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# An Enterprise Architecture Framework for Information Management Improvement:  Transforming Research into Practice

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## Abstract

*This paper reports how a SME in the Engineering Services sector was able to apply the ideas from research on enterprise wide information management to improve the coordination and control of its business processes. An established enterprise wide architecture framework regulated by essential e-business interactions and moderated by a customised portfolio of managerial issues is used to design a roadmap for the SME of future ICT implementations. The results of initial progress along the roadmap showed deliverables were validated and guided and by the three core activities of Business and IT alignment towards e-business transformation from emergent managerial issues.*

### Keywords

Enterprise architecture, information management, IT strategic alignment, roadmap adoption, SME

## INTRODUCTION

This paper is built on the belief that IS research can help practitioners better understand and adapt to emerging situations by applying "good ideas" from research this both timely and relevant (Fernández et al., 2002). Rohloff's (2007) research into enterprise architecture provides good ideas into the emerging IS phenomena of enterprise-wide information management.

To achieve success of realising the benefits from adopting enterprise wide information, it is important to understand from the outset the complementary nature of business and IT strategy alignment (Venkatraman and Henderson, 1993, Luftman (2000). This raises the importance of examining both technological and sociological issues with respect to practice (Guha, 1997).

The context of this paper is a new small privately owned company that specialises in project management and engineering services in the oil and gas sector. Professional Engineering Services (PES) is structured to enable efficient delivery of projects for small to medium exploration and production companies. PES has a staff of 55 core employees. An initial observation of PES shows a lack of a sound information management practices. Specifically, the organisation lacks a proper validating system for human resource functions; timesheet and payroll.

The study was carried out during the first half of 2008 where the researchers consulted published literature to obtain insight into approaches to enterprise wide Information Management.  The review findings were then applied to draw up a customised roadmap for PES, detailing its transition towards enterprise wide architecture for improved information management.

## THEORECTICAL FRAMEWORK

The Open Group Architecture Framework (TOGAF, 2003) provides for a clear distinction of the business oriented description of the enterprise architecture and the derived technological implementation. The framework gives a comprehensive description of all relevant elements of enterprise architecture providing a principal structure and classification schema used as a reference for architecture development. Rohloff (2007) identifies three architecture domains, each is composed of distinct architecture building blocks including, information management:

- Business Architecture - business models, organisation, processes, *information*

- Application Architecture - enterprise applications, data repositories, EAI services, *information management platform*

- Infrastructure Architecture - basic services, workplace services, server systems, networks

Significantly Rohloff's 2007 framework is different to TOGAF (2003) in that the information architecture is not described as a separate architecture domain but rather split in a building block of the business architecture in terms of logical information structures and a building block of applications architecture in terms of implementation of data repositories. With this architecture definition in mind, it should be obvious that Enterprise Architecture is more than the collection of the constituent architectures. The interrelationships among these architectures, and their joint properties, are essential to the enterprise architecture. The framework has been chosen as it gives a comprehensive description of all relevant elements of enterprise architecture providing a principal structure and classification schema used as a reference for architecture development.

## METHODOLOGY

The methodology of this project is based around the same notion. In this context, no single research method holds the solution to exploring the range of issues about the complex phenomenon of enterprise architecture (Rohloff, 2007). For this research, a three staged approach is adopted using a combination of methods. This is meant to achieve a balance between techno and socio approach using multiple research models (good ideas) for applying research to practice.

This study based on PES proposed to answer the following research questions:

Q.1 How can a brand new SME, with a very narrow focus, in a extremely specialised field, and with a managerial mindset that ICT will get built as we go along, have  relevant existing but general theoretical frameworks applied to build a transformational roadmap to Enterprise Wide Information Management?

Q.2 How can an enterprise wide information management transition be mapped or visualised when no clear methodologies exist and the enterprise lack of ICT skills?

The tasks carried out included:      (i) literature review,      (ii) construction of relevant theoretical framework, (iii) application of developed theory,    (iv) development, implementation and validation of a transformational roadmap. Figure 1 details how a three staged development process was used for achieving a comprehensive and rigorous enterprise architecture where:

- Stage 1 is the construction a map of e-business interactions with external B2B and internal B2E

- Stage 2 is the identification of managerial issues and classified into a hierarchical *break down* structure

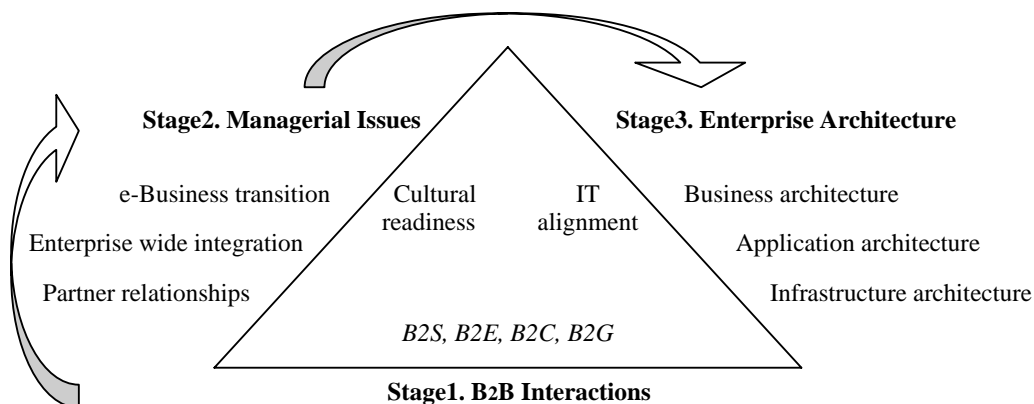- Stage 3 is the application of the enterprise architecture illustrated in Figure 1.



Figure 1: Three Stages of **E**nterprise **A**rchitecture **D**evelopment (EDA)

Each stage represented in Figure 1 reflects the different views of the organisation's behaviour and progress, namely; Business-to-business (B2B) operations, management issues portfolio, and enterprise architecture development.

At stage 1 a map of e-business interactions is constructed at various levels of abstractions to incorporate both external (B2S, B2E, B2C) and internal (B2E) interaction (see Appendix A).

At the next stage a portfolio of managerial issues was constructed (see Appendix B). A detailed analysis was performed for each Managerial Issue (MI) was drawn up to identify "ICT required" to address each issue (Miles and Huberman, 1994). The identified ICT requirement was then analysed to draw up the transition from "as-is" to a "to-be" architecture. The completed structures portfolio if MIs is based on the generic managerial issues provided by Turban et al (2008).

At the third stage we make use of stages 1 and 2 to help regulate and moderate the development of an enterprise architecture detailed by Rohloff's approach as seen in Figure 2. The outcome of stage 3 is a customised "road map" of ICT adoption driven by the organisation's business and IT strategy alignment. Projects along the transition path were prioritised as suggested by Rohloff (2007). The approach of business and IT alignment was adopted to outline the succession of projects.
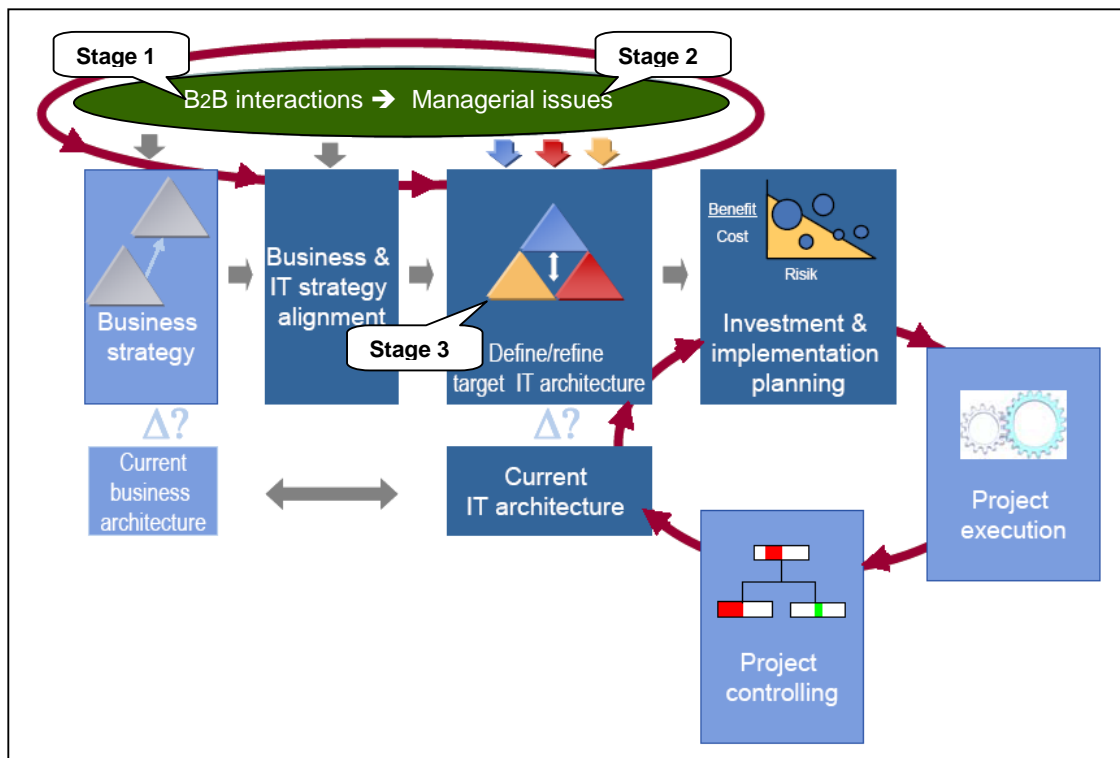


Figure 2: Overview of the Enterprise Architecture Development process (Adapted from Rohloff, 2007)

Figure 2 was adapted from Rohloff's (2007) Enterprise Architecture Development (EAD) process by the substitution of "environmental and technology trends" by *Stage 1* as the progress of e-business interactions and *Stage 2* as managerial issues portfolio with priorities.

The blueprint of the target architecture describes the deployment plan to implement IT strategy. From the gap analysis of "as is" and target architecture IT projects are derived. The projects are prioritized and the overall IT program is defined. The execution of the respective IT program and projects finally result in changes to the current IT architecture and IT service operations. The implementation of the target architecture forms the second cycle of business/ IT alignment.

The following listing sketches some objectives to be pursued with enterprise architecture TOGAF 2003):

- Strategy and business orientation - enabling, leverage of IT, new business models

- Transparency - complexity and dependencies of architecture building blocks

- Communication between business and IT community - different people from management to IT experts involved

- Planning - target oriented, steering of I&C program with strong impact and to secure compliance to corporate standards

- Synergies - develop & implement the I&C landscape in a systematic manner and to utilize synergies

- Adaptability - dynamic development of market, business, and technology, provide for scalability and growth

## DEVELOPMENT OF THE PES ROAD MAP WITH INITIAL IMPLEMENTATION

The theoretical framework relevant to PES was then adopted to map out a practical path to EAD alignment and validation. An iterative process was to be drawn on the road map to factor in the dynamics of business change at each stage of the transition process. For each stage a uniform validation and review guideline was drafted. The validation was to re-affirm alignment to the EAD process. The review guideline was to revisit the changes in business environment at the time of completion of each stage.

The roadmap deliveries were guided and validated by the three stages of 1: EAD alignment, 2: successful Management and 3: e-Business interactions. The idealised roadmap needed to outline application projects in a staged format.

The three staged theoretical frameworks to EAD (Figure 2, above) adopted for this case research into PES, provided the basis for the formulation of an implementation model / roadmap to Enterprise Wide Information Management (EWIM) for PES is outlined in Figure 3 below.
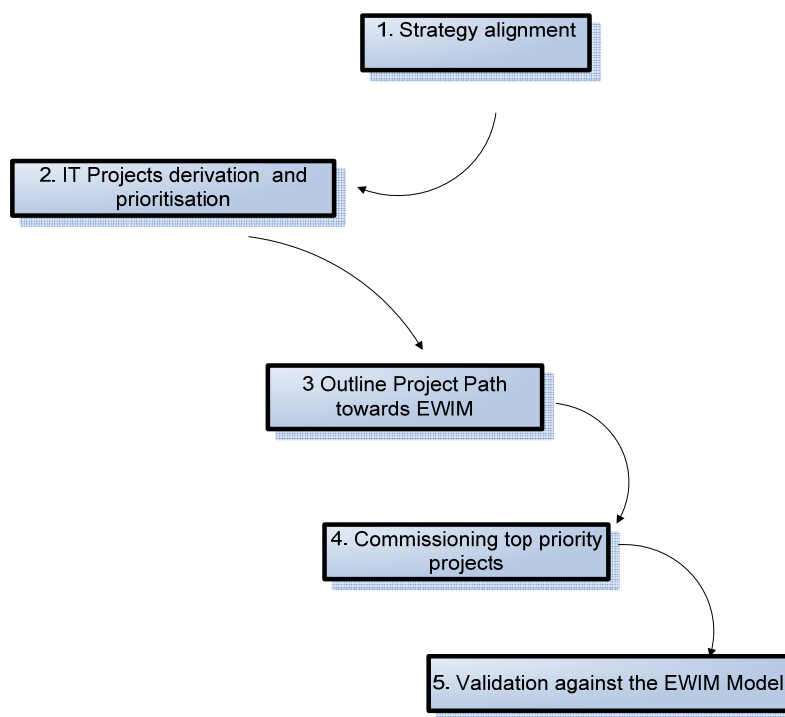
Figure 3: EWIM Implementation model

Following the end of each project delivery, provisions for a review process needed to be made within the roadmap to re-evaluate itself for the suitability and priority of subsequent undertakings. This review is essential to circumscribe the change of business needs that emerge since the time of last review; at the initiation of preceding projects.

**Strategy Alignment**

Strategy alignment, IT project derivation and prioritisation, and the outlining of project path towards e-business are guided by the "process of architecture development" (Rohloff, 2007). Immediate commissioning of top priority projects is imperative for this roadmap to be effective. Validation against the three dimensions EAD Model is the final task to map the worthiness of the transition. Organisations need to start all over again if the implementation efforts along the project path are delayed till a later time.

In the case study of PES, Strategy Alignment was facilitated by a series of interviews and email exchanges with the Director and the administrative staff of PES. The objective feedbacks were formulated into a portfolio of "Managerial Issues" (MIs) as outlined in Appendix B. Each managerial issue was reflected "ICT required". The matrix of MIs versus "ICT required" outlined benefits, barriers, expected improvements, success criteria and benefit realization of minimal level "satisficing" of each ICT in context of the managerial issue.

**Road Map of ICT Project Derivation and Prioritisation**

The listing of "ICT Required" was then mapped on a "score card" as best option. Table 1 outlines the scorecard used and project weightings. Incidentally, the projects that scored higher had showed better cost benefit. PES Management was also given a copy of the outcomes. It was reassuring to discover that the executives at PES had similar projects in their priority listings. The top most project of interest was that concerning employee/contractors timesheet reconciliation and reporting. This so called "Rec-Time System" was implemented as a "Proof of Concept" project and the findings are reported below.

The series of proposed projects in priority order is listed below in Table 1. The table shows two priority lists determine by the researchers in the first instance and a revised list by consensus of PES's management team. The Projects with the same priority are very closely related and need to be delivered in the same timeframe. The "Integrated Help Desk" project show up as the one difference between the two parties. This raises the question as to whether, implementing a complex theoretical model to solve a practical problem is better that the system approach demonstrated by the PES management?

Table 1. Project Path towards EWIM

| ICT Required | Researcher's Priority Nos. | PES Mgrs Priority Nos. |
|---|---|---|
| *Timesheets reconciliation and reporting systems – "Rec-Time Sys"(RTS)* | 1 | 1 |
| Web application to integrate ASP timesheet with Finance & HR - Project | 2 | 2 |
| Integrated help desk - project | 3 | 16 |
| Content Management System - project | 4 | 5 |
| Delegated web content management system (CMS) - project | 4 | 8 |
| e-Procurement - project | 5 | 3 |
| e-Procurement with financials - project | 5 | 4 |
| VPN - project | 6 | 9 |
| Reporting systems - project | 7 | 6 |
| Integrated work flow - project | 8 | 10 |
| RtMS - project | 9 | 11 |
| Offsite backup - project | 10 | 7 |
| DR Site - project | 10 | 12 |
| Staff portals - project | 11 | 13 |
| Wireless LAN - project | 12 | 15 |
| Video and virtual collaborative environment - project | 13 | 14 |
| Internal replica of outsourced systems - projects | 14 | 17 |
| Unified Messaging - project | 15 | 18 |
| Decision support systems - projects | 16 | 19 |

**Commissioning of top priority projects**

In this case study, only one (1) project was picked as top priority by PES management to which resources could be allocated to. This was the above mentioned "Rec-Time System" and findings are Table 1. Management was made aware that future efforts towards EWIM will need to start at the "Strategy Alignment" again due to the dynamics of business change during the "idle period".

The existing applications were identified and moderated by Managerial Issues portfolio:

- Email and Document Management System where ICT exits

- Fully fledged ISD as part of HR implementation

- Moderated Mass Mailing Systems (Distribution Lists) where ICT exits

- Online timesheet/time tracking where ICT exits as ASP hosting

A pilot project, the highest priority project on the project map, was then implemented, validated, and followed by a roadmap review. The rationale was that success in all areas with the first project would validate the chosen theoretical framework as effective for formulating the project path chosen. This would further be an indicator of further success to the organisation in adopting the methodologies and subsequent projects, and thus the roadmap as a whole.

**Validation against the EAD Model**

The project path towards EWIM had "Rec-Time System" as the flagship application. Following the implementation of the "Rec-Time System", a validation effort was required to certify the "worthiness" of this project by triangulation against the three dimensions of EWIM.  The architecture alignment is not required since the road map ensures that projects are derived within the realm of Enterprise Architecture approach.

In relation to change management, "the findings from studies in "business process change" by Guha et al (1997), suggests that successful e-Business change projects should tend to have facilitators in all dimensions of the e-Business change model by Ash and Burn (2006). Thus each component of e-Business change contributes towards the delivered e-business project was tabulated with positive contributions desired for all components. The e-business model conformance is achieved by demonstrating a high level of integration within the supply-chain.

## FINDINGS FROM THE INITIAL CASE PROJECT

In this case study application the "Time-Rec System" was identified as initial of the projects along the project path to be taken by PES as part of the roadmap to EAD. Further analysis, matched with feedback from management marked this as the top priority project and became a "proof of concept" undertaking for this research.

"Time-Rec System" was developed as an intranet accessible web project in a three-tier architecture with the web being the client tier and the application logic and database forming the other two tiers. Integration with the ASP "GetHarvest" was facilitated using APIs and data synchronised using XML interactions. The differential capability built into TRS which included added functionality such as monthly reporting, invoicing on approved work only, variant schema of charging for work and input of other HR related data. The whole analysis to handover/ maintenance cycle of TRS was guided by the application development paradigms.

To validate the roadmap as an effective path to EWIM, the "Time-Rec System" undertaking was tested and regulated against the three stages of the EAD model (Figure 2).

The qualification to successful change management was done by rating the positive (+ve) or negative (-ve) contribution of each of the component of business framework towards the e-business project (Ash, 2007). Table 2 adopted from Ash and Burn, (2006) outlined the findings to "show an overall level of success achieved." The +ve impact for all component of business framework towards the e-business project confirmed a high degree of success in the area of change management.

Table 2: Summary of impact for component of business framework towards an e-business

| Business Framework Components | Rating +ve/-ve | Summary of Findings |
|---|---|---|
| Environment | | |
| *Strategic Initiatives* | +ve | This project provided for the shortcomings of the ASP hosted solution. This allowed senior staff to report on/view realtime date on consultancy costs and mark-ups to client. |
| *Cultural Readiness* | +ve | Management, HR and IT administrator were already looking forward to the completion of the project. The deliverables was well accepted |
| *IT Leveragability* | +ve | Provided use of API and XML data exchanges to integrate the ASP solution with TRS |
| *Relationship building* | +ve | Management/administrators had improved communication with clients in reporting real time consultancy allocation to projects |
| *Learning Capacity* | +ve | ICT Manager picked up skills on data archiving and techniques on in-house application management. |
| Management | | |
| *Change Mgt Practice* | +ve | This was already regarded a high priority project by management. The change process was well managed |
| *e-Business Mgt Practice* | +ve | Improved information flows from employee to administration and from Administration to clients |
| Performance Gains | | |
| *Employee working Life* | +ve | HR's manual data entry process/reconciliation on hundreds of timesheets entries was eliminated. This reduced hours of tedious work. |
| *B2B interactions* | +ve | Clients historically had to wait for month end to get consultancy costs. Now the indicative costs are available on an ad-hoc basis on approved work. |

The fact that the "Time-Rec System" was a product of the methodologies outlined by Ruholf (2007) provided validation of the "Time-Rec System" to EAD approach for the organisation. This helped evaluate the success of initial implementation along the organisation's proposed projects road map by applying an established e-business change framework.

## CONCLUSIONS

The undertaking in this research project, "to transform research into practice" has so far produced a positive initial outcome. An accepted theoretical EAD framework with a high degree of relevance to any type of organisation was adopted. The rational that the framework details the domains in architecture building blocks to give a comprehensive overview of all constituents of enterprise architecture was demonstrated.

As a newly formed company PES was not a conventional SME. The roadmap to enterprise wide information management in this "unconventional" organisation was drawn to ensure a high degree of rigour to the theoretical framework. It was this high degree of relevance/rigour that guided "proof of concept" project and the roadmap as a whole to a successful implementation.

Further, the management mindset was not focused on enterprise architecture for improved information management but to only concentrate on core business and to only build ICT on an ad-hoc basis. The lack of ICT skills was evident and so was the lack of any clear framework for transition towards EAD for this "unconventional" organisation. However, this project also re-iterated that effectiveness in information management for an unconventional organisation can be extracted by transforming research of a high degree of relevance into practice whilst demonstrating an acceptable degree of rigour.

In this context, further research is needed into the usefulness of implementing a complex theoretical model to solve a practical problem when a good system approach would lead to the same solution of enterprise wide information management.

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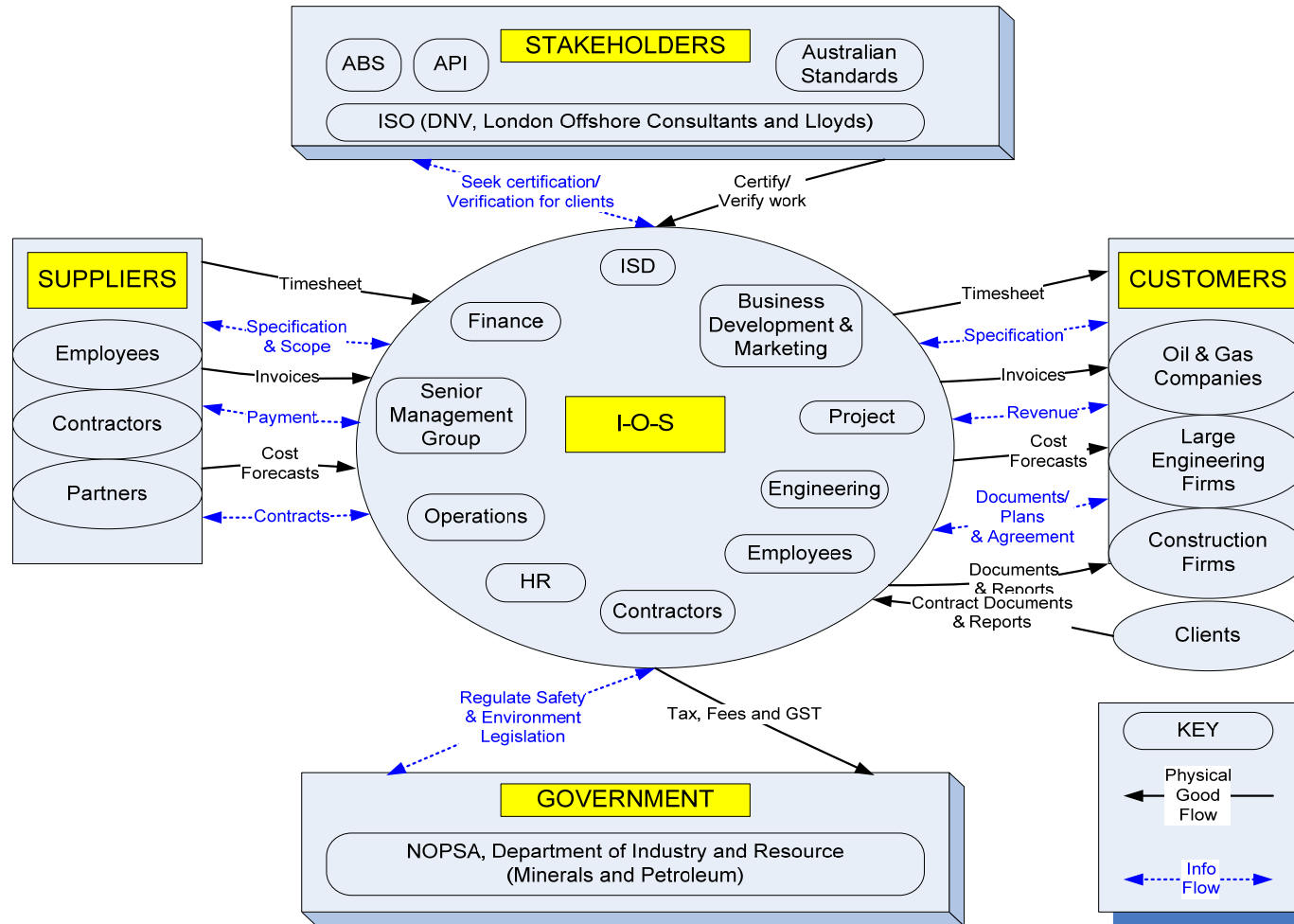
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**APPENDIX A:**



Figure 4: Current e-Business Model (B2B)

## APPENDIX B: Managerial Issues Portfolio

**Enterprise wide Info. Management for IOS**

| 1.0 Transition to ebusiness | 2.0 Enterprise Wide Integration | 3.0 Outsourcing | 4.0 Partner Relationship Management | 5.0 Security | 6.0 Ethical Issues |
|---|---|---|---|---|---|
| 1.1  How much eBusiness | 2.1  Cost Justification, Intangible benefits | 3.1  Application Service Providers | 4.1  Partner and Supplier Relationship | 5.1  Quality of Data Security | 6.1  Legal Implication |
| 1.2  How much to integrate | 2.2  Application Integration | 3.2  Disaster Recovery | 4.2  Partners' Collaboration | 5.2  Risk | 6.2  Control of employee time/ activities |
| 1.3  How much IT | 2.3  Data Delivery | 3.3  Lack of qualified personnel and outsourcing | 4.3  Preferred Supplier in Engineering | 5.3  Controlling access/ managing content of material on Intranet | 6.3  Telecommuting |
| 1.4  How much infrastructure | 2.4  System Integration | 3.4  Internal or External | | 5.4  Disaster Recovery | 6.4  Managing/ Evaluating remote workers |
| 1.5 Recognizing opportunities for using ICT and web based systems | 2.5  Increasing Reliability of Systems | 3.5  How to deal with outsourcing and utility trends | | 5.5  Quality Management of Information | 6.5  Ethics and Social Implication |
| 1.6  Business Process Redesign | | 3.6  New infrastructures | | | 6.6  Installing Digital Dashboard |
| 1.7  The roles if ISD and end users | | | | | |