IS BASED ASSET MANAGEMENT
An Evaluation

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Keywords: Information systems, organisational culture, performance evaluation.

Abstract: Information systems (IS) for engineering asset lifecycle management act as strategy translators as well as enablers. Therefore, the real value of IS relies upon how effectively these systems are mapped to asset lifecycle management processes, and how effectively they are synchronised with other IS in the organisation. On the other hand, engineering asset managing organisations adopt a traditional technology-centred approach to asset management, where technical system implementation command most resources and are considered first, whereas skills, process maturity, and other organisational factors are only considered relatively late and sometimes only after the systems are operational. This paper provides an evaluation of the IS implemented to support asset lifecycle in an asset managing organisation.

1 INTRODUCTION

Contemporary asset management paradigm demands an elevated ability and knowledge to continuously support asset management processes, with support in terms of quality data acquisition, real-time data exchange, and computer supported categorization and analysis of asset operation divergences from standard procedures. These factors are essential for effective planning, scheduling, monitoring, quality assurance, and acquisition of necessary resources required for supporting asset lifecycle, and consequently enhancing the competitive profile of the asset managing organisation. Information technology (IT) in general and information systems (IS) investments are no more considered as inwardly looking systems aimed at operational efficiency through process automation; in fact, it extends beyond the organisational boundaries and also addresses areas such as business relationships with external stakeholders, to deliver business outcomes.

The term asset in the context of this paper is defined as the physical component of a manufacturing, production or service facility, which has value, enables services to be provided, and has an economic life greater than twelve months (IIMM 2006), such as manufacturing plants, roads, bridges, railway carriages, aircrafts, water pumps, and oil and gas rigs.

IS utilised in asset management have to provide for the decentralized control of asset management tasks as well as have to act as instruments for business intelligence and decision support. IS for asset management, therefore, are required to provide for an integrated view of lifecycle information through integration of information spanning asset lifecycle stages. An integrated view, however, requires appropriate hardware and software applications; quality, standardised, and interoperable information; appropriate skill set of employees to process information; strategic fit between asset management processes and IS; and a conducive organisational, cultural, and social environment.

This paper presents an evaluation of IS implementation for asset management at a public sector Australian utility that manages infrastructure assets. This paper provides an overview of the water industry in Australia and an account of the case organisation and the major IS it employs. This is followed up by discussion based on the evaluation of IS employed in various areas of asset lifecycle management within the case organisation.

2 CASE BACKDROP

Australian water industry is primarily developed around a linear model of collecting, storing, treating, distributing, and then discharging the water (Barton group 2005). However, the players in Australian water industry represent a mixed picture and consist of public and private water services providers. The industry is regulated at both federal and state level to manage water through a range of initiatives, such as pricing, service levels, and environment. The

Haider A. (2008).
IS BASED ASSET MANAGEMENT - An Evaluation.
In *Proceedings of the Tenth International Conference on Enterprise Information Systems - HCI*, pages 293-298
DOI: 10.5220/0001718902930298

scarcity of water resources and the continuing drought in Australia is placing renewed demands on water asset management. These demands on one hand require effective supply and demand management of water, and on the other hand require operators to sustain and manage their water harvesting assets with reduced levels of performance, due to predicted climate changes. In order to counter such challenges state governments as well as the Council of Australian Governments has engaged in water reforms aimed at better planning and allocation.

The concept of Asset management in water industry has been strongly endorsed by the governments at federal as well as state levels, and water utilities have actively engaged in developing asset management regimes since early 1990s. However, the increased interest in asset management is largely due to the legislations that have forced operators in the water industry to improve their financial management, recover full cost of service, and use cost benefit analysis on a regular basis to evaluate the performance of their assets with the profits that they enable (GAO 2004). However, water infrastructure assets in Australia are aging fast and are being exposed to challenges of various types.

3 RESEARCH METHODOLOGY

This research employs an interpretive epistemology with a qualitative perspective. It is obvious that the issues relating to evaluation of IT investments in asset management are complex and multifaceted, and require a broad and flexible perspective for comprehensive examination. These include technical issues as well as an assortment of others issues such as organisational, social, and cultural issues. IS can be classified as interpretive if it is assumed that our knowledge of reality is gained only through social constructions such as language, consciousness, shared meanings, documents, tools and other artefacts. Interpretive research does not predefine dependent and independent variables, but focuses on the complexity of human sense making as the situation emerges (Kaplan and Maxwell 1994). It attempts to realize the phenomena under investigation through the meanings that people attach to them (Deetz 1996). In order to address the issue at hand an interpretive stance provides a richer understanding of the contextually oriented IS based asset management issues, than the more conformist positivist approaches. In compliance with the University of South Australia's ethics regulations, the case study organisation cannot be identified and will be referred to as OzDrop. Similarly, the interviewees are referred to by their job description rather than their actual designation, for example design manger, operations manger. The research methodology comprises of open ended interviews with 14 middle managers representing various roles within the organisation.

4 OZDROP BACKGROUND

OzDrop owns and operates bulk water supply and distribution infrastructure located throughout regional Queensland that has a replacement value of $4.6 billion. It supplies about 40% of the water used commercially in one of the largest states of Australia via 27 water supply schemes and three subsidiary companies. Its water supply customers number close to 6,000 and comprise mining, industrial and manufacturing companies, local governments, power stations, irrigators and local water boards. The water infrastructure on which the business is built includes, 26 major dams, 85 weirs and barrages, 83 pump stations, 40 balancing storages, 920 km of industrial water pipelines, 2,000 km of irrigation pipelines and open channels, 800 km of irrigation drainage works.

4.1 IS at OzDrop

OzDrop employs various IS to support asset lifecycle. However, the path to process automation has been far from being a liner one. In the early part of the last decade OzDrop took initial steps towards introducing IS for asset management. This was in response to increased regulatory reporting pressures and demands of aging asset infrastructure. As a result an asset register and management system (ARMS) system was implanted. However, this system was nothing more than simple record keeping of asset inventory. Apart from limited functionality the system was not integrated with any other organisational information system, hence there was no way of finding out costs incurred during asset lifecycle. In addition, there were issues with data quality, duplication of data, and the data lacked standardisation, therefore maintenance history varied greatly from actual and lacked creditability. In mid 1990s OzDrop expanded ARMS to include extra functionality such as, accrual accounting, asset identification, asset valuation, bill of quantities, and direct and indirect costs. In 2000, OzDrop adopted SAP R/3 as its core asset management system.

However, the initial focus was on implementing the plaint maintenance module to provide improved data quality, work management and costing, and management decision support tools. Though, SAP was implemented due to the regulatory pressures rather than in response to the process needs of OzDrop. Consequently, implementation of SAP has been far from satisfactory. At the same time, ARMS was not a completely functional system and both ARMS and SAP conform to different information, therefore migration of data from ARMS to SAP was not possible. Since implementation of SAP was initiated as phased approach, this incomplete configuration of SAP PM was insufficient to handle asset management data. Nevertheless, SAP is still not fully operational and the company is using specific modules of the system. In another major technology implementation initiative, in 2002 an Oracle based information management system was introduced to incorporate customer relationship management, and customer and water account management. The company aspires to integrate these systems as well as their electronic data management systems and make it available on the company's intranet. At the moment, customer billing system is available online, however the system and billing has been sublet to a third party. In addition to these technologies, the company also utilises a variation of CMMS (with limited functionality) and SCADA systems.

OzDrop lacks a centralised technology adoption policy and does not conform to a common information model. As a result, different departments have implemented their own customised spreadsheets and databases to aid their day to day operations. Although these applications aid in the execution of work within the department, however they are not integrated with other information systems and are of little value to other departments who could use this information for better asset lifecycle management. OzDrop has a strong cost focus and little commitment from senior management in terms of adoption of new technology, which is reflected by OzDrop's Manager Business IT systems *Last year (while the company was considering implementation business intelligence infrastructure) vendor walked into the door and asked what you want. Management did not know what are business intelligence systems, what are their capabilities, and what kind of reports can they generate……… I am not a qualified engineer so I can not quality assure if the system is capable of providing what the engineers want ………(for implementation of technology) we consider the total cost of ownership. The actual implementation may be cheaper but when we consider costs incurred on learning new technology, and costs relating to adoption of technology you have to make a decision on the total cost of ownership and not just the initial implementation cost*.

4.2 Sustainability and Design

Asset demand management at OzDrop is governed by the system of prioritising customers as well as water. However, due to drought condition in Australia, OzDrop's assets have been underutilised in the last decade. Nevertheless, most of the assets owned by the OzDrop were designed and developed before 1950. Therefore almost all information regarding their design, except for some relating to their refurbishment, is in a hard copy format. There is no exchange of design information with other asset lifecycle management functions. The lack of digital information poses a number of issues; the foremost among them is the inability to develop an information culture. For example, the design manger noted, we *have particular needs in design and most of our information is driven from top down. To be honest with you our experience with technology has not been that good. Software implementation is usually very difficult to achieve and infect we've seen quite a few of them come and go without providing benefit to us. The intricacies of integration with other applications just ended up proving to be too difficult. SAP has been with us for a long time, but we are not seeing the benefits though I am sure what SAP is capable of providing us - Chief Engineer.*

In the formal process of asset design/redesign chief engineers visit different regions and talk to designers and operations to discuss the design and operational requirements. Deign/redesign process of an upgrade or refurbishment is carried out through consultation with designers and is fully reviewed by the technical service engineers in that region. The company thus ensures that they have consensus from all the parties involved. In so doing, there is heavy reliance on the tacit knowledge held by staff, whereas there is no system for preserving the same or making it available to other functions within the organisation. In the words of the design manger, '*we use AutoCAD but that just gives us an electronic version of a drawing. Ideally we would like to have access to information to analyse how good our design is. The information available to us has been input by the people who really don't have sufficient technical background to understand the key things that need to be there. We've got long way to go I think before our systems are going to be sufficiently* *up to date and have sufficient useful information that our guys could pretty quickly get a hand on. Once we cannot get our hands on this information we have no choice but to rely on the knowledge held with our field staff' - Design Engineer.*

The design exercise has a strict focus on the design of the asset and there is not enough consideration given to the supportability analyses of asset lifecycle design. Although it can be attributed to the fairly stable nature of water infrastructure assets, however the major cause for inability to carryout a comprehensive set of supportability analyses is the non availability and lack of access to requisite information. Apart from this, OzDrop, being semi government, retains the hierarchical silo approach that resists information exchange and collaboration, which is evident from the following response of a design engineer, *'getting the historical information in order to get the design right at the first place is very difficult. In order to get this information costly onsite information extraction is required, that is by talking to the local people. We would like to see accurate maintenance information in the field, like what is happening, why it happened, what are the failures etc. On top of this, there is no interaction between electrical and mechanical engineers. They just log information in their own systems for someone else to look at and make decisions. If you want to know performance of a particular system, your best bet is to go and speak to a field engineer' - Design Engineer.*

This argument is further supplemented by another design engineer, which illustrates another manifestation of a silo approach to asset lifecycle management. *'we are not into risk assessments in a big way. Obviously all of systems are subject to corporate risk assessment. From design point of view we look at what condition we need to implement to manage risks posed to an asset, and that's where all the issues are that we want to monitor. For example, what space do we need to back the system up, what redundancies do we need to guarantee etc. So all those sort of things we do as a matter of course in the design exercise. Once the asset is in operation its for the operations and maintenance people to do risk assessments. They never ask us for information on any previous assessments and even if they do we cannot provide it to them easily since we perform our assessments manually' - Design Engineer.*

4.3 Operations Management

The nature of water infrastructure asset operation is quite different from other assets. Water is sourced from specific supply points and thus cannot be pumped from anywhere, which means that the infrastructure is static and the environmental and operational constraints on the asset are relatively easily predictable. This also means that the water asset infrastructure has to operate at a certain level and the usual principles of load apportionment don't work in this situation.

OzDrop's assets base consists of a variety of asset types and are spread anywhere between 30 km to 100 km or even longer. Asset monitoring therefore is not only costly but is also time consuming. Although, OzDrop makes use of GIS (geographical information system) and SCADA system to monitor asset operation, yet asset operation and condition assessment is largely manual. The information captured through SCADA systems is only used for alarms generation and failure reporting, it is not used or aggregated with other information for analysis such as failure root cause. The operations manager of OzDrop suggests that, *'condition assessment is manual exercise at the moment, since we are struggling to integrate different systems with our major asset management system (SAP). When we are required to do condition assessment, our guys will go and do that and in the process if they identify something that in their opinion presents an undesirable outcome they will flag that' - Operations Manager.*

Although, asset operation is the least automated area in OzDrop, however the company is making progress towards establishing an operations specific module within its asset management base system, i.e. SAP. According to operations manager, *'we are developing a fairly significant module within SAP, which will allow us to capture risk and condition information on each of our assets. And also to identify refurbishment and maintenance work that needs to be carried out on each of those asset. So we can actually develop a 30 - 35 year schedule to rank and prioritize vulnerabilities or risks posed to assets' - Operations Manager.*

4.4 Disturbance Management

OzDrop generally carries out a periodic preventive maintenance on its asset base, which ranges from the ones built in 1920s up till now. Therefore, the maintenance demands of these assets are quite divergent, with some of the older assets are operating well in excess of their design capacity. Nevertheless, maintenance information is generally processed either manually, or through an array of custom made spreadsheets developed by regional offices. Maintenance scheduling, however, is done centrally at the company offices by using SAP PM (plant management) module. Maintenance plans are developed with a 12 months time horizon and include a list of tasks for the same period. At the start of each month, monthly work requests are released. There is a budget allocated for carrying out these maintenance activities. However, there is little provision of emergency repairs, for example if the failure at the station requires replacement of small component or a minor treatment; it is attended to by the maintenance crew at the station. However, in case of major failure, maintenance requires approval from various levels as well as needs commissioning of expertise and resources and therefore takes time.

OzDrop differentiates between maintenance and asset ownership, i.e. work is executed by maintenance crew, whereas asset ownership is the mandate of another function. Consequently, there are multiple versions of the same information within the organization. Furthermore, these versions have their own bias and standard of quality. Although the organisation is aware of the potential of quality information, yet there is little emphasis made on recording and capturing correct and complete information. For example, a maintenance engineer summarised the situation as under, *'maintenance crew is not technically qualified or capable to operate an IT system. They consider it as an add-on to maintenance work, something that just has to be recorded. At the end of the day they will not be judged on what information they entered. Their performance is evaluated on the quality of their maintenance work' - Maintenance Engineer*.

Maintenance information, however, is crucial for asset lifecycle management, as it provides the basis for lifecycle cost benefit analysis, remnant lifecycle calculations, as well as for asset refurbishment, upgrade, and overhauls. However, like other functions, maintenance information is not exchanged with other lifecycle functions. In addition, the main focus is on capturing maintenance execution information with little provision for integrating this information with financial information. Consequently, there is no way of calculating the cost of failure as well as real costs incurred on maintaining the asset. OzDrop's finance manager noted that, *'There is fixed maintenance cost which is the routine day to day maintenance, and then there is what we call renewals program or refurbishment program. This is what you would call the irregular lumpy parts of your maintenance over the life cycle of the asset. We have always separated out refurbishment or renewals program from maintenance program. Most organizations will clump it together because you have to clump it together to get any kind of resource planning, but yes, we are not using the financial indicators as input into reinvestment or investment in assets' - Finance Manager*.

4.5 Operational Responsiveness

IS in OzDrop are primarily being used for recording information or what could be best described as recording what the organisation has done. This information is seldom used for more high profile purposes, such as organisational integration, planning, and executive decision support. The prevailing silo approach has affected departmental efficiency as well as functional integration. Management at OzDrop takes a deterministic view of technology and aims more at the perceived benefits from technology than the cause and effect relationships that enable these benefits. User training has traditionally been a weak area at OzDrop. Little training is provided and even that is aimed at training managers and supervisors rather than the staff who use the system on daily basis. The idea is that the supervisory staff (with the help of IT department) train functional staff. In these circumstances it is obvious that staff do not feel comfortable with using major platforms such as SAP, and business units in OzDrop are more inclined towards using internally developed spreadsheets and databases. Due to little information exchange the company faces substantial knowledge drain.

Senior management is not technology savvy and therefore does not rely on IT for asset lifecycle decision support. Even otherwise information lacks quality and there is no way of managing the important asset lifecycle learning. OzDrop depends a lot on the tacit knowledge (particularly for maintenance) and at present more than 65% of the staff at OzDrop are within 10 years of retirement age, which means substantial amount of intellectual capital loss. A senior manager from OzDrop attributes this to the culture of the company and summarises that, *'it has a lot to do with culture. Our culture is wrestling with fundamental issues. Some would argue that we are in an asset based industry and not an intellectual property based industry or anything like that. Certainly true to say that there is a difference of opinion in the organisation as to how asset portfolio should be managed through IS. Perhaps people are not trained or skilled for the organisation to change. IS implementation needs to be addressed a little more strategically. We have to try to convert people from break down heroes into more strategic thinkers' - Group General Manager.*

4.6 Performance Evaluation

OzDrop's IT plan is reviewed every 18-24 months. However this is an informal review and is done by managers and is more of a qualitative observation exercise rather than a detailed efficiency assessment of IS. It must be pointed out that this review is enterprise wide and not solely aimed at IS for asset management. Nevertheless, a review of asset management was carried out in the year 2004 by an external consultant. This review included assessment of asset management processes as well as IS utilized in enabling these processes. The rationale for this review was to reorganise the company in terms of resources, accountabilities, and responsibilities. An important driver within that reorganisation was about skills development, knowledge retention, and ensuring the availability of right environment for information exchange and knowledge sharing. The net result was a gap analysis against industry best practice. IS evaluation, therefore, was a part of the review and not the major focus of the review. This qualitative review was carried out through a steering committee of OzDrop, which ranked and prioritized the recommendation or the follow ups of that review. However, it took OzDrop more than a year to actually agree on the prioritization of the work to be done. The issues encountered in this regard are amply reflected by OzDrop's project manger, when he notes that, *'we have taken a step towards taking stock of our asset management related IS resources; however there are there issues that we must overcome. Firstly, the lack of ownership of data that does not provide any motivation for staff to capture and process right and complete information; secondly, investment in mobile data acquisition solutions such that data is entered as close to its origin as possible; and thirdly, effective change management with emphasis on creating a learning environment and proper training' - Project Manger.*

5 CONCLUSIONS

IS implementation has a number of technical, organisational, cultural, and social dimensions. It is therefore essential to ascertain cause and effect of technology implementation, such that effective change management strategies could be out in place to facilitate institutionalisation of technology within its implementation context. Management at OzDrop conforms to technological determinism and sees technology implementation alone as the prime enabler of achieving its strategic objectives. In so doing, it disregards the organisational, cultural, and social dimensions that help shape technology within the organisation. IS are social systems and their implementation has strong contextual and social underpinnings. OzDrop needs to engage in ex ante evaluation that must take stock of the socio - technical environment of the organisation and align the capabilities of technology with the needs and demands of asset management processes.

REFERENCES

Barton group 2005, 'Australian Water Industry Roadmap, Barton Group Environment Industry Development, Centre for Resources and Environmental Studies, Australian National University, Acton, ACT.

Deetz, S. 1996, 'Describing Differences in Approaches to Organization Science: Rethinking Burrell and Morgan and their Legacy', *Organization Science*, vol. 7, no. , pp. 191–207.

Haider, A, Koronios, A, & Quirchmayr, G 2006, 'You Cannot Manage What You Cannot Measure: An Information Systems Based Asset Management Perspective', in Proceedings of Proceedings of Inaugural World Congress on Engineering Asset Management, eds J. Mathew, L Ma, A Tan & D Anderson, 11-14 July 2006, Gold Coast, Australia.

IIMM 2006, 'International Infrastructure Management Manual', Association of Local Government Engineering NZ Inc, National Asset Management Steering Group, New Zealand, Thames, ISBN 0-473-10685-X.

Irani Z & Sharp JM 1997, 'Integrating continuous improvement and innovation into a corporate culture: A case study', *The International Journal of Technological Innovation, Entrepreneurship and Technology Management (Technovation)*, vol. 17, no. 4, pp. 199-206.

Kaplan, B & Maxwell, JA 1994, 'Qualitative Research Methods for Evaluating Computer Information Systems', in *Evaluating Health Care Information Systems: Methods and Applications,* eds JG Anderson, CE Aydin & SJ Jay, Sage, Thousand Oaks, CA, pp. 45-68.

Waisham, G 1993, *Interpreting Information Systems in Organizations*, John Wiley & Sons, Chichester, England.