Development of a Practical ERP Pre – Implementation Assessment Model for Organisations in Tanzania.

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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. However, implementation of ERP systems in developing countries is complicated, costly and challenges related to business -Information technology alignment. This paper proposes a practical model for assessment of pre-implementation of an enterprise in Tanzania prior to implementation of ERP system. Finally, the researchers conclude on the position of pre-implementation assessment towards successful implementation of ERP system in an organization.*

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

1. INTRODUCTION

ERP projects are expensive and complex by nature; they are featured by exceeding the allocated budgets, incomplete implementation and exceeding completion schedules. Although the outstanding advantages of ERP systems have led organisations towards adopting them, many have cited failures that invoke attention to the nature of ERP implementation [1]. This is supported by other researchers who observed that ERP implementation causes massive change that needs to be carefully managed in order to acquire the benefits of an ERP solution [2][3].In response to this situation, researchers observed the need for extensive preparations prior to the implementation of ERP projects in developing countries in including pre-implementation studies [4]. The pre-implementation assessment problems are featured by complex decision making process with multiple interrelated and interdependent factors [5] [6].

The literature on implementation of ERP system is diverse and mostly focused on developed countries with limited direct applicability to developing countries due to their specific context in terms of the level of socio-economic development, cultural structures, regulatory infrastructure and business environment [4]. In general, implementation of ERP system may be viewed as an integrated strategy towards change with embedded innovation to attain desired levels of competitiveness[3][22]. In this context, the competitiveness of an organization is characterised by its capacity to manage changes under dynamic business environment while maintaining business–IT alignment. Hence, multi-perspective view of organisational change related to include innovation, technology transfer and project management [8].

2. LITERALURE REVIEW

2.1 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.

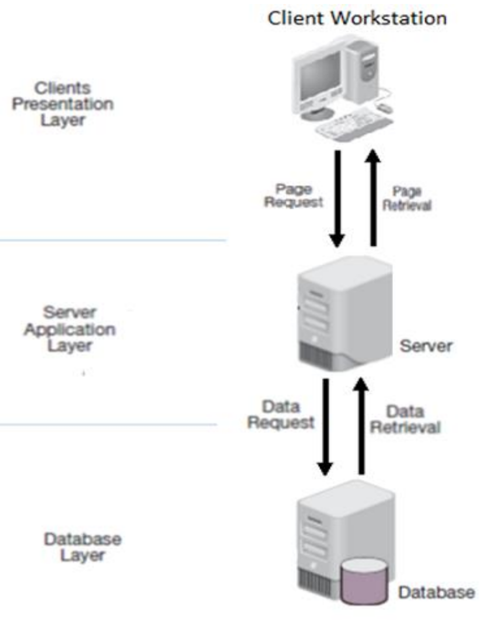

Figure 1: Three Tiers Client – Server Architecture

2.3 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[10]. The implementation of ERP systems causes remarkable change to the existing work processes, hence the need for managing change for project success. The that success of project is concerned with the degree of mutual fit the ERP system and business processes[11]. ERP implementation cycle is composed of the pre-implementation, implementation and post-implementation as discussed in the next sections:

2.3.1 Pre-implementation Phase

The pre–implementation phase of the project of an ERP extends from only a system installation to a wide-ranging process and attempts to incorporate all related activities systematically. Its sub-phases includes sub-phases such as 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[5]. An extensive preparations prior to implementation of ERP system is cited to enhance the possibilities of achieving project success[6]. The preparedness for the implementation of an ERP system incorporates business maturity in a broad range of organisational capabilities and structures. In the context of this study, the preparedness of an organization refers to the readiness to change before the implementation of ERP system.

2.3.2 Iimplementation 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[14]. In addition, the implementation of an ERP system is unique in terms of nature, scale, scope, complexity, organisational changes, project costs and need for business processes re-engineering[15]. During this phase, an ERP system is installed, configured, standardized and customized under the client-server architecture environment and a single centralized database across an organisation. Since the ERP systems are designed to support a diverse variety of enterprises through their pre-defined standard business processes, it must be configured so that at least meets the requirements an enterprise. Researcher 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[16]. 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[17].

2.3.3 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 organization[18]. Enhancing employees knowledge, skills and learning roles in usage are equally important post-implementation issues[19]. Even if usage is mandatory, effective utilisation leads to improved efficiency, productivity and competitiveness[20]. 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[21].

2.4 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.

2.4.1 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[22][24][6]. 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 **Error! Reference source not found.** and strategic level-functional level alignment in **Error! Reference source not found.** 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].

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.

2.4.2Strategic 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].

2.4.3 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][6]. 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]. 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].

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:

2.4 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].

Table 1: Summary of Critical Success Factors

Factors	Sub-factors	References
Human Resources	Top Management	[40] [15] [43]
	Personnel	[6] [23] [45]
	Training and User Support	[46][47][48]
	Organizational change	[49] [1][51]
Organisational	Governance	[52] [53]
	Planning & Strategy	[39][9] [12]
	Communication	[13] [17]

Factors	Sub-factors	References
	Organisational culture	[37][40][23]
Project	Project championship	[40][46][44]
	Project management	Arnott, 2008 [44] Zhang et al., 2003
	Resource allocation	[9] [46]
	Project team	[6][17][9]
Business-IT Alignment	Business Processes	[55] [49][56]
	Information systems	[46] [56]
	Alignment	[57][49][50]
	Data Accuracy	[7][50]

Source: Author's own construction

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 [35][42].

2.4.1 Fuzzy Sets Theory

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[24][25]. The theory provides methods to deal with qualitative as well as quantitative judgements to arrive at a definite solution[26].

Some of the notable utilisation of fuzzy sets include fuzzy multi – objective programming approach in the selection of R&D projects, ANP based decision making and compromise ranking method and fuzzy ANP implementation with MATLAB[27]. 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. The fuzzy sets theory related concepts are further discussed in the following sections.

2.4.2 Pairwise Comparisons and Supermatrix

The supermatrix is developed by incorporating and adjusting the relative importance weights in individual sub-matrices to form a new overall partionioned matrix. It formed using the local weights through pairwise comparisons, the resulting into unweighted supematrix that needs to manipulated into stable supermatrix also known as limit supermatrix[28].

Based on the pairwise comparisons, the local weights are derived as estimates of the relative importance associated with the elements or clusters being compared[25]. The relative importance values are determined using scale of relative importance.

Therefore, each pair of factors is judged only once, where reciprocal values were automatically assigned to the reverse of the pairwise comparison. In order for pairwise comparison to be acceptable for subsequent judgement process must have consistency ratio, CR of 0.10 or less, otherwise the matrix will be revised to improve the judgmental consistency.

2.4.3 Fuzzy Preference Programming with MATLAB

There are several methods to handle fuzzy matrices that are related to fuzzy weights and consistency ratios such as: an extent analysis method, forward fuzzy least squares priority method and fuzzy preference programming method. However, amongst the reviewed methods, Fuzzy Preference Programming Method (FPP) has an effective means of calculating weights and acquire the consistency ratios of fuzzy pairwise comparison matrices without additional manipulation[29].

2.5 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[6]. This situation is associated with major organizational changes as illustrated in Figure 2[50].

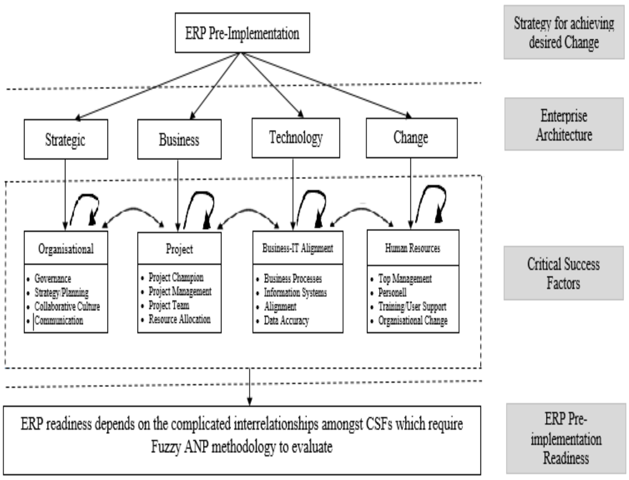

Figure 2: ERP Pre-implementation Conceptual Framework

Source: Author's own construction

2.5 Development of an ANP Enabled ERP Pre-Implementation Model

The development of ANP Based ERP Pre-Implementation Model was based on Fuzzy ANP approach. A global tool for analyzing decision–making process, creating a network model and then evaluating with respect to the proposed network[30]. A comprehensive network of CSFs was developed to capture the subjective judgements under multi-criteria environment in three basic steps: first, group forming and working; second, fuzzy ANP network construction and computations; and third, the ERP Pre-Implementation decisions. These steps are further discussed in the sections below and finally, the proposed model is presented and shown in figure.

2.5.1 Step 1: Group Forming and Working

Step 1.1 Building the Team of Experts

In real business environment, decisions are taken under dynamic environment and time constraint where the final decision is reached at the exploratory process involving knowledge discovery and group dynamics[31]. Many authors point out advantages of decisions making under group environment to include to make most of the combined individual abilities, knowledge and expertise and shared responsibility and commitment leading to the reduced biased opinions and restricted perspectives[32]. There are many methods that can be used for this purpose such as Brainstorming, Dialectical Inquiry, Nominal Group Technique (NGT), and Delphi technique.

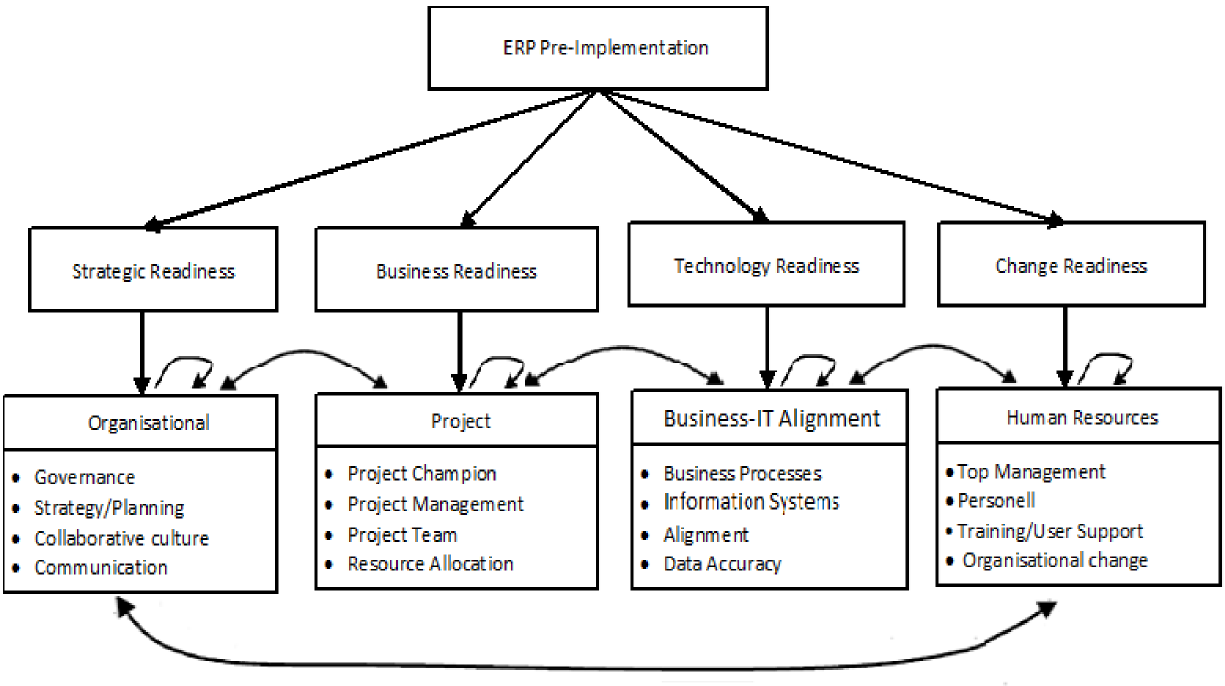

Figure 3: Fuzzy ANP framework for the ERP Pre-Implementation phase
Source: Author's own construction

However, NGT) is a more structured approach where group members are asked to separately think and provide written lists of ideas or alternatives solutions to a problem in the first phase. During the second phase of the process, the ideas are publicly recorded and rated or ranked in order of preference. In NGT approach the group outcome is a group consensus under fuzzy environment. This method was adopted for the proposed model.

Step 1.2 Structuring of Critical Success Factors

The CSFs were used as basis for the ERP Pre-implementation model building, where the factors were identified after a detailed review of critical success factors (CSFs) for the implementation of ERP system as detailed in **Error! Reference source not found.**, indicating factors and sub–factors.

2.5.2 Step 2: Fuzzy ANP Network Construction and Computations

Step 2.1 Fuzzy ANP framework Construction

The decision-making problem was analysed and transformed into a network structure structured CSFs detailed in **Error! Reference source not found.** above, whereby network structure considered the relationships, interdependence and interactions among various elements within and across levels including hierarchical relationship between factors and sub-factors in form of direct parent-child relationships, with the controlling factors influenced by their specific sub-factors[25]. The resulting fuzzy ANP model for the ERP pre-implementation phase is presented in figure.

Step 2.2: Construction of a Supermatrix

Supermatrix may be defined as a partitioned matrix where each sub matrix is composed of a set of relationships between and within the levels of the adopted ANP model[33]. The construction of a supermatrix involved: pairwise comparisons factors and sub-factors levels; calculating of local weights and interdependent weights of the factors and sub-factors followed by building of supermatrix as discussed below.

Step 2.2.1: Pairwise Comparisons of Factors and Sub-Factors Levels

Under the NGT, the team perform pairwise comparisons to examine the impact of all the factors on each other(i.e which factor will influence factor 1 more: factor 2 or factor 3 or factor 4 and how much more?). Each pair of factors was judged only once, where reciprocal value was automatically assigned to the reverse of the comparison using linguistic variables[34]. The pairwise comparisons are performed in the framework of node and cluster matrices, and local weight or interdependent weights are derived as estimates of the relative importance associated with the elements or clusters being compared[25].

Similarly, the same process is performed for the sub-factors. Thereafter, the relative importance values were determined using fuzzy numbers based scale presented in **Error! Reference source not found.**. In general, the consistency ratio, CR of 0.10 or less is considered acceptable for all matrices of pairwise comparisons. However, researchers further suggest CR of 0.05 for 3-by-3 matrix and 0.08 for 4-by-4 matrix respectively, otherwise the matrix will be revised to improve the judgmental consistency[30].

Step 2.2.2: Pairwise comparisons of factors and sub-factors

The pairwise comparisons of the factors and sub-factors are discussed in the following sections below.

a) Pairwise comparisons of factors

The pairwise comparison of factors and sub-factors were conducted to determine the local weights of the compared pairs of factors and sub-factors as proposed by researchers[35][25]. The Fuzzy Preference Programming (FPP) method with MATLAB was proposed and used for obtaining local weights of factors and sub-factors respectively. The local weights obtained from the pairwise comparisons of factors were used to formulate a dependence matrices.

b) Pairwise comparisons of sub-factors

The interdependencies among the sub-factors are taken into account by the pairwise comparison of sub-factors. Similar to the factors, the local weights of the sub-factors were obtained by the use of the FPP with MATLAB. Several pairwise comparison matrices are needed to identify the relative impact of factors on interdependent relationships. Therefore, in order to achieve unique judgements, for each of the sub-factors of the four factors, a matrix was formed and interdependent weights calculated as the product of dependence matrix and independent weight of factors as illustrated in equation (1) below.

$$w_{Fi} = D_M \times w_l \quad (1)$$

Where

w_{Fi}	Interdependent weight of factors i on the final goal
D_M	Dependence matrix of factors
w_l	Local weight of factors

Step 2.2.3: Building a Supermatrix

The supermatrix as partitioned matrix was developed based on the interdependent weights from pairwise comparisons of CSFs. The interdependent weights are grouped and placed in the appropriate positions to build submatrices of a supermatrix based on the flow of influence from one cluster to another and their set of relationships[29][30]. The resulting supermatrice is known as unweighted supermatrix , adjusting the values to attain column stochastic to make the weights converge through Markovian approach for normalising the weights in each column[28]. Then the resulting weighted supermatrix is raised to sufficiently large power for the matrix become stochastic matrix in which the sum of each element column equals 1 using the equation (2).

$$W_F = \lim_{p\to\infty}(W_I)^p \quad \text{.......} (2)$$

Where

W_F the final supermatrix(i.e weighted supermatrix).

W_I the Initial Supermatrix(i.e unweighted supermatrix).

p sufficient large power

The weighted supermatrix will not be in a steady state until the row values of which converge to the same value for each column of the matrix, then the limit supermatrix is achieved. In this step MATLAB was used to obtain the limit supermatrix based on equation(2) above.

2.5.3 Step 3: ERP Pre-Implementation Readiness Decisions

Step 3.1 Calculating Global Weights

The comprehensive weights of the sub-factors were determined by multiplying the local weight of the sub – factor and the interdependent weights of its factors[27], as detailed in equation(3).

$$w_{ij} = w_{Fi} \times w^{I}_{sf} \quad \text{.......} (3)$$

Where

w_{ij} The global(i.ecomprehensive) weight of Sub - factors;

w_{Fi} Interdependent weight of factors i on the final goal;

w^{I}_{sf} Stabilised interdependent weight of sub-factor(i.e. any column of limit matrix);

Step 3.2 Measurement of Sub - factors

The sub – factors are measured using linguistic variables given in **Error! Reference source not found.**, through a questionnaire and structured interview whereby the results are expressed using linguistic variables.

Step 3.3 ERP Pre-implementation Readiness Level

The readiness level for the implementation of the ERP project is determined by the sums of products of the comprehensive weights of each of Sub–factors with its assigned linguistic values as detailed in equation (4).

$$R_L = w_{ij} \times A_{LV} \quad \text{.......} (4)$$

Where

w_{ij} The comprehensive weight of Sub - factors;

A_{LV} The assigned linguistic variable of sub-factors(**Error! Reference source not found.**).

Table 2: The Triangular Conversion Scale

Linguistic Variables	Triangular Fuzzy Scale	Triangular Fuzzy Reciprocal Scale
Just Equal (JE)	(1,1,1)	(1,1,1)
Equally Important (EI)	(1/2,1,3/2)	(2/3,1,2)
Weakly more Important (WMI)	(1,3/2,2)	(1/2,2/3,1)
Strongly More Important (SMI)	(3/2,2,5/2)	(2/5,1/2,2/3)
Very Strongly More Important (VSMI)	(2,5/2,3)	(1/3,2/5,1/2)
Absolutely More Important (AMI)	(5/2,3,7/2)	(2/7,1/3,2/5)

Table 3: Linguistic Values and Mean of Fuzzy Numbers

Linguistic Variables for Sub-factors	Fuzzy Scale	The Mean of Fuzzy Numbers
(1) Very low	(0 , 0 , 0.25)	0
(2) Low	(0 , 0.25 , 0.50)	0.25
(3) Medium	(0.25 , 0.50 , 0.75)	0.50
(4) High	(0.50 , 0.75 , 1.00)	0.75
(5) Very High	(0.75 , 1.0 , 1.0)	1.0

Furthermore, the overall ERP Pre-implementation level was determined as the sum of individual readiness sub-goals proposed by the ANP as it shown in
Figure and modified equation for calculating an overall of ICT readiness of an organization[38], as detailed in equation (5).

$$ERP_{ORL} = R_{LSR} + R_{LBR} + R_{LTR} + R_{LCR} \quad \text{.......}(5)$$

Where

ERP_{ORL} : The Organisational ERP Pre-implementation Level

R_{LSR} : Strategic Readiness Level

R_{LBR} : Business Readiness Level

R_{LTR} : Technology Readiness Level

R_{LCR} : Change Readiness Level

Step 3.4 ERP Pre-Implementation Readiness Decisions

In this study, the decisions levels used for fuzzy ANP competition levels are adopted for the ERP Pre-Implementation Readiness Decisions using an overall ERP Pre-implementation level(ERPOR) obtained in step 3.4 as illustrated in
Figure below[34].

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].

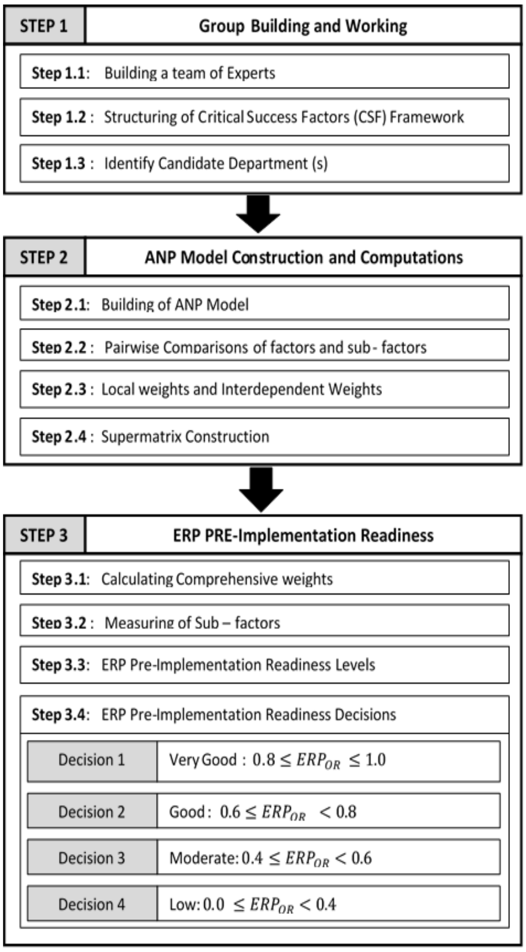

Figure 4: ANP Based ERP Pre-Implementation Model
Source: Author's own construction

3. CONCLUSIONS

The pre – implementation of an organisation is complex in nature and characterised by multi–criteria decision making problem with parameters that can be expressed in linguistic values which are vague. The fuzzy ANP approach was selected to deal with multicriteria and fuzzy nature embedded in the network structure with their relationships and feedbacks. Using this model, it was possible to predict the current state of organisation readiness towards the implementation of ERP system and also the areas that need improvement for the successful implementation of the ERP project. The CSFs obtained from literature review formed a framework of factors and sub – factors in the network structure which is compatible with fuzzy ANP approach and research conceptual framework. Using the proposed conceptual framework, an ERP project may be decomposed into four major aspects namely: enterprise, technology (ERP system), enterprise and organisational change and ERP project. Therefore, the overall ERP Pre–implementation status of an enterprise is the function of strategic readiness, business readiness, technology readiness and change readiness.

The factors and sub–factors were subjected to pairwise comparisons, where the interdependent weights of compared pairs were determined by the fuzzy preference programming method using MATLAB. These weights were used to build an unweighted, weighted and subsequently converging to the limit supermatrix after normalising the unweighted supermatrix. Accordingly, the comprehensive weight of each index and the final score of each sub-goal can be calculated based on the determined limit matrix. Then, the status of the ERP pre–implantation of an organisation is determined to support a more accurate and scientific decision making. Compared with existing research results, the proposed method fully takes into consideration the interaction and feedback relationships between the dimensions and/or attributes. It also uses triangular fuzzy numbers to represent the preference opinions of experts. It helps to make a more accurate and scientific decision. The proposed model was then developed into automated tool, the DSS enabled ANP based on ERP Pre-implementation Tool.

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