



# COMPETITIVE CONSTRUCTS OF ERP IMPLEMENTATION ACROSS SELECTED MANUFACTURING SECTORS

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**Abstract.** This paper evaluates and operationalizes eight competence constructs in ERP implementation in selected manufacturing sectors. This study is questionnaire based and is conducted in three organizations where ERP has been successfully implemented. The role of strategic IT planning, executive and management commitment, IT skills, business process skills and ERP training and Learning has been determined in *CavinKare*, *Manali Petro Chemicals* and *Britannia*. Some of major findings from this study includes excellent ERP project management and top management commitment may be an important key success factors in ERP implementation. Regarding implementation issues employee training and learning in advanced cloud-based ERP modules, continuous business process reengineering, data conversion from legacy system considered most key strategic importance in ERP implementation.

**Key Words:** Enterprise Resource Planning, ERP Competitive Constructs, Strategic IT Planning, ERP training and learning

## 1.0 INTRODUCTION

An ERP system is an integrated suite dominating across various business and industry functions because of latest developments in digital transformation allowing firms to produce and access information through real-time environment by completely automating every business function and process by sharing enterprise-wide application across globally. ERP systems are programs that provide integrated software to handle multiple corporate functions which includes back-and front office functions like finance, human resources, manufacturing, materials management, and sales and distributions. SAP, Oracle Corporation, Microsoft, Infor, Netsuite, Syspro, Rootstock, Acumatica, Workday, SAGE group PLC are the major ERP vendors stay competitive within ERP market by adopting differentiated strategies, perform healthy competition, collaboration, joint ventures and acquisitions. AMR Research predicted global ERP market across various business functions and industry verticals projected towards highest market share in 2023 by occupying three-fifth of the global market. At the same time, service sectors / segments projected to grow with faster pace of 12.3% CAGR from 2021 to 2028 by classifying evaluation of ERP systems into manufacturing integration enterprise integration, customer-centric integration and inter-enterprise integration.

The main goal of the ERP is to facilitate information sharing and integration across varying functions, use technology to develop process standardization across multiple business users in order to improve efficiency and to provide automated solutions to a wide range business processes.

Not all ERP implementations have been successful. Success and failure of ERP implementation with an organization is like two sides of coin. Most of the literature review cited by other author contributions on ERP implementation failure sketched that because of wrongly selecting ERP package, focus on business issues instead of technical issues, choosing standardized process over non-differentiated features, manage expectations, including

timelines, budget and resources, deploying dedicated change management team, not formulating a contingency plan. Majority of these studies have used case studies to conclude their findings and very few have used the empirical to study the ERP implementation process and its success.

This research is an attempt to extend the ERP implementation research by defining the conceptual domains constructs and operational measures specific to ERP implementation and success measure to advance ERP research.

## 2.0 LITERATURE REVIEW

The implementation consists of the configuration of the ERP system and the introduction of corresponding organizational and technical changes, like the definition of new responsibilities or the design of new interfaces. Implementation is defined for the purposes of this study as the process starting after the decision to acquire an ERP system has been made and ending when the ERP system has been released into use with full planned functionality and scope.

ERP implementation models have been based on either system of development life cycle approach or innovation and/or diffusion, but these models lack in empirically validating the impact of these models on the implementation success. This study helps to fill the gaps and proposes a framework which comprises implementation of ERP systems and empirically testing constructs of this model every vendor has its own model, and large companies have their own practices. Several models on the implementation of ERP have been developed by the academicians, practitioners, consultants and vendors. Some framework/models were developed for a particular industry. However, the studies on validating these models are few in numbers. This study conducted a cross-disciplinary literature review on ERP implementation, MIS, strategic management, innovation diffusion, and operations to develop a framework, construct definitions, and item generation for this study. Based on the inputs received the study delivers a baseline process model by developing twelve theoretically important critical success factors which considered as crucial set of initial measurement scales which allow researcher to predict and depict constructive ERP implementation constructs.

Most of the ERP application suites created by recent ERP vendors are cloud based / mobile based suites which completely changed traditional business functions like warehousing, finance, production and sales which can be accessed and monitored via smartphones and cloud based. This ERP changeover enable all business functions to increase business agility, reduce time and cost for newer projects, maximize productivity of every ERP professional by synchronizing both on-premise and cloud-based ERP systems to stay updated with real-time information support.

After ERP implementation, organizations are in position to provide better customer services, empower employees and achieve greater business value. Organizations can also increase efficiency of their processes, accurate provision of product delivery dates and order dates, product returns/repairs tracking, provides seamless service experience across different channels including self-service application-based features, support sales, commerce and marketing with outstanding customer service.

A study indicates that 40% of all ERP installations only achieve partial implementation and 20% of attempted ERP adaptations are scrapped as total failure (in Jazz J Chen, 2000). Some studies rate ERP failure to 50% (Trunick, EscalLe et al., 1999). From a previous survey, Business Process Reengineering (43%). Data conversion from previous legacy system (15%), training and change management (15%), hardware (12%) and software (15%) are other major costs and risks in ERP implementation (Grant Norris, James Hurley et al., 200). The above said costs and risks measures in ERP implementation affects companies like Hershey Foods, Connecticut General, Nike, A-DEC sustained hundreds of millions of dollar loss in some instances (James A. O'Brien, 2000). FoxMeyer, another pharmaceutical company also failed to implement ERP successfully due to field of bankruptcy. 35% of the ERP projects had been cancelled and over half those implemented over ran budget (average overrun 180%) or shop floor (average overrun 200%). According to Fergal, Federic, David, 2008 inappropriate project management has been responsible for low success rate of ERP implementation in most of the companies. Jon Beard and Mary Sumner suggest that success and source of ERP competitive advantage lies in the actual management of ERP projects and their subsequent operations (Elsevier B.V., 2004).

Though there are many benefits but costs and risk in ERP implementation are also considerable. Many of the ERP implementations fails due to rely on too heavily on limited in-house expertise, scare and costly consultants, lack of knowledge, limited employee training and transfer of legacy data. ERP systems are different from in-house or custom development system because business processes and procedures have to be changed, the user need customization to be introduced and the user becomes dependent on the ERP vendor for assistance and update.

Regarding ERP implementation success, the amount of prior research is limited to a handful of articles. Dong (2000) proposed a conceptual model for exploring impact of top management on ERP software implementation effectiveness. Rosemann and Wiese (2000) adapt the balanced scorecard approach to the evaluation of implementation and use of ERP software. Somers and Nelson (2001) explored the ERP success from the end-user point of view and proposed a socio-technical model for examining ERP software implementations.

Hitt (2002) investigated the effects of ERP software implementation and use through statistical analysis of financial data. From this study the author derived findings that investing in ERP tend to show higher performance across a wide variety in terms of financial metrics and also slowdown productivity and business performance shortly after the implementation. Tan and Pan (2002) proposing models for the assessment of ERP success and article by Markus et al. (2000) proposing metrics for the measurement of ERP success, can be considered of a particular importance for the study at hand. White (1984) defined successful ERP implementation along two dimensions: (1) improved performance and (2) user satisfaction (Al-Mashari, 2002, Yusuf, 2004).

### 3.0 RESEARCH METHODOLOGY

This research identified strategic IT planning, executive commitment, project management, IT skills, business process skills, ERP training and learning and change readiness as major constructs for successful ERP adoption.

This paper followseight different constructs to assess the success of ERP adoption in **CAVINKARE**, **MANALI PETRO CHEMICALS** and **BRITANNIA**, all the cited manufacturing industries had their plant located in Chennai. **CAVINKARE** is India's largest manufacturers of hair-care, skincare, personal care products, food and diaryproducts. They are primarily relied in contract manufacturing for many years has now set up its own world class plant across India one at Chennai to the demand for both domestic and international market. **CAVINKARE** has successfully implemented first phase of SAP ERP in 6 months with SIEMENS' consultancy. **MANALI PETRO CHEMICALS** a major leader in the production and marketing of Propylene Oxide, Propylene Glycols and Polyols in India which are used as raw materials across spectrum of industries including those of pharmaceuticals, Resin, Fragrances, Food, Refrigeration, Oil Drilling etc. and they also engaged in the manufacture of petrochemicals products. **MANALI PETRO CHEMICALS** successfully implemented SAP ERP in 2006 and now second phase cloud-based ERP implemented by 2010.

**BRITANNIA** industries are the manufacturers and selling biscuits, bread, rusk cakes and dairy products like cheese, butter and milk. This industry is in the verge of final stage of its cloud-based Oracle ERP implementation whereas HR and accounts modules have been successfully implemented.

In this study, all time key ERP users of selected companies were selected as our investigative sample. The questionnaire was administered on 355 respondents out of which 252 questionnaires were completed, in which respondents were asked to indicate their level of importance for each of the construct items (critical success factors) using their response on a five-point scale. There were 30 questions in the questionnaire which is divided into three sections. Section 1, describes introduction basically identity of the researcher; Section 2, demographics details of respondents which includes age, gender, professional experience in ERP, ERP usage frequency was provided; Section 3, provides elements of ERP constructs questions out of which 15 were on nominal scale and other 15 were on five-point Likert scale ranging from "strongly disagree" to "strongly agree". The raw data captured and then transported to software statistical package (SPSS 17.0).

To ensure reliability and data validity the survey instrument validated with expertise people which includes ERP suppliers, consultants, information system faculty, managerial business users initially to pilot test the attributes and also allows to improve the quality of the survey instrument. Even the survey instrument distributed to ERP project managers and senior project team members of the companies selected regarding implementation issues and risk measures during implementation.

### 4.0 DATA ANALYSIS AND INTERPRETATION

From the data analysis collected through survey instrument, it was observed that change management practices, adaptability, working efficiency, data conversion from legacy application to cloud based system, users' involvement in ERP training with new changed environment shows positive effect in **CAVINKARE**. The above-mentioned factors considered as major issues in **CAVINKARE** during the initial stages of ERP implementation. In **MANALI PETRO CHEMICALS** migration from traditional approach to cloud-based ERP modules considered as major issues especially in users financial and accounting modules where the user considered much complexity in using by pointing out as major issue. After ERP implementation in **BRITANNIA**, more accuracy, reliability and timeliness were observed whereas change management and end users training were the major issues.

After analysis and interpretation of collected questionnaires, it was observed that users consider the following factors as their major advantages which includes efficiency, improvement in their working styles, lead time productivity, speediness were the major after ERP implementation whereas user training, data migration, change management, heterogeneity considered as the major issues in **CAVINKARE**. **CAVINKARE** was further interested in online ERP and business intelligence solutions in future. In **MANALI PETRO CHEMICALS** real-time connection, fully integrated applications, improvement in business processes and user friendliness were the main

advantages whereas transition from traditional cash accounting to new accounting module, data conversion, adaptability ratio and software customization were the main issues. After ERP implementation in **BRITANNIA**, more accuracy, reliability and timeliness were observed whereas change management and end users training were the major issues.

Exploratory factor analysis (EFA) was used to summarize the 15 variables into smaller sets of linear composites that preserved most of the information in the original data set. The major key factors such as strategic, tactical and operations allows the researcher to best described the data for analysis which is shown in Table 1. **Component covariance matrix** further shows that the three factors are not related to each further confirming the results of factor analysis Table 2.

**Table 1: Results of Exploratory factor analysis**

Factor 1 Strategic	Factor Score	Factor 2 Tactical	Factor Score	Factor 3 Operational	Factor Score
Top management commitment	.953	Adequate functional requirements	.726	Adequate training and education	.866
Better middle management commitment	.875	Live cloud-based ERP product selection	.746	Higher Users resistance to change	.805
Treated as an IT project	.904	Reliance on heavy customization	.937	Less attrition rate of project team members	.707
		Accurate data	.912	Adequate resources	.835
		Better quality of testing	.895	Better User involvement	.714
		Appropriate Timing of go-live	.933		
		Better project management effectiveness	.895		

**Table 2: Component Score Covariance Matrix**

Component	1	2	3
1	1.000	.000	.000
2	.000	1.000	.000
3	.000	.000	1.000

Extraction Method: Principal Component Analysis  
Rotation Method: Varimax with Kaiser Normalization

After three factors (dimensions) were extracted from conducting the EFA procedure, the author interpreted the results by assigning labels to the factors. The factors described below for reference.

- **Factor 1** – Strategic: It includes 3 items that are related to top/middle management in implementation of ERP in above selected manufacturing organizations.
- **Factor 2** – Tactical: This consists of 7 items that deals with various project managements & selection criteria related issues of ERP product.
- **Factor 3** – Operational: This consists of 5 items that deals with the user resistance, involvement and training.

## 5.0 RELIABILITY ANALYSIS

As per reliability analysis norms estimates greater than .70 considered as good reliability constructs which meet the desired content validity and it also statistically proved and verified as reliable scale measure which is considered as stable and consistent measured construct. It is also possible to remove certain items from construct scale if the reliability estimate exceeds the construct value by utmost care to ensure content validity components.

As shown in the table below that reliability of each factor is above .81. In table 3, are listed the composite reliability estimates for each of the measurement scales.

Constructs	Items	Cronbach $\alpha$
Critical Success Factors	12	.87
Cloud ERP benefits	14	.89
Degree of importance of ERP domain requirements	6	.81
ERP and BPR	4	.84
Implementation success & failure factors	4	.90

**Table 3: ERP implementation process phases and success constructs (items) and reliability values**

## 6.0 CONSTRUCT VALIDITY ANALYSIS

Construct validity is basically type of measurement which shows the possible construct variables identified need to measure. Through correlation and factor analysis construct validity is evaluated. Correlations with high value specified construct validity. It is interesting to observe that the relative strength of the correlation between process stages and the implementation success.

The phases such as implementation planning and installation strongly influence the implementation success individually and they are found to be statistically significant. The success of ERP implementation (dependent variable) is measured in this study whether the implementation was completed within budget, within time, users were satisfied and users find it easy to use the system across the organizations. This definition is consistent with the definitions for success associated with all types of information system projects, recognizing that there is no single set of accepted measurement criteria for evaluating information system success. Success is dependent not only on the factors that influence the system implementation during the course of the implementation timeframe, but also activities that occur during the ERP implementation.

## 7.0 HYPOTHESIS TESTING

The author tested hypotheses  $H_1$ ,  $H_2$ , and  $H_3$  by using the mean scores of significantly loaded explanatory variables, and in hypotheses  $H_4$  and  $H_5$ , the researcher analyzed the intensity of association between factor variables with Pearson's correlation coefficient. To carry out this test, the researcher created a score for each construct from the mean of its component items.

Hypotheses one and two, " **$H_1$  – The Visibility of Information provided by the ERP system fosters empowerment of system user employees**" and " **$H_2$  – The Visibility of Information provided by the cloud ERP system leads to autonomy of user employees**", concerning the visibility of information provided by the ERP system and its role in facilitating empowerment and fostering autonomy, were proven by verifying mean respondent agreement with questionnaire statements that explain the Empowerment factor.

According to an interviewee in the **CAVINKARE**, adoption of the ERP system was followed by delegation of greater responsibility and autonomy to operational areas, which then showed greater and more significant changes. Prior to ERP implementation, all transactions were performed by employees in the Financial department; according to the interviewee, the ERP system encouraged the (logical) conclusion that each department should carry out its own transactions. ANOVA revealed significant differences in the average agreement with factors related to these hypotheses between age brackets: respondents aged 50–59 or >60 expressed greater perceived recognition of the Empowerment factor than did employees in the 30–39 age range.

The third hypothesis, " **$H_3$  – The Visibility of Employee Activities provided by the ERP system makes it easier for the organization to exercise control over user employees**", verifies whether the visibility of actions provided by the ERP system makes it easier for the organization to exercise control over employees who use the system. Respondents from all the organizations disagreed slightly with the assertions that express the visibility of actions provided by the ERP system to employees' peers and superiors.

Although there was no express recognition that the increased visibility of actions provided by the ERP system facilitates control, our fourth hypothesis, " **$H_4$  – Employee control is positively related with empowerment of user employees**", verifies whether employee control is positively correlated with empowerment of user employees.

The final hypothesis, " **$H_5$  – The disciplinary nature of conforming to the rules of ERP systems is positively related with reflection on work practices**" tests whether the disciplinary nature of conforming with ERP rules is positively correlated with reflection on work practices.

## 8.0 CONCLUSION

This study is valuable to researchers and practitioners interested in to build competitive constructs in implementing Enterprise Resource Planning systems in manufacturing organization. The EFA calculations made in this study provides interesting results by identifying the construct competitive factors that actually have an impact on manufacturing organizations on successful ERP implementation.

The primary contributions of this paper are the definition of competitive constructs associated with the ERP implementation and the development of multi-item measurement scales for measuring various competitive constructs across manufacturing industries. Unlike much prior ERP implementation research, this study takes a grounded theory approach using ERP experts' perceptions. Future ERP implementation empirical research linking these competitive constructs in causal models in an ERP will benefit significantly from the existence of relevant competitive construct definitions and good measurement scales. A secondary contribution of this work is the demonstration of a rigorous empirical scale and item development process.

It was concluded that live-cloud based ERP product selection, adequate ERP functional requirements, top-management commitment, better user involvement are very important factors considered by organizations in successful ERP implementation. There is a gap between ERP users training and education and there is need to bridge this gap by incorporating continuous user training programs on ERP by mass customization policies. There is a shortage of middle man and skilled consultants who can evaluate and recommend ERP application for an enterprise. Skills of seasoned project managers are required for successful ERP implementation.

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