Performance Evaluation to Enable Institutionalisation of Technology

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Abstract

Technology implementation involves understanding of the structure of the technology, the reasons for choosing particular technology and its implementation approaches, assumptions about the context in which technology is to be used, and previous experiences with technology adoption. However, information systems implementation in engineering organizations generally disregards human, contextual, and organizational elements and is driven by the needs of individual departments rather than in response to the strategic needs of the entire organization. This paper presents an account of information systems implementation in a public sector transport organization. The case emphasizes the importance of ex-post or ex-ante evaluation of technology as well as the context of their implementation. It highlights that evaluation of information systems should not be treated as an isolated process, which is often left to auditors. In fact, it is a strategic activity that requires participation from a wider organizational community, which provides core justifications for investments in information systems as well as roadmaps for their implementation and institutionalization in the organization.

1. Introduction

Expectations that engineering enterprises associate with the adoption of information technology (IT) in general and information systems (IS) in particular are quite diverse, such as operational efficiency, reduction in operating expenses, or enhanced competitiveness. However, there are divergent views held about the value creation of IT investment. Although, recent studies have concluded that IT investments provide positive economic returns [1]; nevertheless the impact of IT investments varies within organisations [2]. Evidence found in literature, both industry and academic, sustains the argument of success (see for example, [3]) and failure (see for example, [4]). The reason for this polarisation is the propensity to neglect the active interaction and shared shaping between technology and people [5]. It is also argued that when organisations attempt to evaluate IT, managerial emphasis is mostly on the improving cost benefit management of IT adoption. Majority of IT/IS evaluation exercises are carried out using capital investment appraisal techniques, such as cost benefit analysis, payback and return on investment [6]. These evaluations only give a slice of the total impact of IT investments and disregard the human and organisational aspects of IT adoption, and, therefore, not only keep the softer benefits hidden but the costs of managing these benefits also remain uncovered [7]. Furthermore, these unobserved benefits prevent the systems from delivering at its full potential [8]. Consequently, such evaluations fail to measure the total impact of IT and contribute to failure of IT investments to achieve desired objectives [9].

Most engineering enterprises mature technologically along the continuum of standalone technologies to integrated systems, and in so doing aim to achieve the maturity of processes enabled by these technologies [10]. The term asset in engineering organisations is taken 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 [11], such as manufacturing plants, roads, bridges, railway carriages, aircrafts, water pumps, and oil and gas rigs. Management of assets, therefore, entails preserving the value function of the asset during its lifecycle along with economic benefits. Asset lifecycle management processes are geared at gaining and sustaining value from design, procurement and installation through operation, maintenance and retirement of an asset. The scope of asset management activities extends from establishment of an asset management policy and identification of service level targets according to the expectation of stakeholder and regulatory/legal requirements, to the daily operation of assets aimed at meeting the defined levels of service. Asset managing organisations, therefore, are required to cope with the wide range of changes in the business environment; continuously reconfigure manufacturing resources so as to perform at accepted levels of service; and be able to adjust themselves to change with modest consequences on time, effort, cost, and performance. IS for engineering asset management, thus, have a critical role in enabling learning organisation as well as facilitating organisational learning. Evaluation of IS for managing the lifecycle of an asset needs to enable feedback on the relevance and fit of IS with existing asset management processes as well as the social and organisational maturity of the organisation.

This paper establishes the case of evaluation as the basis for justification of investments as well as institutionalisation of IS in an engineering organisation. The paper, through a case study, exposes a number of technical, social, organisational, and cultural issues that hamper maximisation of value from IS adoption. The paper particularly argues that evaluation of IS needs to enable actionable learning. Such learnings illustrates the gaps in actual versus desired state and allows for strategies that facilitate change and help institutionalise technology in the organization. This starts with different view on IS implementation and highlights the importance evaluation to IS investments as well as ensuing of their smooth operation. The paper then presents a case study of an Australian transport infrastructure organisation's experience with IS implementation for managing asset lifecycle.

2. IS Implementation

IS implementation is defined as "an organizational effort to diffuse and appropriate information technology within a user community" [12, p. 231]. The user community has some aspirations attached to the use of technology, which characterise the values and interests of various social, political and organizational agents. Walsham [13] notes that IS implementation needs to cover all the human and social aspects and impacts of implementation in organizations. Effectiveness of IS implementation, therefore, is subjective term. However, DeLone and McLean [14] argue that there are six dimensions that determine the effectiveness of IS implementation, i.e., systems quality, information quality, information use, user satisfaction, individual impact and organizational impact. The effectiveness of IS implementation is compromised if relevant change management strategies are not put in place [15]. In computer science implementation is considered as an activity that is concerned with installation of technology and is centred entirely on the technical aspects of the IS development process. On the other hand, in IS paradigm, implementation is a process that deals with how to make use of hardware, software and information to fulfil specific organizational needs [16]. This perspective of IS implementation is generally governed by two quite opposing views [17]. In a technology driven view, humans are considered as passive entities, whose behaviour is determined by technology. It is argued that technology development follows a casual logic between humans and technology, and therefore is independent of its designers and users. This mechanistic view assumes that human behaviour can be predicted, and therefore technology can be developed and produced perfectly with an intended purpose. This view may hold true for objective machine such as, microcontrollers which have a determined behaviour; whereas for IS this view has inherent limitations due to its disregard of human and contextual elements. A corollary of this objective view is the managerial assumption that IS implementation increases productivity and profitability. This view basically works on the assumption that social and organisational transformation is measurable and therefore can be predicted. Consequently, management decisions are governed by the expectations from technology rather than the means that enable technology to deliver the expectations. Although, it is clear that these approaches have inherent limitations, yet these views dictate majority of contemporary research and practice. The opposing stance to traditional technical view is much more liberating and takes a critical scrutiny of the deterministic technological and managerial views of the relationship of technology with human, organisational, and social aspects. This view illustrates that technology has an active relationship with humans, in the sense that humans are considered as constructors and shapers of technology as well as reality [8]. In this stance, technology users are active rather than passive, and their social behaviour, interaction, and learning evolves continuously towards improving the overall context of the organisation. As a consequence, IS implementation is increasingly being considered as strategic translation through accomplishment of social action, and technological maturity in an organisation is viewed as an outcome of strategic choices and social action. Castells [19] takes the argument further and posits that IS, due to their information processing capabilities, have the potential to bring about continuous learning and innovation in an organisation. Therefore, IS implementation is not a one off endorsement of technology; in fact it is a continuing process of learning aimed at the evolving use of IS. IS implementation, therefore, is a continuous process aimed at organisational learning through alignment between the organization's strategy and diffusion and application of IS within the organisation, guided by the value profile that IS stakeholders attach to implementation and shaped by the organizational context and actors.

3. Asset Management with IS

In theory IS in engineering asset lifecycle management have three major roles; firstly, IS are utilised in collection, storage, and analysis of information spanning asset lifecycle processes; secondly, IS provide decision support capabilities through the conclusions arrived at from analysis of information; and thirdly, IS provide an integrated view of asset lifecycle through integration of asset lifecycle functions. IS for asset lifecycle, thus, seek to enhance the outputs of asset management processes through a bottom up approach. This approach gathers and processes operational data for individual assets at the base level, and on a higher level provides a consolidated view of entire asset base. At the operational and tactical level, IS are required to provide necessary support for planning and execution of core asset lifecycle processes. For example, at the design stage designers capture and process information such as, asset configuration; asset and/or site layout design and schematic diagrams/drawings; asset bill of materials; analysis of maintainability and reliability design requirements; and failure modes, effects and criticality identification for each asset. Planning choices at this stage drive future asset behaviour, therefore IS are also required to facilitate in analysis of information to make informed choices to ensure availability, reliability and quality of asset operation. As we move forward in the asset lifecycle, the complexity of information increases. For example, at maintenance stage it is important to have historic information on design, operations and condition monitoring, as well as previous maintenances carried out on the asset. This includes financial as well as non financial information. This information is required to perform a variety of actions such as locating and diagnosis of failure condition; allocating spares and maintenance work requests; and informing asset shut down schedules. After maintenance has been carried out, this information needs to be communicated throughout the asset lifecycle chain, such as to design function (to design out errors and faults in asset design, or enhancements required in asset design); to operation (in case asset was not being operated according to as designed specifications); to maintenance planners (to plan and schedule future routine maintenance); to decision makers (to identify the financial and non financial risks posed to asset operation, their impact, and ways to mitigate those risks); to environment protection agencies (to assess and define the level of contamination in case of environmental disaster as a consequence of asset failure). An important measure of effectiveness of IS, therefore, is the level of integration that they provide in bringing together different functions of asset lifecycle management, as well as stakeholders, such as business partners, customers, and regulatory agencies like environmental and government organisations. However, realisation of an integrated view of asset lifecycle through IS requires appropriate hardware and software applications; quality, standardised, and interoperable information; appropriate skill set of employees to process information; and the strategic fit between the asset lifecycle management processes and the IS. This, in turn, is highly is dependent upon objective evaluation that highlights the gaps in the performance of IS as well as its supporting infrastructure and provides actionable learning for follow up actions.

4. IS Evaluation Framework

IS for asset management have dynamic multifaceted roles. These systems enable individual asset lifecycle business processes, provide for an integrated view of asset lifecycle to allow for informed decision support, facilitate organisational learning, and enhance competitiveness and responsiveness of the organisation. Therefore, the IS should enable constructive action oriented feedback, which enables continuous improvement in asset lifecycle management processes and the IS infrastructure that supports these processes. Having a generative learning focused performance evaluation methodology not only provides for the assessment of the tangible and intangible contributions of IS to asset lifecycle management, but also provides assessment of the maturity of IS infrastructure. Evaluation of IS for asset lifecycle management, therefore, is not an isolated process. It actually forms the core component of IS investments and implementation for asset lifecycle management. This evaluation, however, is fundamentally different from traditional evaluations, since it is aimed at assessing economic, operational, and strategic contributions as well as cultural, organisational, and social impacts of IS. Figure 1 provides a comprehensive coverage of these dimensions and provides an IS for asset management performance evaluation framework.

It is a learning centric framework and accounts for the soft as well as the hard dimensions of IS in an asset lifecycle. This framework divides the asset lifecycle into seven perspectives, where each perspective consists of processes that contribute to asset lifecycle management. The framework begins with assessing the usefulness and maturity of IS in mapping the organisation's competitive priorities into asset design and reliability support infrastructure. The framework thus assesses the contribution and maturity of IS through four further perspectives before informing the competitive priorities of the asset managing organisation. In so doing, the framework evaluates the role of IS as strategic translators as well as strategic enablers of asset lifecycle management and enables generative learning. It means that instead of just providing a gap analysis of the desired versus actual state of IS maturity and contribution, it also assesses the information requirements at each perspective and thus enables continuous improvement through action oriented evaluation learnings. This framework is context based and enables action oriented learning as it highlights the gaps between the existing and desired levels of performance.

Being learning centric, it facilitates generative learning and necessitates the need for corrective action through (re)investment in right technology, skills, and organisational infrastructure, thereby facilitating change in the organisation. The evaluation thus provides triggers for continuous improvement regarding IS employed for asset design, operation, maintenance, risk management, quality management, and competencies development for asset lifecycle management.

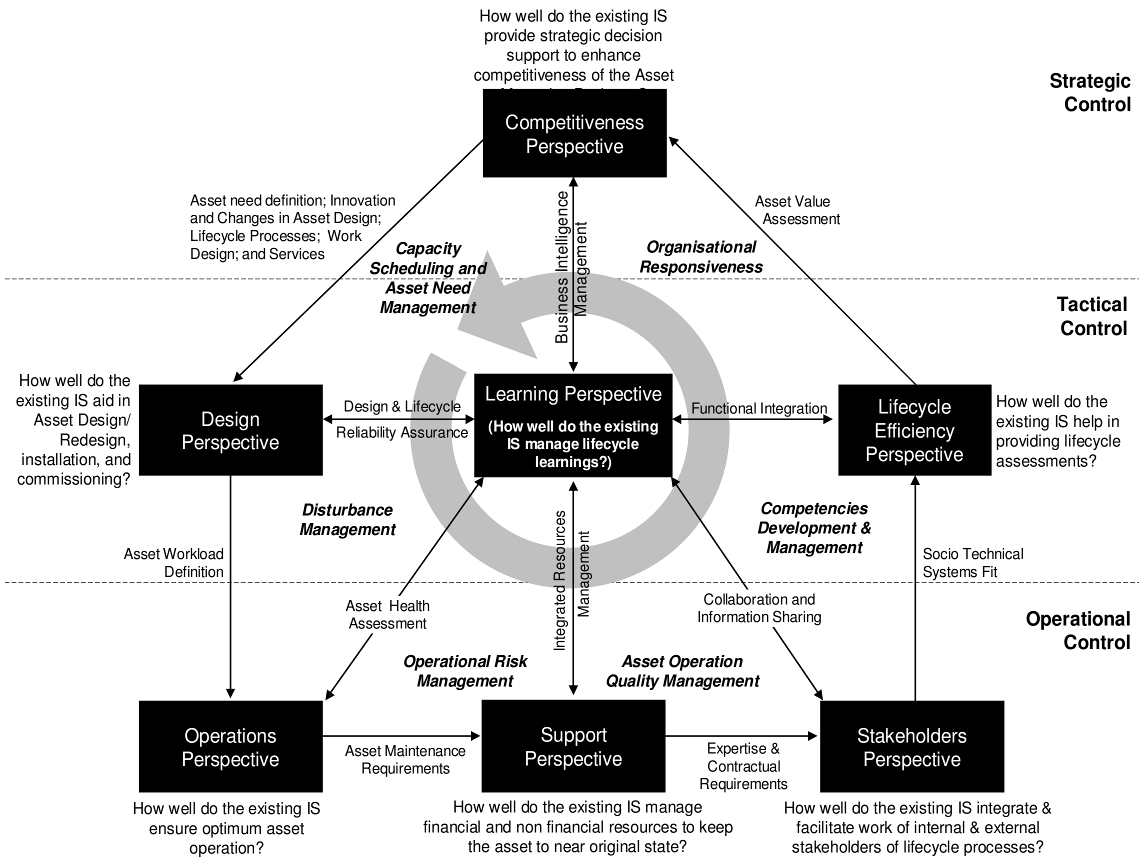

Figure 1: IS for Asset Management Performance Evaluation Framework

[6]

5. Research Methodology

This exploratory research employs an interpretive epistemology with a qualitative perspective. It is obvious that the issues relating to IS investments in asset lifecycle management are multifaceted and require a broad and flexible perspective for comprehensive examination. It include investigation of technical as well as an assortment of others dimensions such as organisational, social, and cultural. The aim of this research is to explore the issues involved in IS implementation and how does IS evaluation facilitates IS implementation. In order to address this aims, middle managers representing various roles associated with asset lifecycle management were interviewed in a large rail asset managing organisation during January 2007 – August 2007. These interviews were conducted over a one - one and half hours period and included the following job descriptions, asset designers, maintenance engineers, network access manager, business development manager, Operations and Maintenance manager, manager projects, manager assets management, project officer assets, finance manager, and IT manager. Interviewees were chosen based on their responsibilities as they are between senior mangers (who make decisions) and operational employees (who act on the decisions made by senior mangers). They are the actual implementers of IS and, therefore, are well placed to provide insights into policy setting and decision making of the senior management and the issues and challenges posed to these policies and decisions at the operational level. The interview questions were open-ended and interviewees had freedom to describe their experiences and problems beyond the scope of the questions. In addition, researchers were provided access to all documentation concerning asset lifecycle management, as well as access to sites of asset operation. The interviews were transcribed and data from all sources were analysed using HyperRESEARCH. The interviews were followed up by email and telephone for further clarifications, where it was deemed necessary. The conclusions drawn in the following case, thus, represent interpretations of the evidence as understood by the authors.

6. Austrans Case

Austrans (pseudonym) owns, operates, and manages rail assets in one of the largest states of Australia. It's nearly 4 billion Australian dollars worth of rail network stretches throughout the important industrial and agriculture stretch of Australia. The company has been in operation for nearly 150 years and is one of Australia's largest passenger, coal, and freight transport provider. In the financial year 2005-06, more than 2600 staff of Austrans operated approximately 260000 passenger services, and carried over 54 million passengers. In all Austrans employs more than 13000 staff and provides a broad range of freight services to a wide customer base in many industries in Australia, through its 9500 km rail network. Austrans's state based fleet includes over 12300 units of rolling stock, which includes more than 10200 wagons, 508 diesel and electric locomotives, 143 three-car electric trains, and 177 passenger carriages. All of which are used to transport people, coal, bulk or containerised freight. Austrans employs in excess of 1400 staff (including 176 apprentices and trainees) at four geographically dispersed locations all over the state to manage these units. In the year 2005-06 Austrans overhauled or maintained more than 3000 of these units. Being a public owned large organisation, Austrans has a fairly large spread of management functions. However, asset lifecycle management activities are spread over the network access, infrastructure services, and rolling stock and component services groups. In addition to providing track access, network access also manages access to corridors, major yards and telecommunications services. Whereas the Infrastructure Services Group constructs, maintains and manages Austrans's rail infrastructure to deliver a safe and reliable network. Rolling stock and Component Services group manufactures and overhauls rolling stock (including locomotives, carriages and wagons) for heritage, national, as well as city fleets. This case, however, is limited to the information systems utilised for managing the track asset infrastructure.

7. Technical Foundations of Austrans

As a part of the ten year review, Austrans recently underwent a comprehensive exercise to develop an Asset Information Management framework aimed at increasing the effectiveness of assets and reducing the running costs of the networks. This framework consists of nine information domains built around three core modules, i.e. asset configuration, asset condition, and asset capacity and capability. One of the core aspects of the proposed asset information management framework is IT reform, which is an initiative to reduce the number of systems operating within Austrans. The company expects to save 20 million Australian dollars in cost savings from standardisation of foundation IS and by increasing the visibility of all spending on IT. The company also has recently set up a scheduling optimisation tool to increase the speed and effectiveness of train, crew and maintenance scheduling on track, and its business intelligence technical infrastructure. However, major technologies employed by Austrans are SAP R/3; CAD; CMMS; and a variety of industry specific asset lifecycle management softwares such as RailFrame, TRIM, PST, V0, RIMS, and RDMS. Austrans does not conform to a common information model for asset management. It is for the same reason that traditionally IS adoption is driven by need of individuals or departments, rather than the process or organisational need. Consequently, there are numerous isolated islands of useful data in the organisation. Austrans's IT manager summarises the technology adoption approach and states, "w*e are not early adopters, and we are not explorers and we are not easily influenced or driven by whatever the latest thing on the market is. Its need driven and business case driven. Basically in past our motivating factors have been tactical needs of individual areas, so it hasn't been strategic at all but its moving towards being more strategic mainly for information integration. We now have stronger governance and cost focus, since we are now viewing ourselves as a market player as we are expanding nationally and are moving into more commercial roles"*. Top management at Austrans is not IT savvy and thus the planning of IT infrastructure has largely been left to IT department. The lack of a wider representation on the choice and process of technology implementation has resulted in a culture where value of organisational information is not given due Functional staff consider recording information on the activities that they carry out as an unnecessary addition to their routine jobs. It is summarised in the quote from the group manager who stated that *"some would argue that we are in an asset based industry and not an intellectual property based industry or anything like that"*.

8. Quality of Information and Culture

Even though there is significant automation of processes, IS in asset operation at Austrans are far from being productive. Multiplicity of information, lack of its quality, and inability of the organisation to capture information from manual inspections, are some of the acknowledge issues. Austrans, being a large public sector organisation, has a hierarchical structure, bureaucratic culture, and centralised decision making. There is no culture of process or technology audit, which could highlight the needs of business processes, such as information needs, skills level, and maturity of existing technology to accommodate new technology. For example, investment in SAP was made due to pressure from regulatory agencies, rather than as a response to needs of asset management regime. Consequently, asset lifecycle management stakeholders saw it as a necessary evil and its adoption was not taken seriously. Being an engineering organisation, functional level employees are more interested in executing the workflow than recording data and information on what they do. General feeling among the staff is that *"their performance will be judged on the execution of their primary roles such as asset maintainer, designers, and monitors and not on how much and how good they enter data into a system" – Maintenance Manager Austrans*. It was only around the year 2004 that the change of guards at the senior management saw more technology savvy management and efforts have since been made to think laterally on how these technologies could benefit asset lifecycle management. However, there is a long way to go before IS could be institutionlised in the organisation, as one of the design engineer notes that "*from the outset when the decision was made for SAP as the core asset management tool its adoption should have initiated. This project started in Sept 05 and we are still (May 2007) umming and ooing about SAP as the core technology for asset lifecycle management. We should sit down and work through all the cobwebs, recruitment issues, training, and a smooth transition to use this technology. My SAP training was left up to me to book in and when you hear so many negative things about it its not something you rush to do"*. A corollary to this issue is the varying quality of information that exists within the IS in Austrans. For example, in asset design the quality of information is restricted to the drawings, since the same have been subjected to a number of reviews. However, quality of the financial and administrative information cannot be guaranteed since it is not audited. In the words of the civil works reviewer, *"we probably can ensure that the checks and balances that we can put in the systems are operating properly. But in terms of the type of information that gets entered, well, you can't check everything. You can check certain things that give a certain level of assurance that things are doing OK"*. Although the intent of business change has been communicated and well publicised within the organisation, change initiatives to achieve the same have been far and few between. Instead of building around the core IS technologies of the organisation, such as SAP and CMMS, different asset lifecycle functions prefer to use simple spreadsheet and database applications. The use of these technologies is justified as *'they are easy to use'*, and that '*they can be customised to meet changing needs'*. This lack of control and disregard of quality culture had led to islands of data throughout the organisation, without being put to effective use.

At Austrans, traffic is managed by state of the art software that manages as well as allocates traffic on the tracks; whereas, the condition of the track is monitored through sensors and manual inspections. Austrans has an extensive network of track inspectors, which includes a substantial number of indigenous Australians who are well known for their knowledge and familiarity with outback terrain and geography. Austrans relies heavily on their tacit knowledge, and these track inspectors have also proven to be extremely reliable sources of track information. However, there has been no effort made to record information collected through these manual inspections, while there are certain aspects of asset operation that seem to be over automated, as described by the Operations Manager of Austrans. He states, *"for a case of a broken rail, essentially it's about train coming off. One system records broken rail, which goes to the network controller who can stop trains from going on the track. Another system records the same incident the same information in a track incidence system to raise signal alarms. Yet another one of the systems records the same incident in the rail defect management system, such that a request could be generated to fix it. Now you have the same information available in three different systems. There is not only duplication, in fact triplication of information. Information in each system is biased towards a particular function, so which version is more credible?"*. This symbolises the typical behaviour of an organisation where each function trusts its own information and does not believe in sharing the same. As a result there is significant wastage of effort and finances, and quality of information is undermined due to lack of integration. According to a design engineer at Austrans, *"a piece of track looks the same today, looked the same five years ago, and will look the same in five years from now. However, it's the formation that keeps on changing…………Although we have got fair bit of say over what software applications we use, we miss the old system where we had somebody that was sort of monitoring what was happening in the market with regards to design software from across Austrans. At the moment where I see some degree of connectivity with civil engineering design, there is little connectivity when we go across other areas like electrical design"*.

There is little cross functional and cross departmental collaboration with each function working within well defined boundaries. Consequently, the general approach is 'if it ain't broke don't fix it'. The business development manger provided some insights into the organisational culture by stating that "his office is at the same floor as many of the electrical engineers, but they have never spoken to each other". This function centred approach has translated into the way IS are utilised in the organisation, with a range of different systems and each aiming to accomplish individual tasks. In the words of the Network Access Manager, *"there is range of stand alone information collection devices, which primarily collect historical information. So it's range of historic information that's available to us. What we want to do is to actually get all of it to be available at one spot, get all of the systems talking to each other, reduce the duplication of data so that when we go in and ask for any query. We want to move beyond the individual data management to predictive issue based management"*.

9. Planning, Tactics, and IS

Austrans has an old set of asset infrastructure as majority of these assets were laid in 1920s and 30s, with some even earlier. Design information for most of these assets is not available in digital format. There are, therefore, significant issues in managing these assets and most of decisions have to rely on the tacit knowledge of middle to senior mangers. While designing assets, design engineers are required to take into consideration asset workload and work out the asset need profile. However, it is all done manually or with support from simple Excel based spreadsheets. Traditionally, design engineers surveyed the area and identified particular routs, they would then design the asset accordingly. In so doing, there has been heavy reliance on the knowledge of field staff in designing or refurbishing sections of asset, since they are closest to assets. However, times have changed and for the up-gradation of assets Austrans utilises a range of technologies to aid design and designing workflow. Now Austrans utilises design technologies such as AutoCAD, Microstations, and 12D civil design software. However, design information is held locally in the regional offices and is not exchanged between regional offices or with other functions of asset lifecycle management. In addition, recommendations on asset lifecycle supportability design form a part of the design feasibility study, however the actual information remains with the designers and is not exchanged or transferred to a system where it could be reused. Although Austrans is aware of these issues, there has been no effort made to improve the situation. Business development manager of Austrans summarises the quandary and argues that, *"Ozaril needs to capture, manage, and maintain knowledge for future generation of Austrans, so we don't have to reinvent the wheel every time. We are long away from that. In terms of information we have proliferation of tactically disparate databases and spreadsheets. We have got the information but it stays with designers. It is not exchanged and even if it were exchanged it could not be merged with other information"*.

All maintenance in Austrans is carried out in house, and no part is sublet to a third party. It follows a periodic preventive maintenance schedule and since the company maintains a number of different assets this schedule varies for each type of assets. Though track assets are fairly stable and do not develop failure conditions too frequently, the inspection of track assets is held frequently. Information on condition of an asset as well as the treatments carried out are kept with the regional offices and only a summarised version of this information (chiefly financial) is communicated to the corporate head offices, unless the track requires a major overhaul or relaying. Major software tools used in maintenance function are the Rail Infrastructure Maintenance System, and Royal Defects Management System. These systems help in condition monitoring, defect detection, and maintenance scheduling and execution; however these systems are not integrated. Therefore, more or less each activity has a separate IS, but the information thus captured cannot be used for any strategic advantage. Austrans's Maintenance Manager describes this trends and states that *"for asset life cycle decision support we generally rely on historic data. There is not a huge amount of data available though. It (decision making process) is a lot based on engineering knowledge, lot of our people have been involved in operational management of the assets. So they know how the asset performs and behaves. They know the discreet life cycle of the asset components, and by putting those things together we can come up with the forward projection of asset. There is no rocket science there, its based on personal knowledge of particular engineers involved"*.

Heavy reliance on tacit knowledge and the inability of the organisation to preserve this knowledge is resulting in significant intellectual capital drain from the organisation. With nearly 35% of employees due to retire in the next 10 years, Austrans will lose significant business knowledge. However, to sieve out learnings from the execution of routine business, integration and interoperability of information is as important and facilitative as developing the culture of information sharing and exchange to achieve higher levels of coordination and cooperation. However, with more information technology savvy staff moving into senior management, these issues are being understood and acknowledged. Infrastructure Group Manager, thus, notes that *"when we talk about the big picture, you may have one piece of information and someone else can have the other piece. He doesn't necessarily see the other piece of information which together can actually point you to a totally new area. For continuous improvement we have to change technology and also have to change the way we do daily business"*.

Austrans does not conform to an exclusive information model and as a result there are many ad-hoc IS solutions in operation within the organisation. This plethora of IS solutions symbolise a number of organisations within the organisation, as the information collected and processed by each asset lifecycle function is geared at fulfilling its own demands rather than contributing to the overall objectives of asset lifecycle management. In fact some of the processes in the organisation could be termed as over automated, where one event is recorded in a number of different IS at the same time. This brings to fore the issues relating to information credibility and authenticity, but also contributes to climate of distrust within the organisation. In addition, asset lifecycle information is not integrated and thus restricts realisation of an integrated view of lifecycle, which affects financial and operational asset profiling.

10. IS for Strategic Advantage

There is no formal process of ex-ante or ex-post evaluation of technology investments in the organisation. Individual departments engage in ex-ante assessments; however, these evaluations are more of a feasibility studies aimed at establishing suitability of technology in accomplishing the required tasks and cost of the chosen solution. The technology thus chosen becomes yet another addition to an ever expanding list of isolated pool of data. Being a public sector organisation, Austrans has traditionally been insulated from competition. However, with deregulation business environment is changing and the company is expanding its operations to other geographic location in Australia. At the same time, with programs like Auslink (Federal government's initiative to improve roads) Austrans is facing increased competition from alternative service providers. Nevertheless, it has been only recently that the top management has started considering itself as a market player rather than a monopoly. This change is forcing Austrans to view information and IS in a different way, as is evident from the business manager's response, who argues, *"we are aiming for total (asset) life (profiling), we are going to total community benefit and trying to financially quantify some of those things such as enhanced access stations and the sort of benefits of integrated bus-train interchange to the community"*. However, a transition to this vision requires quality support from IS in terms decision support for effective asset lifecycle management; whereas lifecycle management functions in the organisation are struggling with the basic questions whether the technology has the depth or detail and elegance required to manage assets. In the words of Group manger infrastructure services, *"SAP doesn't provide engineering state of lifecycle, since our data is not integrated. For example, we may know how much we are spending on track maintenance overall, but we cannot straight away find out how much was spent where. Furthermore, this information is not integrated with maintenance or design or operation. We are in the process of building some systems now and our group is also reviewing several different life cycle scenarios, costing and planning tools for our track. But at this point, we haven't got an integrated life cycle asset management"*.

11. Discussion and Conclusions

The case study revealed a range of factors that contribute to the failure of the organisation to maximise value from IS investments. These factors have human, technical, social, organisational, and procedural dimensions and impact development, adoption, and institutionalisation of an IS based asset management in a variety of ways. Austrans has a reactive rather than proactive approach to technology adoption, which is the major hurdle in effective long term planning for an effective asset management enabling infrastructure. The deterministic approach taken by the organisation for technology adoption lacks the vision and foresight to establish effective institutionalisation of technology. Most of the technology adoptions are either in response to regulatory pressure or due to competitors adopting technology. In addition, technology implementation and planning is carried out independent of the context, and does not take into account the social, organisational, and technical maturity of the organisation. As a result, there is a loose connection between asset lifecycle processes and IS. Thus, the information that has to be captured is not acquired and on the other hand the information that is acquired is captured more than once. The existing information lacks quality and credibility. This lack of information quality and the inability to integrate information cannot provide an integrated view of asset lifecycle. As a result the organisation is unable to preserve lifecycle learning and manage asset lifecycle knowledge.

The issues highlight the importance of having IS evaluations as a core component of business management at Austrans. An objective evaluation of IS will provide the company with a gap analysis of the desired versus actual state of IS and related infrastructure maturity and information requirements of asset management processes. The output will be continuous improvement through a set of action oriented adjustments in technology, related infrastructure, and business processes to maximise value for IS. Evaluation thus becomes a learning activity, which facilitates organisational learning through revealing explicit or implicit dimensions of IS for asset management. The learnings thus gained provide indicators for improvement as well as sustaining the existing form or class of asset lifecycle management. In so ding, evaluation works as mean of feedback on the management actions taken and their impact on the organisation, and develops into an instrument of social learning within the organisation. Such evaluations allows for the prospects of assessment at individual level, exchange of information and ideas among individuals and communities of interest, and create consensus and agreement on the learnings from evaluation and ensure commitment to the consequent follow up actions.

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