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The Current Practice of Data Management of Schools and District Education Offices: Is There a Need for a New Approach?

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Abstract

Currently, many government agencies, such as schools and district education offices, are using manual methods to manage data, which are not only unreliable but also insecure. Even more alarming is that many schools do not have data backups, which surely will have serious repercussions if important data were lost or damaged in unfortunate events. Hence, this study was carried out to examine the current practice of data management in selected schools and a District Education Office (DEO), to determine the problems associated with the current practice, and to propose a new method to help improve data management of such organizations. The study used a qualitative approach using a semi-structured interview, in which eight school principals and one DEO officer were recruited for the interview. The findings showed that the current practice was both ineffective and inefficient, with many schools having no duplicated copies, as backups, of important data. Furthermore, duplicated copies of data made by some of the schools were largely in printed form. More revealingly, the interviewees indicated that they were concerned with the security and safety of their school data and information. Overall, the research findings reinforce the need to develop an information system that is not only reliable but also highly accessible. Hence, a framework was proposed to guide the development of a web-based information system with appropriate functional and non-functional features, with which

practitioners, notably school administrators and education officers, could use to improve the current practice of data management in their schools and DEOs.

Keywords: Data Management, Data Security, Development Framework, School Administrators And Education Officers, Web-Based Information System.

Introduction

Irrespective of their forms, assets are important to the smooth running of organizations in many situations, especially in critical situations. Similar to physical assets, digital assets in the form of data are also prone to damage or loss if steps to secure such assets are lacking or inadequate. As such, data need to be replicated and saved in a safe vault, from which users can quickly and safely retrieve data. In this regard, computer technology can help improve the method of replicating and saving data through digital media. In particular, current computer technology enables web servers and public cloud computing to securely save important data.

Inevitably, some organizations may be caught in dire situations in which important data or information may be lost or severely damaged if such vital information is not properly or sufficiently protected. In certain extremes cases, such losses of or damages to important data may cause the organizations to lose millions of dollars. For example, as highlighted in the *Computer Economics*, Hawlett-Packard (2002) reported that "American businesses lost over $8 billion due to computer viruses in the first six months of 2001". Furthermore, the cost of recovering lost data may be prohibitively expensive, which may further tighten the financial grip over the organizations' financial resources. In this respect, a study carried out in 2002 by Ontrack, a company that provides data recovery services, found that the cost of producing 20 MB of data was very expensive as shown in Table 1 (Hawlett-Packard Development Company, 2004)

Table 1:
Data type, time, and cost of producing 20 MB of data

Data type	Time	Cost ($)
Sales and marketing	19 days	17,000
Accounting	21 days	19,000
Engineering	42 days	98,000

Source: Hewlett-Packard Development Company (2004)

In certain countries, the number of companies losing important data might be higher due to some natural disasters, such as earthquakes, fire outbreaks, and floods. In fact, not only companies will be affected but public institutions, such as schools and hospitals, too will be exposed to such critical events. A case in point was highlighted by Bambang (2014), whose analysis of damaged facilities due to the massive floods in Jakarta in 2014 showed a staggering number of public buildings were badly damaged, including 1500 schools and 150 hospitals. Obviously, losses incurred because of such catastrophic events will be astronomical. In this regard, Haraguchi and Lall's (2012) research findings may shed some light on the cost of such losses. Specifically, their research focused on the impact of floods on the global economy through the chain supply. Additionally, they proposed the appropriate components that should be taken into account in measuring the risks of the supply chain.

Likewise, Peninsular Malaysia too was not spared of such devastating floods. In the east coast of the country in 2014, the damages and losses of physical and intangible assets were unprecedented, running into millions of ringgit. For weeks, government premises and public building, such as schools and hospitals, were completely submerged under water, causing massive loss of physical properties and data. According to the Kelantan's Education Department, 300 schools were badly affected, of which six were almost beyond repair that forced the Malaysia's Ministry of Education to close the affected schools in the following year (The Star, 2015).

Obviously, such losses of physical assets were greatly felt by all concerned. However, many might not realize that other assets related to information or data, which were equally important, had also perished or destroyed. In view of the sheer scale of the devastation caused by the floods, it is reasonable to assume that important data (which were usually kept as files) of the affected schools and hospitals were also destroyed. Thus, it is important that data related to school administration and management, students, and medical records have to be classified as critical information that needs secure reliable backups. With such duplicated data, the process of recovery and retrieval of vital information can be quickly and securely carried out.

Several methods have been proposed to help overcome loss of data resulting from natural disasters, such as cloud computing and web-based information system. According to Bradley (2017), cloud computing consists of hardware and software resources made available on the Internet that are managed by third-party services. These services rely on advanced software applications and high-end networks of server computers. Service providers create cloud-computing systems to serve common business or research needs. In fact, some providers offer cloud-computing free, while others require users to pay some subscription fees. In general, cloud-computing systems are designed to support large numbers of customers and to meet surging demands for fast and flexible information access. Web-based information systems are information systems that use the internet technology to provide information and services for users or for other applications or services. On the other hand, web-based systems are software designed to publish and maintain data based on the principles of hypertext.

Regardless of such methods, the protection and security of data has to be treated as an important issue that needs serious consideration in data management. One of the techniques for data security is data backup and recovery. Nevertheless, Blaho (2013) argues that data backup and recovery are two separate elements, thus requiring a new mechanism to help protect important data. Currently, several technologies are available to support data management, such as database management, distributed database, and others. However, according to Shen and Gou (2015), a dedicated system needs to be developed to help handle data management more systematically. As such, a need analysis is entailed to determine users' expectations of the desired performance of an information system.

The devastating floods in the east coast of Peninsular Malaysia on December, 2014, had caused massive losses and damages to properties, including a few deaths and loss of important files

and documents of schools and hospital, among others. Clearly, this unfortunate event highlighted the weaknesses of existing practice to control, manage, and protect important data. Therefore the researchers carried out this study with the research objectives as follows:

a) To examine the current practice of data management of several selected schools and District Education Office (DEO).

b) To examine the problems associated with such current practice of data management.

c) To determine the functional and non-functional elements or features of a proposed information system to support data management.

The researchers carried out a semi-structured interview involving a small group of practitioners to help define the essential user requirements. In the interview, the selected individuals were asked the following questions:

(a) What is the current practice of data management of your school or your office?

(b) What are the prevailing problems associated with such practice of data management?

(c) What are the appropriate functional and non-functional elements of a proposed information system to support data management?

This study contributes to the development framework of the proposed information system namely e-BRP based on relevant principles of data management.

Methodology

In essence, research methodology is a systematic approach in seeking a solution to a research question (Kothari, 2004). For this study, a qualitative approach based on the semi-structured interview technique was used to elicit relevant data to help answer the above research questions. Specifically, this interview technique helped the researchers to obtain a comprehensive set of data from the research subjects.

a) Research Sample

The research sample of this study comprised nine practitioners, of which eight were school principals and one was an officer from a District Education Office (DEO). They were selected from several schools and a DEO in one of the districts that was hardest hit by the massive floods in 2014. As such, purposeful sampling technique was used given that their workplaces were directly involved in such natural disaster.

b) Research Instrument

The main research instrument used in this study consisted of two sets of questions for the semi-structured interview. An interview checklist was developed by the researchers that primarily focused on the relevant field and questions to answer the specific research questions (Robson, 2002). To elicit an overall view of the problems, the interview checklist was developed according to the funnel analogy, where general questions were asked at the beginning, which were then followed by specific questions at the end of the interview. The first set of questions focussed on the data, current practice of data management of the schools and DEO, and problems associated with such practice. The second set of questions focussed on the analysis of functional and non-functional elements of a proposed information system. A group of experienced qualitative researchers was recruited to check and ascertain the accuracy, clarity, and relevancy of the interview checklist.

c) Procedure

The procedure of this study consisted of three phases as follows:

Phase 1:
Securing a written approval from the Educational Planning and Research Department (EPRD) and from the respective school principals who were selected for the interview.

Phase 2:
Securing a written approval from the relevant District Education Office to interview one of its officers.

Phase 3:
Interviewing the selected school principals and the officer from the District Education Office.

Each interview session lasted between 40 and 60 minutes, in which the interviewees were asked the relevant questions pertaining to the research questions. All their responses, views, and ideas with regard to data management were recorded by the researchers.

Findings

From the interview, the interviewees' demographics were recorded, such as gender, post, age, and working experience. In terms of gender, the interviewees consisted of one male officer from the selected District Education Office, seven male school principals, and one female school principal. Their ages ranged from 45 to 56, and their working experiences ranged from 20 to 29 years. Table 2 summarizes the demographics of the nine interviewees in this study.

Table 2:

The demographics of the interviewees

Respondent ID	Pseudo name	Post	Gender	Age	Working experience
1	AAA	Principal	Female	45	20
2	BBB	Principal	Male	49	24
3	CCC	Principal	Male	50	25
4	DDD	Principal	Male	52	27
5	EEE	Principal	Male	55	30
6	FFF	Principal	Male	56	31
7	GGG	Principal	Male	57	32
8	HHH	Principal	Male	49	24
9 (DEO)	ZZZ	Officer	Male	53	28

As highlighted in Table 3, five important elements related to data management practiced at the selected schools and District Education Office were the data provider, data type, data medium, location of data storage, and stakeholder. For the first element, the data providers involved were the Ministry of Education (MOE), schools, and individuals. Four schools reported that the standard operating procedures (SOP) of data management was provided by the relevant ministry, with which only two schools indicated using such procedures. More revealingly, eight school principals claimed that the SOP were too general, lacking the detailed information needed by them to manage their school data effectively. As such, some of these affected schools created and used their own SOP for data management of their schools.

For the data storage mechanism, seven schools principals reported that data were kept at their schools or saved on the personal computer or both. In contrast, only one school had its school data kept at the MOE. In addition, the same seven principals indicated that they had duplicated data stored at their respective schools. Evidently, these findings showed that a majority of the schools did not fully use the available online system.

All data kept at the three locations were teachers data, students data, and administration data. Nevertheless, data pertaining to “Buku Rekod Perkhidmatan” (BRP) were not included, except for two schools with the “Pusat Tanggungjawab” (PTj) status. In fact, schools with such status are those that have excellent track record in the management of school finance for three years in a row, without having any non-compliance audit warnings. In addition, the status was conferred to these schools as a recognition of their sterling school management performance. Thus, it was not surprising to learn that these schools were able to manage BRP data more efficiently compared to other schools.

For the second element, which is the type of data, six school principals indicated that they kept their school data in either manual form or digital format. For the remaining schools, such data were kept in both formats. For the medium used for data storage, which is the third element,

data were mainly kept as paper (manual) files and a few were saved on computers, cloud-computing drives (e.g., google drive), and pen drives. Among the above four data storage media, paper files were the dominant medium used, with six school principals indicating that they kept their school data in such format. Next, computers and pen drives were the second and third common media used for storing school data, with four and three schools principals indicating that they used such data formats respectively. The least common medium used was google drive, with only one school principal indicating that data were kept in such a medium.

For the location of data storage, which is the fourth element, data were largely kept in three main areas, namely the files room, administration office, and vault room. Four school principals indicated that they kept data in the files room, making such an area the most common place in which data (kept in various formats) were hosted. The second and third common areas to host such data were the administration office and vault room respectively, with three and two school principals indicating that they used such locations to keep all the data files. For the final element, the stakeholders of data were the school principals, teachers, administrative staff, and head of units. The table clearly shows that the school principals were the most important stakeholder, as they had to manage all sort of data related to their schools. The teachers and administrative staff were the second and third most important stakeholders of such data respectively. Interestingly, data were also located in more than one storage area in the schools as shown in Table 3.

Table 3:
The current data management practice of the selected schools and District Education Office

ELEMENTS		DATA MANAGEMENT										
		SOP provided / needed by:	SOP needed	Data storage Mechanism	Data backup	Data format	Media for data backup	Special place to store data	Data authority	Student data	Staff data (excluding BRP)	Others (BRP)
DATA PROVIDER	MOE	4	0	1								
	School	2	8	6	7							
	Individual			6								
DATA TYPE	Manual					6						
	Digital					6						
DATA MEDIUM	Paper file						6					
	Computer						4					
	Google drive/email						1					
	Pen drive						3					
LOCATION OF DATA STORAGE	Filing room							4				
	Office							3				
	Vault							2				
STAKE-HOLDERS	Principal								6	6	6	2
	Teacher								5	6	1	0
	Staff								3	0	2	0

	Head of unit											1

Table 4 summarizes the respondent feedback regarding the level of risk of data loss, data protection, and data confidentiality. Unanimously, all interviewees indicated that the type of data that had the highest risk of loss in disastrous events due to natural calamities (e.g., floods) was the BRP data. With seven interviewees indicating such a risk, administration data had the second highest risk of loss. The type of data having the third highest risk was the student data, with five interviewees indicating that their schools could easily lose important data in such events. Data with the least risk were the teacher data, with only three interviewees indicating their concerns for this type of data in the events of catastrophic nature.

Table 4:
The type of data and level of risk of data loss, protection, and confidentiality

Type of data	Data loss	Data protection	Data confidentiality
Teacher	3	4	6
BRP	9	9	3
Administration	7	6	4
Student	5	5	9

Clearly, BRP were data that had the highest risk of getting loss and needed strong protection. This finding suggests that among the four types of data, BRP is the most vulnerable data that could easily be destroyed or lost in calamitous events. Such a risk is attributed to the manual method of keeping the data, which is in the form paper files. Obviously, in the case of floods or fires, saving these paper files containing vital information would be a daunting task. In contrast, the need to protect student data, which have the highest level of confidentiality, is less critical compared to those of other types of data. Arguably, schools are less likely to lose such student data because important information is kept in digital form that facilitates duplication of files as backups.

Table 5 shows the problems faced by the schools and DEO in the current practice of data management and the proposed solutions to such problems. The most common problems faced by these organizations are the dissimilarity between data used in the schools and DEO and the loss of data. Between the two, the latter was more acute, given that eight school principals indicated that loss of data was quite common in their schools. Therefore, it was quite natural for all the interviewees to propose a new method for data management at their workplace. Specifically, two school principals of the PTj schools and the DEO officer proposed public computing or web-based system to be used as an alternative to the current practice of data management.

Table 5:
Problems of the current practice of data management and the alternative proposals

Organization	Problem		Proposal	
	Dissimilarity between data used in the schools	Loss of data	Agreement to a new method	Public computing or web-based system
DEO	1	1	1	1
Schools	-	8	8	2*

* PTj schools are the schools that are entrusted with the responsibility to keep and maintain the BRP data.

Table 6 highlights the functional system requirements that were needed by the respective schools and DEO. Essentially, the functional system requirements were the input, process, and output. For input, nine school principals stated that the input were teachers service data, while the remaining three school principals indicated that student data were the primary input. For process, all the schools principals and DEO officer stated that the elements involved were data creation, access, updating, and deletion. For output, the same principals and officer indicated that they needed scheduled and detailed reports, letters, and memos.

Table 6:
Functional system requirements

Function	Element	No.
Input	Teachers service data	9
	Students data	3
Process	Creation	9
	Access	9
	Updating	9
	Deletion	9
Output	Scheduled and detailed reports	9
	Letters	9
	Memos	9

Table 7 shows the non-functional system requirements of the proposed information system. The non-functional elements identified to be important by the interviewees were safety, security, and performance. In fact, all the school principals and DEO officer emphasized that these three non-functional elements had to be taken into account in the development of the proposed information system to ensure data could be safeguarded in any given condition, especially in times of crisis.

Table 7:
Non-functional system requirements

Organization	Non-functional element		
	Safety	Security	Performance
School	8	8	8
DEO	1	1	1

DISCUSSION

Clearly, every organization needs a sound, systematic standard operating procedure (SOP) to ensure uniformity and consistency in its business process across departments that affects its products and services, such as in pharmacy, medical, business, and services (DeSanti, 2017 & Rognas et al., 2013). Moreover, SOP ensures compliance, accountability, and efficiency of organizations (Zimmerman, 1999). However, in Malaysia's educational context, the SOP for school data management, which is provided by the MOE, is general. As such, without detailed SOP, many schools are forced to manage their school data without a clear direction or guidance, thus giving rise to inconsistency and non-uniformity in managing data and seriously affecting the efficiency of data management of such schools. In view of this pressing matter, the MOE of Malaysia has to provide schools with new and relevant SOP to help overcome such problems. The call for such SOP is critical to the management of school data, which is in line with Gidey's (2012) assertion, stating that "the standard operating procedure, if realized and materialized as a component of an effective management system, helps cultivate transparent functions, implement error prevention measures, facilitate corrective actions, and transfer knowledge and skill".

In the aspect of data storage, a majority of the interviewees stated that they kept their data in more than one place, but data backups (copies of data) were only saved on personal computers. Obviously, such a practice puts school data at high risk of being damaged or lost in the event of a major natural disaster, such as floods. Therefore, saving data on servers, particularly on those that use the concept of "mirror", is highly recommended. Such recommendation is consistent with the Rouse's (2012) contention, who asserts that "database mirroring is the creation and maintenance of redundant copies of a database, the purpose of which is to ensure continuous data availability and minimize or avoid downtime that might otherwise result from data corruption or lost, or from a situation when the operation of a network is partially compromised". Hence, such data redundancy helps ensure that at least one viable copy of a database will always remain accessible during system upgrades. To this end, many leading organizations such as Microsoft are now using database mirror to manage their enormous data (Mike & Craig, 2016).

The stakeholder element was closely related to the data management practice, showing that the principals of the non-PTj schools had the highest authority in dealing with student data and teacher data. For the DEO, the officer with highest authority to manage the BRP data was its Head of Unit. By contrast, for PTj schools, the principals had the highest authority in controlling and managing the staff data, student data, and BRP. Arguably, such practice

relating to data access and relevant authorized personnel of these schools and DEO helps ensure the security of important data is high, which is in line with the non-functional requirements stipulated by the IEEE (IEEE Software Engineering Standards Committee, 1998). Hence, the above discussion thus helps address the first research question of the study, which concerns the current practice of data management of schools and DEOs.

As for the second research question, the second serious problem faced by these schools and DEO is the loss of important data. Among the three categories of data, BRP data have the highest probability to be lost or damaged as such data concerning teachers' service are largely kept in manual form (paper files). As such, losing such manual documents is quite common in many schools, which has adversely affected the ability of school administrators in handling important records of teachers. Further compounding this predicament is the inconsistency of data that are kept in these schools and DEO. This finding mirrors Abu Kassim's (2011), Harnani et al.'s (2009) and Chowdhury's (1987) research findings, which highlight the main problem of using manual-based processing systems, namely data loss, misplacement of documents, and data inconsistency.

In fact, it is quite common for the above two problems (data loss and inconsistency) to take place together, especially in times of crisis. Left unmitigated, the management of data will become problematic, causing serious delays or errors in decision making and, thus, adversely affecting workers' (e.g., teachers') welfare and tarnishing the reputation of affected organizations. For example, missing or loss of data concerning teachers' service records can severely delay their promotion or payment of pension and gratuity. Furthermore, inconsistency of data can negatively affect all the stakeholders, in particular the MOE, schools, and DEOs, in managing important procedures, regulations, and directives, which, if not addressed promptly, can stall organizations' efforts to achieve their vision and missions. Given the gravity of such problems, these organizations must endeavour to seek a better solution by using a better and reliable system, notably by utilizing a web-based system or cloud computing. Between the two, the researchers believe that the former is more practical and secure, because the latter is fraught with some unresolved issues, namely security, service-level agreement, and different capabilities (imposed by cloud service providers) (Muhammad, Omar & Osman, 2017). Interestingly, the principals and DEO officer enthusiastically indicated their strong preference for a web based system, expressing that such a system would be able to provide reliable, secure data management service for all educational institutions, especially for schools and DEOs

As demonstrated, such schools and DOEs do need a new, novel method of managing their data, as the current one is not only inefficient but also insecure. In this study, the interviewees unequivocally made it clear that their organizations had not been managing their data efficiently, and they strongly needed a more reliable system to help them better manage such data. In fact, they agreed that a web-based information system would be the better solution compared to other systems. For such a system to be effective and efficient, it must be equipped with appropriate functionalities and capabilities. Specifically, the proposed system should have adequate and reliable functional elements or features to support the input, process, and output of data as recommended by IEEE (IEEE Software Engineering Standards Committee, 1998). As found in the interview, the proposed system should have the capability to facilitate accurate and fast data entry of the BRP data. Such a system should also be able

to help users to easily create, access, update, and delete data. In particular, direct access to the proposed information system should be emphasized to ensure officers or teachers in charge of data management can readily gain quick access to important information or data. In addition, the proposed information system should be able to produce output in various forms, such as reports (under exception, schedule, or ad-hoc categories), letters, and memos.

Additionally, feedback regarding the non-functional elements of the proposed system, namely safety, security, and performance, were also elicited from the interviewees. They viewed these elements to be equally important as that of the functional elements. Such finding is consistent with the guidelines laid down by the IEEE (IEEE Software Engineering Standards Committee, 1998) and (Non-Functional Requirements Definition, 2011) which places equal emphasis on the non-functional elements of information systems. To date, such elements have been successfully implemented in a number of systems, such as the Sustaining the Earth's Watershed-agricultural research data system (Conservation Effects Assessment Project), Johnson, et al. (2015) and Amazing Lunch Indicator System (Geagea, Zhang, Sahlin & Hasibi, 2013).

Recommendation

As a whole, the proposed information system, with its recommended features or elements, had received positive feedback from all the practitioners interviewed, namely school principals and DEO officer. Surely, such positive feedback would help the researchers to build an efficient system, which will be called e-BRP, based on relevant principles of data management. Figure 1 shows the development framework of the proposed information system with the required system components.

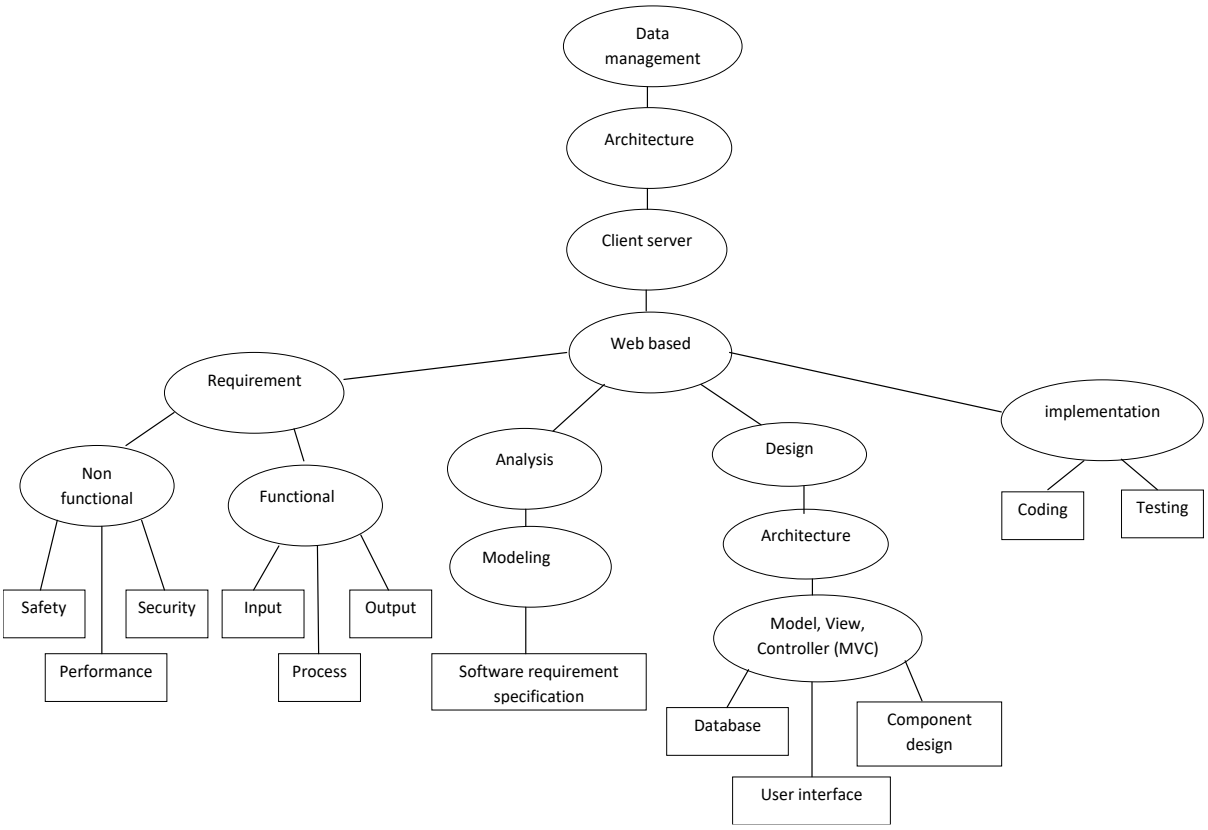

Figure 1: The development framework of the proposed data management system

As learned from the interview, the development of the proposed e-BRP will be based on web technology with the essential functional and non-functional elements. The former element will consist of input, process, and output, whilst the latter will comprise safety, security, and performance. Using the proposed e-BRP, practitioners will be able to perform the following tasks: (i) to improve data security by keeping important data in the digital format, (ii) to automatically generate reports, and (iii) to use the national language in all transactions and instructions. More importantly, such functional and non-functional elements of e-BRP will help all the stakeholders to manage important data more easily and securely. On a final note, more efforts are required to help develop a working prototype such that it can serve as an effective solution, with which educational institutions can use to overcome the current problems of data management. Naturally, with improved data management efficiency, schools and DEOs nationwide can reap the benefits accorded by the adoption of proposed e-BRP in managing their data, thus improving their current practice on the long run.

Conclusion

Undisputedly, data are an integral part of organizations that is vital in running their operations and activities. In this regard, data management plays an important role in helping personnel to make proper, appropriate decisions in their work. As such, organizations need to treat data as an important asset, which is equally vital as that of the physical asset. However, the current practice of data management of many schools and DEOs is ineffective and inefficient, which on some occasions resulted in loss of data, particularly in times of crisis such as floods. To

make matters worse, the lack of a proper, systematic method in managing data may compromise data security. Thus, the effort to seek a viable solution to overcome such problems becomes imperative. Premised on this context, the researchers proposed a computerized web-based information system, called e-BRP, to help schools and DEOs to better manage their data. Prior to developing the proposed system, an interview involving several school principals and a DEO officer was carried out to determine their current practice of data management, the associated problems, and the required functionalities of the proposed system. The findings indicate that the current practice of data management is fraught with many issues, such as poor data security and high risk of data loss. More importantly, the findings reinforce the need to develop an information system that is not only reliable but also highly accessible. Hence, a web-based information system was proposed with the appropriate functional and non-functional features, with which practitioners, notably school administrators and education officers, would use to improve the current practice of data management in their schools and DEOs.

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References

Musa, A. K. A. (2011). *Sistem My e-MEP dalam menguruskan merit pelajar secara berkomputer* (Unpublished master's dissertation). Universiti Pendidikan Sultan Idris, Perak, Malaysia.

Bambang, S. P. (2014). *Flood information management in Jakarta 2014*. Retrieved from https://www.gfdrr.org/sites/gfdrr/files/EAP_Session%203_Mr%20Bambang%20Suryaputra_JakartaFlood%20Information%20Management.pdf.

Blaho, J. P. (2013). *Three reasons data backup is different from disaster recovery.* Retrieved January 28, 2015, from http://www.forbes.com/sites/sungardas/2013/10/31/three-reasons-data-backup-is-different-from-disaster-recovery/.

Bradley, M. (2017). *What is cloud computing*?. Retrieved August 10, 2017, from https://www.lifewire.com/what-is-cloud-computing-817770.

Chowdhury, A. A. (1987). *Predicting success of a beginning computer course using logistic regression*. Paper presented at ACM conference on Computer Science 1987, Dubai, UAE.

DeSanti, J. (2010). *Not-so-standard operating procedures: Bioscience technology webcast series*. Retrieved July 3, 2017, from http://www.dddmag.com/articles/2010/09/not-so-standard-operating-procedures.

Geagea , S., Zhang, S., Sahlin, N., & Hasibi, F. (2013). Book software requirement using the unified process. Retrieved from

solusvm.external.exonar.com/software_requirements_using_the_unified_process_a.pdf

Gidey, A. (2012). Reviewing the values of a standard operating procedure. *Ethiop Journal Health Science*, 22(3), 205-208.

Hawlett-Packard Development Company. (2004). *Why back up? The importance of protecting your data*. Retrieved from http:// static.highspeedbackbone.net/pdf/hp_why_backup.pdf.

IEEE Software Engineering Standards Committee. (1998). *IEEE Std 830-1998, IEEE recommended practice for software requirements specifications*. Retrieved July 8, 2017, from https://standards.ieee.org/findstds/standard/830-1998.html.

Johnson, M-V., (2015). *The conservation effects assessment Project, CEAP: a national scale natural resources and conservation needs assessment and decision support tool*. IOP Conference Series: Earth and Environmental Science 2015. https://doi: 10.1088/1755-1315/25/1/012012.

Kothari, C. R. (2004). *Research methodology* (2nd ed.). New Delhi : New Age International Publishers.

The United Nations Office for Disaster Risk Deduction. (2013). *Flood risks and impacts-future research questions and implication to private invesment decision-making for supply chain networks*. Geneva, Switzerland: Masahiko Haraguchi & Upmanu Lall.

Mike, R., & Craig, G. (2016). *Benefit of database mirroring*. Retrieved July 9, 2017, from https://docs.microsoft.com/en-us/sql/database-engine/database-mirroring/database-mirroring-sql-server.

Muhammad, E. R., Omar, S. S., & Osman, G. (2017). Cloud based software engineering learning environment: Guidelines to host software engineering tools on the cloud. *Journal of Theoretical and Applied Information Technology*, 95(3).

Non-Functional requirements definition. (2011). Retrieved July 8, 2017, from https: //www2a.cdc.gov/cdcup/library/templates/CDC_UP_NonFunctional_Requirements_Definition_Template.doc.

Robson, C. (2002). *Real world research: A resource for social scientists and practitioners-researchers* (2nd ed.). Oxford: Blackwell.

Rognas, L., Hansen, T. M., Kirkegaard, H., & Tonnesen, E. (2013). Standard operating procedure changed pre-hospital critical care anaesthesiologists' behaviour: a quality study. *Scandinavian Journal Trauma, Resuscitation and Emergency Medicine*, 21(84).

Rouse, M. (2012). *Database mirorring*. Retrieved July 9, 2017, from http://whatis.techtarget.com/definition/database-mirroring.

Shen, T., Dai, Q., Wang, R., & Gou, Q. (2015). The impact of online additional reviews on consumer's purchase process. *International Journal of Information Systems and Social Change*, 6(1), 24-40.

The Star. (2015, Jan 3). *Banjir: Jumlah kerosakan harta benda, infrastuktur cecah RM1 billion*, Retrieved from http://www.mstar.com.my/berita/berita-semasa/2015/01/03/banjir-1--bilion/.

Zimmerman, J. F. (1999). *The importance of standard operating procedures for Investigators*. Retrieved from http://www.impactcg. com/docs/SOCRA_11.99_SOPs.pdf.