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A SYSTEMATIC FRAMEWORK FOR ASSESSING THE IMPLEMENTATION PHASE OF ENTERPRISE RESOURCE PLANNING SYSTEMS

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Abstract: Enterprise Resource Planning (ERP) systems are a major pillar in the management of evolving modern businesses. With the continuous change of technology and increase of business process complexity, ERP systems had to evolve drastically to accommodate the needs of modern businesses. This makes the implementation of such systems very complex hence increasing the risk of failure. Aiming to reducing such risks and protecting businesses as well as ERP vendors from financial losses, this paper proposes a set of categorized critical success factors (CSFs) for assessing ERP implementations. A support tool is also presented to visualize the assessments of the current and past implementation states to help in monitoring the implementation's evolution history.

1 INTRODUCTION

Enterprise Resource Planning (ERP) systems have become a vital element in the success of numerous modern businesses. ERP systems differ from other information systems in their higher complexity and impact on an enterprise's operations.

Prior research has shown that the ERP system lifecycle consists of six phases, generally identified as adoption decision, acquisition, implementation, use and maintenance, evolution, and retirement (Esteves & Pastor 1999). Our research focuses on the implementation phase, which deals with the actual system deployment and includes customizing the ERP for business needs, data migration, user training, etc.

An ERP implementation strategy determines how the ERP system will be made operational in an enterprise. Different companies may implement the same ERP software using a totally different process and the same company may deploy different ERP software through the same approach (Leon 2008). This definition points to the varying needs between different industries, and even businesses within the same industry, adding a layer of complexity to the implementation of ERP systems.

Although ERP systems are technically complex to develop, one can notice that the problems facing ERP implementations are produced from various sources such as business process, technological and human factors.

The complexity of ERP implementations creates a high risk of failure. Since implementing an ERP system is generally expensive, such a failure could mean a great financial loss for enterprises. This issue creates a real need for a method capable of predicting implementation outcome beforehand in order to avoid financial losses. Also, the method should allow a constant assessment throughout the implementation for reaching the optimal outcome.

The purpose of this paper is to study the ERP implementation phase in more details, in order to find the factors that determine the success and failure of the implementation. In particular, our main objective is to create a framework for characterizing the success of ERP implementations. The proposed framework could help in reducing the risk of ERP implementation failure and hence protect enterprises from possible financial losses.

2 CHARACTERISTICS OF AN EFFECTIVE FRAMEWORK

In order to be effective, a framework for forecasting the outcome of ERP implementations must have a number of features. In addition to being general purpose, reusable and capturing international diversity, these features include the use of quantitative measures of success and scientific forecasting methods. We elaborate these features as follows.

A **general purpose framework** is not restricted to a specific industry or a particular enterprise scale. This aspect is maintained by including Critical Success Factors (CSFs) from different literature sources in addition to identifying and testing new factors.

Ngai et al. (2008) covered a broad literature review, yet their work is limited to observation and does not result in a general purpose framework.

A **scientific forecasting method and software tool** are essential in a framework devised for the assessment of ERP implementations. A model containing numeric figures could be obtained by using a scientific forecasting method. Additionally, the software tool, which is a practical reflection of the model, would provide a simple yet clearly defined method of assessment.

Some researchers aimed towards a common framework (Magnusson et al. 2004). They generally illustrate factors such as: Change, process, technology, users, etc. Although the researchers emphasize the usage of a well defined methodology and the creation of a software tool, the paper does not provide a clear elaboration in that direction.

Quantifying the Critical Success Factors is important for assessing the risks associated with ERP implementations. The quantification will help the assessment model to be embodied within a tool capable of visualizing the implementation state.

Somers & Nelson (2001) used means to classify the importance of each CSF and its impact on a particular implementation.

Adding an **International dimension** would make the framework more comprehensive. This dimension would encompass factors related to international diversity and might vary between countries even if we are considering different branches of the same organization. This "*International*" dimension is especially important for multi-national corporations operating in multiple countries with different regulations and enterprises, which employ or conduct business with people from different cultural backgrounds.

Although different researchers based their work on implementations done in China, North America, and Europe but they did not specifically identify the factors pertaining to the international diversity within corporations. Other researchers compare implementations in different countries, yet they merely consider particular cases (Motwani et al. 2005).

Providing a **reusable outcome** should be the aim of a framework designed for forecasting ERP implementations. This reusability is characterized by a general purpose, comprehensive, and quantified model in addition to a simple enough support tool.

3 RESEARCH OVERVIEW

As illustrated in Figure 1 the procedure and outcome of this research describes how we have integrated the features presented above into our forecasting framework. The steps are numbered 1 to 6 for descriptive convenience. Additionally, the part encircled with blue is the primary research whereas that encircled with red is the reusable outcome.

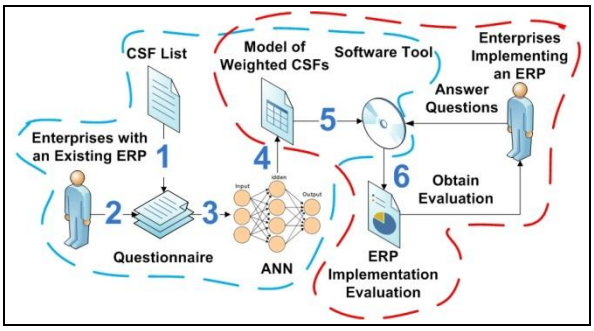

Figure 1: Research Overview

In order to ensure the generality of the famework, a comprehensive list of CSFs, including international factors, was compliled and a questionnaire was formulated (1) and filled by enterprises from multiple industries with existing ERP systems (2).

The outcome was analyzed through a statistical package using a scientific forecasting method, namely Artificial Neural Networks (ANN) (3). The analysis provided a quantified model composed of weighted CSFs (4).

Finally, to promote the model's reusability a software tool was created (5) to help enterprises wishing to implement an ERP system in evaluating their implementation by answering a minimal set of questions (6).

4 CRITICAL SUCCESS FACTORS

Initially we collected a vast number of critical success factors (CSFs) mostly based on a wide range of secondary data due to several considerations. In order to compile a comprehensive list of CSFs, which would span across multiple industries, companies, countries, and cultures, we would have to conduct dozens of case studies and field works. Since this would take years to accomplish it would be more appropriate to rely on the existing research from which we can collect secondary data. Hence we resorted to multiple resources to identify, study, and establish a comprehensive list of CSFs.

Afterwards, the CSFs are categorized to establish the foundation for our framework. Additionally, the dependent and independent variables are identified.

4.1 Identifying the CSFs

We conducted a vast and comprehensive literature review in order to identify a more comprehensive list of CSFs. Including the whole literature review would be out of the scope of this paper hence we will provide a short summary instead.

We classified the secondary sources into the following four categories (*Case Studies*, *Secondary Data*, *Surverys and Interviews*, and *Field Studies*).

Case studies conducted in particular enterprises are discussed in the following paragraphs.

Rajapakse & Seddon (2005) conducted a case study of 6 organizations. They relied on Hofstede's cultural dimensions to study the impact of adopting western ERP systems in developing Asian countries.

The preliminary results of a case study conducted in two organizations in addition to a literature review, allowed Brown & Vessey (1999) to build a basic framework based on the CSFs including: "*Top Management Support*", "*Leadership in the ERP Implementation Team*", "C*hange Management*", "*Employing Outside Consultants*", and "*Managing Complexity*".

Holland & Light (1999) relied on a case study conducted in 8 organizations. Their CSFs were classified under two categories, namely strategic (i.e., "*Legacy Systems*", "*ERP Implementation Strategy*", etc.) and tactical (i.e., "*Configuration and Customization*", "*Monitoring and Feedback*", etc.).

Secondary data such as practical implementation data or literature reviews form the basis of the following studies.

Gargeya & Brady (2005) base their research on secondary data related to 44 different implementations of the SAP ERP system. Their research identified six factors, which could indicate the success or failure of SAP implementations.

Klaus et al. (2000) relied on a literature review in order to identify their success factors, which were split into technical factors (i.e., "*Modeling Methodology, Language, and Tools*", "*Modeler Expertise*", "*Modeling Team Orientation*") and business factors (i.e., "*Managerial Approach*", "*Employee Participation in Implementation*", "T*op Management Support*").

O'Kane & Roeber (2004) rely on a case study and a survey done in one Korean organization. They studied the impact of natural culture based on other research (Davison 2002), and (Martinsons 2004).

Surveys and interviews conducted in multiple organizations were the basis of the following research works.

Tsai et al. (2005) relied on a survey conducted in multiple organizations for suggesting a list of factors that could increase the success rate of ERP implementations.

Somers & Nelson (2001) conducted a survey across 116 organizations. Their research helped in identifying the key players and activities across the ERP lifecycle that affect the success of ERP projects. The identified factors were categorized into key players (i.e., "*Top Management*", "*Implementation Committee*", "*Vendor/Customer Partnerships*", etc.) and key activities (i.e., "*Employee Training*", "*Business Process Re-engineering*", "*Change Management*", etc.).

Liang et al. (2004) conducted interviews in 5 organizations, which made unsuccessful ERP implementation attempts.

Field studies conducted on particular commercial ERP systems are the basis of the following research.

An elaboration was made on how ERP users evaluate the impact of such applications on their businesses (Keystone Strategy 2007). This field study compares two ERP systems: Microsoft Dynamics and SAP. Based on their research results we are able to deduce several factors which could impact the success of ERP implementations. These factors are: "*Usability*", "*Familiarity*", "*Transactional Efficiency*", "*Flexibility*", "*Business Insight*", and "*Collaboration*".

4.2 Dependent and Independent Variables

The variables in our research are the CSFs, which influence the outcome of ERP implementations. We have compiled a list of 63 variables, which are classified under categories, subcategories, and classes as shown in Table 2 (*Appendix*). Each variable was given a reference such as "*EPECCM01*" and a name such as "*External Consultants Dedication*". Additionally, the variables were classified as either scale or ordinal. This would simplify their usage in the software application.

Table 1 illustrates the general CSF categories, which are based on (Leon 2008) where 3 categories ("*People*", "*Process*", and "*Technology*") are used. In our classification the "*People*" category is split into "*Internal People*" (Employees, management, etc…) and "*External People*" (Vendor, external consultants, etc.). This provides a more exact identification of what affects the implementation.

Table 1: Number of CSFs Classified by Category

Category	Abbreviation	Number of CSFs
Internal People	P_{int}	19
External People	P_{ext}	12
Process	Pr	16
Technology	$Tech$	16

We define the major dependent variable, the ERP Implementation Success (S_{ERP}), as follows:

$$S_{ERP} = f(P_{\text{int}}, P_{ext}, Pr, Tech) \qquad (1)$$

In turn P_{int}, P_{ext}, Pr and $Tech$ are functions of a set of factors, which are included under each of the sub-categories.

We allow a project at the implementation phase to be a partial failure and a partial success. This provides a more accurate judgement of the ERP implementation than merely adopting two strict states failure or success.

Hence we allocated the following states for an ERP implementation:

- "*Full Success*" if $0.8 < S_{ERP} \leq 1$
- "*High Success*" if $0.6 < S_{ERP} \leq 0.8$
- "*Moderate Success*" if $0.4 < S_{ERP} \leq 0.6$
- "*Partial Failure*" if $0.2 < S_{ERP} \leq 0.4$
- "*Complete Failure*" if $0 \leq S_{ERP} \leq 0.2$

5 PRIMARY DATA COLLECTION AND ANALYSIS

After gathering the secondary data and performing a classification of the CSFs, a methodology is required for gathering the primary data. The results collected from the primary data are then compared to those collected from the secondary data in order to be more accurate in forecasting the outcome of ERP implementations.

5.1 Preparing the Questionnaire

We setup a questionnaire based on the list of CSFs we accumulated and organized. This questionnaire is composed of 65 questions and is used to collect primary data, which will allow us to compare our results to those of other researchers. The result comparison is based on the effect of each of the CSFs on the outcome of the implementation.

The prepared questionnaire incorporates a few general information questions, in addition to a question for each of the CSFs included in our framework. We based the questionnaire on a 5 point scale, which is also used by other researchers such as Somers & Nelson (2001) and could achieve accurate results without driving participants away.

The following are an example of a *scale* and an *ordinal* question from our questionnaire:

- How would you rate the overall management involvement in the ERP implementation?
  □ (Very High) □ (High) □ (Moderate) □ (Low) □ (Very Low)
- Which management style would you say was the most dominant during the implementation?
  □ (People Oriented (*Missionary, Compromiser*))
  □ (Task Oriented (*Bureaucrat, Benevolent Developer*))
  □ (People Oriented (*Developer, Executive*))
  □ (Task Oriented (*Deserter, Autocrat*)) □ (Other)

5.2 Selecting the Sample

Since our study aims at a generic approach towards ERP implementations, the selected sample was chosen to be varied in terms of company size, industry and number of ERP users. The selected industries included: *Retail*, *Banking*, *Manufacturing* (Various Products), *Healthcare*, *Food & Beverage* (Sales and Restaurants), *Books*, *Insurance*, and *Computer Hardware & Accessories*. The questionnaire was distributed for a period of two months on various enterprises allocated under the abovementioned industries. The collected primary data was combined with the secondary data in order to rank the selected CSFs.

5.3 Forecasting using ANN

Many forecasting techniques currently exist and could be used for forecasting ERP implementations. In particular, Artificial Neural Network (ANN) models were proposed by several researchers for business decision making applications such as bankruptcy, customer churning, and stock price forecasting (Palocsay 2004), and (Yang 1999).

Also, ANN was proposed as an efficient method for forecasting ERP implementations since it outperforms other techniques (*Case Based Reasoning* and *Multivariable Discriminate Analysis*) in terms of accuracy and defining the relationship between independent and dependent variables (Lim & Nam 2006).

Based on the abovementioned reasons we decided to use ANNs in this research. ANNs are composed of multiple layers, which include an input layer, a hidden layer, and an output layer. An ANN's processing element is modeled on a neuron function. The performance of an ANN depends on the levels of hidden layer numbers, hidden node numbers, learning rate, and momentum.

To configure ANN in the statistical software package "*SPSS*" we set the dependent variable to be "*ERP Implementation Success*" and the covariates to be the CSFs. The rescaling of the covariates was set to "standardized". Batch training was used to train the neural network because it directly minimizes the total error (SPSS Inc. 2007).

6 INTERPRETATION

The data collected through the questionnaire was fed into a statistical software package "*SPSS*" to rank the CSFs in terms of impact on the implementation outcome using ANN. Each CSF is allocated a weight indicating its importance as an independent variable impacting the dependent variable namely the "*ERP Implementation Success*". The summation of the weights listed in Table 2 (*Appendix*) will add up to 1 (100%), which is the total impact on the implementation.

Next, we will demonstrate the weights of each category of CSFs and attempt to interpret the results. Due to the existence of a large number of CSFs we included in the coming sub-sections an interpretation for some of the highest ranking factors.

The results are displayed on radar charts with CSFs (Table 2, *Appendix*) on the edges. The further the CSF value is from the chart's center, the more impact it has on the implementation outcome.

6.1 Categorization

The **Internal People** category includes all the CSFs related to individuals or groups working within an enterprise. Concerning the CSF weights depicted in Figure 2, we attribute the importance of the "*Management Style*" and "*Empowerment*" to the complexity of ERP implementations. Whereby if the management followed a passive style it could decrease employee empowerment and hence threaten the success of the implementation. Additionally, "*Technology Acceptance*" ranked as the CSF with the highest impact on ERP implementations. This emphasizes the importance of the international factors in such implementations.

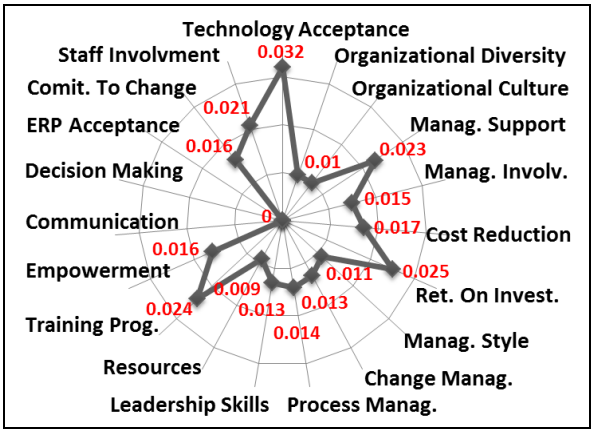

Figure 2: Internal People CSF Weights

The **External People** category includes CSFs related to people outside the enterprise such as the ERP vendor's implementation teams and external consultants. As for the weights depicted in Figure 3, we consider that "*Balanced Skills"* (among the implementation team members) was ranked as an important CSF due to the large scale and diversity of work necessary for a successful implementation.

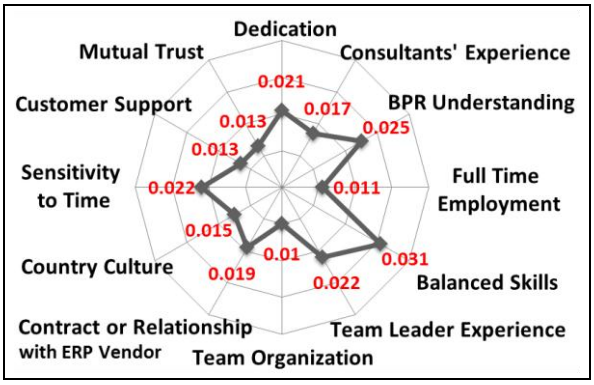

Figure 3: External People CSF Weights

The **Process** category includes the factors that are related to both the implementation and business processes adopted by the enterprise implementing the ERP system. We can notice that the factors with the highest importance are "*Customization*" and "*Troubleshooting*". We attribute that to the implementation complexity with regards to the variability in the needs of enterprises.

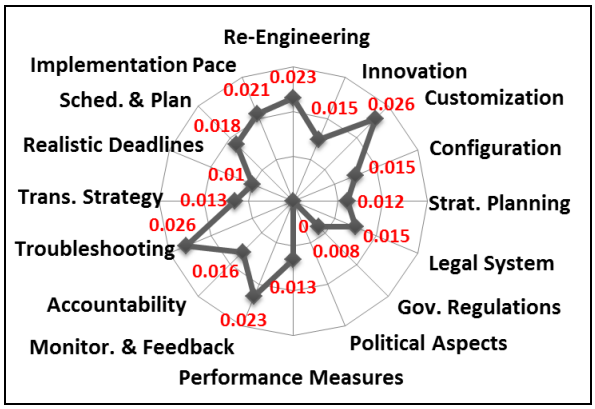

Figure 4: Process CSF Weights

The factors included under the **Technology** category are either related to the ERP system itself or to technology within the organization implementing the ERP. We can attribute the importance of "*Multi-Company*" support to the necessity of dividing businesses into several strategic business units (SBU). These SBUs would require the ERP to support multiple companies using the same data such as vendors, customers, employees, items, etc. but separating daily activities such as sales, accounting information, etc.

Additionally, the general "*Flexibility*" of the ERP system has the highest weight and affects both adoption and implementation.

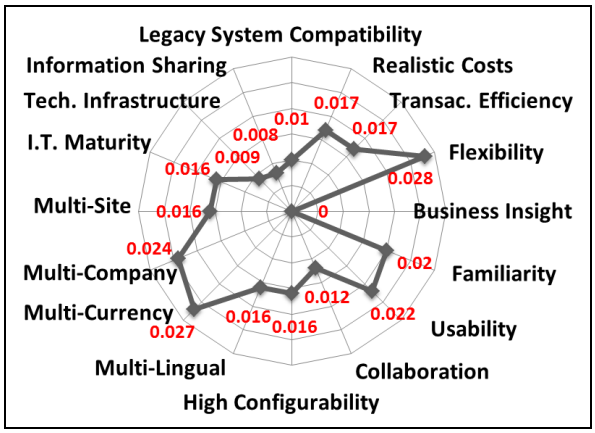

Figure 5: Technology CSF Weights

6.2 Comparative Analysis

In order to determine the accuracy of our results we have to benchmark them against those found by other researchers. Two types of benchmarking are conducted both by global category weights and by individual critical success factors.

The **CSF Global Category Weights** are illustrated in Figure 6. The results are close to those discussed by Leon (2008), whereby the "*People*" category maintains the highest impact of *51%*, whereas "*Process*" and "*Technology*" maintain a lower impact 22% and 27% respectively.

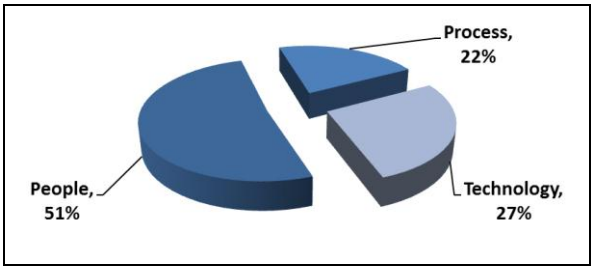

Figure 6: CSF Weights by Category

Individual Critical Success Factors were also benchmarked against the results of other researchers.

We benchmarked our top 25 CSFs against those of Somers & Nelson (2001) and found the following twelve common critical success factors:

1. External Consultants' *Experience*
2. *Cost Reduction* (Cost of running the business)
3. *Contract or Relationship* (Short term contract or long term cooperation with the vendor)
4. External Consultants' *Dedication*
5. *Team Leader Experience*
6. *Management Support*
7. Business Process *Re-Engineering* (The level of necessary business process re-engineering for the ERP to fit properly within the enterprise)
8. *Training Programs*
9. *External Consultants' BPR Understanding* (How well the external consultants understand the business process)
10. *Return on Investment* (The management's expected ROI from the implemented ERP)
11. *Customization* (The level of necessary customization for the ERP to work properly with the business at hand)
12. *Balanced Skills* between the implementation team members (Right work load distribution)

The same benchmarking was done against the results of the Standish Group (1995) and several CSFs were in common: "*Formal Schedule and Plan*", "*Management Support*", "*Staff Involvement*", "*Implementation Pace*", "*Technology Acceptance*", "*Balanced Skills*", "*Return on Investment*", etc.

Although our CSFs might not be ranked in the same position as their counterparts, yet they fall within the top 25 factors. This fact plays an important role in supporting our results' accuracy.

Also, by comparing our results to those of Plant & Willcocks (2007) one can find several common CSFs including: "*Management Support*", "*Team Leader Experience"*, "*Balanced Skills*", "*Cost Reduction*", "*Contract or Relationship*", etc.

7 MODEL AND TOOL SUPPORT

In order for our research to produce a reusable outcome, we have to codify our results into a model that can be used by users interested in the ERP implementation phase. This requires the model to be supported by the appropriate software tools.

7.1 Assessment Model

Based on our research for the assessment of the ERP implementation phase we devised a hierarchical model for depicting the categories and subcategories, which impact ERP implementations (Figure 9, *Appendix*). The purpose of this model is to provide a simplified overview of the different ERP implementation CSF categories.

Each of the categories includes a set of CSFs with a certain impact weight on the final ERP implementation outcome (Table 2, *Appendix*). Additionally, the correlation between the different CSFs is also considered (Table 3, *Appendix*).

A set of external agents (*Staff*, *Management*, *ERP Vendor*, etc.) are also illustrated with their corresponding impact on the implementation.

7.2 Software Tool Characteristics

An important characteristic of the devised software tool is the simplification of the assessment model. Initially in order to assess the weights of the different CSFs, we used a questionnaire composed out of 65 questions. Since ERP implementations could span for a period of several months, and due to the need to continuously assess the implementation state, we aimed towards minimizing the number of questions in the software tool.

The CSFs were classified into 3 categories according to the frequency by which their values change throughout the implementation (*Appendix*). This would minimize the overall number of questions.

Factors marked with a star (*) have a fixed impact hence do not continuously change with every iteration. For example factors classified under the "*Adoption*" class, in the "*Technology*" category will only be assessed when the ERP system is adopted. These factors would not require further assessment during the implementation. This is due to the fact that the major ERP system features are not likely to pass through dramatic changes in the period between the adoption phase and the implementation phase.

Factors that rarely vary are marked with two stars (**). These factors might change less frequently throughout the implementation procedure.

The remaining CSFs are not marked, indicating that their values will most likely vary continuously.

The software was written in C#, and the Windows Presentation Foundation (WPF) was used for the GUI. Additionally, SQL Server 2008 was used for managing the assessment information.

7.3 Questions Asked by Software

The devised software tool is a wizard, which allows the user to answer the necessary questions in order to interpret the current implementation state.

The wizard prompts the user to evaluate each of the factors through a user friendly interface. The user will have to perform a onetime entry for the information related to the factors with a fixed impact. The information related to the factors with a variant impact will be mandatory first and optional later. On the other hand the questions related to the remaining factors will be mandatory.

Figure 7 illustrates one screen of the wizard, in which the user can answer a series of questions. Questions that are not mandatory may be skipped or substituted by the answer from the last execution.

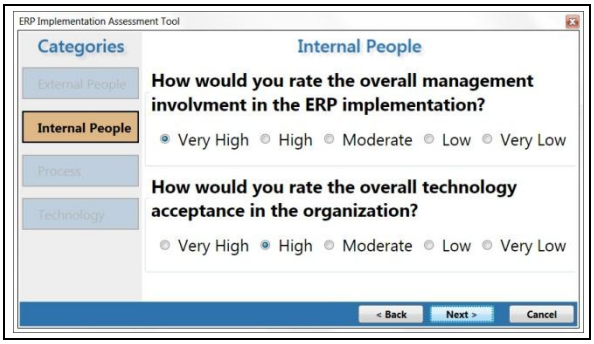

Figure 7: Assessment Tool - Question Wizard

The following are sample questions, which could be asked by the software:

- How would you rate the overall technology acceptance in the organization at the current implementation stage?

  □ (Very High) □ (High) □ (Moderate) □ (Low) □ (Very Low)
- How would you rate the speed in which the implementation team is able to configure the ERP at the current implementation stage?

  □ (Very High) □ (High) □ (Moderate) □ (Low) □ (Very Low)

By combining answers to similar questions and the CSF weights (Table 2, *Appendix*) the software is able to calculate the effect of each CSF. The user could either view detailed reports or a global state (Figure 8).

7.4 Results Provided by the Software

Upon processing the information the software will use the weights and correlations listed in the *Appendix*, in order to provide a numerical assessment of the current implementation state. The various evaluation results will be stored inside a database. The user will have the option to view the average of all the assessments conducted throughout the ERP implementation. Additionally, the user has an option to view how the state evolved throughout the entire implementation period. The software will also provide the user with key figures indicating the weaknesses of the implementation in terms of the predefined CSFs.

Figure 8 depicts a sample of the software's visualization, which helps in interpreting the ERP implementation state in a user friendly manner.

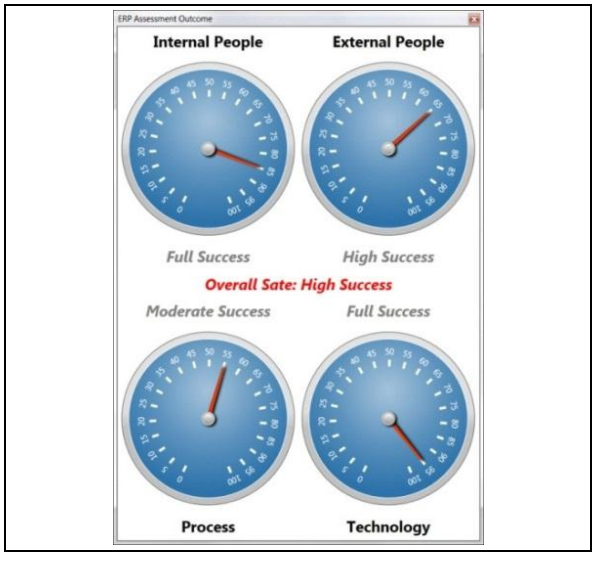

Figure 8: Assessment Tool - Result Visualization

In addition to assessing the implementation at each stage, the software will allow the user to review the historical assessment information in order to be able to monitor the state's evolution over time.

8 RECOMMENDATIONS

The following is a small subset of our list of recommendations based on both the quantitative results (Section 6 and Table 2, *Appendix*) in addition to qualitative information obtained through side discussions conducted alongside the questionnaire. These recommendations could help in minimizing the risks associated with ERP implementations.

1. **Enterprises (General)**
   - To adopt an ERP that suits the business process, and try to minimize the sacrifices related to software features
   - Adapting to the idea that ERP systems are the responsibility of everyone in the enterprise including the different levels of management and all the employees

2. **Enterprises (Multi-National)**
   - A careful evaluation of the international features (*Multicurrency*, *Multilingual*, etc.) of the adopted ERP is vital
   - Upon adopting an internationally known ERP systems check if the local reseller can live up to the reputation of the international vendor

3. **ERP Vendors (General)**
   - Helping an enterprise in accelerating and getting more business value from the ERP rather than just mere transaction management, emphasizes long term cooperation rather than short term contracts
   - To provide a sufficient number of people for supporting the enterprises' needs during and after the implementation

4. **ERP Vendors (Multi-National)**
   - Informing the international clients of the ERP's limitations for their industry and region establishes a relationship based on trust
   - Adapting an ERP to markets that would require a complete re-engineering of the system would increase the risk of failure

9 CONCLUSIONS

ERP systems have advanced significantly since their first appearance on the market and are now a major pillar in the management and optimization of modern businesses.

In this paper we have developed a model for assessing the ERP implementation phase. The model consists of critical success factors classified under logical categories and subcategories. The aim of this model is to provide a simple yet systematic technique for continuous assessment of an ERP implementation. Additionally, we have developed a supporting software tool that allows a more simplified assessment of the ERP implementation to be carried out by stakeholders interested in evaluating the success of this phase of the lifecycle.

In the future we can consider extending our model by adding a new dimension related to the co-existence of multiple ERP systems in the same company, whether due to mergers and acquisitions or to diverse business needs. Our tool could also be extended to provide more elaborate visualizations.

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APPENDIX

Table 2: Compiled List of Critical Success Factors

Reference	Name	Class	Weight
Internal People *(19 CSFs)*			
>> International *(3 CSFs)*			
IPIFC01	Technology Acceptance	**Commitment**	**0.032**
IPIFM02	*Org. Diversity	**Management**	**0.01**
IPIFM01	*Org. Culture	**Management**	**0.01**
>> Management *(8 CSFs)*			
IPMC01	**Manag. Support	**Commitment**	**0.023**
IPMC02	Manag. Involvement	**Commitment**	**0.015**
IPME02	**Cost Reduction	**Expectations**	**0.017**
IPME01	**Return On Invest.	**Expectations**	**0.025**
IPMM03	Management Style	**Management**	**0.011**
IPMM01	Change Management	**Management**	**0.013**
IPMM02	Process Management	**Management**	**0.014**
IPMM04	**Leadership Skills	**Management**	**0.013**
>> Organization *(5 CSFs)*			
IPOC03	Resources	**Commitment**	**0.009**
IPOC02	Training Programs	**Commitment**	**0.024**
IPOC01	Empowerment	**Commitment**	**0.016**
IPOM02	Communication	**Management**	-
IPOM01	Decision Making	**Management**	-
>> Staff *(3 CSFs)*			
IPSC03	ERP Acceptance	**Commitment**	-
IPSC02	Commitment to Change	**Commitment**	**0.016**
IPSC01	Staff Involvement	**Commitment**	**0.021**
External People *(12 CSFs)*			
>> External Consultants *(3 CSFs)*			
EPECCM01	**Dedication	**Commitment**	**0.021**
EPECCP02	**Experience	**Competence**	**0.017**
EPECCP01	**BPR Understanding	**Competence**	**0.025**
>> Implementation Team *(4 CSFs)*			
EPITCM01	**Full Time Empl.	**Commitment**	**0.011**
EPITCP02	**Balanced Skills	**Competence**	**0.031**
EPITCP01	**Team Leader Exp.	**Competence**	**0.022**
EPTOCU01	**Team Organization	**Culture**	**0.01**
>> International *(3 CSFs)*			
EPIFCM01	**Contract or Rel.	**Commitment**	**0.019**
EPIFCU01	*Country Culture	**Culture**	**0.015**
EPIFCU02	**Sensitivity to Time	**Culture**	**0.022**
>> Vendor *(2 CSFs)*			
EPVECM01	**Customer Support	**Commitment**	**0.013**
EPVECM02	**Mutual Trust	**Commitment**	**0.013**
Process *(16 CSFs)*			
>> Business Process *(4 CSFs)*			
PRBP04	*Re-Engineering	**Adoption**	**0.023**
PRBP01	*Innovation	**Adoption**	**0.015**
PRBP03	Customization	**Adaptation**	**0.026**
PRBP02	Configuration	**Adaptation**	**0.015**
>> International *(4 CSFs)*			
PRIF01	**Strategic Planning	**External**	**0.012**
PRIF02	**Legal System	**External**	**0.015**
PRIF03	**Gov. Regulations	**External**	**0.008**
PRIF04	**Political Aspects	**External**	-
>> Quality Control *(4 CSFs)*			
PRQC04	Performance Measures	**QC**	**0.013**
PRQC01	Monit. and Feedback	**QC**	**0.023**
PRQC03	Accountability	**QC**	**0.016**
PRQC02	Troubleshooting	**QC**	**0.026**
>> Transition *(4 CSFs)*			
PRTR01	*Transition Strategy	**Transition**	**0.013**
PRTR03	**Realistic Deadlines	**Schedule**	**0.01**
PRTR04	* Schedule and Plan	**Schedule**	**0.018**
PRTR02	* Implement. Pace	**Schedule**	**0.021**
Technology *(16 CSFs)*			
>> ERP System Aspects *(2 CSFs)*			
TGESAA01	*Legacy Sys. Comp.	**Adoption**	**0.01**
TGESAA02	*Realistic Costs	**Adoption**	**0.017**
>> ERP System Productivity *(6 CSFs)*			
TGESPA03	*Transac. Efficiency	**Adoption**	**0.017**
TGESPA04	*Flexibility	**Adoption**	**0.028**
TGESPA05	*Business Insight	**Adoption**	-
TGESPA02	*Familiarity	**Adoption**	**0.02**
TGESPA01	*Usability	**Adoption**	**0.022**
TGESPA06	*Collaboration	**Adoption**	**0.012**
>> International *(5 CSFs)*			
TGIFA05	*High Configurability	**Adoption**	**0.016**
TGIFA01	*Multilingual	**Adoption**	**0.016**
TGIFA02	*Multi-Currency	**Adoption**	**0.027**
TGIFA03	*Multi-Company	**Adoption**	**0.024**
TGIFA04	*Multi-Site	**Adoption**	**0.016**
>> Organization I.T. *(3 CSFs)*			
TGOITI01	*I.T. Maturity	**Implementation**	**0.016**
TGOITI02	*Tech. Infrastruct.	**Implementation**	**0.009**
TGOITI03	* Info. Sharing	**Implementation**	**0.008**

Legend: Scale Ordinal * One Time Input ** Rarely Changes

Table 3: Top 10 Correlated Critical Success Factors

CSF 1	CSF 2	Correlation
IPMC01	IPMC02	0.832
IPMM01	PRQC04	0.836
IPMM01	PRQC03	0.817
IPME01	PRQC01	0.742
IPME02	EPITCP01	0.722
IPOC01	PRBP01	0.746
IPSC02	IPIFC01	0.768
IPIFM02	EPVECM01	-0.803
EPECCM01	EPECCP01	0.949
EPECCM01	EPECCP02	0.959

The **questionnaire** could be accessed from the following URL (a generic hosting service was used for the purpose of the double-blind review):

http://bit.ly/ERP_Implementation_Questionnaire

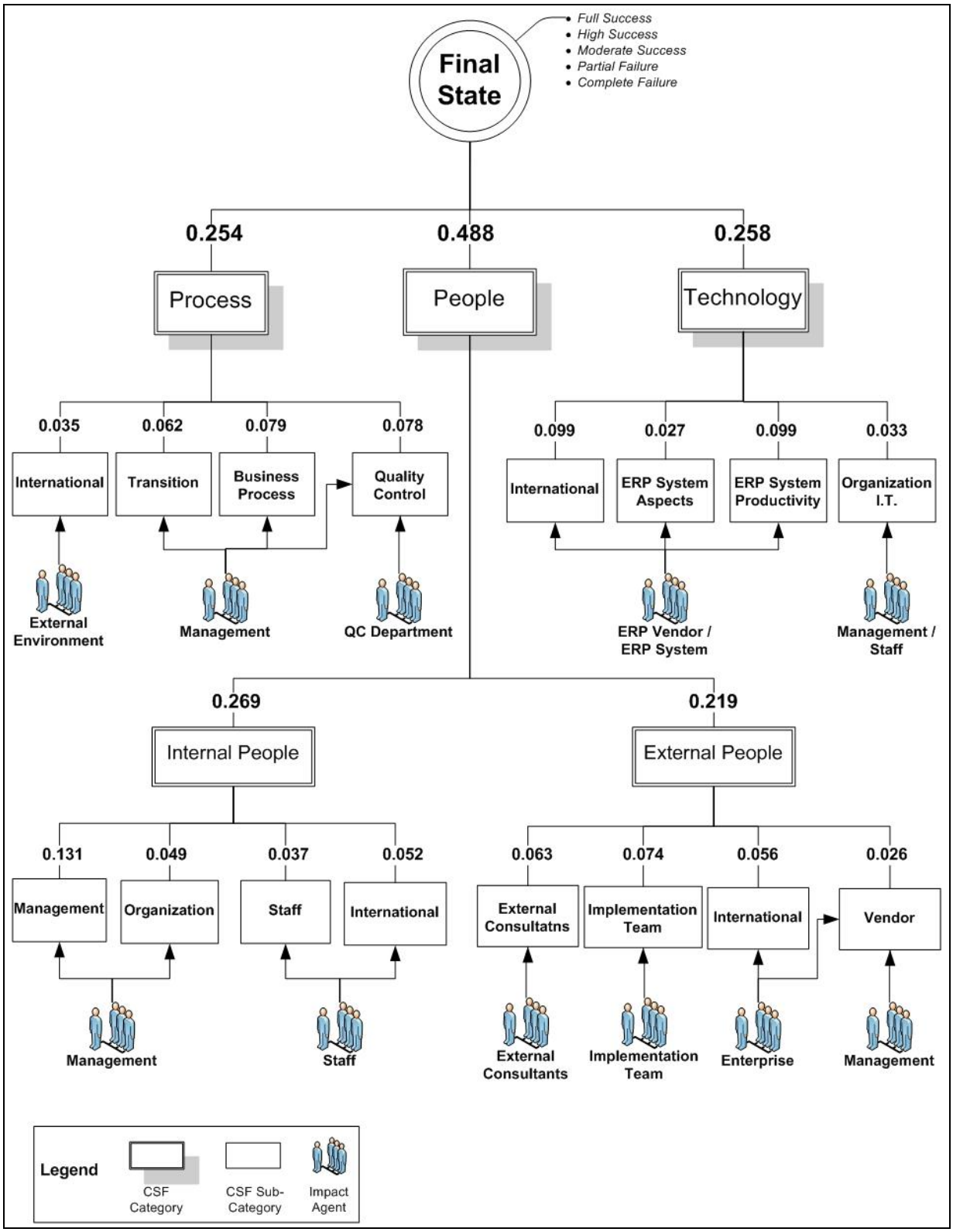

Figure 9: Implementation Assessment Model