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ERP Implementation in a Developing World Context: a Case Study of the Waha Oil Company, Libya

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Abstract – This article examines the implementation and functioning of a major Enterprise Resource Planning software package in a Libyan oil company. The study uses a process mapping and systems profiling approach to establish the current status of a 10 year project - which the company embarked upon in 2007 - to implement the new company-wide software. It examines the project from the point of view of progress in new technology, new people skills and process change, and concludes that a balanced approach to these three change elements has underpinned successful project outcomes.

Keywords – Enterprise Resource Planning; Libyan oil companies; information systems; ERP; process change; information systems strategy.

I. INTRODUCTION

It has been over 25 years since Enterprise Resource Planning (ERP) packages first came to the market. The emergence of the UNIX operating system in the late 1980s as a standard for minicomputers running the Intel chipset significantly increased demand for integrated packaged software. SAP and Oracle were two of the first software vendors to offer packages that combined software modules, providing integrated solutions for order capture and processing, invoicing, ledgers, materials requirements planning, inventory management, payroll, and human resource management. The functionality and integration of this software was enhanced in the 1990s, sometimes through the acquisition and incorporation of rival vendors' software. By the end of the decade, ERP offered the prospect of one integrated package for all company operations. As Koch noted, "ERP attempts to integrate all departments and functions across a company on to a single computer system that can serve all those departments' particular needs" [1].

ERP packages were initially used in some of the major international organizations of the Western world. In the UK, for example, GlaxoSmithKline, Kraft, Nestle, Kellogg's and Diageo all became early users of the SAP ERP package. The number of ERP vendors increased as small to medium sized enterprises started to acquire and deploy cheaper ERP packages, specifically geared to smaller scale operations. In the developing world, the uptake of these new systems was slower, for a number of reasons, including budgetary constraints of the user organization, and the non-availability of sales and support operations for many of these vendors in developing world countries. Since the turn of the new

millennium, the use of ERP in developing world countries has accelerated, but the current literature suggests that there have been both significant failures [2], as well as successes [3]. Although many authors [4] [5] now question the concept of the "digital divide" between developed and developing worlds, there remain divergences of opinion regarding the suitability of systems developed in the western world for a developing world context. When discussing IS in the developing world, Gomez and Pather [6] observe that there is lack of literature and evaluation studies, and the World Bank view that "analysts and decision makers are still struggling to make sense of the mixed experience of information technologies in developing countries" is highlighted by other authors [7]. This article attempts to contribute to addressing this imbalance and focuses on the implementation of SAP – a mainstream ERP package - in the Waha Oil Company (WOC) in Libya, identifying the key issues that underpinned project outcomes.

This introductory section is followed by a discussion of the theoretical framework for this paper in Section 2. In Section 3, the case study methodology used in this research is briefly discussed, and Section 4 then focusses on the primary research findings from the core study of the ERP implementation in WOC. In Section 5, the benefits that have ensued from the company's information systems (IS) strategy are outlined, highlighting the importance of making sure that change in process, people and technology is kept in balance, as large IS projects such as this are progressed.

II. THEORETICAL FRAMEWORK

The Design - Actuality Gap model developed by Heeks [8] identifies four main elements of change that are key to transitioning an organisation from local actuality - where the organisation is now – to its future state or design (see Figure 1). While Heeks' model can be applied to various business change environments, in this paper it is used to support the analysis of the implementation of an ERP package. Other authors [9] have adopted a similar approach in looking at structures that are embedded in both packages and organisations, in trying to assess the reasons for misalignments between an ERP package and the organisation. According to Heeks, the transition to such a major new system can be considered from four interrelated dimensions of change – people, structure, technology and processes. Here, however, we will focus on what have been

termed the “three pillars” in other literature [10] for successful systems implementation – people, processes and technology. This is justified because the structure of the company under study changed little over the period of ERP implementation, although processes within the company were affected. As regards process change, Harmon [11] has argued that process redesign should not only look at the top level process functions, but should also examine how the lower level activities are managed day-to-day, looking at how activities are planned, communicated, organised, monitored, and controlled.

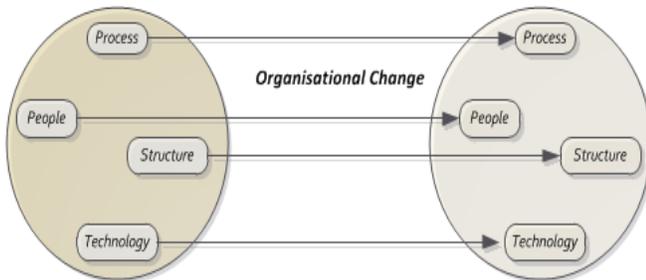


Figure 1. Design - Actuality Gap Model
Source: Adapted from Heeks [8]

The process mapping technique can help the researcher assess systems deployment at process level. It generates a sequence of maps that are used in identifying the information systems that are used in defined business areas. While process mapping is used as a framework to identify the business processes, it can also be used as a point of reference for assessing the functionality of the information systems themselves at process level. This “systems profiling” encompasses a review and assessment of functionality, reporting capabilities, user interface and soundness of the underlying technology [12].

Within this context, and in accordance with the research aims and objectives given above, this research addresses the following questions:

1. How has the SAP ERP package been implemented at WOC and what is the underlying IS strategy?
2. How successful has the implementation been in supporting the growth of the company?
3. How can the ERP implementation at WOC be assessed using the three pillars of people skills enhancement, technology capability improvement, and process change?

III. RESEARCH METHOD

A case study approach is adopted in this research. “A case study is a research strategy that focuses on understanding the dynamics present within single settings” [13]. The case study is a widely used research method within business research, and can focus on one single case or a single organization [14]. Bryman and Bell [15] argue that the case study is particularly appropriate to be used in

combination with a qualitative research approach, allowing detailed and intensive research activity. In a qualitative case study, an inductive approach is usually adopted, and a case study is also appropriate for the combination of qualitative methods. This is particularly relevant to this study of information systems in one large oil company, which combines mapping and profiling techniques with questionnaire and interview material. Saunders, Lewis and Thornhill [16] argue that case studies are mostly used in explanatory and exploratory research, and affirm that the case study is a good choice when the researcher requires a deep understanding of one specific organisation.

Case studies are often used to provide insights into a significant managerial issue, providing an analysis of the context and processes that illuminate the theoretical issues being studied [17]. The need for a case study arises from the quest to understand, analyze, and highlight a complex phenomenon and it is explicitly applicable for doing research on strategic developments or processes [18]. The primary purpose for undertaking a case study is to explore the particularity, the uniqueness, of the single case. The goal for the researcher is to design a good case study and to collect, present and analyze data “fairly” [19].

The central tendency among all types of case study is that it tries to illuminate a decision or set of decisions: why they were taken, how they were implemented and with what result. Because phenomenon and context are not always distinguishable in real-life situations, other technical characteristics, including data collection and data analysis strategies, have to be recognized as a secondary technical dimension of case studies. In this context, case studies are not limited to being a data collection tactic alone or even a design feature alone. Like other research methods, it is a way of investigating an empirical topic, by following a set of specific procedures to gain appropriate valuable information and ideas [18].

In this research, the case study under investigation is the SAP implementation at WOC, the largest domestic oil company in Libya. It was founded in 1955, and its headquarters are in Tripoli, the Libyan capital city. It is 59% publicly owned (by Libyan state entities) and 41% privately owned. It employs 3,200 staff, has over 1000 oil wells and an annual turnover of 690 million Libyan dinars (LDs) in 2013 (1 Libyan dinar = \$0.8US). Since 2007, the company has spent over 1.5 million LDs on hardware and 4 million LDs on software. The main investment in software has been on SAP licence acquisition and annual maintenance charges.

Data collection was pursued through a combination of questionnaires, interviews, observations and documentary evidence. Yin [18] suggests that the utilisation of multiple sources of evidence is one way of increasing the construct validity of case studies. A detailed structured questionnaire was filled in by two respondents – the IT manager and the Finance Director, and this was followed up by face to face interviews to build up a picture of IS strategy and systems deployment in recent years. There were several iterations of follow-up emails and phone calls to clarify points made in the questionnaire responses, and this resulted in further

conversations with other staff members. The topics included in the questionnaire can be categorised as follows:

- a) Company information: To confirm basic company data, company profile, size, turnover, operations and other general information.
- b) Company processes: To explore the company's main business processes and to determine secondary processes (sub-processes).
- c) Information systems: To establish the deployment of information systems and to assess the underpinning technical architecture.
- d) Current systems status: To confirm the functionality of the main information systems and general satisfaction levels in different departments that use them.
- e) Problems and challenges: To determine if there were any key problems or issues, both from a technical perspective and also from the point of view of the end user. Integration and interfacing of systems, report quality, systems performance and access were some of the issues covered.

Follow-up interviews encompassed sessions with IT staff in which there were wider-ranging discussions of IS strategy, the management structure in the company, and decision-making regarding IS investment. Interviews were conducted in English, although certain sections of the questionnaire were translated into Arabic. The initial interviews took approximately two hours, excluding follow-up phone calls and emails.

IV. CASE STUDY FINDINGS

This section applies process mapping and systems profiling to the current systems portfolio at WOC. The business activities of WOC can be grouped into six top-level business processes, each of which has a number of sub-processes. These processes are briefly outlined below, along with the information systems that currently support these process activities. This is depicted in Figure 2.

1. Exploration: The company carries out seismic mapping by exploding dynamite and measuring the way in which the resulting seismic waves travel through the underground formations to detect crude oil, which when found, is subsequently drilled for, and pumped to the surface via oil wells into storage tanks. The exploration process in the company is divided into two sub-processes: Planning, and Oil Production. The Oil Production sub-process is automated with an in-house information system developed in COBOL. This records and manages all data associated with exploration of crude oil from setting up oil rigs to pumping the oil into the reservoirs, including the volume, grade, and chemical/sulphur content of the extracted crude oil. The Planning sub-process, however, is still manual in part, with some use of the Excel spreadsheet package for the recording and management of data related to seismic mapping of prospective exploration areas, and other related information.

2. Forecasting: This process has three sub-processes, all of which are partially automated with a specially designed

Microsoft Access and Excel package. The three sub-processes are Sales Forecasting, Price Modelling and Demand Planning. The Sales Forecasting sub-process takes current crude oil market data input into the system, and uses the current supply and demand of crude oil between WOC and its customers to determine some variables and constants, to produce managerial reports that are used in forecasting sales, modelling prices and managing the known and envisaged demand. The Price Modelling function manages data on different chemical compositions of the crude oil, and generates reports on the optimal price for different grades of WOC crude oil in their reservoirs. The Demand Planning function aims to improve the accuracy of revenue forecasts, align inventory levels with peaks and troughs in demand, and enhance profitability for a given channel or product. The system uses data from customer standing orders and planned sales orders, among other statistics, to generate income forecasts and align inventory levels with forecast demand. This system does not completely automate these sub-processes; there are still some supporting manual activities to obtain and enter data into the system.

3. Financial Management: The process can be subdivided into two main sub-processes: Financial Accounting, which manages the balance sheet as well as profit and loss account, different journals used, and other financial reports; and Management Accounting, which handles the financial costing activities, and generates appropriate prices for sales of crude oil. Both these sub-processes are automated using the Financials and Controlling (FICO) module of SAP. Real-time and reliable managerial reports are available from the system, and any new format of financial reporting needed can be customised and generated from the system.

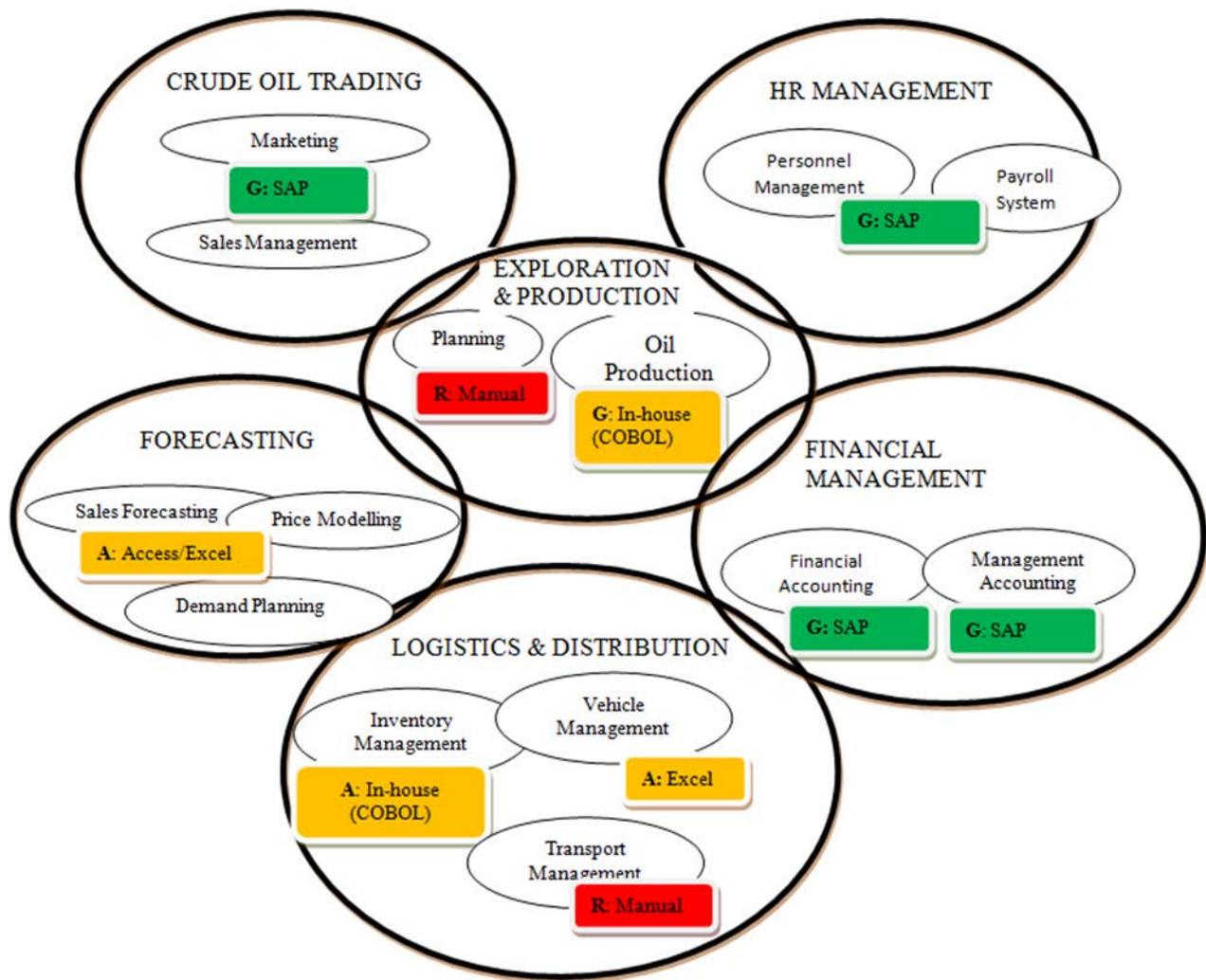
4. Logistics and Distribution: The Transportation Management sub-process is partly undertaken by third party logistics companies transporting crude oil to the customer, and supporting activities in-house are mainly manual. However, Inventory Management is automated via an in-house system developed in COBOL, and the Vehicle Management sub-process is supported by a bespoke system developed in Excel to manage the fleets of vehicles owned by WOC.

5. Crude Oil Trading: Both sub-processes of Sales Management and Marketing Management use the Sales and Distribution (SD) module of SAP. Sales Management involves raising pro forma orders and invoices, and tracking them through the sales order processing cycle. The Marketing Management sub-process encompasses customer relationship management, prospecting for new customers and recording management details of all marketing activities. The system contains up-to-date records of customers and their business activities with the company. The records are used to respond to all customer queries.

6. Human Resource Management: This is centrally managed and automated using the SAP HR module. There are two main sub-processes: Personnel Management and Payroll Management. SAP handles the creation and management of new employee records on the system, and all their professional relationships with the company, including

leave management, bonuses, and allowances. It handles the periodic assessment of staff activity and manages the payment of salaries and wages to regular and casual staff.

The top managerial reports are centrally available via the SAP system and the in-house systems developed in COBOL. Senior management rely on the reports from these different



Notes: G (Green) = indicates a system that is effective.
 A (amber) = indicates a system that may need replacement.
 R (red) = indicates a system that is defective and need replacing.

Figure 2. Main Business Processes and IS profiling at Waha Oil Company

The information system strategy adopted at WOC is a proportionate blend of an in-house/bespoke approach using COBOL and Microsoft Excel and Access, combined with a phased implementation of SAP. The choice of SAP in 2006/7 was largely pragmatic. The company's senior management had elected to move in phases to a mainstream integrated software package, and SAP were the first such company to set up a sales and support office in Libya. There were no realistic alternatives at that time, although Oracle, another major ERP vendor, have since opened a sales office in Tripoli also.

information systems to derive a complete overview of business activities at any one point in time. This illustrates the issues that still prevail regarding systems integration. The Financial Management, the Crude Oil Trading, and Human Resource Management processes are efficiently integrated around SAP R/3 technology. These SAP modules are not well integrated with the in-house bespoke systems. However, information from the Access/Excel systems that support the Forecasting process and Logistics and Distribution processes is exported in comma delimited files (.csv format) and imported into the SAP R/3 system via data ports.

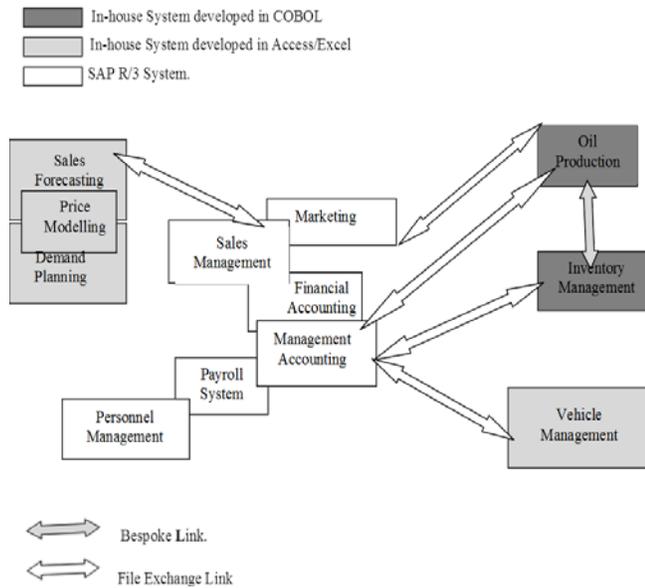


Figure 3. Systems Interfaces at Waha Oil Company

In similar vein, data is exported in a .csv format from SAP R/3 and imported for use in the Access/Excel and COBOL systems. These comma delimited files are used with human intervention to bridge the integration gap that exists between these three different groups of systems based on different technologies (see Figure 3).

V. ANALYSIS AND CONCLUSION

The current information system strategy at WOC was adopted in 2007 to support the company’s business strategy of expansion and increase in bottom-line profits. The development of this strategy was largely a top-down process undertaken by senior management, which envisaged a stage by stage implementation of the SAP ERP system, and a gradual phasing out and replacement of existing in-house developed systems. The initial focus was to be on the core sales order processing cycle and back-end financial systems, where problems of inconsistent data were paramount, and which were affecting customer service levels. In that year, an IS strategy committee was set-up by the senior management of the company, comprising members chosen from across all company departments. The committee focused on aligning the company’s business processes with the newly adopted IS strategy. Since then, over the past seven years, there has been a gradual phasing-out of the in-house systems and their replacement with appropriate SAP modules. The in-house systems that remain continue to meet the basic needs of the sub-processes that they are supporting. Benefits of this hybrid strategy can be generally grouped as follows:

1. Improved turn-around time in business activities. A typical example given by a respondent was the elimination of comparative checks of reports between the ones generated by the Financial Management process and Crude Oil Trading process. The fact that both processes are managed

by a single information system (SAP R/3) has eliminated the need for comparison of reports generated by the two processes.

2. Improved availability of key business information. Once the information from other systems is exported and imported into SAP, management reports become available on a real-time basis: for example, analysis of forecast sales vs. actual sales for a specific period. Senior executives now use systems outputs to support key business management decisions. Reports on the weekly oil production and weekly oil dispatched to customers are used as a guide on how to take decisions on maintenance and the management of the oil storage infrastructure of the company.
3. There is an increased centralisation of data maintenance in the company, which has reduced the human error that results from double or triple entry of data into different systems, and the importing and exporting of information across different systems. This has increased the reliability of corporate information and reporting, both within and outside of the company. For example, the confirmed orders, sales made, invoices generated, amounts involved, tax deducted, discount given, and all the financial stages in the Crude Oil Trading process can be accessed by authorised users in the Financial Management department, because business transactions in both the Crude Oil Trading and Financial Management processes are executed within the SAP system. This reduces time wastage that comes with reconciliation of financial activities, when data is maintained in more than one system. Questionnaire respondents confirmed a significant reduction in data error rate from in excess of 10% prior to the adoption of SAP, to current levels of around 2%.

The current plan is to complete the replacement of all legacy systems by 2017, whilst at the same time increasing the e-business capabilities of the company, exploiting the web capabilities of the SAP modules. The progress made to date in this 10-year implementation plan for SAP can be viewed in terms of the three dimensions of people, process and technology noted above in Section 2. In terms of the advance in people skills and capabilities, there has been a continuous expansion in the number of users of the SAP modules in the organisation, and the general users’ acceptance of the system appears to have contributed significantly to its successful implementation. This was engendered by a clear commitment by senior management to provide staff training, allied to their all-inclusive approach to systems implementation, whereby staff at all levels of the company were included in the process. The one area where there are arguably some significant staff issues is in the IT department, where the work-load of the current support staff is very high. There are only two staff responsible for supporting all the information systems of the company, including the legacy COBOL and Access/Excel systems.

This issue should be resolved to a degree once these legacy systems are phased out.

The new SAP technology is a strategically sound product. The centralisation of data and information provided by the SAP R/3 suite is a major benefit and its ease of use, enhancement capability, and enterprise-wide functionality has made it highly relevant to the day-to-day running of the company's business activities. Its future strategic position among the information systems in the company is guaranteed, because of the company's dependence on it, and upgrade plans for it: it is the central element of the company's IS strategy. Nevertheless, the phasing-out of the key COBOL systems may require some configuration of new SAP replacement modules. These legacy systems are used for managing oil production and management of inventory, which are crucial to the smooth running of the company's supply chain, so their replacement will need to be carefully planned and managed. They currently support business activities to an acceptable level, but their lack of flexibility and associated upgrade problems justify their replacement. The replacement of the Excel-based vehicle management system and the Access/Excel forecasting systems are less problematic, but will also require appropriate testing and configuration of additional SAP modules.

The implementation of the new SAP modules has been co-ordinated with change management with regard to improvement of people capabilities, knowledge and training. A key to success at the company is that there has been a steady improvement in processes rather than any radical change, and change has been centred on the sales order processing and production backbone of the company. The change in the three areas of people, technology and process improvement has been balanced and focussed. This was underpinned by a staged implementation of new SAP modules, that has already spanned seven years, and should complete in a further three years. This has allowed careful management and firm cost control of the phased migration to the SAP product suite.

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