

E-Business: Factors of EAI Adoption in an Australian Electricity Company

Ying Chen, Alex Wong

School of Information Systems, Faculty of Commerce, University of Tasmania, Australia

Ying.chen@utas.edu.au; Adwong@utas.edu.au

ABSTRACT

The awareness of the scarcity of literature in EAI adoption in the public sector led to the current study of an investigation into the factors that influenced the adoption of EAI in an Australian electricity company. Using a case study approach and qualitative methods, data was collected through semi-structured interviews with five informants from different aspects of the EAI project. Data analysis was conducted using the grounded theory, resulting in 24 themes, which were then categorized into three broad themes of environmental influence, current problems and perceived benefits. These themes were taken as factors that contributed to the decision making of the EAI project of the case company. The informants considered environmental change as the trigger for the adjustment of the case organization's strategy. However, they all shared the view that the adoption of EAI was the consequence of a clear identification of the strategic positioning of the organization, the understanding of existing inhibitors and the awareness of the benefits of a chosen technology.

Keywords: EAI, enterprise systems, decision process

1. INTRODUCTION

Enterprise application integration (EAI) has over the past few years quickly become an alternative option other than Enterprise Resource Planning (ERP) to address organizations' problems on enterprise integration. An obvious indication is the rapid development of middleware technology originally designed for data-oriented integration that has quickly transformed into more sophisticated software architecture.

An examination of existing EAI literature reveals more research has been conducted in relation to the private sector as compared to the public sector. A possible explanation is that the public sector has been less dependant on IT than their private counterparts that utilize IT heavily to greater profitability. The bureaucratic structure of the public sector as well as government policy and regulation controlling competition has resulted in a more conservative approach to IT adoption [15]. However, the operational environment is changing for the public sector. In Australia, the government relinquished control of public sector investments in the 1990s, which included telecommunications and energy distribution industries, an endeavour known as deregulation. Deregulation transformed the operational environment of the public sector from a stable and predictable market to one characterised by dynamism and complexity, in which technology became a valued commodity [15]. The public sector became government business enterprises (GBE) and is required to generate profit.

The research presented in this paper aims to investigate an EAI project in a GBE within the electricity industry in Australia after deregulation. To confront competition with other electricity providers within Australia, the

company decided that it required an enterprise system that should streamline the data flow between three major business sectors within the organization: the human resources department, the assets department and the accounting department. The organization examined two alternative approaches of enterprise integration, ERP from one vendor and EAI with the best of breed. It was decided to pursue the latter option. This study intends to investigate the factors that influenced the decision to implement an EAI project. The findings will be of value to researchers in the area of EAI and the public sector and to organizations with a similar endeavour.

2. LITERATURE REVIEW

2.1 Importance of EAI

EAI is an umbrella term that encompasses technologies designed to unite disparate applications to address business problems. It aims at the unrestricted sharing of data and business processes among any connected applications and data sources in an enterprise [11].

Information technology has been utilised in organisations as a means of automating and improving business processes. However, before 1990s, IT was used to address problems based upon the unique needs and beliefs of business units within an organization, resulting in an IT architecture characterised by autonomous and heterogenous solutions [11]. This resulted in inefficient processes, reduced quality and accuracy of information that potentially impacted on coordination of activities and operational efficiency [8].

With increasing competition in the modern business environment, organisations view knowledge as the only source of competitive advantage with which they may

differentiate themselves from competitors [3]. The inherent decentralized IT architecture creates a big challenge for organizations' strategic planning and decision-making [12].

The trend towards E-business, E-commerce, corporate mergers, acquisitions and globalization in the past few decades has also created other incentives for an integrated enterprise system [2].

ERP emerged in the early 1990s as an enterprise-wide solution to address organisation's coordination issues. In 2001, the enterprise system industry was estimated to be worth US\$19 billion [5]. However, the complexity and cost of ERP in combination with the current economic crisis has made ERP an unattractive option [18].

EAI surged as an attractive alternative option for reduced cost [4, 21], for maximising an organization's existing investments as well as maintaining a unique business process that differentiates an organization and gives it a competitive edge [10]. The cost reduction of EAI was also evidently important to public enterprises [7, 8] as they do not have the high profit margins of their private sector counterparts.

2.2 Challenges of EAI

Challenges of EAI range from the incompatibility of different software, lack of standards in IT architecture and lack of expertise [11]. Middleware technology is a fast developing area aiming at the rising EAI market, but the currency of the technology sees a relative scarcity of individuals with the proficient skills necessary for application integration projects. Despite the fact that previous researchers have found EAI a cheaper option than ERP [4, 21], a full EAI implementation can cost up to AU\$10 million dollars, and in many cases represents the largest IT expenditure in the history of an organisation [20]

2.3 Public Enterprise and EAI

The public sector differs from its private counterpart with some unique attributes. It enjoys a significant establishment time, sometimes over 100 years [2], thus has cultivated the perfect breeding ground for a complicated, inconsistent software architecture [2]. It has a large number of employees requiring extensive management and coordination [7, 8]. It is geographically dispersed as a result of acquisitions and mergers to cut down overhead costs [7]. The culture of the public sector displays signs of bureaucratic control and homogeneity, resulting in a slow response to environmental changes. However, this culture will have to change due to deregulation that brings with it consistent unanticipated changes [2].

Although EAI is viewed by some researchers as a better fit for the public sector [7, 8, 12, 17] research within this context is limited. The existing literature reveals EAI has been adopted by public enterprises such as healthcare, education and telecommunications [7, 8, 21]. In the context of the electricity industry, researchers have identified two triggers of EAI. One relates to the wave of mergers and acquisitions and the other to the sudden increase in the adoption of IT as a result of deregulation. [2, 6, 14].

3. RESEARCH METHOD

The research question of the study is "What factors influence the adoption of EAI within an Australian GBE in the electricity industry?" The research, based on a case study technique, is subjective in nature and takes an interpretivist stance to explore informants' personal experiences, perceptions and opinions in relation to the EAI project within the organization.

The interview protocol, with a detailed design of questions to probe for information most relevant to the research, was pilot tested by the IS manager of the project for flow, timing, content and comprehensibility. Based on the feedback from the pilot test, the interview protocol was refined.

Five informants, representing various roles in the steering committee of the EAI project, were invited to take part in the research. Semi-structured interviews, each approximately one hour in length, were tape-recorded with the consent of the informants and transcribed in accordance with Yin's 24-hour rule [22]. To address validity, the research recorded in detail all aspects of the research process. Both the transcripts of the interviews and a copy of the findings of the research were provided to the informants for validity checks. Close collaboration with the IS manager of the project was conducted in relation to the identification of informants, interview design, accessing internal documents and clarification of issues and terms unfamiliar to the researchers. This practice was in close alignment with the recommendation of three methods for achieving validity from Bailey [1]: natural history, member validation and collaboration.

The research addressed the issue of reliability through a complete transcription of the interviews and a detailed documentation of the coding process to reach the final conclusion. This effort recommended by earlier researchers [1, 22] was to facilitate replication of the study by other researchers.

The data were analysed using a bottom-up, three-stage coding process: open, axial and selective as devised by Strauss and Corbin [19]. Each 'pass-over' was intended to refine and condense the data by identifying salient themes. Dominant themes were expected to be explicit by the conclusion of the coding process.

4. FINDINGS

In order to facilitate discussion, and for ethical reasons, the informants are represented with their positions, as shown in Table 1: Profile of Informants. The initial coding of the interview data generated 24 unique themes, that were then categorized into three broad themes, namely environmental influences, perceptions of current problems and perceived benefits as shown in Table 2: Categorization of Emerging Themes.

4.1 Environment Influences on EAI Adoption

An analysis of the data indicated that a series of external factors contributed to the organizational decision on EAI adoption. Most informants acknowledged that the push to enter the National Electricity Market changed the organization's operational environment as some informants stated:

We're going from a fairly sedate market into a national commercial environment (External Contractor).

The entry to a national market essentially exposes us to full competition with other providers (IS Manager).

Table 1: Profile of Informants

Position	Project Involvement	Employment in Company
IS Manager	Steering committee member	2 years
Process & operations (PO) Manager	Experience with similar projects	15 years
Financial Systems Manager	Consultative committee member	6 years
External Contractor	Project Manager	2 years
Engineering Manager	Business client	2 years

Table 2: Categorization of Emerging Themes

Broad Themes	Underlying Themes
Environmental Influences	Entrance to market; Competition; Competitive positioning; Opportunities; Shareholder ROI; Evolving business
Current Problems	Lack integration; Geographic dispersion; Low assets knowledge; Slow decision-making; Low IT expertise; Change resistant culture
Perceived Benefits	Efficiency; Data accuracy; Information accessibility; improved decision-making; improved productivity; cost control; investment maximisation; standardisation; Extensibility; Systems usability; High ROI; Risk reduction

New external products such as natural gas triggered the need to compete and define the organization's competitive positioning.

It's more important that we position ourselves correctly in the market (IS Manager).

The performance of the asset is an important contributor to being part of the competitive market (External Contractor).

When we go into the national market, we're supposed to have machines that have high availability (Financial Systems Manager).

However, a perception of new opportunities created another environmental factor.

If we can improve capacity a minute portion, that provides sales opportunities (External Contractor).

The entry to a competitive market itself raises the opportunity to exploit higher availability (of assets). We could end up managing assets interstate – which would create another level of complexity... The degree to which opportunities could be exploited, were dependent upon the performance of the assets... essence of the project (IS Manager).

Other environmental factors included shareholders' interests and the need to evolve the business.

The major stakeholder, the government, will know we are running these things, we are sort of maximising the dividend and the tax that we have to pay to them (Financial Manager).

It is quite conceivable that within 4-5 years that 20 –30% of our energy will be derived from wind – and that's a big change and the new EAI system is expected to manage the maintenance of the assets of wind farms (IS Manager).

4.2 Current Problems Leading to EAI Adoption

A series of problems were identified that initiated the necessity of the EAI project for the case organization. The first is the awareness of “no integrated approach to anything” as the External Contractor observed.

We could see a big gap in the organisation in terms of the (assets) maintenance management system (that) was really stand-alone (Financial Manager).

We just need something to pull it all together. It's like having many horses. They all pull in different directions, the cart, not one coach driver to pull the thing into the right direction (Engineering Manager).

The second problem lies in the geographically dispersed nature of the organisation.

Geographic dispersion works against us in terms of being able to have very effective process and good maintenance procedures' (IS Manager).

Geographic dispersion has caused massive differentiation between processes; local processes rather than uniform processes across the entire company (Engineering Manager).

Geographic dispersion appeared to be a particular problem for process standardisation attempts. It suggested that the organisation's control over geographically dispersed factions was tenuous.

The third identified problem was the lack of sufficient understanding and knowledge concerning their assets.

The second, I guess, main aspect of what they need to do is that employees need to improve their understanding and management of those assets (IS Manager).

How long did it take to fix (the problem with assets)? Well the current answer is: 'it depends.' Well it shouldn't depend. Breakdowns of a certain calibre should be fixed in a certain period of time (Engineering Manager).

The informants felt the lack of systems integration and geographic dispersion resulted in a slow organisational decision-making.

*Decisions tend to be taken in a fairly measured way and that can be a frustration sometimes because... you feel you need to respond quickly to something (IS Manager).
We have a certain number of hurdles you have to go through to reach a decision (Financial Manager).*

The informants also pointed out the low level of IT expertise within the organisation.

*We need some good IT professionals as well as internal people (External Contractor).
There would be a fair scarcity of expertise. The organisation's fairly, you know, short at the moment as far as those expertise (PO Manager).*

Further probing revealed that the IT component of the organisation had been outsourced to a third party. The last identified problem related to the organization's resistance to change.

*I think in general, our acceptance and willingness to change could be a lot better... I think more people resist change... People are just not prepared to really embrace a case for change (Financial Manager).
Some people... don't have a lot of contact with the corporate side of the business and they've been there for a long time and are pretty entrenched in the way they do things, so sometimes, trying to get people like that to change is difficult (External Contractor).*

4.3 Perceived Benefits of EAI Adoption

Analysis of the data indicated that informants were well aware of the benefits that the EAI project would bring to the organization.

The first benefit is greater process efficiency as a result of the increased speed of information retrieval, the accessibility, and improved accuracy and quality of data.

*It will streamline a lot of the tedium they have to put up with (External Contractor).
There will be asset efficiencies, and people utilisation by us having the information at our fingertips rather than having to search for it, make phone calls et cetera... It is supposed to provide them with the right information at the right time, it is supposed to save them time by not having to put information into that system... (Engineering Manager).
At the end of the day the organisation should hopefully finish up with better data. They (steering committee) are after up-to-date, complete data on their generation assets, and I don't believe they're getting that at the moment (Financial Systems Manager).*

The informants felt an integrated system with improved accessibility and quality of information would also result in better operational decision-making in asset maintenance. Its significant role in this assets-based organization can be seen with these statements.

*Generation management are able to make better calls about when (to) and when not to run the machine. They'll have a lot better ability to make some of these decisions once they have an integrated system (Financial Systems Manager).
A fully functional platform, which gives me the right information when I need it to make a right decision on the spot. (Engineering Manager).*

It was believed that an integrated system would improve employee productivity and reduce operation costs.

Instead of spending our time doing time sheets three times a day, we only do them once, and in the two hours that we save, we're actually doing something a bit more useful towards managing the assets... It's certainly reducing a lot of our operating costs (External Contractor).

All informants indicated that the reduction of cost could be realized through efficient assets maintenance management, mainly the maximization of the life span of existing assets. A rippled effect would be a higher return of investment (ROI).

*We can predict with reasonable certainty that the life of this particular piece of equipment in service is so long. So we will aim to maintain it inside that window (IS Manager).
It (the integrated system) is to provide us with a suitable platform to maximise the return on investment, these assets which is the essence of asset management – get the best bang for your buck – this is the ultimate objective (Engineering Manager).*

Standardisation of processes for geographically dispersed organization was another crucial benefit.

*There is an impact there or a value in having a system that brings commonality to the way these people work (IS Manager).
If I put this system in, all the regions are going to adhere to exactly the same processes, and you don't get a 'cowboy' manager in one area not adhering to it (Financial Systems Manager).*

The integrated system with its uniform processes and improved information sharing would ensure better asset management, thus reducing the level of risk toward the organisation.

*Unless they (assets) are maintained (with) a regular schedule (and) kept up to date the whole process of when, where, and how (they are) monitored - we put the whole organisation at a fairly big risk (PO Manager).
If you start trading, signing contracts, and then your asset doesn't work to fulfil those contracts, you're likely to be hit with a fairly severe penalty (External Contractor).
If we don't get our operation right, obviously we have the potential to be undercut, lose market share, lose revenue, potentially affecting profit (IS Manager).*

Other benefits included the new system's potential to support new emerging products and services of the organization.

I imagine once (the system is) implemented, they'd (high level decision makers) probably see other advances, they'd say "OK, you can do this", they'd probably look at another area and do this as well, so I'd imagine it would get bigger or have more required of it as time goes by (PO Manager).

I've got an idea because of its nature it will evolve gradually over time (Financial Systems Manager).

The informants also believed that the system would support high usability and generate high returns.

Usability would be high (PO Manager).

They're also really strong on wanting a usable system (External Contractor).

The payback period is only about eighteen months. It has a very high return on investment that is quickly paid back (IS Manager).

The internal rate of return of the project when we put everything in there it came out as something 150% of 200% something huge – that's the beauty about such maintenance improvement, that anything that can assist the plant performance, directly or indirectly, has got a huge payoff (Engineering Manager).

5. DISCUSSIONS

The data analysis shows that there are three contributing factors to the organizational decision on the EAI project: a thorough understanding of the operational environment of the organization, a clear identification of existing problems and a good knowledge of the benefits of the EAI project to the organization. The relationships of the three elements are demonstrated in Figure 1.

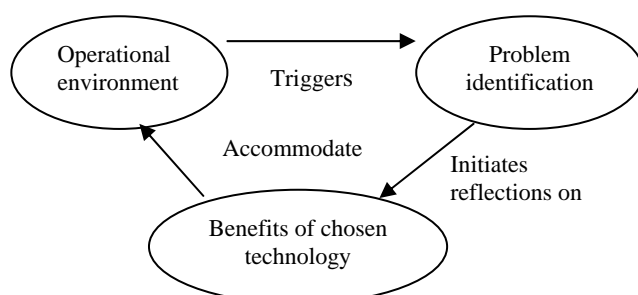


Figure 1: Relationship of factors of EAI adoption

This decision-making process is in alignment with the organismic approach to decision theory in which environment plays a significant role [9]. The organizational practice also suggests a close affinity with the game theory [9], which incorporates both environmental influences and organisational objective as being responsible for an organisation's actions. Another interesting observation was the similarity between the case organisation's objectives and those of private organisations. Foer and Moss [6] observed that private enterprises have an "entrepreneurial culture" that is characterised by an undue focus on profitability, reduced product cost, an increase in product diversity,

and meeting customer's needs. The case organization has adopted most of them except product price. This suggested that deregulation, to a certain degree, had served to dilute the characteristics that differentiated the public and private sectors. However, the public sector might still see an edge in their product availability rather than reduced prices. A possible explanation is a public organization is usually heavily assets based that gives it the potential of providing better service if the assets are well managed and utilized for maximum productivity.

The geographically dispersed nature of the company had its merits in pre-deregulation days when electricity generation companies were responsible for providing electricity to vast land masses [13] and decentralization provided a degree of flexibility [15]. However, in the deregulated regime, geographic dispersion became a weakness when competing against centralised rivals [13]. Furthermore, decentralisation was also viewed as a weakness for public sector organisations as it results in higher operating costs as compared to centralised rivals [16]. The informants expressed similar concerns, blaming the geographic dispersion to be the cause of inconsistent processes that had reduced the organisation's ability to perform efficiently.

The organisation's slow decision-making process can be viewed in the context of lack of information due to dis-integrated systems and the culture of public sector organisations. As mentioned previously, the culture of many public sector organisations tended to reflect their monopolistic nature [6]. Aspects of the monopolistic nature included a bureaucratic structure, and aversion to risk [6]. This implies that public organizations have a culture more unfavourable for change. Any business process reengineering endeavour that involves new cross-functional business processes can be expected to incur more resistance. This is certainly supported by the interview data of the study. The 'Mateship' program used in the organization to encourage loyalty of its employees seemed to further complicate any change initiatives. This accounts for the critical role of the "usability" as identified by the informants. Research indicates an EAI system is a more attractive solution for its minimal impact on culture change, which may account for the case organization's decision to take EAI instead of ERP.

The low level of IT expertise is common within public sector industries. However, like other public organizations that chose to resort to IT for competition [14], the subject organisation used the same strategy and attempted to enhance and cultivate its IT skills through training and recruitment.

The informants' perceptions of EAI benefits are consistent with existing literature. The case organization's paramount interest in work efficiency reflects the observation of many former researchers [17,

7, 21, 2, 8]. Also, the data analysis reveals the inter-relationship between the perceived benefits of EAI projects. Process efficiency was to be achieved through the increased accuracy and accessibility of data, that yields numerous other benefits such as improved organisation's decision-making process, increased productivity of employees and a better control over both cost and risk in relation to assets maintenance. The linked system, as a result of the EAI project aims to help overcome the physical boundaries, a big issue among the majority of public organizations, and help facilitate greater communication and greater control of a standardised business process.

6. LIMITATIONS AND FUTURE RESEARCH

As this research takes an interpretivist stance, the researchers of this study consider it improper and unrealistic to generalise the results to other organizations. However, the research provides some insights into the decision process of adopting advanced technology for the public sector, which will be of value to both academic research and practitioners. A number of issues have emerged for possible further research. They include the impact of organisational culture or top management support on EAI adoption within the public sector and the degree to which the objectives and operations of the public and private sector converge after deregulation.

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