

Conceptual Framework for Understanding of the Pre - Implementation Phase of ERP Projects in Tanzania

Baraka Mdima, Beda Mutagahywa, Juma Mohamed and Victoria Mahabi
Department of Mechanical and Industrial Engineering
University of Dar es salaam

Abstract—Tanzanian organisations faces challenges associated with implementation of ERP systems in order to fully benefits from technology in order to improve their competitiveness. This paper reviews relevent literature on ERP technology in the country and eventually proposes a conceptual framework for understanding the ERP pre-implementation phase in Tanzanian enterprises .

Keywords — *Enterprise Resource Planning , Enterprise Architecture , Critical Success Factors , ERP Pre-implementation .*

I. Introduction

The literature review forms summarised frame of references from studies on Enterprise Resource Planning systems and related disciplines. This frame of reference was based on extensive search of relevant research on ERP to form a research database of the work done. The database is the basis of the proposed primary research and defined gap between the existing research and the proposed research. In general, the review explores and analyses a range of theories and models to provide an analytical foundation for the purpose of this research.

II. Enterprise Resource Planning System

Many researchers have defined ERP based on IT, business process, inventory control and architectural perspectives. According to [1], ERP is defined as “an enterprise information system that integrates all departments and functions of an enterprise into a single computer system that can serve needs of all the departments. Similarly, researchers define ERP system as a modular integrated business software system that facilitates an organisation to use its resources efficiently and effectively [2]. A critical review of these definitions indicates common features such as business integration, business–IT alignment, central database and enterprise architecture. An ERP system streamlines business processes by creating an enterprise-wide transaction

structure that integrates the key functions of different departments within an organisation.

For the purpose of this study, ERP is as a set of packaged enterprise application software modules, with an integrated architecture that can be used by an organisation as their primary engine for integrating data, processes, and information technology, in real-time, across internal and external value chains. This definition identifies an ERP system as a business process management software that allows, enables and facilitates all business transactions of an organisation to be entered, recorded, processed, monitored and reported from a single information system with centralised database while ensuring interdepartmental cooperation and coordination.

A. ERP System Design and Development

The design and development of an ERP system has a foundation on software architecture design which is guided software development methodology, in most cases the Object–Oriented Design and Development (OODD). The software architecture design and modelling provides a set of artifacts needed to articulate requirements that lead to the solution [3]. In this context, software architecture is a holistic high–level structural view of a software system that describe set of components, views and relationships that guide the design, development and deployment of information systems. Unified Modelling Language (UML) is the comprehensive and integrated approach for software architecture design that deals with growth and complexity software systems to ensure mutual communications and transferable abstract action of a system. The position and relationships software architecture design in the software development process is illustrated in Figure .

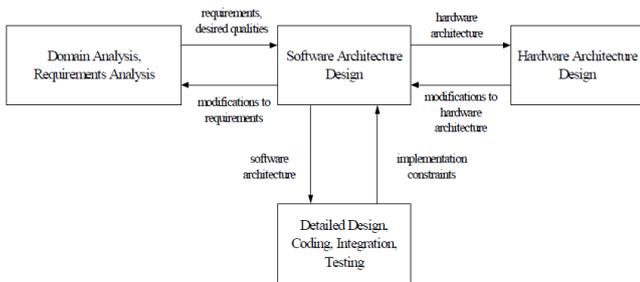


Figure 1: Software Architecture and Development Process

Researchers suggest that organisations should formulate their software architectural design in to ensure business-IT alignment[4]. The software architecture design starts with the domain and requirement analysis that may produce the requirement specifications, a key input to the software architecture design. The architect reviews the requirements and proceeds with the design. However, some modifications to the requirements may be needed after the review. Also, the architect works closely with hardware architecture experts to get another input to the software design. The software architecture then guides the implementation of the software, including the detailed design, coding integration and testing. The software design process is illustrated in **Error! Reference source not found.** below.

B. ERP Technology

ERP technology is a set of application software modules with an integrated architecture used by an organisation as their primary engine for integrating data, business processes and information systems across its business value chains in real time[1]. The technology is featured by the centralisation of all data from business processes in a single unified database based on the popular three tiers client-server architecture, presented in **Error! Reference source not found.** The three tiers client-server architecture is dependent on the network computing, where the processing of the application is split between servers and client work stations. This arrangement enables the ERP user interface to be run on the upper tier of client presentation, the module processing to run on the middle tier application server and database to run on the database servers.

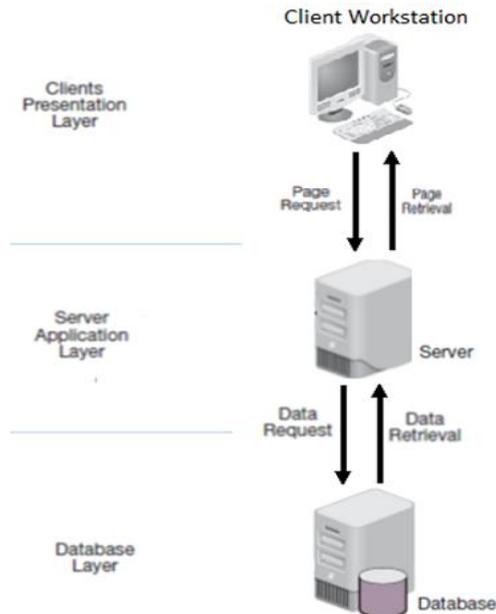


Figure 2: Three Tiers Client – Server Architecture

The recent developments in internet technology is driving the migration of implementation of ERP into web-based ERP systems. This migration to web-based ERPs is facilitated by lean built web services such as service-oriented architecture.

III. Implementation of ERP Systems

Implementation of ERP system is an ongoing process where new functionality, modules, updates, and corrections need are carried out in conjunction with changes in business processes [5]. The implementation of ERP systems causes remarkable change to the existing work processes, hence the need for managing change for project success. The success of project is concerned with the degree of mutual fit the ERP system and business processes [6]. ERP implementation cycle is composed of the pre-implementation, implementation and post-implementation as discussed in the next sections:

A. Pre-implementation Phase

The phase prior to the implementation of the ERP project mainly involves the readiness assessment, requirement identification and solution selection. Studies suggest that, an effective readiness assessment framework is a necessary condition towards utilization of the opportunities provided by the ICT [7]. Some extensive preparations prior to implementation of ERP system are cited to enhance the possibilities of achieving project success [8]. In the context of this study, the preparedness of an

organisation refers to the readiness to change before the implementation of ERP system.

B. Implementation Phase

Implementation of an ERP systems generally large and complex project with an extensive, lengthy and costly process covering all organisational levels, business processes and activities, characterised by unique nature, scale, scope, complexity, organisational changes [9] [10]. During this phase, an ERP system is installed, configured, standardised and customised under the client-server architecture environment and a single centralized database across an organisation. Research suggests that organisations must invest in ERP project and enterprise architecture initiative as package to ensure the business–IT alignment as the supplement each other during implementation of the ERP system [3]. This implies that to ensure successful implementation, there are critical issues that must be carefully considered before, during and after implementation of the ERP project [2].

C. Post Implementation Phase

Researchers indicate that, once an ERP system is introduced, the effectiveness and successful utilisation of the system becomes a crucial concern of an organisation [13]. Enhancing employees' knowledge, skills and learning roles in usage are equally important post-implementation issues [12]. Even if usage is mandatory, effective utilisation leads to organisational efficiency, productivity and competitiveness [14]. While training the ability to use an ERP system, training programmes are always provided before implementation, different authors indicate that lack of continuous IT learning will cause a gap between how IT is actually used and the realisation of its full potential [15].

IV. Perspectives of ERP Systems Implementation

There are several perspectives in relation to the implementation of ERP projects, described in terms of technology, project, knowledge and innovation as further discussed in the sections below[16].

A. Technology Transfer Perspective

Technology may be defined as an aid for conducting an activity which is repeated from time to time[17]. Based on this definition, technology may include tools, techniques, materials, skills, capabilities and organisational structure or knowledge. In this regard, an ERP system which provides capacity to plan and

manage resources in form of integrated business processes of all departments in an organisation may be referred to as ERP technology. In practice, technology is composed of four major components, namely technoware which includes facilities used such as IT infrastructure and ERP software; humanware, composed of abilities to understand capacity for systematic application of knowledge, human capability and change agent; orgaware, consisting of frameworks, procedures, standards, organisational culture and organisation structure to utilise technoware; and infoware, made up of data, information and scientific knowledge such as system documentations, guidelines, and reports. Technology transfer happens when the technology comes from a developer organisation to a receptor organisation. Technology transfer is the process by which the technology consisting of technological innovation from R&D developed by a creator is applied and utilised by an applier. For the ERP technology transfer to be complete, it must constitute the total composition of technology including technoware, humanware, orgaware and infoware.

B. Innovation Diffusion Perspective

This perspective of implementation of ERP system is closely linked to technology transfer perspective [17] [18]. This is due to the fact that technological R&D and innovation in most cases are closely interdependent processes. The technological innovation perspective may be described as the organisational effort to diffuse an appropriate information technology such as ERP system within a user organisation. However, researchers point out that traditional innovation models are not suitable for complex technology which have strong interdependencies across multiple adopter sand impose high knowledge burden [19]. Hence, there is the need for technological innovation perspective which encompasses both innovation and technological aspects.

C. Organisational Change Perspective

The implementation of an ERP is predominantly a change management project based on chosen business model. Despite the fact that developers claim degree of flexibility, the business model embedded in an ERP system dictates and directs the manner of doing business [20]. Also, research indicate that enterprises are facing problems and difficulties in completing implementation information systems due to technical, managerial and organisational challenges [9]. In order to take advantage of ERP software, organisations need to adapt to the new business model and consequently change organisation's core business

processes to take advantage of the software. ERP incorporate changes in the areas of business processes, organisational culture and technology. On the other hand, individuals and groups in an organisational structure are resistant to changes as they are used to current procedures and conditions. Hence, this gives us the main reason to adapt the change management approach in implementation of ERP system. In practice, ERP systems have changed how businesses operate by integrating business processes and IT infrastructure.

D. Project Management Perspective

Some organisations regard ERP system implementation as project management issue that involves management functions which leads to different levels of re-organisation with application of knowledge, skills, tools, structures and techniques to project requirements [21]. This implies that ERP projects are more susceptible to rapid changes in the business environment. Furthermore, the success of an ERP project depends on adherence to the project management processes, allocation of resources and the fit between the project level and business level strategy [22].

V. Enterprise Architecture, Strategic Planning and Critical Success Factors

Researchers have pointed out the close link between Enterprise Architecture, Strategic planning and critical success factors in meeting corporate goals and objectives, corporate competitiveness. These concepts are further discussed in below.

A. Enterprise Architecture

The concept of EA has been discussed in diverse literature and it is related to organisation structures, information systems, business processes and their relationships to fulfil a specific purpose[24][44]. It provides an understanding of business processes and information flow, flexible framework for harnessing IT to the needs of the business, a holistic view of an enterprise and a platform for cooperative effort for systematic design of enterprise as a complex system and captures the essentials of business, IT and its evolution for successful implementation of ERP system [23]. Therefore, EA closes the gap between the business and IT by guiding managers in designing business processes, system developers in building applications in a way that they are in line with business

objectives and accommodate/facilitate change. The drivers towards EA development and application are both, internal and external to an organisation. A major internal driver being the alignment of business processes with information systems, future technology and industry trends to achieve business objectives with the focus to delivering stakeholder/ shareholder value[24]. Another driver is external pressures from customers, suppliers, regulatory bodies and government.

The development of an EA involves definition, analysis and identification of a minimal set of components to represent organizational concepts while ensuring alignment between the business processes, information systems and corresponding technology. It can be noted that, EA is a multidisciplinary initiative and not an IT discipline. Therefore, a good enterprise architect must possess skills in business, technology and communication skills to co-operate with key stakeholders including policy makers, managers, data architect, technical architect and possibly ERP application developers. In this context, the development of EA may be achieved through combination of frameworks, methods, standards and modelling language [24]. In general, an enterprise Architecture, may be sub-divided into the following subdivisions, namely: organisational architecture, business architecture, application architecture and technology architecture based on layered view of service orientation.

On the other hand, EA is key to ensure Business-IT Alignment in an organisation. It may be referred to as the process and goals of achieving competitive advantage through developing and sustaining a symbiotic relationship between business and IT by matching between the processes embedded in the ERP system and business processes to conform to the business requirements. In this context, the alignment is classified into horizontal and vertical alignment. The vertical alignment describes the relation between the top strategy and the people at the bottom, whereas horizontal alignment describes the relation between internal processes and external customers. In ensuring both vertical and horizontal alignment, EA is of a valuable assistance in dealing with diverse complexities embedded in the implementation of ERP systems [25].

Several models have been developed to deal with both vertical and horizontal alignments. However, the most popular includes: strategic alignment model as shown in Figure and strategic level-functional level alignment in Figure respectively [26][27][28]. The strategic

alignment model describes business-IT alignment along two dimensions and defines four domains that have been harmonized in order to achieve alignment, each domain has its constituent components including scope, competences, governance, infrastructure, processes and skills[26].

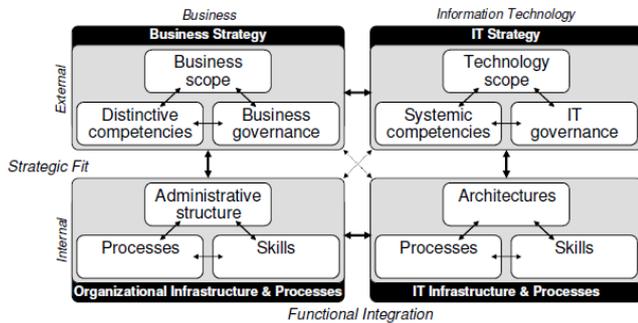


Figure 3: Strategic Alignment Model

The strategic level–functional level alignment mainly focuses on the alignment between software architecture, business processes and information systems. In this model, business processes–information system alignment has been handled, but with limited attention on strategic level - functional level alignment [29]. The observable gap is to be handled by positioning of EA in the process of implementation of ERP project.

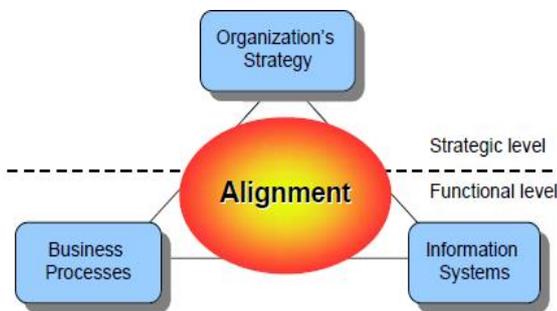


Figure 4: Strategic level–Functional Level Alignment

B. Strategic Planning

EA has strategic position within the context of strategic planning, related business transformation and supports all its three major phases namely, strategy formulation, strategy implementation and strategy evaluation respectively [23]. It assists in exploring of business context, identifying necessary changes, clarifying the limits of new developments, improving strategic planning and providing insights on innovations [30]. In strategic planning, EA is a useful tool in translating the organisation's mission, vision and strategy into a comprehensive framework for strategic management [31].

The goals set during the strategy formulation phase are instrumental in driving changes to the daily operations of the organisation where enterprise architecture comes as a tool for organisation change [23]. Based on analysis above, it evident that business processes are the foundation of EA and implementation of strategies in an organisation [24]. During strategy evaluation phase, EA allows traceability back to the strategic choices and increase knowledge of corrective action to be taken [23].

C. Critical Success Factors

Researchers indicate that Critical Success Factors (CSFs) are important components of corporate strategic direction emphasising on areas of focusing to achieve corporate vision and mission [33][44]. The relationship between the CSFs and strategic planning is illustrated in **Error! Reference source not found..** CSFs are crucial parameters required to identify and state the key elements for successful business operations and continuity through attainment of set goals [34][12]. These factors indicate managerial areas that must be given special and continual attention to attain set goals that are positively associated with successful implementation [36].



Figure 5: Strategic Alignment Pyramid

This suggests that organisations are adopting CSFs based approach to overcome challenges and difficulties to ensure successful implementation of ERP systems [37] [38]. CSF affecting ERP implementation are numerous, complex and abundant, for the purpose of this study, only selected CSFs are summarised in Table 1 below:

Table 1: ERP Pre – Implementation Factors

Factors	Sub-factors
Project	Project championship
	Project management
	Resource allocation
	Project team
Human Resources	Top Management
	Personnel
	Training and User Support
	Organizational change

Factors	Sub-factors
Organisational	Governance
	Planning & Strategy
	Communication
	Collaborative culture
Enterprise Architecture	Business Processes
	Information systems
	Alignment
	Data Accuracy

D. CSFs and Decision-Making Approach

From the analysis and discussion above, it evident that ERP pre-implementation is a multi- criteria decision making that involves complex relationships between the factors which are subjective and expressed in linguistic variables that requires multi criteria making approach [39]. This suggests that a decision-making approach should provide a flexible way takes into account several factors and their relationships to arrive at a reasonable solution. Researchers proposed the use of fuzzy set theory whose basic component is membership function was introduced to deal with observations, decisions and judgements which are subjective, vague and imprecise in relation to pairwise comparisons [40].

Some of the notable utilisation of fuzzy sets include fuzzy multi – objective programming approach in the selection of R&D projects, Analytical Network Process (ANP) based decision making and compromise ranking method and fuzzy ANP implementation with MATLAB [41][43]. Therefore, the fuzzy sets based ANP technique offers a generalised form of interval analysis that addresses uncertainty to derive meaningful priorities from complex decision structures. In addition, Decision Support System is proposed to handle complicated relationships amongst CSFs of the ERP pre-implementation phase [32] [35][42].

VI. CONCEPTUAL FRAMEWORK

A. Research Gap

The literature on implementation of ERP system is diverse and focused on developed countries, large enterprises and off-shelf software packages. Although various studies have been conducted, applicability of these results is limited due to differences in socio – economic development. Also, comprehensive studies on ERP pre - implementation are limited in developing countries including Tanzania. This gap on ERP pre - implementation literature is going to be contributed by findings of this paper. Based on review and analysis of relevant of literatures, the conceptual framework for the assessment of ERP Pre – Implementation has been developed and detailed in the following section.

B. Conceptual Framework

The ERP project conceptual framework identify the main areas of assessment of ERP project. The pre-implementation phase of the ERP project is initiated by the strategy of an organisation to achieve the desired change. Once the decision to implement ERP project is made, changes to organization will be initiated by project through assessment of the readiness of an organisation to implement proposed changes. In this context, the Enterprise Architecture as crucial tool for managing change is adopted in the assessment of pre-implementation of an organisation to implement and ERP project through CSFs[44]. This situation is associated with major organizational changes as illustrated in Figure 1 .

Therefore, the overall ERP readiness of an enterprise is the function of organizational readiness, change readiness, technology readiness and project readiness. Whereby enterprise architecture provides a platform for successful implementation of ERP system in an organisation.

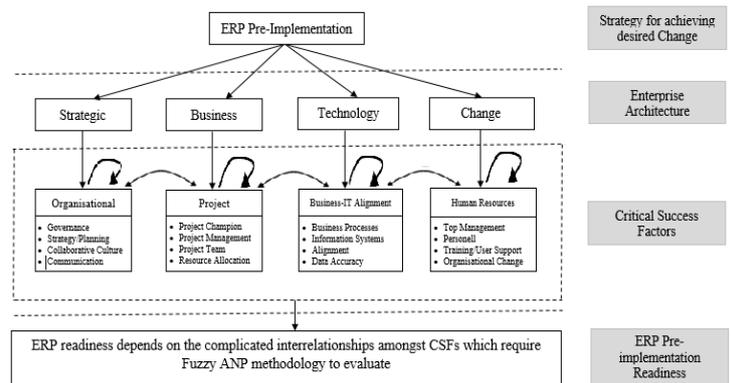


Figure 1: ERP Pre-implementation Conceptual Framework

VII. CONCLUSIONS AND RECOMMENDATIONS

From the review and analysis of various relevant literature on the implementation of ERP systems, the authors propose the following conclusions and recommendations.

- a) ERP systems are useful in improving productivity efficiency and competitiveness, however ERP project are characterised by complexity, high cost, unpredictable completion schedules. Hence, the need for pre – implementation assessment prior to implementation of ERP project.
- b) The Enterprise architecture is very important to ensure Business – IT alignment for adding value to organisational products and services. Therefore,

Enterprise architecture must be adopted for ERP Pre-Implementation Assessment prior to implementation of ERP system.

- c) Tanzanian organisations and other developing countries are the early stages of adoption of ERP systems. Care must be taken to ensure alignment between business processes and Information technology to ensure optimal utilisation of ERP systems while maintain their competitive advantages during implementation.
- d) The relationship between CSFs that affect pre-implementation phase of ERP project are complicated and vague. Hence there is a need for the development of the DSS enabled ERP Pre-Implementation Model that may further being developed into a a practical DSS Enabled ERP Pre-Implementation Tool for industrial managers and other practitioners.

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