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Akeel, Hosian, Wynn, Martin G ORCID logoORCID: <https://orcid.org/0000-0001-7619-6079> and Zhang, Shujun ORCID logoORCID: <https://orcid.org/0000-0001-5699-2676> (2013) Information systems deployment in Libyan oil companies: two case studies. *Electronic Journal of Information Systems in Developing Countries (EJISDC)*, 59 (4). pp. 1-18.

Official URL: <http://www.ejisdcs.org/ojs2.../index.php/ejisdcs/article/view/1204>

EPrint URI: <https://eprints.glos.ac.uk/id/eprint/1388>

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Published in the Electronic Journal of Information Systems in Developing Countries, and available online at:

<http://www.ejisdc.org/ojs2.../index.php/ejisdc/article/view/1204/484>

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Information systems deployment in Libyan oil companies: two case studies

[This is the post-peer reviewed final draft of the following article: Akeel, H., Wynn, M. and Zhang, S. (2013), 'Information systems deployment in Libyan oil companies: two case studies', **Electronic Journal of Information Systems in Developing Countries**, Volume 59, Issue 4, pp 1-18, which has been published in final form at:<http://www.ejisdc.org> > Home > Vol 59 (2013) > Akeel].

Abstract

This article assesses information systems deployment in two oil companies in Libya and thereby helps address the general shortage of information on the implementation of information systems in Libyan companies. It explores the information systems strategies of these two companies and explores and analyses how these have been implemented in recent years. One company has pursued an in-house/best of breed approach, whilst the other is in the process of migrating to an integrated ERP software solution. The study uses a number of analytical models developed in a western context in recent years to assess the status and nature of IS deployment, and concludes that a combination of these models is of value in an IS industry context in developing world countries.

Keywords

Libyan oil companies, information systems, ERP, process change, IS strategy, IS models

INTRODUCTION

Libya has a population of over 6.5 million people and covers an area of 678,000 square miles, being slightly larger than Alaska, and more than seven times the size of the United Kingdom. It is the fourth largest country in the African Union. The Mediterranean Sea flanks it in the North, in the east it is bordered by Egypt and Sudan, in the south by Niger, Chad and Sudan and in the west by Tunisia and Algeria. Within Libya, 90% of the land is made up of desert or semi-desert. The climate of Libya is hot in the South, as it is dominated by the Sahara desert, and moderate along the coast of the Mediterranean Sea. The Libyan population is growing rapidly; indeed, it has the highest growth rate in the World, growing at a rate of 3.5 per cent per annum. Five per cent of the population is under 20 years of age, making it a country of young people. Eighty-six per cent of the population is urban, which is the highest urbanisation rate in the world.

The bulk of the population lives in the coastal strip of over 1,000 miles in length, mainly in the two main cities of Tripoli and Benghazi. Life expectancy for the total population is 76 years for males and 74 years for females. Arabs and Berbers represent 97% of the overall population and 97% of the population is Sunni Muslim. Libyan people speak Arabic as a first language, but English and Italian are widely understood in the main cities. 82% of the total population is literate, 92% of males, 72% of females.

There are few studies of IS deployment in Libyan companies. A study of information systems in Libyan banks (Sharkasi and Wynn, 2011) revealed distinct IS strategies that were the product of a number of different interacting issues – cost constraints, management capabilities, political will and cultural factors. The implementation of mainstream information systems is often a costly process, which requires significant effort, time and funding at every stage of the systems life cycle. Such investment contributes to the organisation's subsequent long-term productivity and profitability, and effective project management in systems implementations and proper training and skills enhancement for the systems users are key factors in achieving this (Wynn and Maldonado, 2007). It is also dependent on the knowledge of how to use these systems in an effective manner, to support the information requirements of the decision makers and strategic planners. This will often entail change and improvements in the basic business processes of the organisation. This article investigates and analyses the way that information systems are deployed in Libyan oil companies, taking as case studies one domestic, and one foreign owned, oil company.

CONCEPTUAL FRAMEWORK

Beynon-Davies (2002) argues that the impact of information systems (IS) can be considered on a number of levels: individual, on groups and on the organisation as a whole. The effects may be positive or negative. In addition, the adoption of IS in an organisation may cause both intended and unintended effects. Laudon and Laudon (2005) note that “information systems must be aligned with the organisation to provide information that important groups within the organisation need. At the same time, the organisation must be aware of, and be open to, the influences of information systems in order to benefit from new technology”.

One major area of impact in the introduction of IS is in the improvement or re-design of main business processes. There are many definitions of the term business process. Davenport (1993) defined business process as "a specific ordering of work activities across time and space, with a beginning, an end and clearly identified inputs and outputs: a structure for action". Gladwin and Tumay (1994) describe a business process as a "group of logically related tasks that use resources of the organisation to provide defined results in support of the organisation's objectives". Even though IT is acknowledged as one of the main enablers of business process change, existing modeling techniques are often unable to fully represent the impact of new IS on business processes. This can lead to the expected benefits not being achieved (Eatock, 2003).

Earl (1988) outlined three alternative approaches to IS strategy development and examined how new systems deployment can impact on core business processes. It is not always easy to embrace process management especially if an organisation is dominated by traditional functional structures, as is the case in many Libyan companies. The implications of process management are often neither fully understood nor thought through. Ramaswamy (1996) suggests that companies that provide services normally consider a process to be a sequence of activities needed to perform transactions that help to provide those services. Process modeling can provide a straightforward means of classifying business activities. "Modeling, in general, aims to provide an abstract description of one slice of reality by omitting details and thus reducing complexity which is usually inherent in real world situations" (Tsalgatidou and Junginger, 1995). In practice, functional areas do not disappear when companies organize themselves around processes. When process owners assume their responsibilities for specific projects, the functional area heads can focus on core competencies and related staff training and resource planning and management.

Top level process maps can be used to depict the deployment of IS in different areas of an organization or industry (Wynn, Turner, Abbas and Shen, 2009). As regards the oil companies studied here, they are an integral part of a supply chain that can be broadly divided into the upstream supply chain and the downstream supply chain. Hussain, Assavapokee and Khumawala (2006) have suggested that the upstream process encompasses "the exploration, forecasting, production, and logistics management of delivering crude oil from remotely located oil wells to refineries", whilst the downstream supply chain starts at the refinery and involves the processes

of “forecasting, production, and the logistics management of delivering the crude oil derivatives to customers around the globe.” Nnadili (2006) asserts that “the structure of the petroleum upstream supply chain is more discrete than the supply chains of other industries because it involves many independent operations starting with exploration and logistics involved in trading and extending to variable modes of transportation....., to the complex refining process, which in most companies requires the use of very large-scale optimization models.” Figure 1 depicts the activities of the petroleum upstream supply chain, which is the main focus of this analysis.

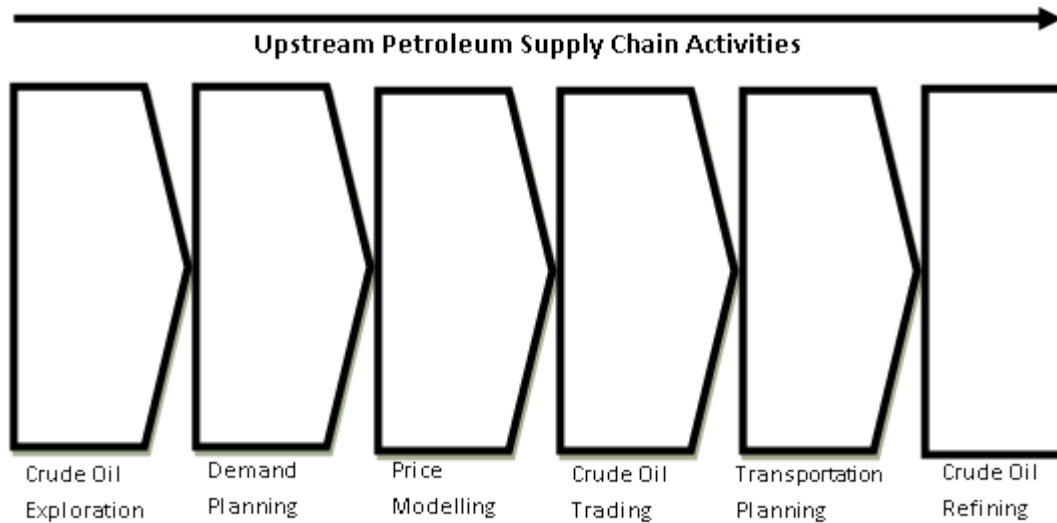


Figure 1. Main Activities in the Upstream Petroleum Supply Chain

Source: Nnadili, 2006

To assess the impact of systems and technologies on different processes, a number of models can be used. The UK Government’s CPIT (connect-publish-interact-transform) model (DTI, 2001) seeks to determine the level of e-business adoption at individual process level, and this has been used successfully in a number of company studies in the UK to assess the level of e-business across an organisation (Taylor and Murphy, 2004; Lau, Wynn and Maryszczak, 2010, Wynn, Turner and Lau, 2013). However, the distinction between e-business and systems deployment in general is now very blurred; as Chaffey (2007) has suggested e-business might well now be considered as “all electronically mediated information exchanges”. Zuboff’s concepts of automate-informate-transformate (Zuboff, 1988) are an alternative means of assessing IS impacts in individual process areas. In this context, ‘automate’ signifies the basic use of computer systems to support a process; ‘informate’ implies that IS are being used to generate management

and operational information to advance process improvement; and ‘transformate’ means the deployment of IS has had a major change on the business process leading to a degree of transformation. This framework was used by Sharkasi and Wynn (2011) to assess information systems in Libyan banks.

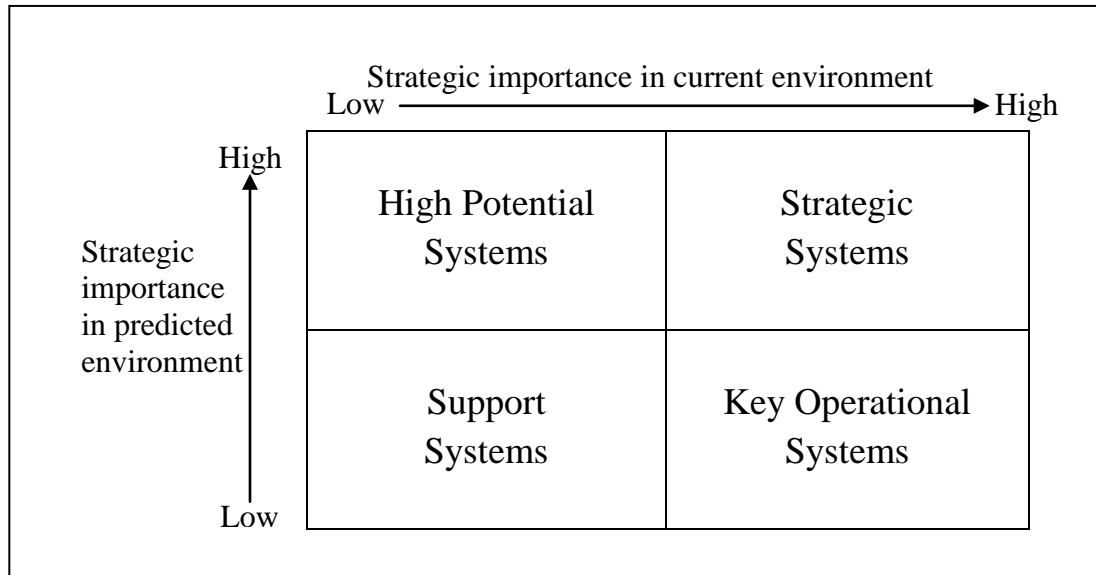


Figure 2 The McFarlan-Peppard model – a quadrant grid of the IS applications portfolio

In addition, Nolan’s model (Nolan, 1979) of the evolution of the IT/IS function in organisations is still relevant today, particularly in developing countries where the uptake of technology has been relatively recent. The model depicts six evolutionary stages in the development of the IT/IS function, starting with end-user Initiation of computer use, through Contagion to Control, when an IS/IT department is established, to Systems Integration, Data Administration and Maturity. It remains a valid and relevant model that can be used to assess the role of IS and IT in an organization. The quadrant grid model developed by McFarlan and Peppard (Ward and Peppard, 2002 – see Figure 2) is also useful because it enables an assessment of how well IS deployment and IS strategy are aligned with overall business strategy. The model considers the contribution of IS to the business at present and also considers the future contribution of IS based on their industry impact.

This research will address the following questions:

- What information systems are currently deployed in the Libyan oil companies?

- How effective are these systems in supporting core business processes and what has been their impact?
- What evaluative frameworks can be used to assess information systems deployment in these and other companies in the developing world?

RESEARCH METHODOLOGY

The research methodology and design is based upon an inductive approach using two main case studies. Qualitative, inductive research can be carried out in a number of ways, encompassing case studies, the development of grounded theory, and ethnography. Remenyi et al (1998) suggest that widely accepted theories are unlikely to be available within a business context and that Glaser and Strauss's (1967) grounded theory methodology needs to be used for theoretical conjecture. Grounded theory is "an inductive, theory discovering, methodology that allows the researcher to develop a theoretical account of the general features of a topic while simultaneously grounding the account in empirical observations or evidence" (Martin and Turner, 1986).

Hartley (1994) defines case study research as a "detailed investigation ... of one or more organisations, or groups within organisations, with a view to providing an analysis of the context and processes involved in the phenomenon under study"; and Remenyi et al (1998) conclude that case studies can be used as part of a grounded theory approach. This study researches two main oil companies as case studies, because a multiple-case design can increase the validity of generalizations developed from the research (Benbasat, Goldstein and Mead, 1987). This view is supported by Yin (2003), who suggests that single case studies are vulnerable, and that there may be substantial analytical benefits of having multiple case studies. Grounded theory can emerge through analysis of the evidence from the case studies. This can be analysed in conjunction with findings from a literature review to develop theory and concepts. This allows empirical generalisations and a series of clear statements to be developed (Remenyi et al, 1998).

Data collection was pursued through a combination of questionnaires, interviews, observations and documentary evidence. Yin (2009) suggests that the utilisation of multiple sources of evidence is one way of increasing the construct validity of case studies. Semi-structured

Table 1: The case study oil companies: basic data
(N.B. 1 Libyan\$ = 0.79 US\$)

Company	Year Established	Current Ownership	Number of Employees	Company Oil Wells	Annual Revenue (millions of Libyan\$)
Waha Oil Company	1955	Domestic: 59% Public 41% Private	3,200	1,100	689.85
Petro Canada Company	1975	Foreign: 100% Private	6,000	1,500	365.00

interviews were used with a number of employees in the two oil companies - Waha Oil Company and Petro Canada Company, two of the biggest oil companies in Libya. While the Waha Oil Company (WOC) is a domestic upstream crude oil company, Petro Canada Company (PCC) is an international oil company which works in collaboration with the National Oil Corporation, again in the upstream sector of Libyan oil industry. The two cases studies (Table 1) are thus representative of the two different categories of oil companies in Libya – domestic and foreign owned.

CASE STUDY FINDINGS

IS strategy and IS deployment

Questionnaire and interview feedback from company personnel suggest that the six main business processes depicted in Figure 3 comprehensively encompass all activities in the oil companies. This is top line process mapping that builds on the supply chain activity classifications discussed above, and which can also recognise sub-processes within each process area at a lower level.

The IS deployment to support these main business processes reflect the distinct IS strategies pursued in the two companies. PCC, the foreign owned oil company, have a collection of in-house systems developed in Microsoft Excel or Access and/or Java and SQL, there being just one main software business package purchased from an outside vendor – a Java-based system for inventory management (Figure 4).

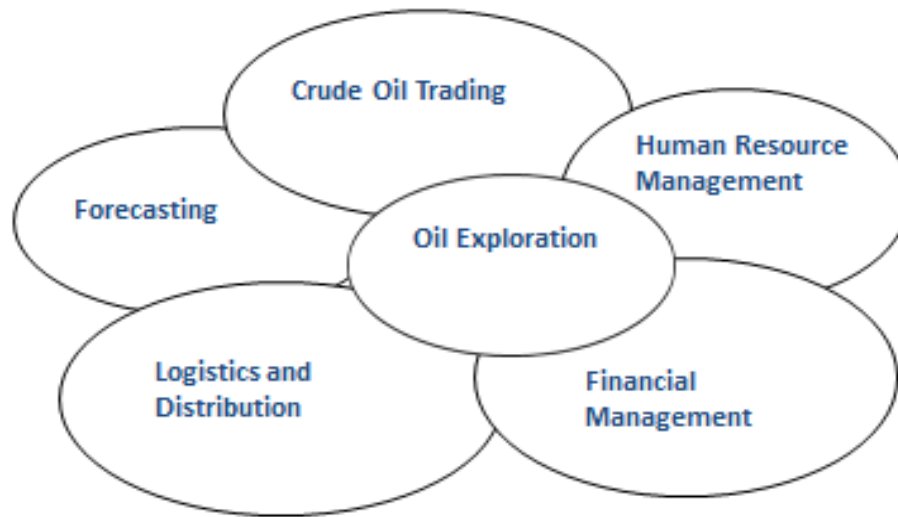


Figure 3. Main business processes in the Libyan oil companies

In parallel, hardware infrastructure has been upgraded, but there is no clear strategy regarding a move to packaged software or adoption of a mainstream ERP solution. This has resulted in problems of integration and management information, and has also meant that the move to web enablement, discussed below, has suffered from an inadequate underlying IS infrastructure. It is also true, however, that some of the processes in oil companies, notably petroleum production, are particular to different business environments, and standard ERP production module functionality will not necessarily be a good overall 'fit' to these requirements. It is partly because of this that PCC elected to bespoke their systems for oil production and have remained with them. This strategy was embarked upon by PCC in 2005, and in-house developed information systems are still viewed as of key strategic importance to the company. The company is moving towards having specific in-house solutions for each of its business sub-processes. This strategy of developing standalone solutions in each process area has been progressed over the past 8

years, but the company is still using a simple file exchange method to share information across most of its IS, and there is no properly automated integration of IS at present.

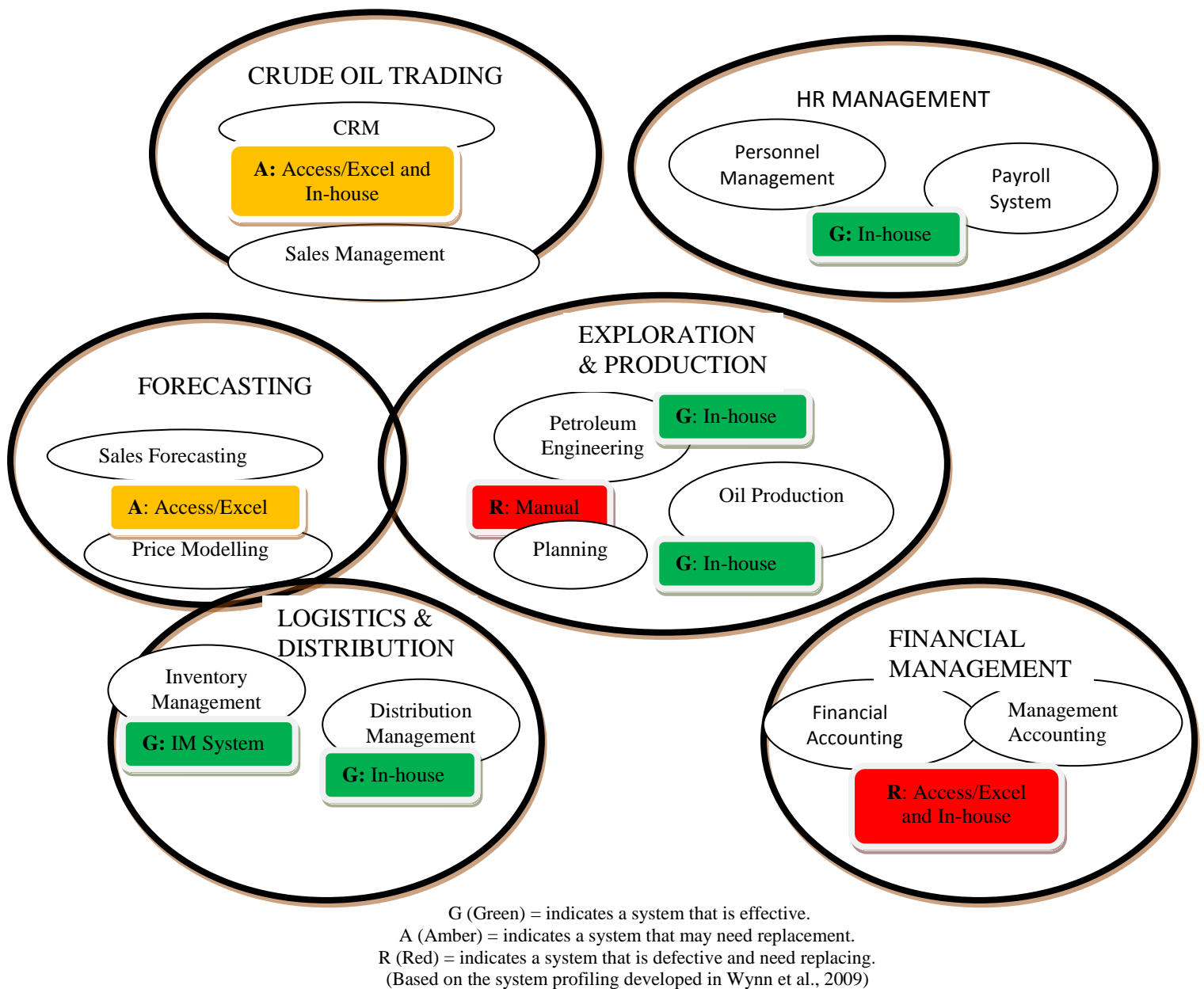


Figure.4. Main business processes and IS Profiling at Petro Canada

At WOC, there has been a clear strategy since 2007 to implement the SAP R/3 ERP integrated package (hereafter ‘SAP’) in phases. At present, SAP is used to support the financial management, human resource management and sales and marketing (crude oil trading) processes, with in house developed legacy systems still in place in other process areas (Figure 5).

Adoption of the SAP throughout the company is still on-going, and an upgrade to incorporate a web-based user interface is planned. The legacy systems, which pre-date the first SAP module implementation, were developed in COBOL, and there are also point solutions developed in Microsoft Access and Excel. Integration of the SAP modules with other systems is done via a mixture of bespoke links and manual updates. Despite the clear need for automated integration of IS, the company still relies on a file exchange method for data and information flows between systems. However, WOC is currently progressing its phased implementation of SAP across all its sub-processes, with a target of phasing out all other IS in the company by 2016. This will eradicate the need for any integration of SAP with the company's old IS.

IS and e-business assessment

Although the two oil companies have generally matured in their deployment of IS since adopting their current strategies, integration remains a key issue, particularly at PCC. Human errors can arise from the practice of semi-automated file exchange, a problem compounded by human intervention to maintain key elements of corporate data, notably customer and product related information. Timely and reliable information is very important for managers in the oil companies to inform and support managerial decisions. It also assists them in solving short-term and long-term business problems. For example, in WOC, there is an approval system in SAP for official expenses incurred by employees of the company. When implemented, the system eliminated delays in expenses approvals incurred when senior staff were not available for formal sign-off procedures. At PCC, regular reports on the sales forecast and historical sales records are critical in the effective management of the crude oil inventory via the IM system. At both companies, updated financial reports, like the income statement, balance sheet, journal activities and trial balances, are regularly generated and used by the senior management to inform financial decisions. Availability of such important reports has significantly assisted the oil companies in making both short term and long term decisions. The deployed IS in both companies have had significant impacts on business efficiencies, notably in the sales support function at WOC, where headcount and overall costs have been reduced.

Both companies have a form of customer relationship management (CRM) system – via a combination of an in-house development and Excel spread sheet at PCC, and via the SAP sales

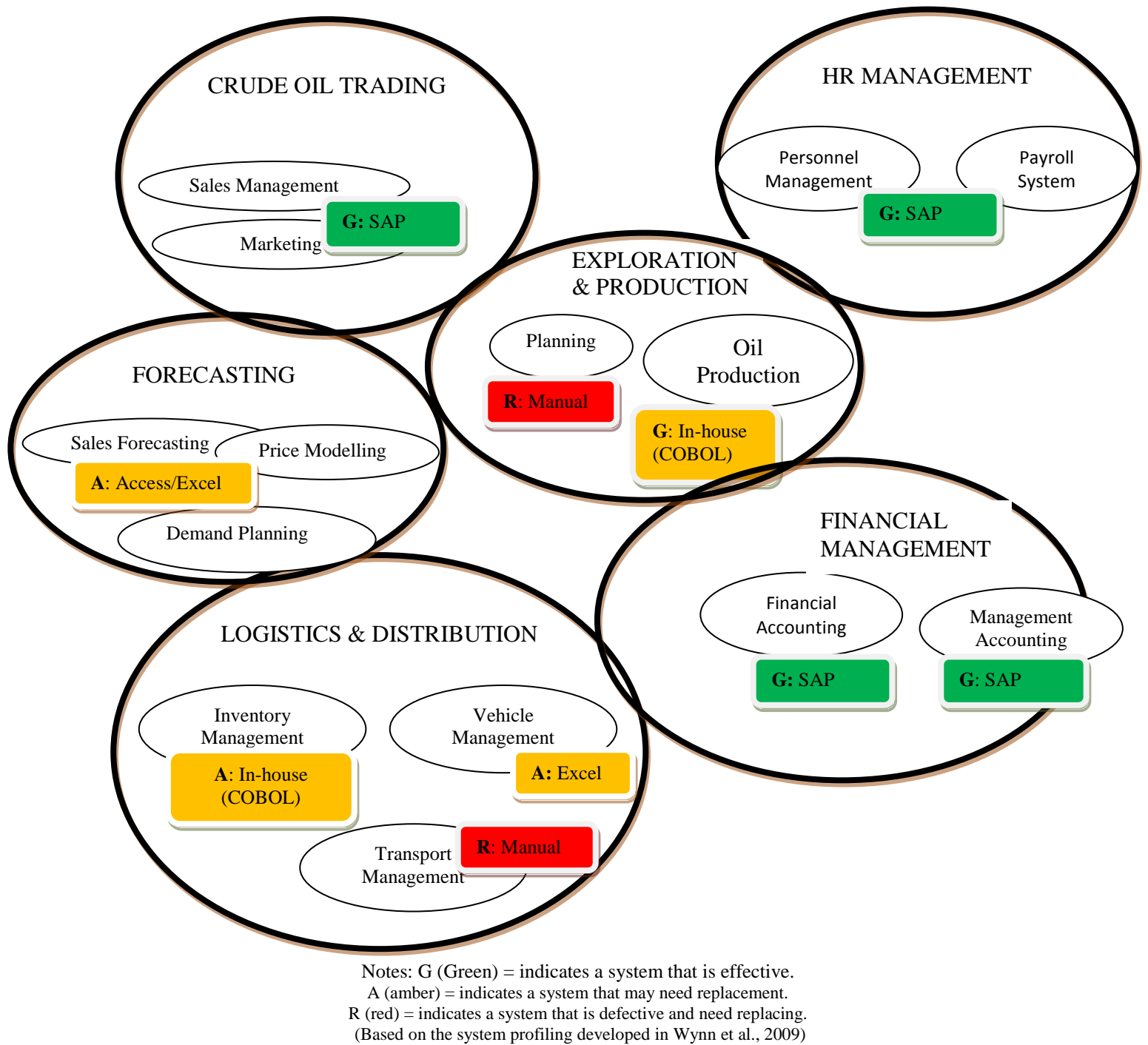


Figure 5: Main business processes / sub-processes and IS Profiling at Waha Oil Company and distribution (SD) module at WOC. Ageing analysis of the customer-companies' debts, and quarterly best performing customers, are examples of customer-related reports available to support the CRM process. These are but a few examples of the uses of information, provided via

interview and questionnaires, that have allowed a RAG analysis of existing systems as shown in Figures 4 and 5.

As regards e-business, neither company has yet fully embraced the potential of the internet and web enablement. Building on Chaffey's definition, we take e-business to mean 'the deployment of internet or web technologies to enhance core business processes, to include the use of mainstream business systems if they are accessible via the internet or intranet; but to exclude the use of other information systems and tools that do not leverage advantage from the use of web technologies' (Wynn, Turner and Lau, 2013). PCC is arguably more advanced in its use of e-business, largely because of its ownership by Suncor Energy, which, via its corporate website, allows access to information relating to PCC (e.g. actual and forecast oil production, financial reports, crude oil trading and distribution of oil). The company also provides an intranet communication facility among its employees, but their main business systems are not accessible from the intranet, and are not web enabled. WOC also has some corporate information available online and provides e-mail exchange among its employees. The 'upload and download' facility on their website allows senior staff and Libyan government agencies, as well as key customers, to access financial and crude oil trading information. Individual profiles of trading and financial information are created by the company's IT staff for exclusive access by key customers. However, WOC is not yet taking advantage of the web capabilities of the SAP modules used in the company, in the main because of the lack of internet technology support skills in the country.

ANALYSIS USING EXISTING MODELS

In recent years, the two oil companies have made concerted efforts to use IS to improve business performance and enhance bottom-line benefits. PCC overhauled its information system strategy in 2005 while WOC adopted a new information system strategy in 2007. Both companies were negatively affected by the year-long Libyan war which began in February, 2011, but the recent relative peace in the country has given them the chance to forge ahead with their businesses and chosen IS strategies.

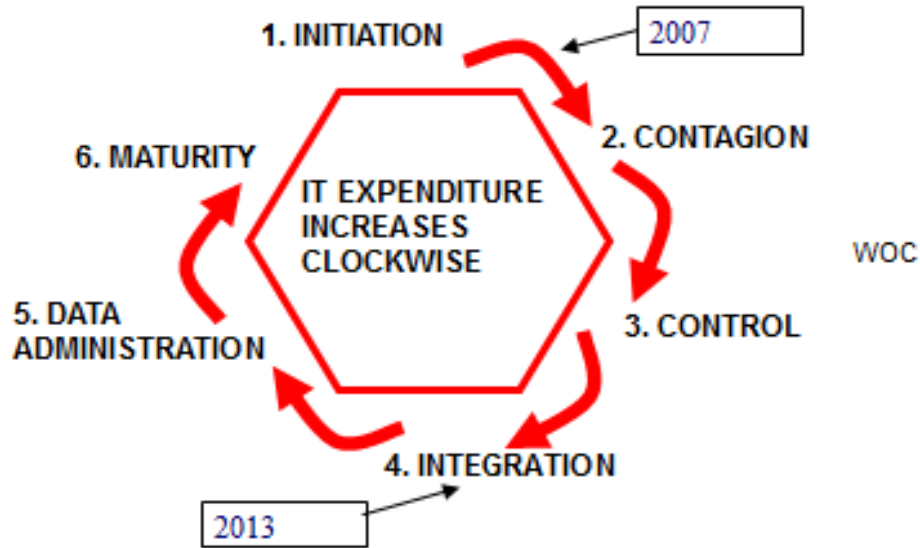


Figure 6. Progress of Waha Oil Company against Nolan's model 2007-13

PCC's IS strategy centres on applications developed in-house with the addition of one software package for inventory management (the IM system) purchased from an external vendor. There is a degree of integration of the in-house developed information systems, with an automated batch transfer function to export and import data into and out of the IM system. The IS strategy at WOC is to migrate to the SAP ERP package to manage all the business activities of the company. SAP is currently deployed for financial management, human resources management and crude oil trading. If we assess the two companies against Nolan's model (Figures 6 and 7), it suggests both companies have advanced significantly in their use of IS, moving from the early Initiation/Contagion stage in 2005/7 to the current status quo where Control is well established via in-house IT functions, and Integration is being actively pursued. The challenge for both companies is to improve systems integration (via contrasting strategies) to allow a focus on data management and the exploitation of web technologies.

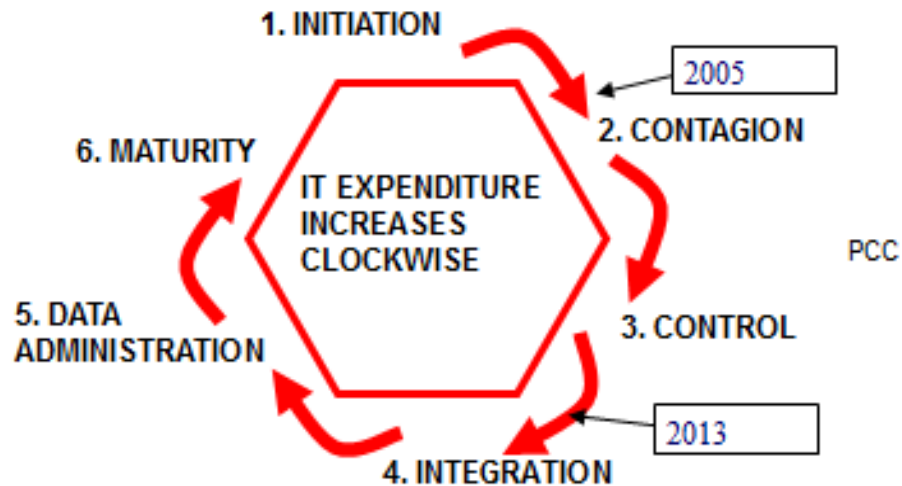


Figure 7. Progress of Petro Canada Company against Nolan's model 2005-13

We can also use Zuboff's model to analyse the impacts of IS deployment, which recognises the Automate-Informate-Transformate distinctions and applies them at process level, rather like the UK Government's CPIT model (DTI 2001). This analysis (Figures 8 and 9) shows that all main processes at both companies have been, with just a few exceptions, automated and that the informate stage is quite well advanced also. The informate stage implies that operational reports, management reports and other important information can be generated to drive business plans and strategies as well as to support key decision-making. Examples of the informate phase at PCC include oil production reports being used for decision making by the different managers that were involved in crude oil trading, sales and financial management reports used in sales forecasting; and at WOC, monthly, quarterly and annual sales reports from SAP are used by top management for customer analysis and performance assessment.

The analysis against the Nolan and Zuboff models suggests both companies have made major progress in developing and implementing divergent IS strategies in the past 6-8 years. WOC has pursued a phased implementation of a world leading ERP package, whilst PCC has built up a series of point solutions, most of them developed in-house. Both strategies have had major impacts on all main business processes. Analysis against the McFarlan-Peppard strategic grid (Figures 10 and 11) helps us view these strategies within a future timeframe of the next 5 years. Interview feedback at PCC indicates that the suite of in-house systems developed in Visual Basic/SQL are viewed as strategically sound both now and in the future, and will thus be the cornerstone for future IS strategy development. The range of Access database and Excel spread

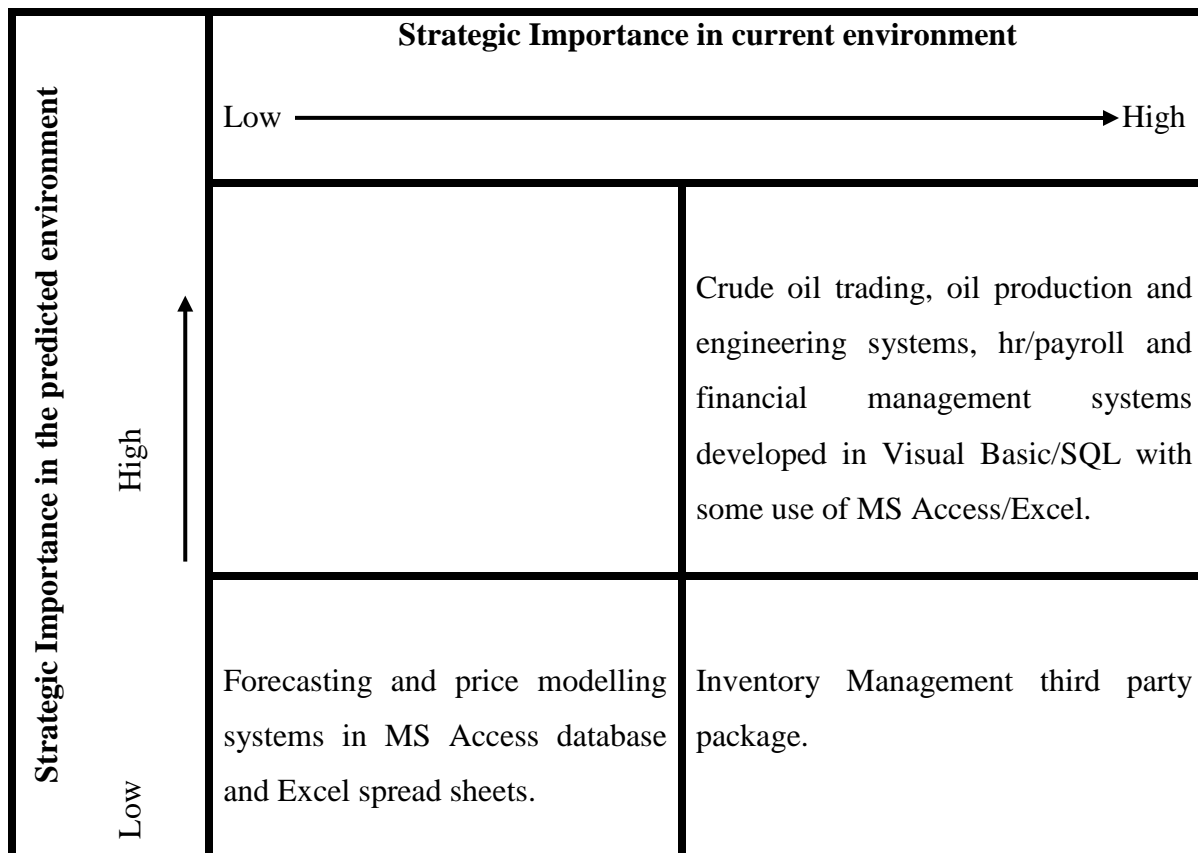


Figure 10. McFarlan-Peppard strategic grid applied to Petro Canada Company

sheet systems are seen as short-term solutions that may be superseded in due course, and the inventory management package is considered as of key strategic importance at present, but, interestingly, not necessarily in the future. One reason that the in-house information systems are

highly favoured by the top-management of PCC is the confidentiality of data they provide, being maintained and supported in-house. Future IS strategy will be to further develop, enhance and integrate the in-house developed suite of IS built in VB/SQL.

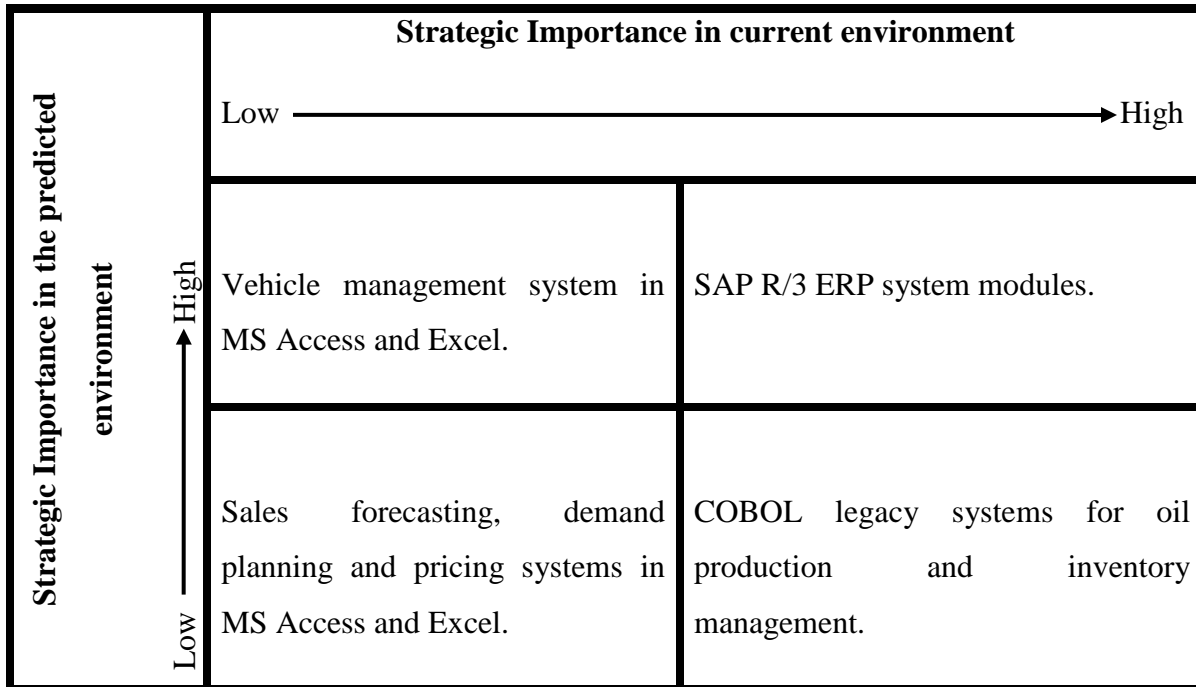


Figure 11. McFarlan-Peppard strategic grid applied to the Waha Oil Company

In contrast, WOC is strategically heavily dependent on the SAP R/3 ERP system for management of its business activities, and this dependence will likely increase in future years as it replaces old legacy COBOL systems and Microsoft Access and Excel developments with SAP modules. Crude oil trading, financial management and human resources management processes all use the SAP modules and these provide the platform around which other modules and associated processes will be implemented and developed. The integration and centralised maintenance of financial, sales and people related data is currently a major benefit which will be increased as other modules for production and inventory are added. The legacy COBOL systems that currently support oil production and inventory will be phased out, and the only non-SAP system that may remain is the vehicle management database and spread sheet development. This

is viewed as of strategic importance and as yet, no SAP module appears to offer the required functionality, although this will be periodically reviewed.

CONCLUDING REMARKS

Overall, the two oil companies have advanced their IS deployment positively in a turbulent political and economic environment. However, it would be incorrect to suggest there are no outstanding issues. Some technology upgrades are outstanding (notably of Visual Basic at PCC), and some of the Access database developments are not well supported or documented. The high dependence of both companies on the expertise provided by external IT consultants for some functions is also a concern. There are issues of continuity of support personnel, and possible conflicts between short-term tactical fixes versus long term strategic considerations. One example here is the need for proper automated integration of the current IS in both companies, as against the current ad hoc file exchange systems that exist in both companies at present. There are also issues with providing adequate training for busy support staff. Staff recruitment is also often problematic - locally available staff are generally not appropriately qualified or trained as regards academic and professional education in IT. Attendance at seminars and workshops that review mainstream developments in IS outside of Libya should be (but are not) standard practice. For example, review of levels of e-business adoption in developed countries could help the Libyan oil companies to further exploit e-business technologies and practices. The full benefits of the web- enabled/online IS have yet to be fully explored by the oil companies in Libya.

Overall, however, the two oil companies have successfully adopted and implemented distinct IS strategies over the past 6-8 years. These strategies have introduced new IS to support and improve core business processes and have provided sound systems infrastructures for future growth. This assessment has been reached using a hybrid framework consisting of the following six steps:

- **Identify top level business processes**

These will vary, depending on the nature of the company's business, although there are some core processes common to all businesses (e.g. financial management, HR management). Sub-processes within each process area may also be identified.

- **Develop Systems Portfolio Map**

This should highlight systems functions, package versus bespoke, technologies used in the application and database technology. The communication technology (if any) linking systems should be shown. e.g. Application Programming Interface (API), Bespoke Link, Data and Information File Exchange, etc.

- **Allocate IS to process/sub-process areas and undertake RAG analysis**

The information systems can be associated with their respective processes (or sub-processes) and classified as Red, Amber, or Green (RAG) according to user perception and management assessment. (Green indicates an information system that is sound and warrants continued deployment and support. Amber indicates an IS that is functioning but may need replacement. Red represents an IS that is defective and in need of replacement).

- **Assess IS function against Nolan's model**

Nolan's model (Nolan, 1979) can then be used to assess the IS/IT function in the company, and to clarify where the company may be in the key areas of Control, Integration and Data Administration.

- **Apply Zuboff's model at process level**

This will allow an examination of the impact of IS at individual process level and also provide a framework for assessing e-business capabilities and practices.

- **Apply McFarlan-Peppard analysis**

IS are considered from two perspectives:

- i. The strategic importance of the information system in the current environment.
- ii. The strategic importance of the information system in the future/predicted environment.

This allows an assessment of the company's perception of a system's strategic significance which feeds into an analysis of IS strategy development and deployment.

In conclusion, there are obviously a wide range of theories, models and concepts that can be utilised to assess IS and e-business deployment in developing countries. However, as Batchelor et al (2003) have pointed out, the World Bank believes that “analysts and decision makers are still struggling to make sense of the mixed experience of information technologies in developing countries.” Gomez and Pather (2012) conclude that in developing countries, there is a general lack of literature and particularly a lack of evaluation studies. ‘Until very recently, the entire literature on IS and developing countries would struggle to fill a single bookshelf ... those who have the will to evaluate, such as academics, often lack the resources and capacity.’

The research reported in this article has developed framework based on established concepts and models. Heeks (2002) suggests that ‘information systems cases in developing countries help to elaborate such models and, in so doing, contribute to underlying theory. IS cases from developing countries therefore provide fertile ground for helping understand the complex interplay of action and context that underlies all organizational change.’ This study has shown how existing models can be combined to evaluate IS in a developing world business context, and it is hoped that other studies will build upon and further develop the findings and analysis presented here.

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