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Analyzing Crucial Elements of Research Data Management Policy

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Abstract: Research data management is essential for an institution. Before planning a research data management, an institution needs to build a research data management policy. Each university needs the policy as a guideline for the implementation of research data management. Therefore, this study aimed to investigate essential elements of research data management policy. A qualitative content analysis was used to gain insights into best practices of data management policy in selected universities. The findings yielded eight standard items of research data management policy utilized by most top universities globally. The findings are useful toward devising a research data management policy for the Malaysian higher institutions to support research data life cycle and to provide improvements in research efficiency. Future studies should focus on implementing the framework and measuring the effectiveness.

Key words: Research data and record, research data management, element, policy, efficiency

INTRODUCTION

Research data can be described as collections of structured digital data from any discipline or sources which can be used by academic researchers to carry out their research or provides an evidential record of theirresearch. Data management is defined as how data can be organized, stored, preserved, shared and access with other researchers and reuse in the future. The best practices of research data management required the process and action throughout the research data lifecycle for present and future reference (Wolski and Richardson, 2011). In fact, many higher learning institutions in the United Kingdom, Australia, United State and other developed countries implement their research data management. Presently in Malaysia, the primary researcher's data and research records are managed by individual or agencies (Johare *et al*., 2009). They also state that Malaysian universities should follow the practices of the universities in the develop countries as a guideline so that data can be used and re-used for one or more users because each university keeps their own research data and records. According to Fitzgerald *et al*. (2012) current data sharing practices in Malaysia are restricted by the fact that none of the public research university allow to use research data beyond what is permitted due to the fair dealing exceptions in the Malaysian Copyright Act. This study aimed to investigate the crucial elements of research data management policy and formulate new research data management policy for the Malaysian higher institutions.

Literature review: Australian National Data Service states that to have a good research data management, researchers and all departments in university must play a role to ensure they can meet funding requirement, develop the efficiency of research and make data available for sharing, validation and re-use. Research data management is abroad term and it will be covering how information is collected and processed during a research project; it is organized, stored and curate even in the short or longer term.

Research data management is beneficial for universities. According to University of Edinburgh, research data management can assists in meeting funding requirement, making data reusable for the future reference and preventing and avoiding duplication from other researchers. The University of Edinburgh approved a policy for research data management in early 2011. Research data management is very important in higher education and research sectors. University of Nottingham state that managing research data are very important and thus, University of Nottingham has provided their researchers with training and support as a guideline for research data management. A good practices of research data management is important and beneficial to researchers and institutions.

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Research data management framework: University is responsible in providing the basic elements to support effective research data management. According to Australian National Data Service, four elements are crucial in developing a research data management framework; "institutional policy and procedure", "information technology infrastructure", "support service" and "managing data". In University of California, a research data life cycle is supported through five types of activity namely; "plan", "collect", "manage", "share" and "publish". With research data management, research data is more organized and systematic and will enhance collaboration with other researchers in terms sharing knowledge, making data more reusable and available for future reference.

Research data management policy: Research data management is very important for universities and to all departments such as library, research center, faculty and researchers. However, developing research data management policies is the first thing to be done to implement the research data management in universities. This is because, the policy will be the basic guidelines for the university to realize the key of objective implementation research data management and applied by all parties involved like researchers, research center, library and all departments in university or institutional. According to Jones three steps to define the strategy of research data management are through identifying current position, considering what will be achieved in the near future, planning and executing programmed. They also state that in HEI's, the formation of research data management policy was the first step in the process to define strategy. An example of a research data management framework (policy) by the Australian National Data Service.

Appropriate policies and procedures in place to cover:

- Research data management
- Research data ownership and storage
- Access to database and archive
- Retention of material and research data following a research project
- Collaborative research project with other research organization
- Ethics, codes, funding requirements and relevant legislative frameworks
- Data sharing and re-use
- Secure and disposal of research data
- Intellectual property, patents, copyright and data licensing
- Records management

Australian National Data Service creates a data management framework for research institutions as a guideline to improve infrastructure and support data management. However, according to Bohemier *et al.* (2011) not all universities apply the policies as a whole, but they only apply a specific discipline, collection and project. Currently, there are some examples that can be used as a guide such as digital curation center has collected a list of United Kingdom institutional research data management policies and the examples from oversea are also available. Working group of Association of Southeastern Research Libraries and Southern Universities Research Association Data Coordinating Committee have also proposed "Model Language for Research Data Management Policies" as a guideline when drafting policy in order to support data management practices and infrastructure in institutions.

Research data management in Malaysia: In developing countries research data and records for archiving had been established such as European Data Archive, North American Data Archive and other data archive worldwide (Johare *et al*., 2009). However, in case of Malaysia, there is no standard policy focusing on research data management. According to Fitzgerald *et al.* (2012). Malaysian public research universities are still lacking specific policies for researchers to access their data, share and reuse research data in the future. Implementation of research data management is very demanding because it involves cost, funder requirement, universities responsibility and commitment from others. Yet, many organizations have provided elements in research data management policy as a guideline for other universities to follow. Fitzgerald *et al.* (2012) mentioned that accessing the research data as designed procedures will enable the policy framework which consist of "data release", "data security", "data retention, preservation, maintenance and disposal" and "data documentation and record keeping".

MATERIALS AND METHODS

To analyze the research data management policy elements, qualitative content analysis was utilized. Referring to Mazlan *et al.* (2015), qualitative content analysis can also be used to integrated view of speech, text and specific contexts. Using content analysis as a research method can have a better understanding in what types of policy exists and issues they are address. Content analysis is used to code standard elements in order to develop research data management framework.

Table 1: Sample of universities and origin

Code of university	Country
U1	United Kingdom
U2	United States
U3	Australia
U4	United Kingdom
U5	United States
U6	United Kingdom
U7	Australia

Samples and data collection: The samples consisted of the research data management policy collected through top 50 universities listed in the Time High World University Ranking 2014-2015. However, only a few numbers of policies can be accessed. Not all universities provided policies to be viewed online. Hence, purposive sampling was used, selecting only those universities which included their policy in their websites. This project proceeded through the following three main phases: compilation of the research data management policies which may be accessed, identification of standard elements in research data management policy and development of the framework.

Phase 1: Compilation of research data management policies seven policies from 50 top universities listed in the Time World University Ranking 2014-2015 were gathered. The documents were saved as doc or pdf files. Seven policies were accessed and coded during a period of ten days from May 5-14, 2014. Table 1 shows the selected universities and origin

There are seven universities from different countries; United Kingdom, United States and Australia. However, among top fifty universities listed in the Time High World University Ranking 2014-2015, only seven university policies from these countries can be accessed, saved, downloaded and printed from their websites to be analyzed during the period of time.

Phase 2: Identification of standard elements of research data management policies which were frequently used among the seven samples of university policies through the coding schemes. The data were analyzed qualitatively to ascertain the patterns of standardization which exist among the samples.

Phase 3: Development of framework based on the standard features employed among universities, a framework of research data management policy was devised.

RESULTS AND DISCUSSION

The findings yielded that standard elements exist in research data management policy throughout top universities in the world. The standard elements in research data management policy consist of title of policy, policy purpose or objective or scope, access of research data and records, responsibilities of research data and records, storage of research data and records, retention of research data and record, security and protection of research data and record and funding requirement and related matter. Standards elements in research data management policy.

Standard elements in research data management policy:

- Title of policy
- Policy purpose/objectives/scope
- Access of research data and records
- Responsibilities of research data and records
- Storage of research data and records
- Retention of research data and record
- Security and protection of research data and records
- Funding requirement and related matter

There are eight standard elements which are most frequently used by the seven universities in their research data management policy. However, each policy is different from other university in terms of content and mission and most universities have these elements to include in their policy.

Title of policy: Title of policy is one of the standard elements. The title must be clear and represent the whole of what is in the research data management policy. Basically, the title consists of a few words and straight forward. Table 2 illustrates the keywords of "title policy" for different universities. The table shows the keywords for "title policy". Each university has a different title for policy.

Policy purpose or scope or objective: The second element is identifying purpose, scope or objectives in developing research data management policy. Before drafting a policy, universities have to state clearly the expectation and rationales to implement research data management. Each university has different objective for implementing research data management to ensure the policy is more useful for researchers, faculties and all departments. Table 3 shows keywords used in the "purpose or objective or scope" for different universities.

Table 2: Keywords of "title policy" for different universities

University	Keywords of title policy
U1	"Policy on the management of research data and records"
U2	"Policy on access and retention of research data and material"
U3	"Management of research data and records policy"
U4	"Research data management policy"
U5	"Policy on retention of and access to research data"
U6	"Research data management policy"
U7	"Research Data management policy"

Table 3: Keywords of "purpose/objective/scope" for different universities

University	Keywords of purpose/objective/scope
U1	"To promote the highest standards in the management of research data and records as fundamental to both high quality research and academic integrity"
U2	"To protect researchers and the university"
U3	"This policy applies to research undertaken by students, staff and honorary staff"
U4	"To maintain the highest standards throughout the research data life cycle as part of the university's commitment to research excellence"
U5	"Maintaining accurate and appropriate research records is an essential component of any research project"
U6	"Manage and curated to the highest standards throughout its lifecycle and with due regard to relevant legislation on access and p rivacy and the possibility o f the beneficial re-use"
U7	"Policy regarding the management of research data is clearly set out in the policy"

Table 4: Keywords of "access of research data and records" for different universities

University	Keywords of access
U1	"Researchers are responsible for collection, storage, use, reuse, access and retention"
U2	"The primary responsible investigator will have access to research data generated by the project"
U3	"Researchers will develop appropriate process for the collection, storage, use, re-use, access and retention of research data and records"
U4	"Research data management must ensure that research data are available for access and re-use"
U5	"Complying with funding agency requirement regarding data access and retention"
U6	"All collage staff ensuring that access is only granted to those persons authorised to view it"
U7	"Researchers must take all reasonable steps to re use, access, retention and destruction of the research data"

The table shows the "purpose or objective or scope" for each of the universities. The purpose or objective or scope can be seen as a primary guideline to the university, researchers or staff department.

Access of research data and records: The third elements are access of research data and records. Each university has included access of research data and records elements in research data management policy. Research data and record must be accesses so that research data can be available use by other researchers. Table 4 shows keyword use in the "access of research data and records". The table shows keywords of "access of research data and records" for different universities. Each university has state about who is responsible and authorized to access research data and records.

Responsibilities of research data and records: The fourth elements are responsibilities of research data and records. Universities and institutions need to clarify to whom this policy is applied. Based on findings, all universities include this matter. This is to avoid any conflict among of them in terms of role and responsibility. In general, this is the standard requirement needed in any policy because, university needs to mention to whom this policy should apply. Table 5 shows keyword use in the "responsibilities of research data and records".

Based on results, U3 and U7 explain several of their responsibilities in the policy compared to the U1, U2, U4, U5 and U6; however, it is dependent on such a prominent authority and the policy. Every policy has explained their responsibilities, scope and specification of their duties. In term of implementing and developing university research data management policies it is crucial to understand the roles and responsibilities of key group (Wolski and Richardson, 2011).

Storage of research data and records: The fifth element is storage research data and records. A university must have a specific location to keep a research data and make it available and reusable in the future. The policy also needs to mention who own the data if researcher move to other countries. Table 6 shows the keywords of 'storage'.

In research data management policy, university is need to mention where and how research data can be stored (Australian National Data Service, 2010). The finding shows that university, researchers, head of department and the primary responsible investigator are responsible to provide facilities of storage research data and records.

Retention of research data and record: The sixth element is retention of research data and records. How long a data should be retained must be considered when making and writing a research data management Table 7 shows the keyword of "retention".

Each university has a different period of retention. Research data are essential to be retained for a certain minimum of time period. The finding show U1, U3, U5 and U7 has state the period of retention of research data and record while U2 and U6 have provided the retention of research data and record in their policy that is responsible for the retention of research data and record. U4 describe type of research data will be retained. Security and Protection of research data and record.

Table 5: Keyword of "responsibilities" in different universities

University	Keyword of responsibilities
U1	"Researchers" "university"
U2	"Primary responsible investigator"
U3	"Researchers" "head of department" "research student"
U4	"Principle investigator" "university"
U5	"University""primary investigator"
U6	"The vice principal (research and innovation)" "heads of services and school" "principal investigator" "the research management directorate and the information management team" "the information teams" "information technology service" "college staff"
U7	"Researchers"

Table 6: The keywords of 'storage'

University	Keywords of 'storage'
U1	"University are responsibility to providing access to services and facilities for the storage"
U2	"The primary responsible investigator of a research project is responsible for selection of an appropriate method of storing and archiving research data"
U3	"Head of department will establish and implement departmental process for the storage and retention of research data"
U4	"University will provide mechanism and service for storage, backup "
U5	"Sufficient records are kept to document the experimental methods and accuracy of data collection"
U6	"Will provide appropriate mechanisms and support services for long term preservation and storage of the data"
U7	"Ensure that primary material are kept safe and secure storage and that"

Table 7: Keywords of "retention"

University	Keywords of "retention"
U1	"The minimum retention period for research data and records is 3 years after publication or public"
U2	"And for determining what needs to be retained in sufficient detail and for an adequate period of time to enable appropriate"
U3	"The university will retain research data and records for a minimum of 5 years after publication or public"
U4	"Research data of future historical interest for deposit and retention in an appropriate national or international data"
U5	"For the longer of 3 years after the final project or 5 years after the final reporting or publication"
U6	"Provided for retention and disposal of research data during project duration"
U7	"The minimum period for retention shall be at least 5 years from the date of publication

The seven elements are security and protection of research data and records. Research data and records must be protecting. Table 8 shows the keywords of "security and protection".

Each policy has described security and protection of research data and records but in different terms. For example, U1 had given simple explanation while U7 state on how research data and record will be protect.

Funding requirement and related matter: The last element was meet research funder requirement and other related matters; university policy, legislation and policies of relevant agencies, act, appendices, web link form and ethic. Each university has included related matters in policy like university intellectual property, ethics, research data management plan and others. However, it depends on universities to insert other related matters in their

Table 8: Keywords of "security and protection"

University	Keywords of "security and security"
U1	"Research data and records should be secure and safe"
U2	"The primary responsible investigator is responsible for educating all participants for protection of the university's rights and ability related to the research data"
U3	"Researchers will ensure that the integrity and security is maintained and that this material is stored in a retrievable way"
U4	"The legitimate interests of the subjects of research data must be protected"
U5	"Establishing and maintaining procedures protection of essential records in the event of a natural disaster or other emergency and securing"
U6	"Ensuring the security of research data access is only granted to those persons authorized to view it"
U7	"Maintain confidential or private data in secure locations provide suitable encryption or password protection"

policies that would be necessary to protect research data. For example, U1 states the other university policies such as data protection policy, information security policy and other to compare with U2 are include appendices, web link and forms. Each university has different attachments and this is dependent on the important of the university should have in their policy.

This study analyzed the standard of research data management policy adopted by the different universities. Other elements that are not listed on the seven universities in overall such as:

- Research data ownership
- Removal and destroy of research data and record
- Provide training service and support
- Definition of terms
- Information of policy; approved date, responsible officer

Based on this finding, it does not mean that every university has no other elements. This study is focused on the standard elements used by seven universities. For example U4 does not include research data ownership in their policy to compare with U2 where they have included research data ownership in their policy. Horton and Digital Curation Center (DCC) have collected overview of United Kingdom Institution research data management policies. The finding shows that comparison research data management policy in United Kingdom institution.

In summary, the element of research data management policy include title, purpose or objectives or scope, access, responsibilities, storage, retention, security and protection, funding requirement and related matter, data ownership, removal and destroyed, provide training and support, definition of terms and information of policy; approved date and responsible officer. According to Erway state that research data ownership, funding agencies requirement, retain of research data, period of retention, preservation data, ethical consideration, data access and open data access, cost and storage of

research data are elements should be addressed among stakeholders when develop a research data management policy. However, the finding shows title, purpose, objective, scope, access, responsibilities, storage, retention, security and protection, funding requirement and related matter are standard elements exist in seven universities.

CONCLUSION

This study develops a standard of research data management policy framework based on seven universities. To implement research data management policy, essential elements are as follows; title of policy, policy purpose, objective and scopes, access, responsibilities, storage, retention, security and protection, funding requirement and related matter, ownership, removal and destroyed, training and support, definition and information policy. However, not all universities cover all elements in research data management policy. This study is useful for universities toward devising a research data management policy and to develop the necessary components to have an effective and sustainable data management service for research. Future studies should focus on implementing the framework and measuring the effectiveness.

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