

Positioning of the ERP system Pre - Implementation Assessment in the Enterprise Architecture in Tanzanian Organisations

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Abstract - Tanzanian organisations faces challenges associated with ERP implementation in order to fully benefits from technology in terms of improved productivity , competitiveness and efficiency .This paper reviews the development of ERP technology in the country , challenges of ERP system implementation , position of enterprise architecture in business – IT alignment and propose ERP project conceptual framework for ERP pre-implementation assessment in Tanzania and other developing countries. Finally , the paper concludes on the position of Enterprise Architecture in pre – implementation of ERP project and offer related recommendations.

Keywords — Enterprise Resource Planning , Enterprise Architecture , ERP Pre-Implementation , Critical Success Factors , ERP and EA .

I. INTRODUCTION

Tanzania is among developing countries with ambitious plans to become the middle income nation by the 2025 as envisioned in Tanzania Development Vision 2015 [1]. The role of Information and Communication Technology (ICT) in achieving the plan cannot be underestimated as it has been identified as one of the determinants of growth in the globalizing economy through building an appropriate enabling environment for creation and access to products, services, markets and employment development [2]. Organisations in developing countries including Tanzania are turning towards Enterprise Resource Planning systems to resolve business challenges to ensure corporate competitiveness and productivity , access to relevant information ; increases access to market opportunities [3]. Several measure have been taken by the Government to improve ICT related infrastructure and services in Tanzania [4]; [5]. However, regardless of these efforts organisations in Tanzania are facing several challenges in implementing ICT projects such as shortage of qualified IT professionals, rapid developments in ICT, failures in implementations and power shortage [6][7].

On the other hand, organisations in Tanzania are facing various challenges as result of business environment dynamics such as changing technological opportunities, customer's demand for innovations, changes in markets, and raising customer expectations forcing enterprises to be more customer - oriented and knowledge-driven [8]. These developments affect organisations in terms of business processes, business practices, organisational procedures and maintaining the status of their competitive advantage. In this situation, an Enterprise Resource Planning system (ERP) as part of Information Technology is implemented by many organisations as an integrated solution to various business challenges and provide integrated framework. This has resulted in an increasing trend of organisations turning towards the implementation of ERP systems as a tool to improve their business operations [9] [10]. ERP is a diverse set of technological tools and resources used to communicate, create, disseminate, store and manage information with embedded large scale collaboration and data exchange.

A critical review of ERP definitions indicates common features such as business integration, alignment, central database and integrated architecture. Therefore, for this study, we adopted the global definition of ERP as proposed by Seddon and others, that ERP may be defined as a set of enterprise application software modules, with an integrated architecture that can be used by an organisation as their primary engine for integrating processes, data, and information technology, in real-time, across internal and external value chains [11].

II. HISTORICAL PERSPECTIVES OF THE ERP SYSTEM

The development of ERP systems has a foundation on inventory control package in 1960s. In order to automate their inventory control systems by using inventory control packages, many organisations adopted and implemented centralized computing systems. The name ERP originated from Manufacturing Resource Planning II (MRP II) that followed Manufacturing Resource Planning (MRP).

The MRP was developed in 1970s to support production planning according to the principal production schedule. Following optimization of manufacturing processes in the 1980s, the MRP II as the new generation of software was introduced to allow synchronization of materials with production requirements. This generation included new areas such as distribution management, shop floor, finance, human resource, and engineering.

Since the business environment is dynamic and organisation keeps on facing new challenges and constraints as result of market trends, IT infrastructure have to follow the new challenges met by organisations. ERP systems appeared in the beginning of 1990s with advantage of coordinating and integrating all enterprise-wide business processes [12]. Today ERP are implemented in organisations and allow to standardize their business processes and aggregate best practices. The evolution of ERP system is illustrated in Figure 1.

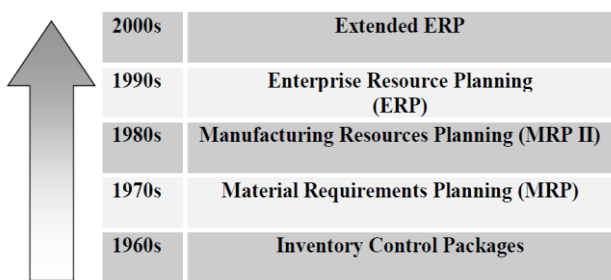


Figure 1 - ERP System Evolution

III. ERP SYSTEM TECHNOLOGY

ERP 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 technology across value chains in real time operations [4], [5], [6] and [8]. The ERP system technology is the centralization of all data from business processes in a single unified database and client-server architecture illustrated in Figure 2 . First, the client presentation layer including a graphical user interface (GUI) or browser for data entry or accessing system functions. Second, Application layer comprising of business rules, functions, logics and programs acting on data received/transferred from/to database servers. And third, database layer focusing on organization's operational and transactional data, mostly employed is the industry standard Relational Database

Management System (RDBMS) of the ERP system [13].

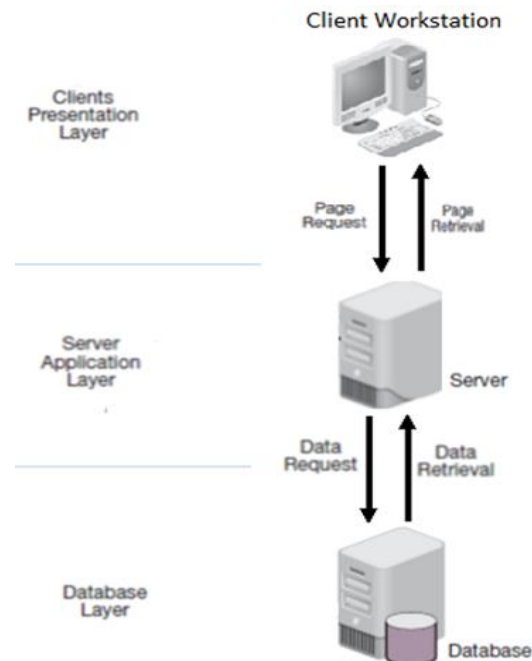


Figure 2 : Three Tiers ERP Architecture

The generalised concept of the ERP system presented Figure is illustrated in Figure 3 below.

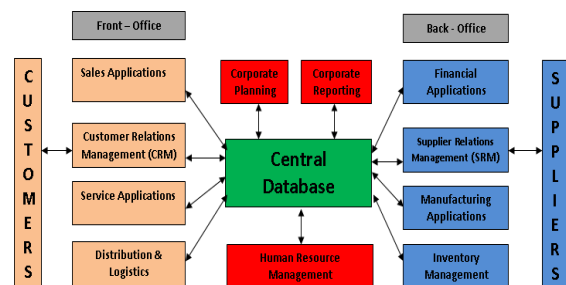


Figure 3 : ERP system concept

The developments in internet technology are currently causing migration of ERP systems into web based ERP system facilitating integration of different applications belonging to different information systems [10] and [13]. The migration to web – based ERP systems is facilitated by lean built web services such as Service – Oriented Architecture as illustrated in Figure 4 below.

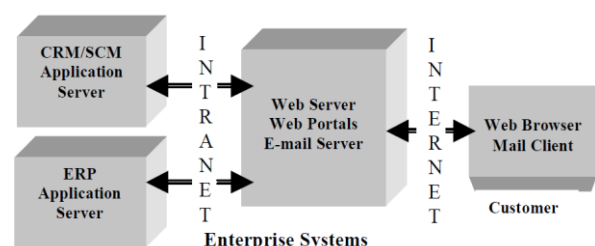


Figure 4: Web-enabled extended ERP system

IV. IMPLEMENTATION OF ERP SYSTEMS

In general implementation the cycle of implementation of ERP system, may be grouped in three phases namely: pre-implementation, implementation and post- implementation phases [14]. This paper is focused on the pre – implementation phase, more specifically on readiness assessment which is have limited studies [15]. Authors have indicated the need for detailed and effective pre – implementation assessment framework prior to implementation of ERP systems to reduce reported risk linked to implementation of ERP systems and pre-condition for project execution [16], [17]. It is important to note that, ERP systems are large and complex, and their implementation is an extensive, lengthy and costly process [18], [19]. ERP project covers all levels of an enterprise and hence all enhances all business processes and activities [20].

Scholars have indicated the challenges facing organizations during implementation of ERP systems to include: lack of alignment between software and business processes; contextual biases embedded in business models; misfit between offers of ERP developers and user requirements; appropriate enterprise architecture to support ERP system; exceeding budgets and completion schedules; and failure to institute organizational changes [21], [22], [23], [24], [25]. The complexity and integrated nature of ERP implementation challenges is main cause of high failure rates. Despite the challenges, studies have revealed a positive relationship between implementation of ERP system and organizational performance.

V. POSITION OF ENTERPRISE ARCHITECTURE IN THE IMPLEMENTATION OF ERP SYSTEM

Enterprise Architecture may be defined as a coherent whole of principles, methods, and models that are used in the design and realization of organisation structure, business processes, information systems, and infrastructure with focus on providing a flexible framework for harnessing IT to the needs of the business [26], [27]. EA is helpful in guiding business – IT alignment, while allowing flexibility and adaptability by providing a holistic view of an enterprise [26]. Furthermore, EA promotes systematic design of enterprise as a complex system for achieving better overall results [28]. EA success is a co-operative effort of designers, analysts, managers and users to use enterprise models to capture the essentials of business, IT and its evolution [26]. It is

important to note that organisations specialize their business processes to gain competitive advantage. ERP programmers should identify these processes and ensure that these processes are retained and not affected due to implementation of the ERP software [29], [30] and [31].

The position of Enterprise Architecture in the Pre-implementation phase of ERP system is further discussed comprehensively by business value chain, strategic planning using Balanced Score Card (BSC) as discussed below:

A. ERP and Business Value Chain

Researchers have indicated that successful enterprises have specialised, unique and hard to imitate business processes linked to their business value chain that possesses competitive advantages that must be retained during implementation of ERP systems [29] and [32]. The value chain concept provides the framework that links the business processes and competitive advantage through structures, abilities and resources that allowed the organisation to perform strategies [33]. The value chain value is composed of two major sets of activities, namely: primary activities and supporting activities. The primary activities are the fundamental value-adding processes by which enterprises produce their set of products and services, facilitated by supporting activities that provide resources and management for the primary activities as detailed in Figure 5.

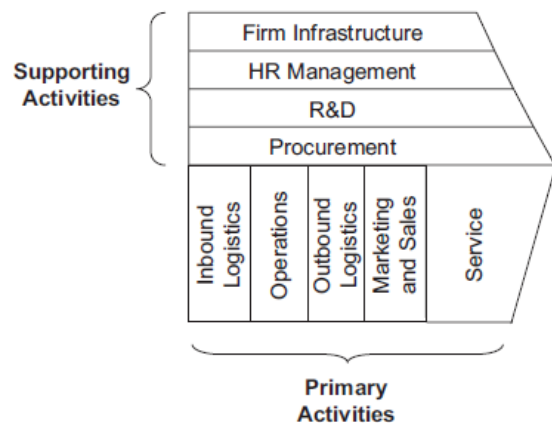


Figure 5: Value Chain Diagram

B. Enterprise Architecture and Strategic Planning

Enterprise architecture has strategic position within the context of strategic planning, organisational change and related business transformations [30], [32] and [34]. Strategic planning approach such as Balanced Scorecard (BSC), Figure 6 is a useful tool in

translating the organisation's mission, vision and strategy into a comprehensive framework for strategic management [32] and [35]. The strategic planning process can be divided into three phases: EA could support the strategic planning process in strategy formulation, strategy implementation and strategy evaluation phases respectively [29]. The advantages of EA in the strategy planning includes: understanding of business context and capabilities; clarifying the strategic limits of positioning of new developments, identifying necessary changes; providing insights on technological and business innovations; enabling clear strategy communication; improving strategic action planning and reporting [30], [36], [37].

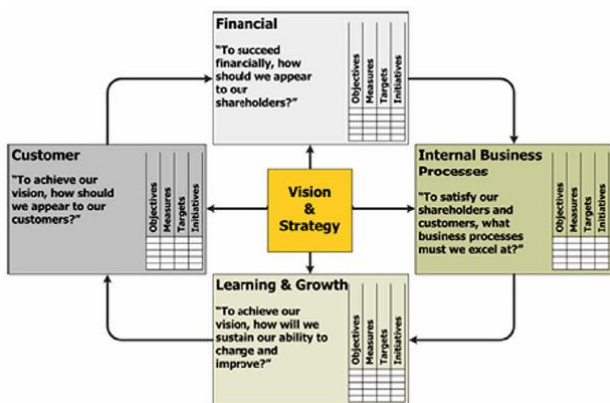


Figure 6: Strategic Planning using Balanced Scorecard Approach

The strategy formulation phase starts by creation of the business vision and mission after analysing of business environment, followed by comparing alternatives and making strategy that states the routes the enterprise takes in achieving its mission and vision [25]. The strategy is further translated into concrete goals that give direction drive changes to the daily operations of the organisation with enterprise architecture as an important tool for managing change as illustrated in Figure 7.

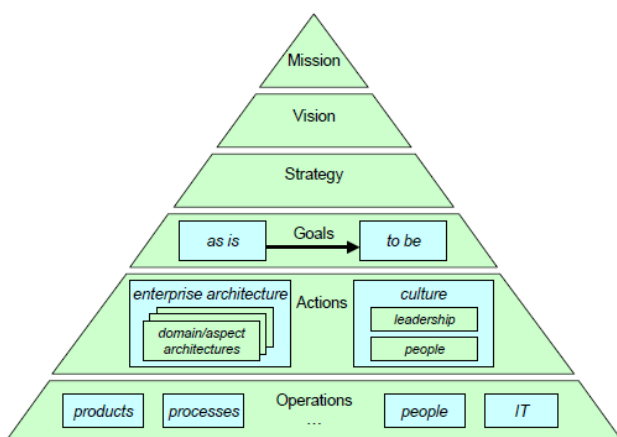


Figure 7 – Enterprise Architecture – Strategic Planning Pyramid

Furthermore, in the strategy implementation phase EA translates strategic inputs to architectural structures by developing business models, business processes and organizational structures from formulated corporate strategy [29]. The EA formally integrates the strategy formulation and implementation to structure important business activities of an organisation [39] and [40]. Business processes is the central component of EA and implementation of strategies of an organisation [26], [34] and [38]. In the strategy evaluation phase, the strategy is reviewed, the performance is assessed and the results of the assessment are used to make corrective actions to the strategy. In the case, EA allow traceability back to the strategic choices and increase knowledge of what corrective action to take [28] and [41].

C. Strategic Planning and Critical Success Factors

Researchers have indicated that Critical Success Factors are important component of corporate strategic direction emphasising on areas of focus to achieve corporate vision and mission [42]. Critical Success Factors (CSFs) refers to what an organisation must accomplish to achieve its mission by examination and categorisation of the impacts [43] as illustrated in Figure 8.



Figure 8: Strategic Alignment Pyramid

Researchers have indicated that, enterprises are facing challenges in completing implementations information systems and achieving effective integration of their business and Information technology due to various technical, managerial, and organizational factors [44].

Most organisations adopted a CSF – based approach to overcome these difficulties and challenges to achieve implementation success [16],[21]. Researchers have realised that the CSFs are interdependent and important in different phases

of implementation process of ERP systems and strategic management [45],[44].

The factors to be used in the ERP Pre-Implementation Assessment were identified based on critical study of critical success factors (CSFs) of implementation of ERP systems, which have been studied and analysed widely [8], [16] and [44]. Also researchers indicated the importance of pre-implementation assessment before ERP project to reduce potential risks [15]. Therefore the identified CSFs must be attended at the pre-implementation phase of ERP project. Based on the discussion above, enterprise architecture is proposed as one of important critical success factor for pre – implementation phase of ERP [26], [27], [28], [29], [30], [31] and [34]. The factors are grouped into four clusters of factors, namely: project, human resource, organisational and enterprise architecture, refer to 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
Organisational	Governance
	Planning & Strategy
	Communication
	Collaborative culture
Enterprise Architecture	Business Processes
	Information systems
	Alignment
	Data Accuracy

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 terms of socio – economic development. In addition, comprehensive studies and systematic studies on ERP pre - implementation are missing in developing countries including Tanzania. This gap in 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 current state of an enterprise is defined by business processes, organisation structures and technology. Once the decision to implement ERP project is made, changes to organization will be initiated by project. Based on proposed organisational change, a suitable ERP system will be implemented taking into consideration the current enterprise architecture and the future enterprise architecture after implementation of ERP system, while maintain business processes that give an organization competitive advantage in the markets. This situation is associated with major organizational changes as illustrated in Figure 9 below.

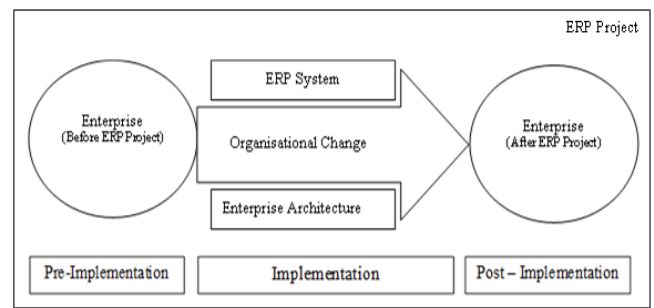


Figure 9: ERP Project Conceptual Framework

Using the proposed conceptual framework, an ERP project may be decomposed into four major aspects namely: enterprise, technology (ERP system), and change and ERP project. 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 organization.

VII. DEVELOPMENT OF DSS BASED ANP ERP PRE – IMPLEMENTATION MODEL

The development of ERP Pre-Implementation Model based on the basics of Decision Support System (DSS) and Fuzzy Analytical Process (ANP) approach using design and development research methods. The research focuses on building the bridging artefact that can serve to strengthen the interaction in the conceptualisation and evaluation [45]. In general, the design and development research addresses an acknowledged problem, building on existing literature and making an original contribution to the body of knowledge [46],[47]. In addition, most design and development be addressed by some form

of human creativity or interaction with focus on disciplined investigation conducted in the context of the development of an artefact, product or program for the purpose of improving either the product being developed or developer [48].

The first facet of the research strategy was that of model building based on intensive literature review and resultant conceptual framework detailed in Figure 10 and ERP Pre-Implementation factors, Table 1 that guided the initial stages of the development. Based on literature review, it is evident that ERP Pre-Implementation preparedness level of an organization is a complex problem with parameters that can be expressed in vague linguistic values. Therefore, in order to deal with this challenge, DSS based Fuzzy ANP was adopted for the development of DSS based ERP Pre-Implementation Model. Using this model, it is possible to predict the current state of organization's preparedness prior to execution of the ERP project and areas that need improvement.

DSS enabled ERP Pre-Implementation Model was further developed into a practical DSS Enabled ERP Pre-Implementation Tool for industrial managers and other practitioners. Researcher indicated the need of practical tool for pre – implementation to indicate the status of preparedness of an organisation prior to implementation of ERP project [12], [13]. Figure 9 represents the research process for the development of DSS based ANP ERP Pre-Implementation model and its automated tool.

The development platform for the DSS enabled ANP Based ERP Pre-Implementation Tool using DSS enabled ANP Based ERP Pre-Implementation Model was C#.NET 2008 for object oriented programming and all fuzzy ANP computational analysis was carried out using MATLAB R009b under Visual Studio 2008 Integrated Development Environment (IDE). MATLAB was selected for its capability and numerical computing environment for engineering applications and powerful capabilities for manipulation of pair-wise comparison matrices and supermatrices, while the MATLAB front – end development is reported to be not user friendly and time consuming as compared to the C#.NET platform which offers strength on Graphical User Interface (GUI) and possibility of integration by connecting MATLAB functions [49].

VIII. 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 review of this paper indicated that 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.

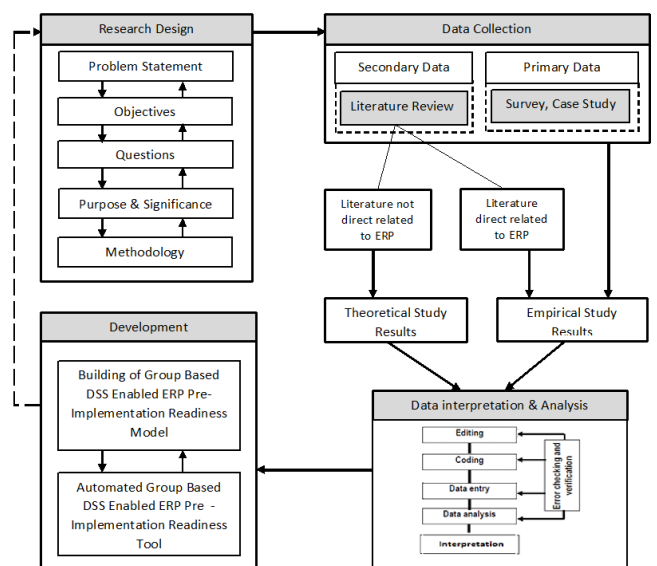


Figure 10: Research Process for Development of DSS Based ANP ERP Pre – Implementation Model

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