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DERIVATION AND VALIDATION OF A CONCEPTUAL MODEL FOR ERP IMPLEMENTATION SUCCESS FACTORS – AN INDIAN CONTEXT

¹ R. SARAVANAN, ² Dr. C. SUNDAR

¹ Research Scholar, R.SARAVANAN, SRM University, India. (Project Manager, CSC India Pvt Ltd) ² Professor and HOD. Dr. C. SUNDAR, School of Management Studies, Ramapuram Campus, SRM University, Chennai, India. E-mail: ¹ sara.raju@yahoo.com, ² hod.mba@rmp.srmuniv.ac.in

ABSTRACT

Enterprise Resource Planning (ERP) Implementations are growing as the business grows in the Industry, whereas the question still remains whether there are real benefits to the Organizations due to ERP. There are multiple factors that contribute to the Success of ERP Implementations. The primary objective of this research study is to bring-out the Critical Success Factors (CSF) which are contributing for success of a typical ERP Implementation and to derive and validate a model for ERP Implementation Critical Success factors. This study has been conducted on predominant industries in India on a select region, who have implemented ERP in their organisations. Through this study we have tried capture the significance of each Critical Success Factor and subjected to analysis for validating the relationship of these factors in Indian Context. Derived Conceptual Model has been successfully validated in which most of the Hypothesis are supported by the research statistics.

Keywords: ERP Implementation, Critical Success Factors, Success of ERP, ERP, CSF.

1. INTRODUCTION

ERP systems are being planned, designed and implemented to improve competitiveness, flexibility, productivity and responsiveness to customer needs in a global economy. They enable the Organizations to achieve greater effectiveness and cost savings. However in current situation, it can no longer be said that an ERP system just implemented would provide completive advantage as majority of large and medium companies have already implemented an ERP System. Instead, a competitive advantage would be how the ERP System is implemented and corresponding Business Benefits.

From continuous industry research by Michael Krigsman (2010)[1] the following are the five primary observations which are highly alarming:

- ERP implementations take longer than expected
- ERP implementations cost more than expected
- Most ERP implementations under-deliver business value

- Software as a service (SaaS) implementations take less time than on-premise ERP implementations, but deliver less business value
- Companies do not effectively manage the organizational changes of ERP

Despite ERP's promises to benefit companies and a substantial capital investment, not all ERP implementations have successful outcomes. (Goeun Seo, 2013)[2]. For example, most ERP systems tend to be large, complicated, and expensive. Moreover, ERP implementation requires an enormous time commitment from an organization's information technology department or outside professionals. In addition, because ERP systems affected most major departments in a company, they tended to create changes in many business processes. Much of the research reported that the failure of ERP implementations was not caused by the ERP software itself, but rather by a high degree of complexity from the massive changes ERP causes in organizations (Goeun Seo, 2013)[2].

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This brings up the following Research Questions:

- What are the primary Critical Success Factors contributing to the Success ERP Implementations?
- What is the significance of each of the Critical Success Factor with respect to Indian Context?
- How these factors are related to each other?
- How the industry can make use of these inputs before they start any ERP implementations for their Organizations?

The purpose of this study is

- To critically identify the Critical Success Factors from literature of earlier studies.
- Derive a model framework out of the identified factors and based on the earlier proven models.
- Validate the model for the applicability of the select region in Indian Context.

2. LIMITATIONS / ASSUMPTIONS

• Identification of Critical Success Factors and Derivation of Model is based on extensive analysis and study of earlier researches and hence this paper does not cover the rationale of selection of listed factors. This takes the assumption that the earlier research literatures have taken care of this part.

- After deriving the model, validation of the particular model is being carried out with select organizations in India.
- The conclusion and outcomes can be positively generalized to the other organizations in India or other parts of India.
- The fundamental assumption of generalization of this study to other organization India could be due to the reason that the Organizational Culture in the corporate companies in India are seamless and similar in terms of literacy, commitment towards work, technical and functional capability, resourcefulness, work attitude and learning aspirations etc.

3. CRITICAL SUCCESS FACTORS LITERATURE REVIEW

3.1 Critical Success Factors Models

As per T.R. Bhatti (2005) [3], the ERP Success factors were framed according to the project life cycle. In this framework, CSFs- were considered as the set of Inputs for the ERP Implementation process.

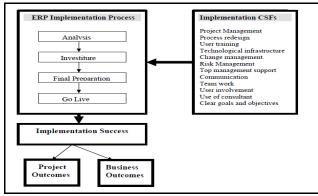


Figure 1: ERP Success Framework by T.R. Bhatti 2005

ERP Implementation process outcome will be the Implementation Success and in turn the Implementation Success results in Project Success and Business Outcomes. This framework was validated from Organizations in Australia. From the studies of Liang Zhang, Matthew K.O. Lee, Zhe Zhang1, Probir Banerjee (2005) [4] through the Chinese Organizations, Top Management Support, Business Process Reengineering, Effective Project Management,

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Education & Training, Suitability of Software & Hardware, and Data Accuracy have more and significant impact on ERP Implementations in China. The framework provided below was supported through their empirical study in China.

This study has matched with the study results of T.R. Bhatti [3] mostly from the first part of the model that is the CSFs are the primary Inputs for any ERP Implementation projects to be considered.

Princely Emili Ifinedo 2006 [5] has come out with a model after conducting the studies in Finland and Estonia. In this study there are two groups of

variables considered as input CSF-s for ERP Implementation viz. Organizational and Technology (IT). Within these groups, the variables or CSF-s referred are more or less aligned with that referred from other authors T.R. Bhatti [3] & Liang Zhang, Matthew K.O. Lee, Zhe Zhang [4]. Some of the common variables within these researchers are Top Management Support, Business Goals Vision, Organizational Culture, / Implementation team, User Satisfaction. In the the Implementation Success same way, measurement also through some set of common variables viz. Organizational Impact & Individual Impact in turn the Business Impact.

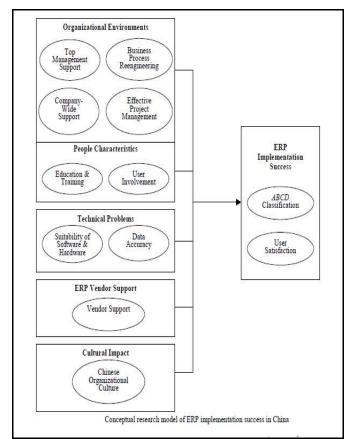


Figure 2: Model by Liang Zhang, Matthew K.O. Lee, Zhe Zhang, Probir Banerjee, 2002

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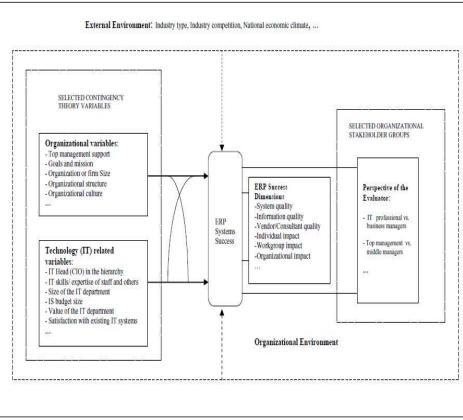


Figure 3: Framework by Princely Emili Ifinedo 2006

BooYoung Chung (2007) [6] has done in-depth research on various models and taken the base of Technology Acceptance Model by Venkatesh &

Davis 2000 and IS Model by DeLone and McLean (1992). Technology Acceptance Model was initially developed in 1989 by Davis et al.

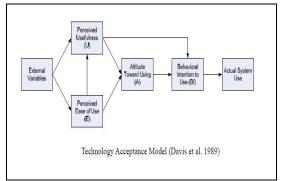


Figure 4: Technology Acceptance Model referred by BooYoung Chung, 2007

Subsequently the Updated TAM was developed incorporating subjective norms by Venkatesh & Davis 2000. TAM mainly focus on "Perceived usefulness & Ease of use" as the motivation for ERP which drives the Usage Behaviour.

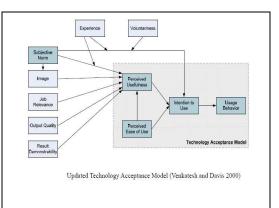


Figure 5: Updated Technology Acceptance Model 2 referred by BooYoung Chung, 2007

IS Model by DeLone and McLean (1992) mainly concentrated on the following factors:

System Quality - the measure of the information processing system,

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Information Quality - the information system output,		Individual Impact - the measure of the effect of information on the behaviour of the recipient, and
Use - the recipient const output of an information sy	-	Organizational Impact - the measure of the
User Satisfaction - the rec	ipient response	effect of information on organizational performance

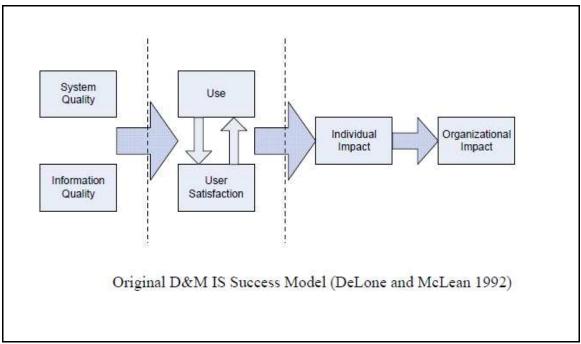


Figure 6: ERP Success Factors Model referred by BooYoung Chung, 2007

In the model developed by Boo Young [6], the Variables are categorized as 'Used Related' & 'Project Related'; Introduced TAM constructs for 'Perceived Usefulness of ERP". IS Success Model was referred for Success Indicators. Oyana Velcu 2008 [7] developed a model combining the factors Business Strategy and Strategic Alignment, This leads to Organizational Internal Efficiency. Internal Efficiency in turn results in Customer Benefits for example On-time Delivery, On-time payment / Invoices, Accuracy of Invoices, High Quality Products and Services. This also results in

to the use of the output of an information

system,

Business Process Changes (Re-Engineering) contributes to perform effective Project Management. Effective Project Management is measured by Time, Cost & Scope (System Functionality). This is what is called as Project Success.

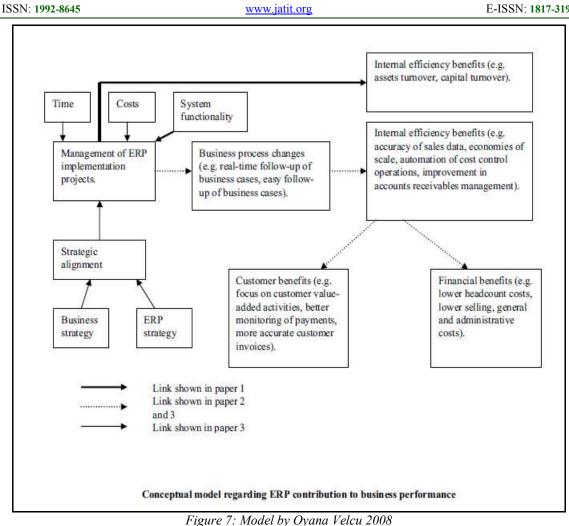
Financial Benefits of the Organization for example Lower of Head Counts, Lower Production Costs, Lower Over Head Costs, and Lower Inventory Costs etc.

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3.1 Critical Success Factors Consolidation

We have taken 23 Research Papers / Journals for analysis as indicated in the table below, which are exclusively conducted towards 'Critical Success Factors of ERP Implementations'. These authors have mentioned and discussed in detail on CSF-s through their studies among various organizations.

Our main approach was to derive the frequency of each CSF-s among these research studies and then to pick up the CSF-s which are having high frequency for our further evaluation for our model derivation and further validations.



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ISSN:	1992-8645				1	ww	w.j	ati	t.or	g								E-IS	SSN	J: 181	7-3	195	;		
	Research Authours & Year	Christopher P. Holland and Ben Light (1999)	G. Shanks*, A Parr**, B. Hu*, B. Corbitt* (2000)	Liang Zhang, Matthew K.O. Lee, Zhe Zhang1, Probir Banerjee (2002)	Ada Wong, Harry Scarbrough (2003)	Meg Fryling (2004)	T.R. Bhatti (2005)	Princely Emili Ifinedo (2006)	BooYoung Chung, Ph.D., (2007)	Houman Kalbasi (2007)	Shih-Wen Chien, Shu-Ming Tsaur b (2007)	E.W.T. Ngai, C.C.H. Law*, F.K.T. Wat (2007)	Shih-Wen Chien, Shu-Ming Tsaur (2007)	Oyana Velcu (2008)	Khaled Al-Fawaz, Zahran Al-Salti, Tillal Eldabi, (2008)	Stephan A. Kronbichler & Herwig Ostermann and Roland Staudinger (2009)	Miguel Maldonado (2009)	Kwang Su Wei and Dr. Alain ChongYee Loong; (2009)	Gordon Baxter (2010)	Majid Aarabi 1, 2*, Muhamad Zameri Mat Saman (2011)	San Luis Obispo (2012)	YEHOSHUA ITZHAIK (2012)	Otto Korhonen (2013)	Goeun Seo (2013)	Frequency
1	Top management support	*	*	*	*		*	*				*			*	*	*			*			*	*	13
2	The implementation team	*	*		*	*	*		*	*					*	*	*						*	*	12
3	Project Management	*	*	*	*		*			*		*			*	*	*						*	*	12
4	Business plan/vision/goals	*	*				*	*				*			*	*	*			*			*	*	11
	Architecture choices, technical implementation, technological infrastructure			*	*	*	*	*	*						*	*							*	*	11
6	Training			*	*		*			*					*	*	*			*			*	*	10
8	Legacy systems knowledge (data analysis & conversion) Re-engineering Business Process Organizational Culture	*	*	* *	*		* *	*				* *			*	*							* *		7 7 7
	Change management programme	*														*	*			*			*	*	6
11	Communication	*					*					*				*				*			*		6
	Partnership / Vendor Support			*												*							*		3
	Testing Effectiveness				*					*															2
	Employees' general IT skills							*		*							<u> </u>								2
	Company-Wide Commitment			*	-												-								1
	Management of Risk				-		*	+									-								1
	Organization's or firm size Organizational structure				-		<u> </u>	*	<u> </u>	<u> </u>							-		<u> </u>						1
-	Data Management				-	-	-	×	-	-		*		-			-		-						1
19	Eigura & F		ļ					<u> </u>	<u> </u>	L				L					L	L					

Figure 8: Frequency Table for Success Factors referred in earlier researches

The factors having relatively high frequency:

- 1. Top Management Support & Strategic Alignment
- 2. Implementation Team
- 3. Project Management
- 4. Business Plan / Vision / Goals
- 5. Technology & Architecture choice
- 6. Training
- 7. Legacy System Knowledge (Can be associated with factor Re-engineering **Business Process**)
- 8. Re-engineering Business Process
- 9. Organizational Culture
- 10. Change Management (Can be associated with Organizational Culture)

- 11. Communication (Can be associated with factor Project Management)
- 12. Partnership with Vendor (Can be associated with factor Implementation team)
- 13. Testing Effectiveness

4. Critical Success Factors Model Relationship **Combined with all of the Earlier Studies:**

We constructed a model after the study across various proven models and factors referred in various researches. We tried to bring up different dimensions dealt in earlier researches to reflect in this model.

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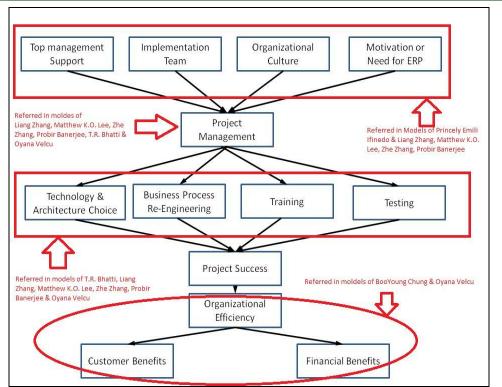


Figure 9: Proposed Model in relationship with earlier proven models

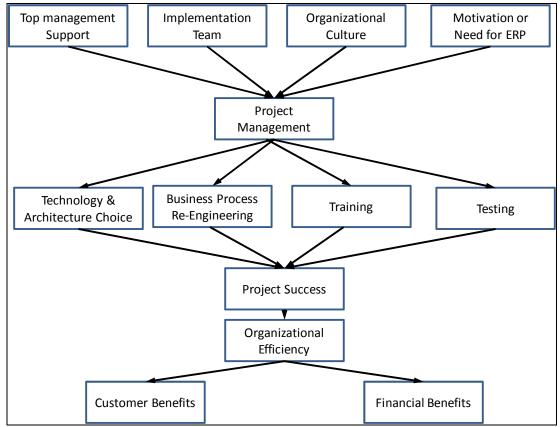


Figure 10: Proposed ERP Critical Success Factors Model

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The formulated List of Hernothesis is as follows to	antion from multiple shoirs	The advantage of

The formulated List of Hypothesis is as follows to validate the model:

H1 – There is a positive association between 'Top Management support' and perceived Successful "Project management".

H2 - There is a positive association between 'Implementation Team's competency and capability' and perceived successful "Project management".

H3 - There is a positive association between 'Origination Culture' and perceived successful "Project management".

H4 - There is a positive association between 'Motivations for ERP Implementation' and perceived successful "Project management". H5 - There is a positive association between 'Project Management' and 'Technology & Architecture choice.'

H6 - There is a positive association between 'Project Management' and 'Business Process Reengineering'

H7 - There is a positive association between 'Project Management' and 'Training'.

H8 - There is a positive association between 'Project Management' and 'Testing'.

H9 - There is a positive association between 'Technology & Architecture choice'' and 'Project Success'.

H10 - There is a positive association between 'Business Process Re-engineering' and 'Project Success'.

H11 - There is a positive association between 'Training' and 'Project Success'.

H12 - There is a positive association between 'Project Success' and 'Organizational Efficiency'. H13 - There is a positive association between 'Organizational Efficiency' and 'Customer Benefits'.

H14 - There is a positive association between 'Organizational Efficiency' and 'Financial Benefits'.

5. RESEARCH METHODOLOGY:

The study used a Closed End Questionnaire to examine the hypothesed factors and research framework. The questionnaire is adapted from prior literature. Data were collected from the organizations that have implemented ERP during the period ranging from year 2000 till 2014 on select organizations located in India with select Industries.

5.1 Design of Questionnaire

The Closed end Questionnaire contains questions with a finite set of answers from which the respondent chooses. These questions can normally be answered using a simple 'yes' or 'no' option, or a selection from multiple choices. The advantage of such questionnaire is that it captures the messages from the respondents and also viable for statistical analysis which leads to inferences. (Yehoshua Itzhaik. 2012) [8].

For our study, the questions were framed to check the significance of each factor considered in the proposed model. Each of the factors had two or three questions and in total there are about 36 Questions for which responses were expected from the respondents.

Each question had a 7 Point Scale rating, with the interpretation of 1 being 'Strongly Not Agree' and 7 being "Strongly Agree". The questionnaire is attached in the Appendix for reference.

5.2 Questionnaire Reliability

Reliability is defined as the extent to which a questionnaire, test, observation or any measurement procedure produces the same results on repeated trials. In short, it is the stability or consistency of scores over time or across raters. (Michael J. Miller, Ph.D., RES 600: Graduate Research Methods) [9]. Reliability is the degree to which a measure of a concept is stable, meaning that if the research is replicated using the same methods of datacollection and analysis, then the claims and conclusions derived from the data should be the same. (Yehoshua Itzhaik, 2012) [8].

This Questionnaire was issued to the respondent sample of 20 members to test the 'Reliability'. The sample population was spread across the Industry, performing their operations through ERP after implementation or the ERP Implementation partners / Solution providing members.

The collected data was processed in SPSS for Statistical Analysis for Reliability. Cronbach's alpha is the most widely used as a measure of reliability. It indicates the extent to which a set of test items can be treated as measuring a single variable. Cronbach's alpha will generally increase when the correlations between the items increase. For this reason, items in each variable should be highly correlated to have higher internal consistency of the test. The lower acceptable limit of .50-.60 was suggested by Kaplan and Saccuzzo (1993) [10], however, as a rule of thumb, a reliability of .70 or higher is required before an instrument will be used. (BooYoung Chung, Ph.D., 2007) [6].

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	Reliability Statistics	
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.959	.961	36

Table 1: Reliability Analysis

From the results, the Cronbach' Alpha value is 0.959 which is more than 0.7 and hence the Reliability of this instrument is accepted and this instrument can be used for the survey.

5.3 Questionnaire Validity

Validity is concerned with the accuracy of our measurement, and it is often discussed in the context of sample representativeness. However, validity is also affected by survey design since it also depends on asking questions that measure what we are supposed to be measuring. (Michaela Mora, 2011) [12]. At the outset, the researchers needed to consider the face validity of the questionnaire. Face validity can be described as a sense that the questionnaire looks like it measures what it was intended to measure (At Work, Issue 50, Fall 2007) [13]. Validity is defined as the extent to which the instrument measures what it purports to measure. (Michael J. Miller, Ph.D., RES 600: Graduate Research Methods) [9].

In quantitative research, the validity of a study is determined by the extent to which the research truly measures what it was intended to measure, or how 'truthful' the research results are or in other words whether the researchers are observing, identifying, or 'measuring' what they say they are. (Yehoshua Itzhaik, 2012) [10]. "Validation" is also the process by which any data collection instrument, including questionnaires, is assessed for its dependability. Validating questionnaires is somewhat challenging as they usually evaluate subjective measures, which means they can be influenced by a range of factors that are hard to control. (Kit Howard, Kestrel Consultants, Inc, 2008) [14].

To check the Face value of the Questionnaire, it was validated by another set of 10 experts in the ERP Industry and their responses were captured as below through the same Questionnaire. In the process they also confirmed the Questionnaire is communicating and trying to get the information which is intended for this study on 'Critical Factors of ERP Implementations'.

Reliability Statistics through alternate group responses							
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items					
.918	.920	36					

Table 2: Validity Analysis

From the results, the Cronbach' Alpha value is 0.918 which is also more than 0.7 through a different group responses. This result confirms the Questionnaire represents a sense that the questionnaire looks like it measures what it was intended to measure.

5.4 Data Collection & Analysis

250 Sample Respondents were identified in the following industry and conducted survey with 50 respondents in each Industry group.

- 1. Automotive Industry
- 2. Manufacturing Industry
- 3. Ancillary Industry
- 4. Petro Chemical Industry
- 5. ERP Professionals (who involved in providing ERP Solutions as a part of Implementation Partner)

The survey was conducted with 5 Companies in each Industry and 10 Users per company through personal interviews. We had one coordinator identified in each organization and through this coordinator we were able to reach out 10 users in each organization in a particular period from October to December 2014. The question was asked to each of the respondent and their responses were noted down and taken for analysis.

5.5 Pathway Analysis

Path Analysis is a Stastical technique used primarily to examine the comparative strength of direct and indirect relationship among variables. A series of parameters are estimated by solving one or more structural equations in order to test the fit of the correlation matrix between two or more casual models, which are hypothesed. The following diagram is the result output from SPSS-AMOS out of the 250 responses collected against the relevance of 13 Critical Success Factors as per the proposed model

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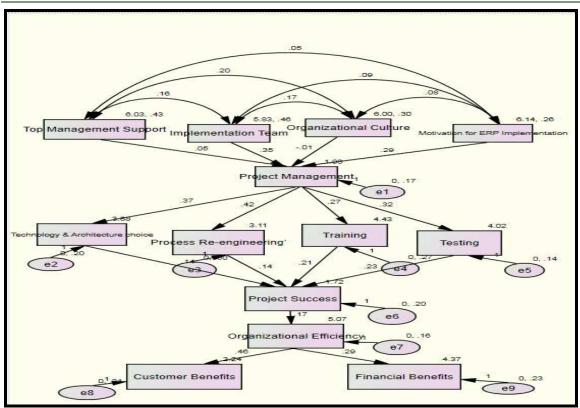
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H1 – There is a positive association between 'Top Management support' and perceived successful "Project management". - **Supported**

H2 - There is a positive association between 'Implementation Team's competency and capability' and perceived successful "Project management". - **Supported**

H3 - There is a positive association between 'Origination Culture' and perceived successful "Project management". – **Not Supported**

H4 - There is a positive association between 'Motivations for ERP Implementation' and perceived successful "Project management". -Supported

H5 - There is a positive association between 'Project Management' and 'Technology & Architecture choice.'- **Supported**

H6 - There is a positive association between 'Project Management' and 'Business Process Reengineering' - **Supported**

H7 - There is a positive association between 'Project Management' and 'Training'. - **Supported** H8 - There is a positive association between 'Project Management' and 'Testing'.- **Supported**

H9 - There is a positive association between 'Technology & Architecture choice'' and 'Project Success'. - **Supported** H10 - There is a positive association between 'Business Process Re-engineering' and 'Project Success'.- **Supported**

H11 - There is a positive association between 'Training' and 'Project Success'. - **Supported**

H12 - There is a positive association between 'Project Success' and 'Organizational Efficiency'. - Supported

H13 - There is a positive association between 'Organizational Efficiency' and 'Customer Benefits' - **Supported**

H14 - There is a positive association between 'Organizational Efficiency' and 'Financial Benefits' – **Supported**

6. CONCLUSION

These studies have brought out various observations on the status of each success factor with respect to the selected 5 industries in India (Automotive Industry, Manufacturing Industry, Ancillary Industry, Petro Chemical Industry, and ERP Professionals) for making a note and improve upon. Conceptual Model has been successfully validated with most of the Hypothesis supported by the research statistics. We hope this model will help the industry to make a reference for any new ERP implementation project and to take care when they formulate the strategic planning and preparation.

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The outcome of this study can be generalized to [14.] Christopher P. Holland and Ben Light (1999) other Organizations in India due to the cultural similarities in the corporate companies' in-spite of language differences. Future studies can be towards the aspect of generalization of this model across other countrie

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		QUESTIONNAIRE							
		Name of the Participant							
		Designation or Role							
		Organization currently working for							
		Your latest ERP Implementation Project							
		Implemented Year							
		Please answer by marking 'X' for below questions from your Latest							
		ERP Implementation Project experience in the 7 scale rating, Rating	Stro	ongl	y N	ot A	Agre	ee	
		1 being 'Strongly Not Agree' and rating 7 being 'Strongly Agree'	Stro						
			1	2	3	4	5	6	7
1	0	Top Management Support & Strategic Alignment							
	1	Organization had clear business objectives towards ERP							
		Implementation							
	2	The project received Top Management Support all along the Project							
	_	Life Cycle							
	3	There was a strategic alignment between the 'Business Needs' and							
	5	ERP Implementation Project							
2	0	Implementation Team		+					
-		ERP Implementation team had a right <i>Capability & Competency</i>		+					
<u> </u>		ERP Implementation team had a right <i>capability</i> a <i>competency</i>		+	-				
		ERP Implementation team was working in an <i>appropriate motivational</i>		+					-
		level.							
3	0	Organizational Culture							
3	U								
		Organizational culture was supportive towards the ERP Project, in terms of Involvement and Learning							
		There was a priority towards the ERP Project across organization							
		Business Users in the Organizations were <i>ready</i> to face the <i>Changes in</i>							
-	0	terms of Business Processes.							
4	0	Motivation for ERP Implementation							
		Motivation for ERP Implementation was mainly driven from							
		Technology perspective.							
		Business requirement was main factor of motivation for ERP							
		Implementation							
5	1	Project Management							
_		ERP Implementation Project has followed the 'Project Management							
		Processes' professionally.							
		Project Initiation, Planning, Execution, Monitoring & Control and							
		Closing were done appropriately							
		Project Reviews and Project Governance were practiced to align all the	1						
		stake holders towards project objectives.							
6	0	Technology & Architecture choice							
-		Appropriate ERP Package (whether SAP, Oracle, PeopleSoft) was		\square					
		selected for our Implementation							
		Appropriate modules and architecture combination was chosen		\square					
7	0	Business Process Mapping and 'Process Re-engineering'							
-		Enough and Quality time allocated to think through all the Business		+					
		Process in ERP Implementation							
		Business Processes and functions are taken care to run the current and		+					-
		future Business needs							
		Business Processes were re-engineered wherever required and adhere		+				_	_
		to best practices from ERP.							
		to best practices nom EXI.							
	<u> </u>			<u> </u>	I				

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8	0	Training					Т
-		Training Material and Training Preparation was good in ERP					-
		Implementation					
		Training was fruitful and helped to understand the necessary ERP					
		Business Processes					
		Users were involved and engaged in training and demonstrated					
		learning aspirations towards ERP.					
9	0	Testing Effectiveness					
		ERP Implementation had a proper planning for testing with enough					
		and appropriate test cases.					
		System Integration was executed to ensure ERP Quality					
		User Acceptance Test was conducted to ensure Business User's					
		comfort-ness					
10	0	ERP Implementation Project Success					
		ERP Project was implemented on schedule with acceptable minimum					
		schedule deviations.					
		ERP Project was implemented within budget cost					
		ERP was implemented with intended process scopes with quality					
11	0	Organizational Efficiency Improvement after ERP					
		Organization is realizing Operational and Transactional efficiency after					
		ERP Implementation					
		ERP is helping with appropriate MIS reports which help in tactical					
		aspects, monitoring and controlling.					
		ERP is helping Top management team for enabling strategic decision					
		makings					
12	0	Customer Benefits after ERP					
		Organization's Customers are benefited in terms of faster and added					
		services due to ERP Implementation, for example delivery					
		performance improved					
		Customer is benefited in terms of reduced or stable cost offered by					
		organizations.					
		Customer is benefited with improved Quality due to ERP in terms of					
		Service or Products.					
13	0	Organization's Financial Benefits after ERP					
		Organizations overall financial status has improved due to better					
		visibility and transparency for senior management for appropriate					
		control and decisions					
		Organization's productivity improved and hence achieved financial				ſ	
		benefits			L		