Key Data and Information Quality Requirements for Asset Management in Higher Education: A case Study

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Abstract

Data and information quality (DIQ) is a critical issue for effective asset management in modern higher education (HE) sectors. Managing DIQ is essential to any asset management program. Problems with data quality can result in a number of unpredictable negative consequences. Several studies have provided strong evidence to indicate that most of HE institutions have DIQ problems. DIQ has recently been brought to the forefront and has become a pressing issue. This is particularly important in an environment where HE institutions begin to share their information systems with their stakeholders such as suppliers and business partners. Moreover Universities have millions of digital assets, thousands of users, hundreds of policies, many departments and stakeholders, and just one goal that is easy, affordable digital asset management that works the way everyone expects it to work. In such an environment, knowledge on how to manage the quality of the information asset has become very crucial in order to support the HE development. This paper describes a study, which explores DIQ problems with existing HE's asset management system, and identifies key factors that impact on DIQ. The study applies a DIQ issues for asset management in a preliminary case study of a large HE institution in Makassar, Indonesia. The findings of the study suggest that the importance of DIQ issues for effective asset management in HE needs to be widely understood. The paper also provides recommendations that may be useful to HE managers/practitioners.

Keywords: (DIQ), (HE)

Introduction

Since asset management is a core function of university administration, it has far-reaching consequences for academic pursuits including instruction and basic research. Assets management has become a weak point in university administration, which has disrupted the otherwise steady growth of higher education (HE) as the reforms have progressed. To understand the current conditions and shortcomings of university assets management and to enhance the efficiency of university assets

management will be meaningful for the benefits of university assets (Wang, 2015). Issues with data quality are at the core of efficient asset management. Benefits such as information integration, interoperability, reduced costs, quality decision support, institutional integration, process innovation, knowledge management, and the capacity to reuse data make data quality management a vital part of any asset management program. To help engineering businesses capture, process, and deliver quality data and information, there is a rising need to address the problem of data and information quality (DIQ) in asset management systems of HE institutions by analyzing current practices and providing current DIQ problems and their solutions. In order to improve asset availability, readiness, dependability, effectiveness, and management, it is crucial to guarantee the quality of data in monitoring systems, control systems, maintenance systems, procurement systems, logistics systems, and a variety of mission support applications. Therefore, DIQ concerns must be given top importance by businesses while managing their priceless technical assets.

Extensive volumes of data are required for long-term performance and reliability prediction in physical asset management, as well as for informing the decision-making process about how and when to retire an asset, and this applies throughout the asset life cycle. Condition monitoring systems create vast volumes of data, but the quality of this data has received little attention. As a result, there may be serious quality constraints in the data produced by such systems (Saunders 2004). The purpose of this article is to investigate DIQ concerns in current HE asset management systems, to identify problems that are unique to the asset management domain, and to learn about potential variances in the data quality important components involved in the management of physical assets.

Data and Information Quality in Higher Education

As managing engineering assets is not seen as a fundamental commercial activity in Indonesian HE institutions, management is left to the more conventional organizational information sources. These conventional data sources are the tacit and implicit knowledge of engineers, operators, and information found in information systems that have been largely developed to boost productivity rather than enhance the efficiency of the processes involved in production. There is not yet a streamlined and cutting-edge approach to managing physical assets. As a result, university asset management remains decentralized, despite mounting evidence that such decentralized approaches are detrimental to effective asset management and the institutions' long-term growth. The fuzziness of accountability is an inevitable byproduct of a flawed management structure. Some of Indonesia's best institutions of higher education have taken steps to improve the clarity of responsibility for managing university assets, but the problem persists. Many colleges have many departments work together to oversee the institution's assets. For instance, the logistics office is responsible for overseeing the university's dorms, cafeterias, and other buildings, while the finance office handles the university's finances. Distinct departments oversee the care of the university's property. This system of managing assets seems to be effective in terms of specialized management. However, this often leads to confusion over who is responsible for what. Wang (2015) emphasize that once there is a problem raised, it is not easy to determine who is responsible.

On the other hand, asset management encompasses a wide range of operational and administrative systems that not only manage the day-to-day functioning of asset equipment, but also provide ongoing assistance in the form of maintenance and documentation. Data is collected electronically and manually in a wide variety of formats, processed in silos, stored in a wide variety of custom and off-the-shelf legacy systems, shared among a wide variety of operational and administrative systems across faculties, study programs, and other departments, and communicated via a wide variety of channels to a broad range of business associates and private contractors. Data captured and processed by these systems is not comprehensive and is process dependent, making it difficult to be reused for any other process or process innovation (Syafar et al., 2015).

Most importantly, there has always been a degree to which data has been obtainable, sometimes due to

lacking data acquisition standards (Syafar & Gao 2013, Syafar et al., 2014), sometimes due to university culture, and sometimes due to the inability of a head of asset manager to judge what data is important. One such example is that of out door devices, which have mainly been used to monitor the condition of asset equipment (Syafar et al., 2013, Syafar et al., 2014a). Whereas, such information could provide the engineering asset manager with vital failure and maintenance trends (Syafar et al., 2014; 2014a), and coupled with financial information it could provide decision support for budgetary constraints, asset improvement, and planning and scheduling to support academic and students activities.

Research Method

For this research, two large Australian Institutions were selected as case sites. Case study research is used to study the contemporary phenomenon in its real-life context (Yin, 1994) and it can be used where the research and theory are at their early, formative stages (Benbasat *et ul.*, 1987). There is a need to investigate if data quality is a vital problem to any asset management program and what the main components are to assure data quality in managing assets, since data quality for asset management has gotten little attention in the academic community. Therefore, it seemed like a case study approach would work best for this investigation.

In data quality studies, four types of stakeholders have been identified by Strong et al. (1997); Wang (1998):

1. data producers;
2. data custodians;
3. data consumers; and
4. data managers.

Bringing the notion of stakeholders to asset management entails:

1. Those who develop data for an asset management system do so via either direct creation or collection.
2. Those responsible for creating, implementing, and maintaining an asset management system are known as "data custodians."
3. People who put asset data to practical use are known as "data consumers."
4. Managers of data are accountable for ensuring the integrity of asset management system data.

The data was gathered via semi-structured interviews with asset management system decision-makers. Questions on the company's history, its asset management practice, the participants' jobs, and their perspectives on data quality challenges in asset management were all included in each interview. Secondary sources like reports and internal/external papers were mined for further insights. The case study set out to look at how data quality challenges related to engineering asset management were really being handled in real-world institutions.

Preliminary Research Findings

Institution A, the case study institution used throughout this work, is a public (government) university with over 31,000 students enrolled across 11 departments and majors and 720 full-time administrative staff members.

DQ problems

The numerous asset management tasks at Institution A were handled by a number of different systems. MainPac was used only for managing electrical and mechanical assets, while PC Works was used for work management, which had extensive built-in checks and validation procedures. The focus was on doing a good job rather than working quickly. In an effort to modernize and streamline operations, Institution A installed Maximo in lieu of many older systems. The latest version of Maximo is a great asset management tool that is helping educational institutions with:

- Access to relevant data for quick action and sound judgment. Total, up-to-the-moment insight boosts agility and reactivity while also facilitating the efficient, flexible, and mobile use of information technology.
- Management that allows for optimal profit with little loss. The solution's base is cost-effective robustness, security, and agility, and it's these qualities that allow for the delivery of better services to customers.
- The use of automated systems to improve efficiency, quicken production, and add nimbleness to company operations. Integration of business and IT services throughout the firm minimizes operational cost, risk, and complexity.

However, the new system is not without its issues. Maximo users have reported difficulties with the package's work management tool, which is intended to schedule tasks but is seen as unsuitable for recording and obtaining asset-specific details such as time and location. Combining tasks for assigning to multiple employees in the work planner is seen as time-consuming. Because of this, it seems that individuals are keeping fewer records than they formerly did. According to one respondent in the interview ***"Now we are worse off particularly from the data quality point of view".*** It was suggested that a trial period be conducted prior to fully implementing the new system in order to iron out any kinks. There was also a requirement for a much simplified User Interface (UI) for the convenience of the staff.

Field people communication

Untrustworthy information from outside Institution A may be gathered by anybody. The data collection at this institution is carried out by people with a wide range of abilities in the face of challenging circumstances. Due to the fact that there is no universally accepted means of doing data collecting and since the information sought may vary from system to system, the formats used to do so are rather diverse. The time it takes for data to be collected from the field and entered into a computer system is a major contributing factor to the occurrence of data inaccuracies over time. In general, the greater the delay, the less likely it is that the data can be cleaned up to be meaningful. This means that the earlier the data is captured, the sooner it may be verified for prospective future study. Laziness and a failure to see the significance of the facts may both play a role in the delay. The usage of paper-based methods of data collecting is another factor contributing to the reliability problems that might arise. Because of the extra effort required to record information by hand, outside employees are less likely to do so. Another factor that contributes to inaccuracies in data gathering is the absence of a feedback information subsystem. As time went on, outdoor workers lost interest and enthusiasm because they concluded there was no value to their efforts. Forms for collecting the appropriate data must be included into the data collection subsystem, but the people aspects (skill levels, motivation, etc.) engaged in the data recording process must also be taken into account. A knowledge of the system and the ends for which the data are being gathered is necessary for the individual who must complete the relevant data form(s). As one would expect, the reliability of any data gathered from an unmotivated observer is quite low.

Data Collection Technology

Updating data recording equipment such that it doesn't discourage data collecting is necessary to better assist field workers. This may be done in a number of ways, the most prominent being the elimination of paper-based methods and the adoption of digital alternatives. Institution A has come up with a few different plans to increase the quality of the data it collects, including creating a wireless mobile device system to aid outside employees in obtaining real-time job information and completing job entries at the area where the task is done. With the help of their smartphones' built-in GPS systems, users of this software will be able to track down any given asset and, once there, edit its position information with ease.

Discussion

DQ Problems

There are often different types of operational and administrative systems in engineering enterprises, which not only control and manage the operation of asset equipment but also provide maintenance and administrative support throughout the asset life cycle (Syafar et al., 2013, Syafar et al., 2014a). Throughout practitioners, data is collected digitally as well as manually in a wide variety of formats, transmitted via extensive and complicated communication networks, shared among a wide range of commercially available and custom-built operational and administrative systems, and disseminated via numerous channels to numerous audiences involved in the business. When data is being shared and dispersed at this scale, the issue of data quality becomes critical. In addition, these assets often operate in hazardous conditions, which leads to unexpected maintenance requirements. In such circumstances, incomplete and historic information hampers the ability of a plant manager to make far-reaching decisions on asset operation; maintenance scheduling, planning and execution; and asset disposal (Syafar et al., 2015).

Wang et al. (1994), Tayi and Ballou (1998), and Orr (1998), term data quality as 'fitness for use'. This definition, although brief, encompasses the fundamentals of data processing. Orr (1998) argues that the issue of data quality is intertwined with how users actually use the data in the system, since the users are the ultimate judges of the quality of the data produced for them. Data quality is a challenge in engineering asset management because of the wide variety of systems that share and use collected information and the methods used to acquire that information. Therefore, according to Syafar and Gao (2013a) conforming to user requirements is extremely difficult.

Integration of Asset Management Systems

Most These days, most universities and colleges in the HE sector buy customized systems from a variety of vendors. Throughout the asset's life cycle, the asset management system is used to regulate and manage the functioning of the asset equipment in addition to providing maintenance and administrative support. Physical asset data warehouses, asset capacity forecasting software, business asset maintenance software, and reliability assessment software are all examples. It is common practice to acquire such systems from a number of different suppliers, each of which carries out a distinct function. When using such different technologies, the end-user may face a daunting task of integrating them. However, physical asset management systems at universities need to be connected if they are to be useful to administrators at all levels. Since condition-based maintenance (CBM)-enabled corporate asset maintenance systems depend on condition monitoring systems to alert them of the need for repair, integration is essential in adopting CBM.

Data Exchange

Asset management software need to be able to share data with one another so that information may be accessed without any hitches by users in completely various areas of a university's infrastructure and in completely separate academic tracks. There aren't any central databases housing information on asset performance across their entire life cycles. Today, universities and colleges manage their engineering assets using a plethora of information systems and databases that mostly operate independently of one another. However, there is a great deal of data that has to be shared across various users and between departments/study programs, and the current technologies do not support this. Therefore, it is important to an organization's performance to ensure that its employees (service and operation, back-office, management) have easy access to all relevant information at all times.

Condition monitoring software and computerized maintenance management systems are two examples of IT infrastructure that may help institutions achieve their objective of properly managing their assets. The former are those that center on a specific piece of equipment and the data it generates, are typically closed systems that are hardwired to the asset in question but don't connect to any other asset management software, and produce data that is only useful and understandable to those with technical training in the field of machinery. Those in the second category are often used behind the scenes and don't need a direct connection to the outside world for verification purposes (i.e., asset themselves).

Data Cleaning

The process of cleansing data is time-consuming, difficult, and expensive. Data quality problems that are addressed by data cleaning can roughly be divided into two categories, such as single source and multi source problems, each of these two categories is further divided into two sections, i.e., schema and instance related problems (Rahm & Do, 2000). Any issues that arise at the schema level that aren't fixed at the instance level may be avoided in the future with better schema design, localization, and unification. Data inconsistencies and mistakes that can't be seen from the schema level are called "instance level problems." Generally, the most common examples of dirty data (Hurwicz 1997; Jake et.al. 2003) are: format differences, information hidden in free-form text, violation of integrity rules (e.g., in the case of redundancy), missing values, schema differences. Data cleansing in higher education asset management will become increasingly important in the future.

Training

Training in real-world instances is not being given enough attention in terms of data and information quality. Training in every facet of asset management is essential, as is thorough documentation of the system. It was discovered that the chosen universities tended to place more emphasis on the "hardware" component of the systems' development process, and less emphasis on the "soft" part, which included training on how to run and administer the system. Data quality in asset management systems relies heavily on the proficiency and proficiency of the users. High-quality data cannot be generated by any system, no matter how flawless it is, if its operators lack the necessary skills and experience. There might be major consequences due to a lack of training, including a decline in the quality of the data being collected. Institutions may easily come up with justifications for not providing sufficient training to its employees and management. Education and training are crucial for everyone using the new system, say Syafar et al. (2015). This is due to the fact that the system will enhance business processes, create operational efficiency, and boost collaborative-shared information in real-time, in addition to knowing just enough to get by. Therefore, effective and quality training should concentrate on strengthening the know-why knowledge of data collectors in order to provide high-quality data for all roles involved in the data production process (data collector, data custodian, data consumer).

Conclusions

In addition to presenting relevant practitioner results from real-world practice, this case study improved our knowledge of data and information quality challenges for HE asset management. The discussion of key data quality concerns should aid HE institutions in gaining a better knowledge of data quality issues throughout the process leading to initiatives that will assist assure information quality. This higher education establishment can handle these shifts actively, even if the university cannot. Internal academic information quality management might be accelerated by external demands on institutions.

The university's lack of a comprehensive assets appraisal process leads to asset management confusion and significant loss. Currently, "focus on acquisition over management" is a widespread phenomena in the administration of university assets in Indonesia. Multiple facets of management are now unchecked because of the absence of rules. When it comes to managing their assets in full, many colleges don't even have a clear picture of what they have.

Losses in university assets due to a decline in their original purpose have also come to the fore. The classical economic theory holds that people are motivated by their own self-interest. Those in charge of managing university property are no different. We anticipate that the university's asset managers will become much more cognizant of the value of the university's holdings in order to maintain the status quo of classroom instruction and research.

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