ABSTRACT

Although ERP system implementations can lead to major performance changes, there is already evidence of high failure risks related to ERP system implementation projects. In the past few years, one of the major research issues in the ERP system area has been the study of ERP system implementation success in order to help better plan and execute ERP system implementations. A typical approach used to define and measure ERP system implementation success has been the identification and validation of critical success factors (CSFs) for ERP system implementations. In this research CSFs for ERP system implementations identified in the literature are consolidated and the use of these factors in practice is analyzed. A case study research is conducted in order to evaluate their impact on an ERP system implementation at a public utilities institution - a subsidiary company of the General Electricity Company of Libya (GECOL). The research conducted leads to the recommendation that especially the requirements analysis phase plays a decisive role for the ERP system implementation success. It is therefore essential to accord the necessary attention to this phase and not to start the implementation until functional and technical specifications are elaborated.

Key words: ERP, post-implementation evaluation, public sector, case study

1. INTRODUCTION

Successful Enterprise Resource Planning system (ERP) implementations do not end at "go-live". The activities after the system is implemented are essential to ensure a sustainable value-added. However, most companies fail to conduct a post-implementation audit to see how their ERP systems are fitting in with their business [11]. The General Electricity Company of Libya (GECOL) has started in 2005 a challenging program aiming to implement an integrated Enterprise Resource Planning (ERP) system. After the implementation of ERP modules for Human Resources (HR), Finance, Logistics and Service Management, an ERP system implementation has been started at the department in charge of Project Management (Contract and Development Accounts - CDA). The enhancement of the ERP system implementation targeted to implement the adopted system for the planning, execution and controlling of capital-intensive projects.

This paper offers an overview of the results of the ERP system implementation in the case study considered and evaluates its success measured through the comparison of the benefits realized in relation to the project targets. Thereby a focus is set on a model of critical success factors (CSFs) for ERP system implementations identified in related literature. Documentation review and interviews conducted with key users of the implemented ERP system are used in order to assess the ability of this model to afford the benefits expected.

The remainder of the paper proceeds as follows. Following section summarizes the literature review conducted and consolidates its results in a model for ERP system post-implementation evaluation. Section three introduces the case study considered and summarizes the targets of the ERP system.
implementation in this case. The evaluation of the ERP solution implemented and the validation of the CSFs model defined are subject of section 4. The paper ends with a summary of findings and outlook of next steps.

2. Enterprise Resource Planning: Definition and Critical Success Factors

For many companies around the globe, ERP systems have evolved into a necessity for doing business. According to AMR Research, the ERP systems market was $28.8 billion in 2006 and is likely to increase at a compound rate to $47.7 billion, by 2011 [1]. In Libya, few recent projects are known in the ERP system field.

2.1. Definitions of Enterprise Resource Planning

ERP system has been defined by researchers and practitioners in different ways. In the early 1990s, the Gartner Group introduced the term in order to describe a set of integrated applications that help an enterprise managing its business activities. An important function of ERP systems is their ability to integrate different processes within and between enterprises as well as related software modules [7]. An ERP system offers the capability to link all areas of a business including order management, manufacturing, human resources, financial systems, and distribution. ERP systems are referred to as enterprise systems (ES) [13]. They allow business processes to flow across organisational functions and levels. From a software architectural perspective, this integration is realized through a set of software modules sharing a central database.

The software is built around predefined business processes often designated as standard processes. ERP vendors claim that these processes represent “best practices”.

2.2. Critical Success Factors for ERP System Implementation

The rise in the popularity of ERP systems worldwide has generated academic interest in analysing their underlying concepts and the impact of Critical Success Factors (CSFs) on system implementation projects. Shehab et al. (2004) state: “Although companies spend millions on ERP packages and the implementation process, there is extensive evidence that they experience considerable problems, particularly during the actual implementation project” [13]. Researchers and practitioners addressed these problems and a number of publications was elaborated in the last years in response to them. CSFs and process models represent major concepts developed to help better planning and executing ERP SYSTEM implementations. In following, selected publications related to this area are summarized in chronological order.

Holland and Light (1999) differentiate two levels of CSFs for ERP-Implementation [13]:

- strategic factors such as Business vision, ERP strategy and top management support, and
- Tactical factors such as client consultation, software configuration and troubleshooting

The authors validated their approach by two case studies and emphasized through their analysis the impact of legacy systems and the importance of ERP strategy.

Sousa and Collado (2000) found out that non-technical issues within ERP implementations are not offered the necessary attention in comparison to technical and financial aspects [20]. They consolidated CSFs found in the ERP literature, classified them and proposed their model as “Unified critical success factors model”.

Al-Mudimigh et al. (2001) identified dominant ERP implementation CSFs as part of a framework for ERP implementation [3]. They included Top management commitment, business case, project management, change management and training. This research is deepened in a following paper [2] in form of taxonomy of CSFs for ERP implementations, where CSFs are classified into broad categories: setting-up category, implementation grouping, evaluation category, and success grouping.

Research on the critical factors for initial and ongoing ERP implementation success has been discussed also by Nah et al. (2001). In this paper [17], eleven factors were identified to be critical to ERP implementation success: ERP teamwork and composition; change management program and culture; top management support; business plan and vision; Business Process Reengineering with minimum customisation; project management; monitoring and evaluation of performance; effective communication; software development, testing and troubleshooting; project champion; appropriate business and IT legacy systems.
Kraemmergaard and Rose (2002) based their research on a four phase model of an ERP SYSTEM implementation developed by Makus and Tanis in a paper published in 2000 [15]. They identified in a first step three CSFs categories [12]:
- Business competence (organizational, strategic, business process, project management),
- Technical competence (technology, ERP), and
- Personal competence (human resource, leadership, communication)

In a second step, these CSFs are classified over the four stages of the ERP system implementation project. The CSFs in the chartering phase are strategic, technology, project management, and communication. In the project phase, the CSFs are project management, business process, leadership, ERP, communication, and human resource. The CSFs in the shakedown phase are ERP, human resource, leadership, and communication. In the onward and upward phase, the CSFs are business process, organizational, ERP, technology, human resource, leadership, and strategic.

Sarker and Lee (2003) emphasized social factors affecting ERP implementations [12]. They use a case study for the analysis of three social enablers: strong and committed leadership, open and honest communication, and a balanced and empowered implementation team.

Nah and Delgado (2006) identified seven categories of CSFs from the ERP literature [16]: plan and vision; change management; communication; ERP team composition skills and compensation; management support and championship; project management; system analysis selection and technical implementation. They considered the four phase model developed by Makus and Tanis [15] and validated their CSFs through two case studies. They could through the data collected confirm the importance of the CSF categories across the four phases of ERP implementation and upgrade.

Madapusi (2008) reviewed different types of methodological studies in the ERP literature (descriptive studies, case studies and survey studies) and identified 15 CSFs [14]. He conducted a cross-study comparison of them and classified them into three categories [14]:
- 12 CSFs with consensus agreement about their role and therefore crucial in ERP system implementations (top management support, planning, project management, alignment, implementation strategy, consultants, implementation team, data accuracy, user support, training, organizational culture, and communication).
- 2 CSFs with majority agreement and designated as “key factors for facilitating the implementation process”. These are learning and national culture.
- 1 CSF with lack of agreement, which is IT readiness.

The 14 CSFs identified by consensual and majority agreement in [14] can be considered as essential for the success of ERP system implementation.

3. Case Study: ERP system Implementation in a Utility Company

3.1. Company Background

GECOL (General Electricity Company of Libya) is the electric utility company of the Great People's Libyan Arab Jamahiriya. It was founded in 1984, to perform operation and maintenance of the national power grid including power stations, transmission network, distribution networks, control centers, and desalination plants country-wide. GECOL generates and distributes about 6000mw/h of electricity and has about 37,000 employees.

The General Department of Contracting and Development Accounts (CDA) is responsible for the planning and execution of GECOL’s investment projects. CDA can be considered as a subsidiary since it is managed as a profit center. It acts within GECOL as supplier of assets and power generation and distribution equipments. CDA consists of three main departments which are: Contracts, Project Management and Finance and has about 200 employees.

In the year 2006, CDA management decided to introduce ERP software mainly in order to control and follow up the development projects.

3.2. Business Processes prior to the ERP system Implementation

The content of this section is based on internal documents [6], and on personal experiences of the authors.

A project at GECOL has two lifecycles:
- The first lifecycle covers the preparation phase prior to project realization. It starts with long term planning studies and external authorization studies. Then it goes through the feasibili-
ty study, preparation of tender documents and invitation of bidders to bid. This first phase is closed by the evaluation of all bids and awarding the contract to the selected bidder.

- The second cycle covers the project execution. It starts with a kick-off meeting and site survey. In this phase, the manufacturing process is initiated and the equipment is tested before its shipment. After receipt on project site, the installation starts and tests are conducted on-site. In a closing step, the operations of the new equipments are tested and the project is closed.

The analysis of the project management processes before the ERP system implementation revealed a number of weaknesses.

In terms of Project Management methods, clear and standardized project management processes were missing. The project management success measured in time, budget and quality depended highly on the project management team. Because of the lack of IT support it was not possible to ensure the control of project progress status and even not to ensure appropriate control of payments to GECOL suppliers.

In terms of financial controlling, the processes lacked of appropriate controlling instruments. Within a single project, controlling instruments allowing to follow-up the project progress and accordingly the financial payments were missing. A consolidated view of all projects was also missing and it required tedious manual work to be elaborated. Because of the lack of accurate reports, decision making processes took long time and missed in some cases valuable information.

In terms of information flows, both information availability and quality suffered under the lack of centralized database collecting the project data. The project managers had to rely on fragmented information. Because of the lack of IT support it couldn’t be excluded in some cases that documents got lost.

In terms of processing time, the initial project management processes before ERP system implementation were taking a long time. This led in many cases to delays in project plans and higher costs.

3.3. Targets of the ERP system implementation

The major target of implementing an ERP system at CDA was defined in following up and implement-

3.4. ERP SYSTEM Implementation Project

The project started in August 2006 and was planned to be finished in April 2007. The go-live occurred in Q3/2008. The evaluation in scope of this paper was conducted during the ERP system is in a stabilization phase.

Additional challenges resulted from a number of customizations identified during the implementation project. An important customization consisted for example in the programming of a software module to cover the functionality of processing Letter of Credits (L/C).

3.5. Assessment of support for CSF

The 14 CSFs identified according to [14] by consensual and majority agreement are considered as essential for the success of ERP system implementation. They constitute the CSF model to be used for the analysis of the case study and to be validated. In following, the support for these CSFs during the ERP implementation at CDA is evaluated.

Top Management Support: Top management support consists in the sustained management commitment, both at top and middle levels during the implementation, in terms of their own involvement and the willingness to allocate valuable organisational resources [8]. CDA top management allocated the resources necessary for the ERP system implementation, afforded financial incentives for the project team and communicated the high priority of the ERP system implementation. The general manager followed up the ERP implementation in the steering committee personally and communicated high commitment to the ERP implementation targets.
Planning: ERP system planning includes assessing needs and defining a clear vision and clear targets. Though these aspects can be evaluated as covered in the case of CDA, the ERP system selection process was not conducted systematically and according to well-defined criteria. The matching of business processes started with the implementation project and not in a prior planning phase. The lack of detailed to-be business processes as starting point for the implementation generated difficulties for the implementation team and agreeing guidelines for the vendor during the implementation itself.

Project Management: the project management includes affording the structures and resources needed. This aspect was afforded to a high extent in this case. The project management team had also clear project phases and milestones defined in well defined methodology. Nevertheless the lack of clear control objectives and the major changes in project scope and process configurations represented major weaknesses in the support for this CSF.

Alignment: Alignment refers to the match between the processes embedded in the ERP system and the firms’ business processes. The lack of clear defined to-be business processes and the poor vendor support for the implementation of agreed customizations led to gaps between targeted and implemented processes.

Implementation Strategy: Implementation strategy refers to the rollout of the ERP system modules across the firm. Because of the limited project scope covering three major processes (Project Management, Finance and partially Procurement) and because of the centralized character of the implementor, the implementation strategy comprised a single phased rollout. Nevertheless it was decided not to migrate existing projects to the ERP system and to limit the go live scope to new projects.

Consultants: In order to ensure the ERP system implementation success, CDA engaged besides the ERP vendor consultants, third party consultants with ERP experience and supporting the own ERP team. The vendor consultants were all senior consultants with experience in the relevant business processes and ERP modules.

Implementation Team: the implementation team comprised members with high process understanding. Nevertheless the lack of ERP system understanding and the lack of detailed to-be processes led to communication problems with consultants and too many changes in the solution design.

Data Accuracy: Data accuracy refers to the integrity of data that is input into the ERP system as well as the output obtained from the ERP system. The decision not to migrate old project data to the new system simplified this CSF and limited it to the new project data.

User Support: the user support depended in the case study considered on the realisation of quick wins when using the new system. This effect could be realized in many cases. A quick solution of remaining issues after go-live contributed in a major way to covering the user support CSF.

Training: as well training plans as training infrastructure were afforded in a high quality.

Organizational Culture: the lack of experience with IT applications and on a second level with integrated enterprise systems engendered major drawbacks for the necessary change management. The centralized organizational structure and the lack of employees empowerment for decision making has also to be considered as potential for further improvements. Nevertheless these aspects could be compensated through user motivation and willingness to use modern technology.

Communication: Team meetings occurred on a daily basis during the implementation project and led to a constant and open communication.

National Culture: the ERP system implemented didn’t afford the support needed for business practices and usual policies in Libya. An important example in this regard is the L/C issue. Another example raised also in the Finance area and consisted in the lack of accounting standards. This lack required the project team to adapt the ERP system to the company specific accounting practices. Another issue related to national business practices is related to the need for a three decimal points for money amounts and also the need for multiple currencies for managing a single project. This functionality which was not available in the standard ERP system is necessary for a Libyan company, since contractors from different currency regions may participate at the delivery of a single project.

Learning: a specialized support team was allocated exclusively for this task and training measures were planned and conducted after the ERP go-live. This measure helped to increase the user acceptance.
According to this analysis 8 CSFs had good support in CDA’s ERP system implementation: Top management support, implementation strategy, consultants, implementation team, data accuracy, user support, communication and training. 5 other CSFs didn’t have necessary support, either fully or partially: planning, project management, alignment, organization culture, national culture. The evaluation of the CSF learning implies at first glance good support, but still needs further observation and evaluation.

4. Evaluation of the Solution implemented for Project Management at GECOL

An ERP system implementation is considered to be a success if it achieves the level of ROI identified in the project approval phase. An alternate definition of implementation success is that the system achieves substantial proportion of its potential benefits [21].

4.1. System evaluation method

For the evaluation of the ERP system solution implemented, semi-structured interviews were conducted with representatives of the different user groups. Interviews were conducted with:

1. ERP program manager at GECOL and its subsidiaries,
2. Super users from the three CDA ERP project sub-teams for Project Management, Finance and Logistics, and
3. IT support engineers responsible for IT infrastructure and IT Operations at CDA.

After filling in the evaluation form, an interview was conducted with each participant. The statements collected during these interviews were consolidated in order to elaborate a general evaluation of the ERP software.

4.2. System Evaluation Results

The ERP system implementation at CDA went live in Q3/2008 with a delay of more than 12 months and with major restrictions in project scope. One major difficulty which led to these drawbacks was the lack of an appropriate requirement analysis prior to the start of the ERP system implementation project. Accordingly the software selection process was not based on clear requirements.

Because of the lack of clear requirements, necessary customizations of the standard ERP software were not clearly defined before beginning the implementation. This situation led to long discussions during the implementation project and not all customizations needed could be realized before go live. At the time the post-implementation evaluation is elaborated, some of the issues identified are still open. Nevertheless the project targets could be reached for the most part. Especially in comparison to the situation before the implementation, major process improvements could be realized.

4.2.1. Assessment of project targets

For the purpose of assessment, the project targets defined before the ERP system implementation [6] are subdivided into four areas: project management efficiency (project management being the major activity field of CDA), financial controlling, business process standardization, and Business/IT-Alignment.

(A) Project management efficiency:

Major benefits could be reached in the area of optimizing the use of resources (budget, human resources, material). The definition and documentation of clear business processes supported through an IT system allowed working in a systematic way for each type of projects.

Especially the document management functionality allowed to minimize manual and paper-based activities.

(B) Financial controlling

The target of generating automated reports (detailed project status) through reliable management information system is reached partially. The implemented ERP System generates a number of automated reports. A further analysis of reporting needs and their implementation in scope of an executive management system is planned.

The target of speeding up the decision making process with help of system interfaces with contractors/suppliers was also reached to a high extent. The internal process integration could be realized. The integration with external systems depends on contractors’ cooperation and represents a future step for the system set in place.

(C) Business process standardization

Standard methods are now applied for project execution and control. Reporting is automated thanks the use of a standard ERP system.
Standardization is also reached through a central system and unified process definitions and the elaboration of unified business process documentation and procedures, including:

- Business Process definition
- Business Process roles
- Working out the workflow and drafting the interrelations between the processes.

CDA assumed it possible to improve its existing project management processes based on best practice experiences of the software vendor. An important lesson learned is that a standard software package includes standard processes, which may help to improve business activities and practices. Nevertheless an effort is needed to analyse own processes and deduce optimization potentials. Business process requirements have to be defined prior to software implementation and optimization potentials represent major business requirements, which cannot be defined during ERP implementation.

(D) Business/IT – Alignment

The ERP system implementation targeted an optimized IT support for the business processes. The ERP system was expected to allow integrated processes internally and also at the interface to suppliers and customers. Resistance against the use of the new ERP system still exists, even one year after go-live. Manual processes and breaks in the process flow contribute (according to the super users) to this situation.

4.2.2. Evaluation Summary

A perusal of this analysis reveals that the ERP implementation can be evaluated as successful since all defined targets could be realized at least partially.

This positive evaluation can be explained through the support for most of CSFs identified in the previous section. During CSF on the tactical and operational level held good support, CSFs on the strategic level especially Planning, Alignment and National Culture were not supported as needed. This lack of support of these CSFs led to difficulties during the ERP implementation and explains the longer implementation period. Nevertheless, it didn’t jeopardize the overall balance.

4.3. Lessons Learned and Recommendations

The ERP system implementation doesn't imply automatically that business processes implemented are perfect. Process inefficiencies and breakdowns still need to be identified and eliminated. Identifying process inefficiencies and conducting analysis to find out their reasons allow identifying opportunities to improve business processes and make them more efficient and effective.

Following aspects summarize the lessons learned from the evaluation conducted and recommendations for further steps:

1- Change Management

Change management is considered as the most important aspect to optimize the use of the ERP system implemented. Some acceptance issues are reported. They are argued by the rigidity of standard process. Contractors as well as users which are not used to perform according to standard processes are not accepting a standard system not allowing the flexibility of the former way of working. For example some contractors are not able to report against fixed time schedules.

2- IT and communication infrastructure:

The lack of appropriate IT and communication infrastructure in some GECOL project sites leads to the situation, that the project manager has to rely in project reporting on information delivered manually by project members on site. Therefore the activity progress can not be tracked synchronously. The reliability of information delivered by end users being on site is still crucial for project controlling. It is important for the success of any ERP implementation to insure that all sites where the system should be rolled out are connected into the system network.

3- Manual Reporting

Some project reports delivered to the top management are still elaborated manually and not derived from the system. This is caused by lack of data accuracy in the ERP software and reduces the system benefits. The reason for this state is in some cases related to the lack of information needed from the suppliers. Top management support is necessary in order to establish a unified way of reporting
based on the procedures defined during the ERP system implementation.

4- Business Process Management:
In this stabilization phase following the ERP implementation, efficiency improvements are still not measurable. It is important for next phases to establish throughout business process management and to define Key Performance Indicators related to processing time and cost. The interviewees reported current efforts in order to initiate defining and using such KPIs.

In comparison to the process efficiency before the ERP system implementation (based mainly on paper work), the project managers involved in the ERP evaluation report major improvements.

5- Further process standardization
The execution of the standard processes defined in the ERP system are requiring further standardization efforts and consolidated procedures and process rules for all departments. During the last phase of ERP implementation many issues related to the discrepancies of process procedures could be solved. Some projects currently conducted could take profit from this improvement.

In order to go live with the system, it had to be decided to postpone the solution of open issues not preventing business process from being accomplished in the system. Workarounds have been defined and final solutions postponed to the stabilization phase. Customizations are still necessary to cover the requirements especially of a public sector company and in order to fully cover the government requirements.

These aspects confirm a major lesson learned from this case study consisting in the importance of defining optimized end-to-end business processes prior to starting the ERP system implementation.

6- Operations and support of the ERP software
The IT support for the users is still depending for many support cases on vendor support. The ERP system operations and support teams still need more experience about how they can deal with the support cases and how to solve incidents raised by users. The introduction of standardized IT processes according to an international framework like ITIL [10] could strengthen knowledge management and could optimize ERP system operations at GECOL.

Besides ensuring the implementation success in terms of a working system covering the requirements defined it is necessary for companies implementing ERP software to plan the integration of appropriate operations and support in their IT organisation.

5. Conclusion and Next Steps
In this paper, we considered the implementation of the ERP system solution implemented at CDA – a subsidiary company of GECOL - in order to validate CSFs for ERP system implementations and derive lessons learned and recommendations for companies aiming to introduce ERP systems. A model consisting of 14 CSFs for ERP implementations subject of consensus or majority agreement in the literature was used in order to assess the implementation project. This study confirmed the impact of these factors on the success of ERP implementations. CDA’s ERP system implementation can be evaluated as successful since all defined targets could be realized at least partially. This positive evaluation can be explained through the support for most of CSFs identified. During CSFs on the tactical and operational level held good support, CSFs on the strategic level were not supported as needed. This lack of support of these CSFs led to difficulties during the ERP implementation.

Through this research, the importance of the appropriate implementation Planning could be emphasized. The lack of an adequate software selection process at CDA prior to the ERP implementation led to implementation difficulties, higher implementation costs and major project delays.

Another aspect which needs to be offered more attention when introducing ERP systems is the impact of the national culture. ERP systems are built upon number of assumptions and developed according to standards which don’t consider special requirements of companies in Arabic countries, in this case Libya. This aspect could be revealed at CDA through the customizations needed for example for L/C or multi-currency functionalities. Especially this aspect of the impact of the National Culture on ERP implementations still requires further research in order to identify in a systematic way the special requirements of national companies
and conduct a gap analysis towards the standard packages.

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