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Framework for the Estimation of Delays in Enterprise Resource Planning System Implementation

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Abstract: The difficulties and high failure rate in implementing the Enterprise Resource Planning (ERP) System have been widely cited in the IT literature. The effort and money involved in the ERP implementation is huge, most of the time the investor realizes in the middle of the project that the decision to go in for ERP is not appropriate but it is a tricky situation and difficult to come out. The main focus of this research is to contribute to the business community for an assessment of the situation before embarking themselves on the ERP implementation project. It attempts to develop a framework for estimation of implementation delays and time frame of the implementation before start of the project. The framework is validated through a descriptive study attempted in 52 companies selected through multistage random sampling and analysed using software like SPSS. The study will help to exhibit readiness of the organisation for the change process of ERP implementation so that the organisations can minimize risk and save time and efforts required for the implementation.

Key words: ERP, implementation, assessment, prediction, embarking

INTRODUCTION

Enterprise Resource Planning (ERP) Systems help in managing the whole operation throughout the business network efficiently. Those who implemented the ERP systems are reaping the benefits of having integrated working environment, standardised business processes and achieved optimum operational efficiency. There are technical, operational and business reasons for the acquisition of ERP by the business which is listed in Table 1.

Not all ERP implementations are successful (Bhawarkar and Dhamande, 2012). It is distressingly common to see >60% of the implementations exceed timelines and budget (Panorama Consulting, 2013). There are many reasons to quote for this failure and every implementation face challenges as:

- Integration problems
- Technological complexity
- Staff turnover
- Organizational change
- Product quality and vendor unreliability
- Lack of proper ERP management
- Cost of technology
- Dynamic nature of the business

However, there are factors common to the success or failure of ERP implementations regardless of the ERP systems they implement and the methodologies they use. Hence, most of the earlier researches on ERP implementation focused on deriving Critical Success Factors (CSFs) for implementation. Though there are many CSFs available from earlier studies, still there is a need for a study on ERP implementation is required because of following arguments: first, despite the promises and the continued popularity of ERP systems, evidence is accumulating to demonstrate that obtaining benefits from an ERP is not as straightforward as those selling and promoting such systems would like us to believe (Boersma and Kingma, 2005).

Second, although a number of challenges of ERP systems adoption and use have been identified, they are mainly experiences of companies in the developed countries. There is very limited empirical research on ERP implementation focused on developing countries.

Third, it is arguable that most ERP implementation frameworks and models reported in IS journals are based on ERP studies carried out in developed countries like United States of America, European countries and Australia. The political, social and economic uniqueness that India and other developing countries presents could provide researchers with fertile ground for fresh

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Table 1: Technological, operational and business reasons for the acquisition of ERP

Technological reasons	Operational reasons	Business reasons
Desire to replace ageing IT infrastructure	Data visibility and integration	To facilitate globalization
Desire to outsource software maintenance and development	Improvement in managerial accounting and reporting	To facilitate merger/acquisition
Standardisation in technology used	To implement cost control and work flow automation	To adapt best practices available in built-in ERP
Resolution of year 2000 problem	Improve customer service and new product development	To facilitate the implementation of BPR
Long term IT cost reduction	Unified reporting and increase reliability of information	To increase flexibility and agility in doing business
Need for adapting clean state approach for improved software system	Improve managerial decision making and operational efficiency	Pressure from value chain and need for electronic networking and collaboration

extensions of existing theoretical paradigms and sometimes development of entirely new and different research frameworks.

Lastly, there is a need to support business community to take a decision on ERP investment before starting the project. As explained earlier the failure rate of implementation is >50% and approximately, 90% of the implementations are late or over budget. Implementing these projects demand more organisations time and effort. Most of the investors burn their fingers after entering into this exercise. Hence, there is a need for further research on this area. These ERP projects exceed budgets and timeline expectations due to many factors including:

- Not devoting knowledgeable resources to the project
- Leadership that carried over by vendor sales pitch at the time of selection
- Leadership teams that fail to anticipate the magnitude of change management
- The project team which focused mainly on the technical aspects of the system at the time of training than the new processes and user orientation
- The knowledge gaps between various groups involved in the project like vendor, consultants, internal experts and end-users

Most of the above points are focusing on people involved in the project. ERP failure is accounted more with the people related issues than process and technology related issues (Leon, 2008). Hence, the research attempts to answer the following research question:

- How much delay is contributed by key players associated with the ERP projects?
- How can we predict the time frame of the implementation before starting the project?
- Can we create a benchmark based on key player's involvement for a more accurate forecasting model of the ERP system operation of a company?

Very few studies on people involvement cover the comprehensive list of people involved in the projects, generally, it takes into account top management, user, vendor, project team and consultants. In fact there are three groups of people involved in these projects. User group, internal support group and external support group.

ERP implementation is a change-process; it is the process of making 'business transformation. There are number of barriers that can slow down the progress of this change process or even stop it altogether. One of the barriers that is most difficult to overcome centers on the attitude and behavior of the people who are affected by the change. Change management is a very important activity in the ERP implementation process. The user group is the one of the influencing groups which will be affected more in the ERP implementation change management process. There are three types of users viz.: transaction-users, knowledge-power-users and positional-power-users.

The attitude and behavior of these users depend on the power they are authorized and their perception on the effect of change on them. Power is the ability to control all types of resources such as information, people, expertise, assets, etc. Power does not rest with position alone. There is positional-power and knowledge-power. The positional-power comes from official authority while the knowledge-power is accrued over a period of time by an individual through the acquirement of critical knowledge related to organizational product and processes. As ERP focus on process integrations, this knowledge-power-user plays a dominant role in the implementation stages such as business analysis; 'to be' process design, conference room pilot testing, data migration and post implementation. The transaction-users are those who handle data entry or using the system for day to day transactions. The expectation from these three users from the ERP system is different and the amount of stake in the ERP success by each user type also different.

Esteves *et al.* (2003) says that the lack of efficient interaction between the involved knowledge owners may lead to the failure of ERP implementation. Metaxiotis and Ergazakis (2010) say that the ERP implementation is

so knowledge intensive that the fate of the whole project is in the hands of a group of knowledgeable employees within the organisation and the success of the project relies heavily upon the effective management of knowledge into, within and out of this team during ERP life cycle. Above studies confirm the importance of knowledge owners but there is a significant shortage of empirical research on this aspect. Hence, there is a need to conduct an empirical research in this area.

There are multiple studies (Somers and Nelson, 2004; Chetcuti, 2008; Chung *et al*., 2009; Kronbichler *et al*., 2010) which focused in developing ERP implementation-models. These studies outlined comprehensive list of people involved in the project, it takes into account top management, user, vendor, project team and consultants. These knowledge owners were not considered in any of these studies.

Hence, the objective of the study is to develop a framework for estimation of implementation delays and time frame of the implementation taking into account only the key players involvement in the project.

MATERIALS AND METHODS

The study follows three phase approach as shown in Fig. 1 to answer the research questions, first, it develops a conceptual ERP Success Model based on an earlier studies, second, it conducts a pilot study to develop a framework for estimating delays based on the conceptual model and finally it validate these framework with more samples.

As explained in the previous section, there are seven types of people involved in the ERP implementation process as shown in Table 2. Hence, the statement of research work includes:

- Derive the overall contribution of each people related success factors as per the implementation methodology commonly followed
- Identify the attributes of each people related success factors which contribute to the success indicator 'project-success'
- Develop a framework for estimation of delays and implementation time frame and validate with case studies
- Develop a prediction model for success using people related success factors based on discriminant analysis

Table 2: Seven type of people involved in ERP implementation

User groups	Internal support group	External support group
Positional power user	Top management	Vendor
Knowledge power user	Project team (including project manager and IT team)	Consultant
Transaction users		

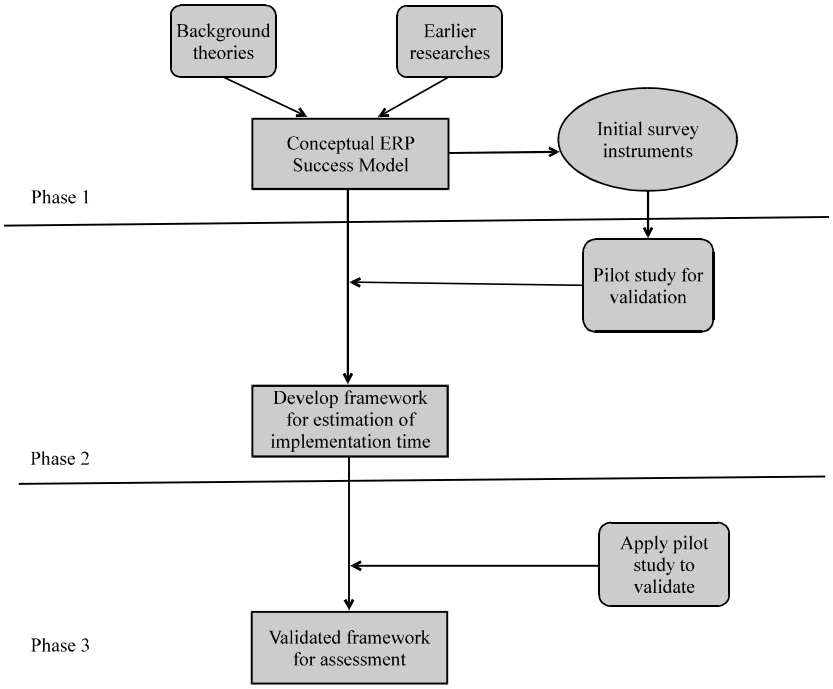

Fig. 1: Research approach

Table 3: ERP implementation models and success measurements

Models	Tested in practice	No. of measures	Measures
Technology Acceptance Model (TAM) (1989)	Yes	5	Image, job relevance, output quality, result demonstrability, subjective norm which includes willingness and experience
DeLone and McLean Model (D&M) (1992/2003)	Yes	6	System quality, information quality, use, user satisfaction, individual impact and organizational impact
The Gable (2003) Model	Yes	5	Individual impact, organizational impact, information quality, system quality and satisfaction
The extended ERP Systems Success Measurement Model by Ifinedo (2006)	Yes	7	Above five plus additional two measures: Vendor/Consultant quality; Workgroup impact
Markus and Tanis (2000) Model	No	4 phases	Defined success based on their observations at planning phase, Implementation phase, Stabilizing phase and Maintenance phase
Ex-ante Evaluation Model by Stefanou (2001)	Yes	5	Clarification of business vision, comparing needs vs. capabilities, selection of needed software, Ex-ante Model costs and benefit estimation for implementation for operation, maintenance and evolution
ERP Balance scorecard by Rosemann and Wiese (1999)	No	4	Financial perspective, internal process perspective, customer perspective, innovation and learning perspective
TTF ERP Success Model from Smyth (2001)	No	6	Task, technology, user, perceived usefulness and aggregate organizational benefit, user satisfaction
Chung *et al.* (2009) Model	Yes	4	Intentions to use/use, project progress, quality and ERP benefits

Research design is descriptive study. Method is questionnaire method. Administration is personal interview and collected response for each question. Study population is SMEs implemented Tier-1 ERPs in Chennai, India (Tier-1 ERPs are SAP, Oracle E-business suite, JDEdwards Enterprise one, etc.). Sample size is 52 sampling method is Multistage Random sampling first stage, Tier-1 ERP implemented sites in Chennai, India were selected, second stage, manufacturing and service sectors were chosen, third stage 5 industries in manufacturing sector and 3 industries in service sectors were chosen. In the fourth stage 85% of the sampling units from manufacturing sector and 15% of sampling units from service sectors were chosen using simple random sampling, in the manufacturing, >1 fourth (27%) of sampling units from Automobile industry and same percentage in FMCG, Electronics 14%, Pharma 10%, Chemicals 7% were chosen. In the service sector 15% chosen from construction, IT, education and equipment services industries.

Questionnaire reliability: Reliability analysis was carried out on the 80 questions related to the attributes of seven people related factors; the alpha value exceeds 0.8 in all the seven factors (vendor related 0.897, top management related 0.849, positional power user 0.916, knowledge power related 0.889, project team related 0.915, transaction user related 0.900, consultants related 0.814).

ERP implementation models and measures: Since, ERP systems integrate various business processes, previous research on user acceptance models for IS can be a starting point to understand the success of ERP systems adaptation. In this study, some models for success measurement are listed and explained. Table 3 shows nine success measurement models.

The success of ERP system can be classified into two categories: the success of ERP adoption and the success of ERP System implementation. For the successful ERP adoption, it used already proven user acceptance models for IS such as TAM and D&M Models as the starting point. TAM (Technology Acceptance Model), Davis (1989) provides basis for tracing the impact of external variables on internal beliefs, attitude and intentions. All the relation among the elements of TAM has been validated through many empirical studies.

Most cited for success measurement in the IS field is the D&M Model, DeLone and McLean (1992) which adopt user centered approach to judge success, it assumes system quality and information quality derives use and user satisfaction which will impact individual performance and that will lead to organizational impact. This model was tested in different use cases like in Taiwanese high-tech industries (2007). The model was initially published in 1992 and reformulated in 2003 with the new construct 'Net benefits' collapsing earlier measures individual impact and organizational impact. The new measure includes financials like cost savings, additional market, etc. (Table 4).

The Gable *et al.* (2003) Model consists of four main dimensions as four quadrants which lead to the fifth dimension the 'satisfaction'. The model can be used for measures at a certain point of time, a snapshot of the organization's experience. The impact dimensions are an assessment of benefits which are caused by the system (in a negative or positive way). The quality dimensions of

Table 4: Attributes for each success factor

Success factors	Attributes
Transaction user	Output quality, job relevance, image, result demonstrability, system reliability and willingness to learn/change
Knowledge power user	Output quality, job relevance, image, result demonstrability, system reliability, willingness to involve in design, testing, training, data migration and post implementation, act as spokes person
Positional power user	Output quality, job relevance, image, result demonstrability, system reliability, willingness to involve in design, training and monitoring, act as spokes person, giving priority, assigning key resources, support project team, interdepartmental co-operation and communication
Top management	Priority, personal involvement, assigning key resources, funds, empowering project team, motivating the project team
Project team	Dedication, image, result demonstrability, job relevance, commitment to achieve, act as spokes person
Vendor	Transparency in product capability, resource capability, project management, past performance, scope, project time frame and understanding the customer requirement. Commitment, partnership, tools availability, post implementation support
Consultant	Quality of output, customization, training, documentation, knowledge sharing, willingness to reach out for help

the model show the future potential. Together, the four dimensions reflect a complete view of the enterprise system and success reached.

The extended ERP System success measurement model, Ifinedo (2006), differs from Gable Model by two additional measures vendor/consultant quality and workgroup impact. It has nearly the same area of application as Gable Model but it provides a framework that allows collecting more comprehensive data influencing the ERP systems success.

Markus and Tanis (2000) model provides a theoretical framework for analyzing retrospectively and prospectively, the business value of enterprise systems. At each phase, it generates a data of successful outcome, necessary conditions, probabilistic processes and a recipe for success which will help to take actions if a result is not good as expected and to get better results in the next phase because every outcome of a phase influence the next phase.

Stefanou (2001)'s ex-ante Evaluation Model is different from other models, it is meant for selection process. It shows how companies can evaluate a planned implementation project ex-ante. This framework provides an instrument to evaluate the future outcome also guides the evaluator through all the important stages which must be considered when evaluating ERP systems.

The intention of Balanced Score Card (BSC) (Rosemann and Wiese, 1999) is the supplementation of traditional financial measures with three additional perspectives customer, internal business process and learning and growth perspectives. In the ERP operation BSC of Rosemann and Wiese, four standard perspective of the original model have to be adjusted to the specific object of an ERP System (Table 5):

- Financial/cost: what is the financial input necessary for achieving the targeted performance level?
- Internal: are the internal process effective and efficient in assuring a level of performance determined by the customer perspective?
- Customer: what benefits derives the company from a certain level performance?
- Innovation and learning: does the ERP system have enough potential for possible future customer needs?

The TTF ERP Success Model, Smyth (2001) describes the match between functionality provided by the ERP package, the tasks undertaken by the users of the package and the skills and attitudes of the individual users. In this model, poor TTF would contribute to a low level of user satisfaction and both leads to ERP failure. Perceived usefulness is influenced by organizational factors and that's influencing the user satisfaction in a direct and an indirect way.

In Boo Young Chung Model, Chung *et al.* (2009) developed for construction industry. It adapts TAM and D&M Model and integrate those with key project management principles. The success indicator ERP benefit includes user satisfaction, individual impact and organizational impact measures of D&M Model. The measure 'project progress' includes questions about project completion on time and within budget while 'quality' has questions related to system quality and the scope matched with the company's needs.

Development of conceptual ERP Implementation Success Model

Reference Model: All the nine models have specific strength and weaknesses. Some of the models are ERP specific, others on IS in general and may need adoption when used for ERP success measurement. Most models considers user's point of view. Each stakeholder has a specific expectation of the outcome of the success measurement. A comparison of ERP success measurement approaches by Kronbichler *et al.* (2010) classified stakeholders and three important dimensions for model selection that consolidates most of the measurements used by the above models: process improvements, future needs and financials.

The present research moderates the above classification to study the stakeholder involvement to

Table 5: Contribution table

Activity	Implement norm days	VE	TM	PU	KU	PT	TU	CO
Implementation phase								
Projects kick off and core team mob.	7	-	7.00	7.00	-	-	-	-
Ordering HW/SW	0 (14 days parallel)	14.0	14.00	-	-	-	-	-
Core team training	28	7.0	-	7.00	-	28.00	-	28.00
AS IS study	28	28.0	-	28.00	28.00	28.00	-	28.00
Hardware software installation	0 (20 days parallel)	20.0	-	-	-	7.00	-	-
To be process	28	28.0	-	28.00	28.00	28.00	-	28.00
Gap analysis sign off	7	7.0	-	7.00	7.00	7.00	-	7.00
Data collection templates	2	-	-	-	2.00	2.00	-	2.00
Configuration	35	-	-	-	-	-	-	35.00
Conference room pilot sign off	14	-	1.00	7.00	14.00	14.00	7.00	14.00
Customization	28	7.0	-	-	-	-	-	28.00
Sample data upload	7	-	-	-	7.00	7.00	-	7.00
User Acceptance test sign off	14	-	-	14.00	7.00	14.00	14.00	14.00
Final data upload	0 (7 days parallel)	-	-	-	7.00	7.00	-	7.00
User training	28	-	-	7.00	28.00	28.00	28.00	-
Security profile	0 (7 days parallel)	7.0	-	-	7.00	7.00	-	7.00
Readiness assessment	2	-	-	2.00	2.00	2.00	-	-
Go live	1 (8)	-	1.00	1.00	1.00	1.00	-	1.00
Post go-live phase								
Transactions update in the new system	28	7.0	7.00	7.00	28.00	28.00	28.00	7.00
Reports from new system	14	2.0	-	7.00	14.00	14.00	14.00	14.00
Reconciliation with legacy system	15	2.0	-	2.00	15.00	15.00	15.00	15.00
Normal operation and legacy system switch off	21	-	7.00	14.00	28.00	28.00	28.00	-
Financials from new	28	-	-	-	28.00	28.00	-	-
MIS from new system	28	-	-	-	28.00	28.00	-	-
User maintenance sign off	2	-	-	-	-	2.00	2.00	-
Project sign off	1 (4)	1.0	1.00	-	-	-	-	-
	366	130.0	38.00	138.00	279.00	323.00	136.00	242.00
Weightage		0.1	0.03	0.11	0.22	0.24	0.11	0.19

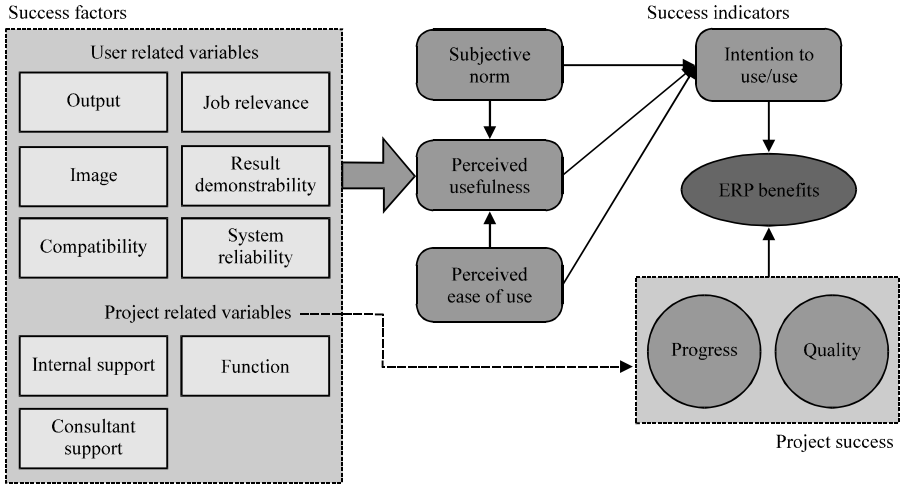

Fig. 2: Reference ERP Success Model (Chung *et al*., 2009)

make ERP project success. The proposed study extends ERP Success Model developed by Chung *et al.* (2009) for construction industries as reference model as well as the success measurements study by Stephen *et al.* (2010).

The success of ERP System can be classified into two categories: the success of ERP adoption and the success of ERP System implementation. For the successful ERP adoption, the reference model shown in Fig. 2, used already proven user acceptance models for IS such as TAM and D&M IS Success Model. The model developed the rationale for the causal relationship based on the combined theoretical backgrounds and incorporated three main dimensions for identifying the truth about the success of ERP systems: success factors, intermediate constructs and success indicators.

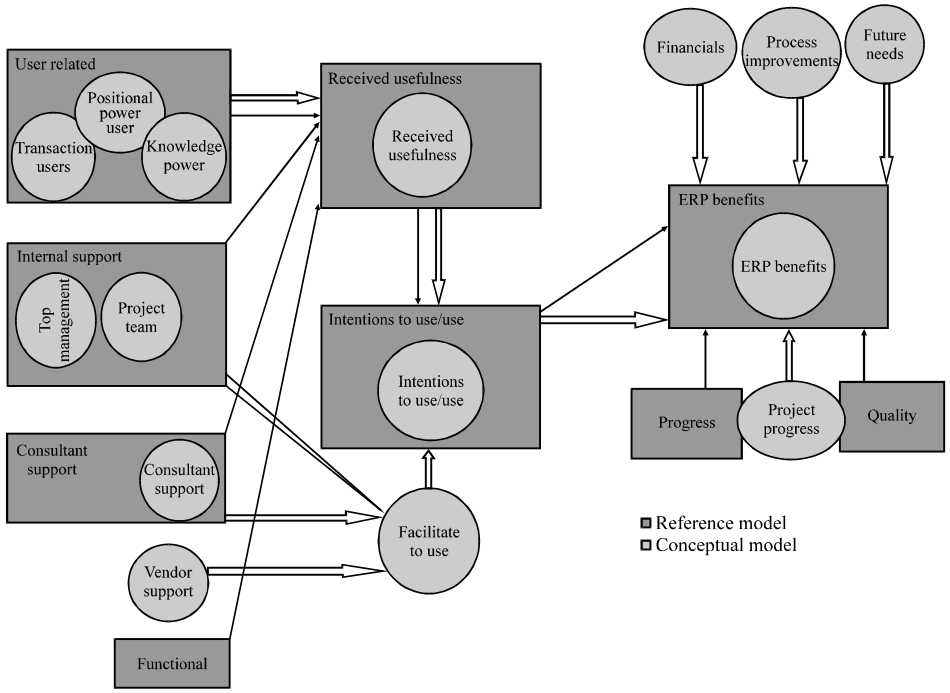

Fig. 3: Conceptual ERP Success Model

The success factors suggested by Chung *et al.* (2009) are used in the proposed model because they were already validated by previous research. This success factors directly affect the perceived usefulness and finally lead to ERP success or failure. For example, the user related attributes directly affecting the perceived usefulness are output quality, job relevance, image, result demonstrability, compatibility and system reliability.

Proposed Model: The Reference Model success factors are broadly grouped into three stakeholder groups. Users, internal groups and external groups which is similar to the classification of stakeholder group by Kronbichler *et al.* (2010).

Figure 3 shows the proposed model, referred to as conceptual ERP Success Model. This model combines the result of both the study Chung *et al.* (2009) and Kronbichler *et al.* (2010) referred above but primarily concentrates on the study by Chung *et al.* (2009) and expands the stake-holder group used by that study (Table 6).

This conceptual model includes four success indicators, the three dimensions of success measurements (financial gain, taken care of future needs and process improvements) proposed by Kronbichler *et al.* (2010) and one more measures by Chung *et al.* (2009) called project-success. Also each success factors is related with certain attributes which are listed in Table 7 that directly influence the 'perceived usefulness' or 'facilitate to use' which finally affect the 'intentions to use/use' as a result 'net benefits' will occur in this conceptual success model.

Table 6: Summary of contribution table

Behavior parameters	Contribution (PC) (%)
Vendor related (VE)	10
Top Management related (TM)	3
Positional Power user related (PP)	11
Knowledge Power user related (KP)	22
Project Team related (PT)	24
Transaction User related (TU)	11
Consultant related (CO)	19

RESULTS

With reference to the problem focused, objective set and the tools applied, the result of the various statistical analytical tools are presented in study.

Derive the overall contribution of each people related success factors as per the implementation methodology commonly followed: all ERP implementation goes through following three phases. Success or failure depends on the activities carried out at each of these phases:

- Selection phase, where requirement finalization, package and vendor selection takes place

Table 7: Factor analysis

People related success factors	KMO values	p-values	Factors extracted	Cum. variance (%)	Factors (attributes that characterize the people related success factors)
Vendor	0.765	0.001	3	61.540	Transparency during sales, implementation capability and commitment
Top management	0.803	0.001	3	68.124	Project team empowerment, funding and priority
Positional power	0.819	0.001	4	70.893	Conviction on ERP, involvement, image and technical infrastructure
Knowledge power	0.837	0.001	2	64.689	Involvement and conviction on ERP
Project team	0.893	0.001	2	67.208	Dedication and conviction on ERP
Transaction user	0.838	0.001	2	64.020	Conviction on ERP and image
Consultant	0.766	0.001	3	66.744	Willingness to support, quality delivery and customer focus

- Implementation phase where the activities like Business analysis, set up/configuration, conference room pilot. Customization, production set up, data migration, security profile, readiness assessment, go live takes place
- Post implementation phase where activities like report generations, monthly/yearly closing, refinement takes place

Time frame for the ERP implementation varies for different type of implementation as well as number of modules implemented. Following are the standard implementation time frame (ST) of different type of implementation (excluding selection phase) based on the experience of the first researcher:

- Green Filed site (GF): 8 months
- Roll Out implementation (RO): 10 months
- New implementations for existing company (NEW): 12 months
- Pilot implementation for a group company (PILOT): 15 months

Based on the standard norms advocated by different ERP vendors for the implementation of existing single company, effective percentage of contribution by the seven people related factors discussed earlier was arrived at and shown in Table 5 and summarized in Table 6. These data indicates that contribution of internal players are 71% and external players are 29%.

Identification of the attributes of each people related success factors which contribute to the success indicator 'project-success': Factor analysis carried out using SPSS, 63 variables in seven people related factors were reduced to 19 factors. KMO is calculated using correlation and partial correlation to test whether the variables in our sample are adequate to correlate. A general rule of thumb is that KMO value should >0.5 for all the people related factor analysis to proceed by observing the above results from Table 7 KMO value meets this condition; therefore, we can proceed with factor analysis. Bartlett's test of sphericity is to find out the relationship between the variables. A $p<0.05$ indicates that it makes sense to continue with the factor analysis, it is found that $p<0.001$ in all cases, therefore, it is concluded that there are relationships between our variables.

Table 8: 'X' and 'C' values

Score (S)	X	C
S>5	10-S	20
S<5	6-S	100

Develop a framework for estimation of delays and implementation time frame and validate with case studies: Estimation of time frame is arrived using the standard implementation time frame of different type of implementations and the delay contributed by each people related factors. Estimated Time (T) = Standard Time (ST)+Standard Time (ST)×Total Delay % (TD).

Total Delay % (TD) = Delay due to people related factors 1 (D1)+Delay due to people related parameter 2 (D2) +...+ Delay due to people related parameter 7 (D7). Whereas delay due to people related parameters (D) = people related contribution (PC)×Percentage delay (Y):

$$D1 = PC1 \times Y1$$

$$D2 = PC2 \times Y2$$

Percentage delay (Y) = X×C which depends on the Score (S) obtained through survey/interview on each people related parameters for every case studied.

If the Score (S) for a people related factor is <5, it contributes more delay (score 5 means 100% delay, 4 means 200% delay, 3 means 300% delay, 2 means 400% delay and 1 means 500% delay). If the Score (S) for a people related factor is >5, it contributes less delay (score 6 means 80% delay, 7 means 60% delay, 8 means 40% delay, 9 means 20% delay and 10 means 0% delay). Above logic is evolved in mathematical form through 'X' and 'C' values shown in Table 8. Hence:

$$T = ST + ST \times \left(\sum_{n=1}^{n=7} (PC_n \times X_n \times C_n)/100\right)10$$

$$\text{Predicted time} = \text{Standard time} + \text{Standard time} \times \text{Cumulative delays contributed by all people related factors}$$

Table 9: Prediction of implementation time frame-pilot study cases

Cases	Actual (months)	Prediction (months)	Time variation (%)
1	12	11.68	3
2	15	17.00	-13
3	14	16.00	-14
4	15	17.00	-14
5	Stopped	67.00	-
6	60	62.00	-3
7	36	34.00	5
8	34	39.00	-17
9	33	28.00	15
10	13	14.00	-7
11	20	18.00	10
12	29	25.00	14

Table 10: Implementation time prediction variance in 40 cases

Cases	Estimate	Actual	Variance	Case	Estimate	Actual	Variance
1	22	20	-10	21	23	22	-5
2	14	13	-7	22	18	22	18
3	30	35	14	23	28	33	15
4	22	30	27	24	22	24	8
5	33	37	11	25	25	29	14
6	33	37	11	26	25	28	11
7	25	33	-9	27	24	31	23
8	20	26	23	28	22	29	24
9	33	34	-3	29	23	24	4
10	31	35	11	30	25	31	19
11	27	35	23	31	22	29	24
12	22	24	8	32	22	28	21
13	24	29	17	33	34	35	3
14	21	19	-11	34	20	24	17
15	19	19	0	35	19	17	-12
16	20	24	17	36	20	26	23
17	23	20	-15	37	25	31	19
18	21	21	0	38	24	32	25
19	22	28	21	39	54	46	-17
20	26	30	13	40	58	51	-14

Framework for estimation of delays and implementation time was developed and validated through Pilot study conducted with 12 cases (eight success and four failure). The estimation of time frame (prediction) is shown in Table 9. Accuracy of prediction is in the range of 83-97% as shown in study.

The model was extended to additional forty ERP implementations at Chennai. The frame work was applied to all the forty cases and the time variance summary is shown in Table 10. The variance in this 40 cases are in the range of -17 to +25%. Time unit is in months:

$$\text{Time variance} = \frac{\text{Actual time-Estimated time}}{\text{Actual time}} \times 100$$

Prediction of project-success using discriminant analysis: Table 11 provides information on each of the discriminate functions (equations) produced. The maximum number of discriminant functions produced is the number of groups minus 1. We are only using two groups here, namely 'success' and 'failure', so only one function is displayed.

The canonical correlation is the multiple correlations between the predictors and the discriminant function. With only one function it provides an index of overall model fit which is interpreted as being the proportion of variance explained (R^2). a canonical correlation of 0.640 suggests the model explains 99.36% of the variation in the grouping variable. Wilks' λ indicates the significance of the discriminant function. It indicates highly significant function and provides the proportion of total variability not explained.

The interpretation of the discriminant coefficients (or weights) is like that in multiple regressions. It is an index of the importance of each predictor. The sign indicates the direction of the relationship. Project team and knowledge-power related attributes are the strongest predictors. Top management attributes is a less successful predictor. These un-standardized coefficients (b) are used to create the discriminant function (equation). It operates just like a regression equation:

$$\begin{aligned} D = {} & (0.026\times\text{Vendor}) + (0.001\times\text{Top Mgt}) + \\ & (0.122\times\text{Positional-power}) + (0.174\times\text{Knowledge-power}) + \\ & (0.206\times\text{Project team}) + (0.042\times\text{Transaction user}) + \\ & (0.002\times\text{Consultant related}) - 6.171 \end{aligned}$$

The discriminant function coefficients b or standardized form beta both indicate the partial contribution of each variable to the discriminate function controlling for all other variables in the equation. They can be used to assess each variable's unique contribution to the discriminate function and therefore, provide information on the relative importance of each variable.

The structure matrix in Table 12 shows the correlations of each variable with each discriminate function. These Pearson coefficients are structure coefficients or discriminant loadings. They serve like factor loadings in factor analysis. By identifying the largest loadings for each discriminate function the researcher gains insight into how to name each function. Here, we have consultants related attributes (low score) which suggest the function that discriminates between success and failure of ERP implementation. A further way of interpreting discriminant analysis results is to describe each group in terms of its profile, using the group means of the predictor variables. These group means are called centroids. These are displayed in the group centroids. Success has a mean of -0.348 while failures produce a mean of 1.914. Finally, there is the classification phase. The classification table also called a confusion table is simply a table in which the rows are the observed categories of the dependent and the columns are the predicted categories. When prediction is perfect all cases

Table 11: Discriminant function co-efficient

Independent variables	Canonical discriminant function coefficients	Standardized canonical discriminant function coefficients	Eigen values	Canonical correlation	Wilks' λ
Vendor related	0.026	0.200	0.693	0.640	0.591*
Top mgt related	0.001	0.003	-	-	-
Positional-power user	0.122	0.528	-	-	-
Knowledge-power related	0.174	0.900	-	-	-
Project team related	0.206	0.636	-	-	-
Transaction user related	0.042	0.246	-	-	-
Consultants related	0.002	0.010	-	-	-
Constant	-6.171	-	-	-	-

*Significant at 1% level

Table 12: Structure matrix

		Group centroids		Classification results (predicted group membership)	
Independent variables	Structure matrix	Success	Failure	Success	Failure
Vendor related	0.964	-0.348	1.914	97.7	2.3
Top mgt related	0.778	-	-	25.0	75.0
Positional-power user	0.698	-	-	-	-
Knowledge-power related	0.634	-	-	-	-
Project team related	0.518	-	-	-	-
Transaction user related	0.500	-	-	-	-
Consultants related	0.278	-	-	-	-

will lie on the diagonal. The percentage of cases on the diagonal is the percentage of correct classifications. The classification results reveal that 94% of respondents are classified correctly into 'success' or 'failure' project.

DISCUSSION

The findings of this research are expected to contribute towards ERP implementation practice. As the effort and money involved in the ERP implementation is huge in order to reduce the risk, a pre-assessment or readiness evaluation is the absolute requirement today. This research attempted to device a tool for carrying out this practice.

The framework developed in this study for estimating delays based on seven people related factors behavior seems to be consistent, proved to be with 83% accuracy, will help to reduce the risk.

The study also contribute to the ERP research by providing the major attributes of each people related factors that influences the success of the project:

- Vendor: transparency during sales, implementation capability and commitment
- Top management: project team empowerment, funding and priority to ERP
- Positional-power user: conviction on ERP, involvement, image, technical infrastructure
- Knowledge-power user: involvement, conviction on ERP
- Project team: dedication, conviction on ERP
- Transaction user: conviction on ERP, image
- Consultant: willingness to support, quality delivery, effort for minimum customization

The study quantifies that >70% implementations are from the internal people; hence an upfront study of these people behavior in terms of the attributes derived from the study, shown above will help to understand the organizational readiness for the ERP implementation.

The study also facilitates prediction of project success. The result of the discriminant analysis carried out will describe each group in terms of its profile, using the group means of the predictor variables. These group means are called centroids. These are displayed in the group centroids. Success has a mean of -0.348 while failures produce a mean of 1.914.

By reviewing literature on taxonomy of key players associated with the implementation and exploring the theoretical frameworks for understanding their behaviours, the study contributes to ERP practice by identifying what organisational factors to look for when initiating ERP implementation and subsequent process change how individuals, ERP implementation and organisational change are linked. The findings of the study can help the management of corporations to better support the deployment of ERP in their organizations.

CONCLUSION

The findings of this research are expected to be of importance to various stakeholders. Given the complexity and integrated nature of ERP and large investment involved it is imperative for organisations to study the experiences of others and learn from their practices and success factors (Umble *et al*., 2003; Colmenares and Otieno, 2005). In this light, organisations planning to implement ERP can learn from the successes and failures of the case study organisations and therefore, avoid pitfalls which can lead to ERP project failures.

LIMITATIONS

The concepts outlined in the study were tested in the existing implementation sites so that it can validated immediately, actual and prediction were compared to identify the variance, the study was extended to multiple sites in order to validate the prediction model in multiple scenarios.

The quantification of various people related factors were estimated based on the 'involvement'. The period in which these individual people group are expected to involve in the project. Hence, application of these contribution factors in other areas requires detailed study.

RECOMMENDATIONS

This framework proposed in this study can be further validated in a new implementations from the start to the end by providing organizational readiness assessment and prediction of implementation time frame which will confirm the current findings and also create more trust in this model. The concepts of this model can be further extended to all information systems projects which require change management. In general, this research would contribute towards theoretical and practical improvements.

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