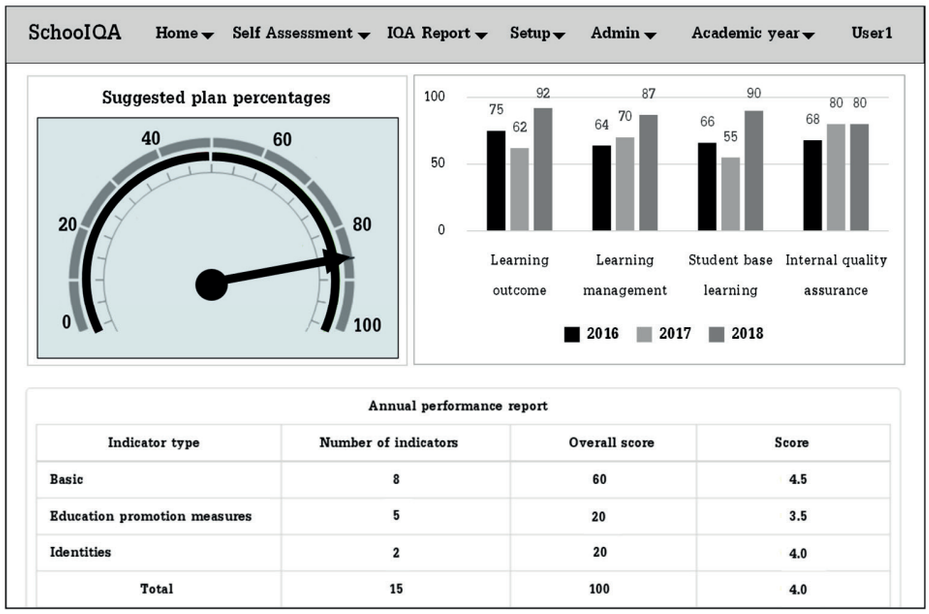

Figure 1 The DWBIS Report Screen Capture

Research findings shown that 75% of education institutes are middle school, while large and small school are 15% and 10% respectively. Most samples are moderately capable of using computer. Information system management policies vary by size of schools in the northern region so efficiency of DWBIS is also different. Information system policies of large school differ from those of small ones at .05 significance level.

Results of system test and performance of DWBIS are divided into 2 parts; average score of system test is considered good at 3.87. By aspect, test results are all satisfactory; score of System Design is 3.78, Performance is 3.82, Functional Requirement is 3.86, Usability is 3.94 and Reliability is 3.96. In term of alignment with target of education institutes, index of relationship of indicator and objective of information system and management policy of schools is 0.75 - 1.00. System test results by aspect are shown in figure 2. Results of information system performance evaluation are as follows;

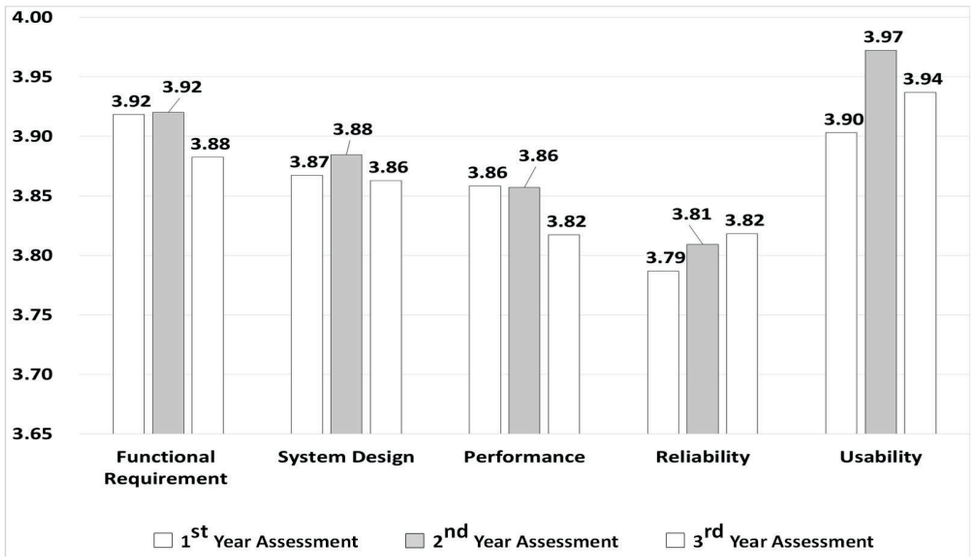

Figure 2 System Test Result by Aspect

Comparing the results of the past 3 years (2016-2018) the results of the evaluation are likely to increase and there are some issues downside. The system has been improved by consulting team for improved the satisfaction to customize the DWBIS functions, adapted report features and adapted user interface for more users. The comparison results of the past 3 years as shown in Table 1-5.

Table 1 Comparison and Evaluation of Functional Requirement

Functional Requirement	2016	2017	2018
1. Function	4.11	4.12	3.99
2. User Interface	3.80	3.81	3.84
3. Input Data	3.89	3.90	3.94
4. Processing and Output	3.63	3.71	3.64
5. Data Management	3.92	3.96	3.78
6. Backup and Recovery	3.98	3.96	3.94
7. Modern and Integration	3.86	3.88	3.83
8. Report	3.91	3.85	3.87
9. Usability	4.16	4.17	4.12
10. Security	3.92	3.83	3.86

Table 2 Comparison and Evaluation of System Design

System Design	2016	2017	2018
1. Process	3.94	3.96	3.92
2. Easy to use	4.12	4.16	4.04
3. Centralized DB	3.88	3.92	3.83
4. High flexibility	3.67	3.73	3.72
5. Clear and beautiful	4.07	4.02	3.94
6. Easy access	3.71	3.72	3.74
7. Standard	3.96	3.97	3.99
8. Elements of art	3.82	3.84	3.84
9. Image and text clarity	4.05	4.10	4.02
10. Data classification	3.46	3.43	3.58

Table 3 Comparison and Evaluation of System Performance

System Performance	2016	2017	2018
1. Basic Data Management	3.77	3.78	3.77
2. Criteria and Indicators	3.66	3.62	3.46
3. Input Data	3.78	3.77	3.84
4. Document Management	4.48	4.53	4.08
5. Intelligent data analysis	3.95	3.90	3.81
6. Report Management	3.71	3.72	3.81
7. Data Warehousing	3.84	3.88	3.93
8. Manual	3.74	3.74	3.83
9. Process Performance	4.03	4.04	4.05
10. Report reliable	3.63	3.58	3.60

Table 4 Comparison and Evaluation of Reliability

Reliability	2016	2017	2018
1. Service	3.63	3.68	3.55
2. Flexibility	3.52	3.55	3.60
3. Reliability	3.50	3.53	3.63
4. Recovery	3.70	3.80	3.78
5. Responsibility	3.81	3.83	3.84
6. Security	3.56	3.58	3.61
7. Quick Access	3.83	3.87	3.93
8. Accessibility	4.13	4.10	4.09
9. Complete	3.98	4.02	3.99
10. Backup	4.20	4.13	4.15

Table 5 Comparison and Evaluation of Usability

Usability	2016	2017	2018
1. Decision Support	4.13	4.17	4.20
2. Paperless	3.95	3.98	4.00
3. Continuous development	3.62	3.74	3.85
4. Standard form	3.66	3.80	3.74
5. Respectively	3.73	3.80	3.70
6. Summary Report	3.92	3.92	3.88
7. Match objective	4.04	4.12	3.74
8. Security protection	3.96	4.04	4.16
9. Motivation	3.89	3.95	4.00
10. Cost effective	4.13	4.22	4.10

The information system performance overall performance is considered good ($\bar{X}$ =3.13) in which large school shown excellent score of overall aspects ($\bar{X}$ =3.56), while medium school shown good score ($\bar{X}$=2.97), and small school shown good score ($\bar{X}$=2.88), as illustrated in Table 6

Table 6 Evaluation results of information system performance by the size of school.

Item	$\overline{X}$	S.D.	Performance Level
Large school	3.56	0.56	Very Good
Medium school	2.97	0.75	Good
Small school	2.88	0.64	Good
Average Score	**3.13**	**0.65**	**Good**

The Input Data performance overall score for input is considered good ($\bar{X}$=3.44). By aspect, completeness of database system gained the highest score, followed by people, application, working environment, supporting equipment, internet and communication system, and management policy respectively. The Process performance Overall score for process is considered good ($\bar{X}$=3.48). By aspect, input process gained the highest score, followed by processing, system operation, reporting, and error monitoring process respectively. The Outputs performance overall score for outputs is considered good ($\bar{X}$=3.83). By aspect, information system results for decision making gained the highest score, followed by accurate and updated results, impacts for education management, operation success, and benefits for education quality enhancement respectively.

The Impacts performance overall score for impacts is considered good ($\bar{X}$=3.39). By aspect, positive impacts gained the highest score, followed by negative impacts, problems that obstruct operation. Positive impacts are considered excellent in all schools, as illustrated in Table 7.

Table 7 Evaluation results of information system performance

Item	$\overline{X}$	S.D.	Performance Level
Input	3.44	1.08	Good
Process	3.48	1.05	Good
Output	3.83	1.30	Very Good
Impact	3.39	1.18	Good
Average Score	**3.53**	**1.35**	**Very Good**

In Table 6, we have tested all data with the One Way ANOVA with a significant level of .05. The results of the experiment have shown that the average of the information system performance of the school directors is not significantly different. On the other hand, both teachers and students are different. However, by using the multiple comparisons with Shceffe', it has been found that the average of the information system performance of each group is not different.

F-test and one-way ANOVA are used to compare and analyze performance of DWBIS for testing mean difference of various schools. Findings shown that (1) The Input performance has information system performance varies by size of schools with .05 significant difference in terms of completeness of database, people, and application, while working environment, supporting equipment, internet and communication system, and management policy are not significantly different. (2) Process performance has information system performance varies by size of schools with .05 significant difference in terms of input process, processing, system operation, reporting, and error monitoring process. (3) Output performance has information system performance varies by size of schools with .01 significant difference in terms of information system results for decision making, accurate and updated results, impacts for education management, operation success, and benefits for education quality enhancement. (4) Impact performance has Information system performance varies by size of schools with .05 significant difference.

Problems of research can be analyzed based on frequency of incidence, which are inability of people in monitoring and improving DWBIS, lack of people who are specialized in computer, lack of knowledge and skill to use DWBIS, workload of people in school that interrupt learning of new DWBIS, insufficient computer and components, low quality of internet system, insufficient budget to enhance capabilities of people, unclear policies of management, insufficient staffs to support users, and lack of public relations and knowledge sharing about policy of system.

Recommendations from respondents (1) Training should be conducted for all levels of people to ensure efficient usage of DWBIS. Knowledge should be shared and updated to make use of technological advance. (2) System should be improved and massive data should be managed to minimize complicated process in operation and promote user-friendly features. (3) DWBIS should be integrated with technical perspectives and behaviors of school directors, teachers and students (4) Computer and supporting information system equipment should be sufficiently provided and (5) DWBIS is crucial for centralized management and empowerment of decision making to various

levels. Therefore, policies of education institutes should be improved by clearly deploying the centralization and decentralization process where appropriate.

Based on research findings, performance of DWBIS is directly related to size of schools; large schools are likely to have better management system, readiness of people, and resources that support DWBIS than those of small schools. Impacts of DWBIS of school are also directly related to operation efficiency of school; DWBIS can promote efficiency of school's operation. These procedures enable management to understand overall DWBIS and empower middle-level management. Moreover, updated, accurate, and reliable data can facilitate thorough decision making and encourage human resource to develop their capabilities and job quality.

Discussion

DWBIS efficiency for quality assurance of education among education institutes in the northern region have been developed based on DWBIS development guideline that states clear procedures (Dennis & Wixom, 2003). In system analysis and design, many models have been developed based on DWBIS development. System will be designed prior to developing computer program in order to verify accuracy, suitability, and feasibility of system prototypes. These processes correspond to research of Chitra (2005) and Indriasari (2006) who develop program by analyzing and designing DWBIS based on IT development guidelines in order to verify its accuracy for developing efficient applied program (Chitra, 2005; Indriasari, 2006). Relevant data are used to evaluate system performance in order to identify evaluation criteria and indicators. These indicators must be validated by specialists. Indicators for testing DWBIS consist of 5 aspects (50 sub items) and indicators for evaluating system performance consist of 4 aspects (19 sub items), which aligns with objectives of this research.

Recommendations of respondents in terms of system performance and management can promote user-friendly features and sustainability. System developer should concern about effectiveness and efficiency of system management and information system usage to ensure integration of these aspects and minimize duplication in operation. Furthermore, developer should follow up and systematically evaluate system efficiency because DWBIS is the backbone of all departments in organization. Such important role of information system is the consequence of change in context (Toffler, 1980). Besides, behavioral approaches of each school should be studied in order to improve system and focus on attitude and mindset changing in terms of management and policies. Regarding Sociotechnical Systems that combine perspectives in terms of technical, social, and behavioral aspects, respondents recommended that these aspects should be applied to ensure perfect integration of organization management, job system design, and DWBIS. By doing so, DWBIS will be ready to support both centralized and decentralized management to all levels of people. Consequently, management process of schools that apply DWBIS will be integrated, thus allowing executives to gain access to updated, accurate, and reliable information system that facilitate efficient decision making in management, and understand holistic perspective of

assignments. This concept corresponds to perspective that application of computer will promote centralization (Hennested, 1983; Leavitt & Whisler, 1958). Application of information system technology also allows middle management to be involved in decision making because sufficient data are available for supporting significant decisions. This concept corresponds to perspective that application of computer will promote decentralization (Burlingame, 1961) these findings also correspond to research of Ozkan who studied about a process capability approach to information systems effectiveness evaluation by comparing differences between information system program and DWBIS, and testing performance of DWBIS. He found that DWBIS is very complicated so improvement of DWBIS is essential for continuous efficiency and development both in terms of operation and organization working process. Study about relationship among key tools to evaluate DWBIS allows researchers to understand overall perspective about quality of DWBIS and efficiency of information system processing under different contexts in organization (Ozkan, 2006). The research results consistent of the theories of the task-technology fit, system satisfaction, and post acceptance continuance models used in information systems area. The results showed that users' assessment of whether the information system fulfilled their work and task needs primarily depended on the system quality, locatability of data, timeliness, ease of use, and system-user relationship. These factors also exerted a crucial influence on system use performance and user satisfaction. Moreover, the system use performance and user satisfaction further affected intentions of continued use (Chang, Chang, Wu & Huang, 2015). The locatability of data can be evaluated by the ease with which the user can find ("locate") and identify the available data (Goodhue & Thompson, 1995).

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