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Critical Success Factors in ERP Implementation and their interrelationship using TISM and MICMAC Analysis

Aradhana Gandhi*

Symbiosis Centre for Management & Human Resource Development, Symbiosis International University, Pune, India; aradhana_gandhi@scmhrd.edu

Abstract

Purpose: The purpose of this paper is to find interrelationships among the factors that impact the process and result of ERP implementation based on the experience of implementation in one of the medium scale company. **Design/methodology/approach:** The purpose of this paper is to identify key variables of ERP implementation through systematic literature review and semi-structured interviews administered on the core team members of BBM Acoustic Private Limited, who were made part of the implementation process. We have resolved debates related to relationship among various constructs of ERP implementation and their relationship using Interpretive Structural modeling and Total interpretive structural modeling. **Findings:** The study indicates that Organizational Culture &Communication and Top Management Commitment and Support have high driving power and deserve serious attention in ERP implementation process. The paper also helps in ascertaining the category of factors that are independent, autonomous, linked or dependent. **Research Limitations/Implications:** This study fills in the gap in literature by proposing a model of critical success factors in ERP implementation in a small and medium sized organization. The reliability of the model should be tested later by conducting a study on large scale. **Originality/value**: The paper indicates factors in chronological order, which need the attention as per their level in the implementation process in small and medium enterprises (SMEs). These finding will shrink the fear of failure in ERP implementation to some extent and encourage SMEs to implement ERP in their organization.

Keywords: Critical Success Factors, ERP Implementation, Interpretive Structural Modeling, ISM, MICMAC Analysis

1. Introduction

Indian economy has consistently beenone ofthe fastest growing economies in the world from which emerging are the young and successful entrepreneurs with small and medium enterprises. These small and medium enterprises (SMEs) have played a vital role in economic growth across the globe. They are contributing to the national economy by adding employment, production and exports (Shashank *et al*., 2013). Acknowledging the growth and future of these SMEs, many multinational companies joined hands with these SMEs to gain a cost advantage and entry into the Indian market. To satisfyincreasing demands of the market and deal with global business partners these SMEs felt need of superior technology and planning tool.Enterprise resource planning (ERP) products fulfill these requirements and hence preferred by SMEs even though cost impacts are high. For organizations seeking growth and competitive advantage, ERP systems always considered as a strategic investment and not expenditure.

ERP systems are the packages in software form, which brings together all the business functions such as marketing, projects, manufacturing, sales, finance, human resources, and budgetingtogether with customer service activities. ERP systems offer significant benefits, such as reduced inventory, faster information processing, shorter project cycles, better financial management, efficient sup-

*Author for correspondence

ply chains, reduced transportation and logistics costs, increased productivity, and improved turnaround time to customers, if used effectively and efficiently.

Organizations are providing significant attention and exercising extra care for making their ERP systems more effective and efficient, but even so, not all ERP implementations have yielded the desired results. Factors which persuadethe success and failure of the ERP may be called as Critical Success Factors (CSFs) or Critical Failure Factors (CFFs). These factors may affect the implementation process as they are interdependent. The impact depends upon the degree of relationship. Hence, for effective ERP project management,it is important to understand the mutual relationship among these factors.

2. Literature review

ERP implementation is considered as an important process improvement and performance improvement tool in an organization, as it is based on best practices, which are derived by studying the processes of top firms in the world in a particular industry. ERP has been implemented throughout the world in different sectors and industries. As the implementation is based on best practices, organizations are able to experience better efficiency in their operations, reduced inventory levels, reduced safety stock levels, faster deliveries to the customers, enhanced production, greater visibility across the supply chain and many more process improvements as compared to the pre-implementation phase. These improvements were possible if the organization was able to successfully implement the ERP system in the organization and all the employees were ready to use the ERP system to do their day to day operations. This definitely is not an easy task as it requires a massive change in the way people were doing their day to day tasks. In past CSFs of ERP implementation has therefore provoked a lot of interest of many researchers from all over the world, in terms of understanding the critical factors, which led to the success of the implementation. The objective of this literature review is to list out the critical factors in ERP implementations as studied by the various authors.

Sawah et al.[28] developed and empirically tested a model that investigates ERP implementation success as a function of interrelated CSFs extracted from literature with help of Egyptian case study. They studied the factors top management support, companywide commitment, organizational fit ERP package, effective project management, user's involvement and education, external support, organizational culture, and trust in the ERP community.

As per Schniederjans and Yadav[3], new research should broaden the viewpoint of trust in the ERP Community. The authors focus on trust that exists between organizations implementing ERP, i.e., vendors and consultants and also trust that exists regarding the ERP system itself.

Akkermans and Helden[33] conducted a study of ERP implementation in an aviation industry. The study highlights that interdepartmental collaboration and communication within the project team as one of the core processes for the success of the ERP implementation. Attitudes of the ERP implementation stakeholders also play an important role in deciding the success or failure of the project.

Kirsch[34] builds a model to understand the dynamics of control and how it progresses at the different stages of the ERP implementation.

Dezdar[23] developed and empirically tested a CSF model for ERP implementation success from strategic and tactical perspective. Strategic success factors like business process reengineering, top management support, project management and tactical success factors like ERP vendor support, enterprise-wide communication, user training and education positively related with the successful ERP implementation.

Piotr Soja[15] proves in certain circumstances, the influence of particular factors on the ERP projects success is different, thus giving insight into the genuine mechanisms for measuring and determining ERP project outcome. His study shows actual impact of factors on project success, recognizing those of greatest influence.

Nah and Delgado[5] suggested seven categories of the CSFsacross the four phases of ERP lifecycle. Project management, ERP team composition,system analysis, selection and technical implementation, skills and compensation are most important factors in the project phase.Top management support and championship and business plan and vision are critical during chartering phase, while change management and communication, are important during project and shakedown phase. A detailed literature review mentioning the critical success factors selected by the different authors for their study is mentioned in Table 1.

Table 1. Literature review

Author	Critical success factors for ERP Implementations
Sumner[10]	Organizational fit, User involvement and training, Skill mix, Project management, Management structure and strategy, Software systems design, Technology planning, Social commitment
Akkermans and Helden[33]	Clear goals and objectives, Management of expectations, Top management support, Vendor support, Project management, Project team competence, Careful package selection, Interdepartmental co-operation, Interdepartmental communication, Project champion
Grabski et al.[22]	Risks associated with project complexity, The lack of alignment of the new information system and business processes, Users' resistance , The possible loss of control due to decentralization of decision making, The potential lack of in house skills.
Iskanius[12]	Technological, Organizational, Entrepreneurial, Contractual Financial risks, Business-related.
Sawah et al. [28]	Top management support, Company-wide commitment, Organizational fit of ERP package, Effective project management, User's involvement and education, External support Organizational culture.
Schniederjans and Yadav[3]	In-house IT expertise, Project management, Competent project manager, Change management, Ease of use, Careful package selection, Accurate data, Resources / assets, IT infrastructure, Testing after Implementation, Top management support, Trust, Teamwork, Communication, Training, Information flow management.
Remus[29]	Change management, Architecture choice, Minimal customization, Business Process Reengineering, Education on new business processes, User training on software, Use of steering committee, Dedicated resources, Data analysis & conversion, Careful package selection, Vendor support, Project champion, Management of expectations, Interdepartmental communication, Project management, Clear goals and objectives, Interdepartmental cooperation, Team competencies and skills, Top management support
Woo[7]	Project management, Top management, Education and training, Project team,Process change, Communication.
Xu et al. [8]	Communication, Training, Data Quality control, Top management support, Manage change, Employee relation
Chockalingam and Ramayah[1]	Long Term Management Support, Setting up of business goals and Objectives, Perceived ERP benefits,Cross-Functional Teams, ERP in-house Training, Business Process Reengineering,Project tracking, Visible Project Phases, Project Phase Update, Interdepartmental Cooperation , Interdepartmental Communication, Appropriate ERP Architecture,Strategic IT planning, Data Analysis and Conversion, ERP Vendor Support
Mehrjerdi[31]	Interdepartmental communication, Management of expectations, Top management support, Interdepartmental co-operation, Project management, Project champion, Careful package selection, Project team competence, Clear goals and objectives, Vendor support.
Finney and Corbett[27]	Top management commitment and support, Client consultation, Post-implementation evaluation, Visioning and planning, Team morale and motivation, Consultant selection and relationship, Communication plan, Project team: the best and brightest, Empowered decision makers, Implementation strategy and timeframe, Change management, Selection of ERP, Training and job redesign, Balanced team.
Franc et al.(2009)	Business plan and long-term vision, Project teamwork and composition, Organizational culture and change management, testing and troubleshooting, Top management support, BPR and customization, Effective communication, Software development, Project champion, Project management, Organizational structure, End-user involvement, Knowledge management, Monitoring and evaluation of performance.
Dezdar and Ainin[25]	Team Composition & Competence, Project Management, BPR
Helo et al.[14]	ERP package selection,Process management, Project management, Training and education, Legacy systems management, Systems interaction, Cultural and structural changes, Communication between organization and people, Systems testing,
Upadhyay et al. [13]	Project execution competency, Package and vendor perspective, Organizational climate, Technical perspective
Saini et al.[26]	Technological factors, People factors, Organizational factors

Author	Critical success factors for ERP Implementations
Dezdar[23]	**Strategic Success Factors** Business Process Reengineering, Top Management Support, Project Management **Tactical Success Factors** ERP Vendor Support, Enterprise-Wide Communication, User Training and Education
Soja[15]	Project Manager, Motivation System, Top Management Support, Top Management Participation, Linking with Strategy, Implementation Goals, Pre-Implementation Analysis, Appropriate Training, Project Team Empowerment, Work Time Schedule, Minimal Customization
Sharma and Yetton[16]	Training, Technical Complexity, Task Interdependence
Dezdar[24]	User Training and Education, Enterprise-Wide Communication, ERP Vendor Support.
Nah and Delgado[5]	Business plan and vision, selection and technical implementation, System analysis,ERP team composition, skills and compensation, Project management, Communication, Change management, Management support and championship.

3. Research Objective

Earlier research work has shown that successful ERP implementation is positively related with performance outcomes, such as financial profitability and performance, as well as human outcomes, such as employee satisfaction, customer satisfaction, and all the various stakeholder satisfaction as a whole. However, in practice an ERP program is not easy to implement and requires a lot of change in the way business operates. The benefits are also not easily visible and require a lot of time to obtain the tangible outcomes of the change. People need to leave their comfort zone of doing task in a certain way and adapt to new processes. Many ERP implementations have failed due to inadequate effort by the top management to push the agenda down to all the employees of the organization. It is therefore paramount to ascertain the reasons or critical success factors, which enable successful ERP implementation. It is also important to ascertain the relationships between the CSF variables. The main objectives of this paper are:

- to identify CSFs in ERP implementation in small and medium scale enterprises.
- to find out the interactions among the identified variables using interpretive structural modeling (ISM) approach
- to propose structural model of CSFs in ERP implementations
- to analyze and categorize success factors affecting ERP implementation in terms of driving and dependence power.
- to analyze and discuss the managerial implications of the research.

4. Research Methodology

Case study methodology has been adopted for the study. A small and medium scale company named BBM Acoustic India Private Limited, located in a metropolitan city of India named Pune was selected. The company is a 100% subsidiary of BBM Akustik Technologie, Germany. BBM provides solutions in the area of industrial noise problems for more than 25 years.It provides solutions whenever unwanted noise has to be attenuated. BBM reduces noise mainly for power plants and chemical installations. The various service offered by the company areproduct specific consulting, assembly or assembly supervision from large silencers to noise enclosures, acoustic planning, manufacturing and delivery,. The company gets job works which are project type, with fixed schedules and deliverables. Project life cycles are of 1 to 3 month's duration and project revenuesarein the range of 1 to 30 billion in Indian currency (INR).

As the business of the company grew and demands from the German counterpart increased, the company spotted the need for ERP system, which could integrate their processes and meet the requirements of customers on time. With due diligence, BBM India decided to implement ERP system for their operations from a company named Infor LN.The Project team comprising of experts from every function were engaged for implementation and all the required facilities were made available to them. The implementation started in month of April,2012 and finished by July, 2012, i.e. approximately 4 months.

From August,2012, BBM started using the ERP for all its functions. Eventually ERP started reaching each indi-

vidual and problems started floating up to the surface. Project team handled these issues with the help of consultants deputed for support. Consultants left after complete handover ofall the set system. Six months after complete handover, the review taken forfunctional fitness of system, but found that it is not yielding expected outcome as per the set targets. Hence, the need for finding short falls in the implementation or in other words factors influencing implementation success aroused to decide further course of action.

From the above discussions and literature review, ascertaining the relationship among the CSFs in ERP implementation is a complex task, as it may have many linkages with one or the other factors. In such situations, ISM model is useful in constructing direct and indirect relationships among the said variables and describes the situation much more accurately than the individual variables taken into isolation. The ISM model helps in developing collective understanding of these relationships.

4.1 Identifying Variables of CSFs of ERP Implementation

To identify variables that can be used for building the CSFs of ERP implementation model, an exhaustive literature review has been carried out, brain storming and expert opinion from the small the medium size enterprises and faculty member in the ERP domain were consulted. These experts from academia and industry were very well conversant with issues of ERP implementation. Thus, 10 critical success factors have been identified, which have been listed below:

1. Top management commitment and support (V1)
2. Organizational fit ERP package (V2)
3. Organizational culture & communication (V3)
4. Effective project management (V4)
5. User's involvement and training (V5)
6. Consultant selection and relationship (V6)
7. Change Management (V7)
8. Business Process Re-engineering (V8)
9. ERP team composition, skills and compensation (V9)
10. Implementation strategy and timeframe (V10)

A brief discussion of the variables used in the study is mentioned in Table 2.

4.2 ISM and Development of Structural Model

Interpretive Structural Modeling (ISM) was first proposed by Warfield in 1973[30]. ISM helps in impose order and direction to a set of related variables and arrange them in a systematic hierarchical model known as structural

Table 2. Brief description of the variables used in the study

Variables	Description
Top management commitment and support (V1)	Strong, devoted, and perceptible top management to promoteERP and to support the implementation process.
Organizational fit ERP package (V2)	Selection, minimal customization
Organizational culture & communication (V3)	Flexible enough to accept change & controlled, regular and accessiblecommunication
Effective project management (V4)	Led by a good project manager with execution plans, schedules,control procedures and milestones.
User's involvement and training (V5)	Appropriate for the employees' needs, as well as meeting the needs of the company
Consultant selection and relationship (V6)	Part of implementation team, effective knowledge transfer, post implementation support
Business Process Re-engineering (V8)	To make more compatible with ERP systems, aligned to best business practices strategy
ERP team composition, skills and compensation (V9)	A cross-functional and qualified team thatalso consist of suitableconsultants. Remunerating employees who are providing extra effort for the cause
Implementation strategy and timeframe (V10)	Aligned with organization strategy, defined and practical timeframes

model[19]. In solving problems, it uses the expert's practical experience and knowledge to break the complicated system into subsystems and construct multilevel model. The ISM methodology is based on the expert opinion and therefore the experts opine whether the variables are related to each other and the direction of the relationship. ISM has been used in various fields. Jharkharia[20] has used ISM to ascertain the critical failure factors in ERP implementation. Singh and Sushil[2] have used ISM to model the enablers of TQM to improve airline performance. Ramesh et al.[17], Faisal et al.[4], Jharkharia and Shankar[21] and Ravi and Shankar[18] have used the ISM model in the supply chain arena.

The various steps involved in ISM technique are as given below: (Singh and Sushil[2], Jharkhari[20] and Sushil, 2012)

a. Identification of variable relevant to the problem or issue. This could be done with group problem solving technique like brain storming. Delphi technique also can be used.
b. Contextual Relationship between the variable to be established. In case of intent structure contextual relationship can be that of "lead to" type.
c. Developing structural self-interaction matrix (SSIM), which indicate pair wise relationship between the variables of the system.
d. Developing reachability matrix from SSIM by converting information into binary numbers reachability matrix "0" and "1" in each cell.
e. Reachability matrix then checked for transitivity. Transitivity is the basic assumption in ISM, which states that if a variable *i* is related *j* and *j* is related to *k* then *i* is necessarily related to *k*
f. Partitioning of the reachabilty matrix into different levels on basis of reachability and antecedents sets for each variable through iterations called as level partitioning.
g. On the basis of reachabilty matrix and level partitioning, a conical or lower triangular matrix formed from which a directed graph (DIAGRAPH) is evolved by removing all transitive links (indirect links).
h. The resultant diagraph is converted into ISM based model, by replacing variable nodes with statements.
i. Finally ISM model is examined for the structural inconsistency and make necessary modifications.

4.3 Development of Model

A number of factors affect the ERP implementation process. If these factors are studied in isolation, they will not describe the situation precisely, instead taking them together and studying relationship among them, helps in developing an understanding of the model. ISM develops understanding of these relationships collectively converting unclear, badly expressed mental models into obvious, well defined model.

For establishing a contextual relationship between variables with respect to the pairs of variables,the expert panel comprising of ten members involved in ERP implementation from BBM acoustic India Private Limited are called for consultation. All the panel members were departmental heads, who spearheaded the ERP implementation process and who have an understanding of the level of success of the ERP implementation in their company, the reasons for success and the reasons for failures.

5. Developing Structural Self Interaction Matrix

A structural self-interaction matrix (SSIM) of CSFs of ERP implementation indicates pair-wise relationships between CSFs. To analyze the CSFs, a contextual relation "Lead to" type was chosen. This means that one CSF*i*lead to another CSF *j*; the latter will be lead by another CSF; the two CSFswill lead each other or the CSFs will be unrelated. For analyzing the barriers in developing SSIM, the following four symbols have been used to denote the direction of relationships between barriers (i and j):

V= CSF i will lead toCSF j;
A= CSF j will lead toCSF i;
X= CSF i and j will lead toeach other and
O=CSFI and j are unrelated to each other

The results of the Self-Structural Interaction Matrix are given in Table 3.

Reachability matrix (RM)

The SSIM has been converted into a binary matrix, called the reachability matrixas depicted in Table 4 by substituting X, A, V and O by 1 and 0. The substitution of 1s and 0s are as per the following rules:

Table 3. Self-structural interaction matrix

FACTOR		J									
		V10	V9	V8	V7	V6	V5	V4	V3	V2	V1
	V1	X	V	V	V	X	V	V	A	V	
	V2	O	O	O	O	X	O	V	O		
	V3	V	V	V	V	V	X	V			
	V4	X	X	A	A	X	X				
i	V5	X	A	A	A	A					
	V6	X	X	V	X						
	V7	V	X	X							
	V8	X	V								
	V9	X									
	V10										

Table 4. Reachability Matrix

FACTOR		J										Driving Power
		V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	
	V1	1	1	0	1	1	1	1	1	1	1	9
	V2	0	1	0	1	0	1	0	0	0	0	3
	V3	1	0	1	1	1	1	1	1	1	1	9
	V4	0	0	0	1	1	1	0	0	1	1	5
i	V5	0	0	1	1	1	0	0	0	0	1	4
	V6	1	1	0	1	1	1	1	1	1	1	9
	V7	0	0	0	1	1	1	1	1	1	1	7
	V8	0	0	0	1	1	0	1	1	1	1	6
	V9	0	0	0	1	1	1	1	0	1	1	6
	V10	1	0	0	1	1	1	0	1	1	1	7
Dependence		4	3	2	10	9	8	6	6	8	9	

If the (i,j) entry in the SSIM is V, the (i,j) entry in the reachability matrix becomes 1 and the (j,i) entry becomes 0;

If the (i,j) entry in the SSIM is A, the (i,j) entry in the reachability matrix becomes 0 and the (j,i) entry becomes 1;

If the (i,j) entry in the SSIM is X, the (i,j) entry in the reachability matrix becomes 1 and the (j,i) entry also becomes 1;

If the (i,j) entry in the SSIM is O, the (i,j) entry in the reachability matrix becomes 0 and the (j,i) entry also becomes 0;

6. Level Partitioning

From final reachability matrix, reachability set and antecedent set for each CSF is found. The reachability set consists of the CSF itself and other, which it may help to achieve; similarly the antecedent set consists of CSF itself and the other CSF which help in achieving it. Then, the intersection of these sets is derived for all CSFs. The CSF for which the reachability and intersection sets are same is the top level CSF in the ISM hierarchy.

The top-level CSF in the hierarchy would not help achieve any other CSF above its own level. Once the top

Table 5. Level Partitioning (Iteration 1)

FACTOR	Rs (REACHABILITY SET)	As (ANTECEDENT SET)	Rs ∩ As (INTERSECTION SET)	LEVEL
V1	1,2,4,5,6,7,8,9,10	1,3,6,10	1,6,10	
V2	2,4,6	1,2,6	2,6	
V3	1,3,4,5,6,7,8,9,10	3,5	3,5	
V4	4,5,6,9,10	1,2,3,4,5,6,7,8,9,10	4,5,6,9,10	1
V5	3,4,5,10	1,3,4,5,6,7,8,9,10	3,4,5,10	1
V6	1,2,4,5,6,7,8,9,10	1,2,3,4,6,7,9,10	1,2,4,6,7,9,10	
V7	4,5,6,7,8,9,10	1,3,6,7,8,9	6,7,8,9	
V8	4,5,7,8,9,10	1,3,6,7,8,10	7,8,10	
V9	4,5,6,7,9,10	1,3,4,6,7,8,9,10	4,6,7,9,10	
V10	1,4,5,6,8,9,10	1,3,4,5,6,7,8,9,10	1,4,5,6,8,9,10	1

Table 6. Level Partitioning (Iteration 2)

FACTOR	Rs (REACHABILITY SET)	As (ANTECEDENT SET)	Rs ∩ As (INTERSECTION SET)	LEVEL
V1	1,2,6,7,8,9	1,3,6	1,6	
V2	2,6	1,2,6	2,6	2
V3	1,3,6,7,8,9	3	3	
V6	1,2,6,7,8,9	1,2,3,6,7,9	1,2,6,7,9	
V7	6,7,8,9	1,3,6,7,8,9	6,7,8,9	2
V8	7,8,9	1,3,6,7,8	7,8	
V9	6,7,9	1,3,6,7,8,9	6,7,9	2

Table 7. Level Partitioning (Iteration 3)

FACTOR	Rs (REACHABILITY SET)	As (ANTECEDENT SET)	Rs ∩ As (INTERSECTION SET)	LEVEL
V1	1,6,8	1,3,6	1,6	
V3	1,3,6,8	3	3	
V6	1,6,8	1,3,6	1,6	
V8	8	1,3,6,8	8	3

Table 8. Level Partitioning (Iteration 4)

FACTOR	Rs (REACHABILITY SET)	As (ANTECEDENT SET)	Rs ∩ As (INTERSECTION SET)	LEVEL
V1	1,6	1,3,6	1,6	4
V3	1,3,6	3	3	
V6	1,6	1,3,6	1,6	4

Table 9. Level Partitioning (Iteration 5)

FACTOR	Rs (REACHABILITY SET)	As (ANTECEDENT SET)	Rs ∩ As (INTERSECTION SET)	LEVEL
V3	3	3	3	5

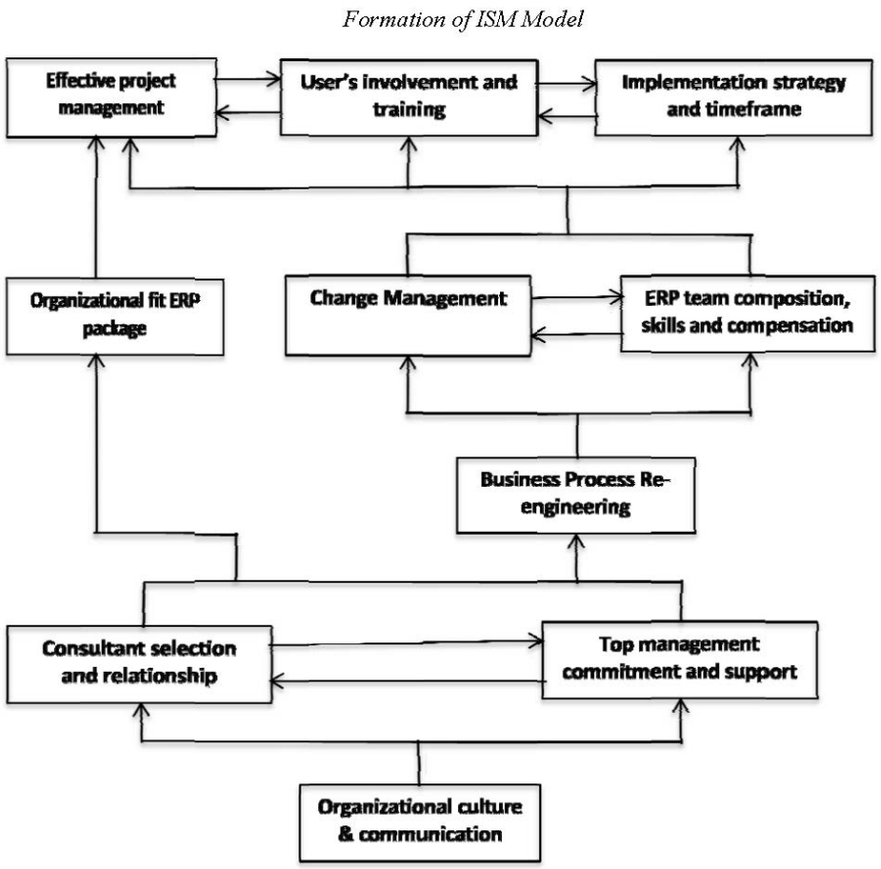

Figure 1. **Structural Model of CSF's in ERP Implementation.**

level CSF identified, it is separated out from the other CSFs. Then, the same process repeated to find out the CSFs in the next level. This process continued until level of each CSF is found. The resulting levels help in building

7. MICMAC Analysis

MICMAC analysis helps in categorization of variables of the study in terms of driving and dependence power. The variables are classified into four different clusters based on their driving and dependence power, which is derived from the reachability matrix as given in Table 4. Figure 2 shows the dependence and the driving power of variables. The first cluster is a group of "*Autonomous variables*" that have weak driving and weak dependence power. These variables are relatively disconnected. The result shows that CSF 'Organization Fit ERP Package (V2)' is in autonomous cluster. The second cluster is a group of "*Dependent variables*" that have weak driving and strong dependence power. In our case 'User involvement and training (V5)' is in this cluster. The third cluster is a group of "*Linkage variables*" that have strong driving and strong dependence power. These variables are very important variables as they have a significant impact on the variables and therefore a change in these variables could have a ripple effect on all the other variables. In our case 'Effective Project Management (V4), Consultant Selection and Relationship (V6), Change Management (V7), Business Process Re-engineering (V8), ERP Team Composition, Skills and Compensation (V9), Implementation Strategy and Timeframe (V10)' are in this cluster. This also indicates that the CSF's above these will get impacted if any changes made to these. The management therefore needs to take special care of these variables. The forth and last cluster is a group of "*Independent variables*" that have strong driving and weak dependence power.In our case 'Top Management Commitment and Support (V1) and

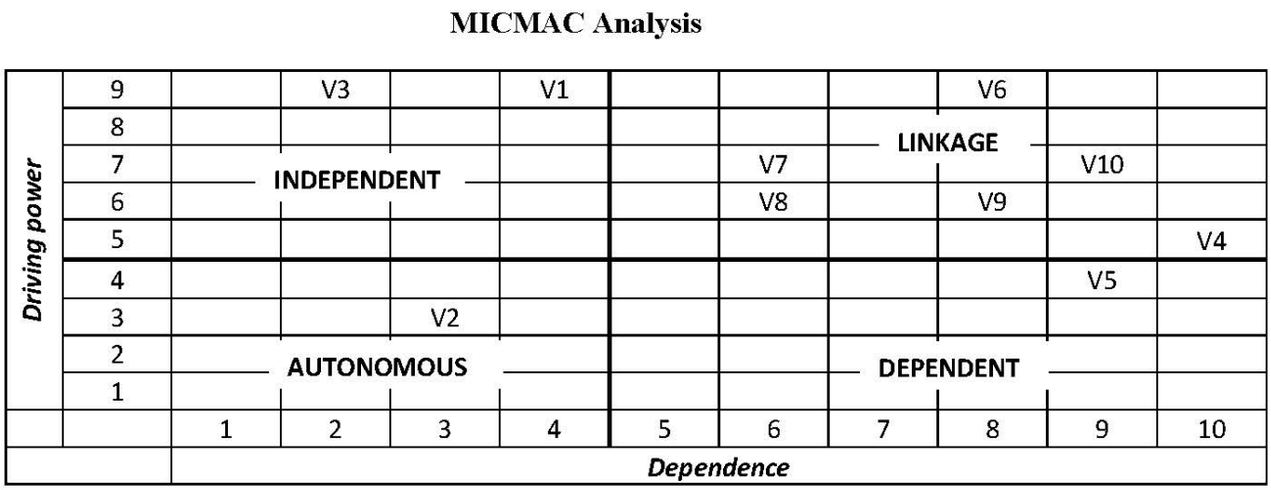

Figure 2. **Driving Power and Dependence Diagram.**

Organizational Culture &Communication (V3)' fall in this cluster. Hence, these CSFs are the most important and have great influence on other CSFs.

8. Total Interpretive Structural Modeling (TISM)

The ISM model suffers from the limitation of subjectivity as it does not explain the interpretation of the links and therefore lacks complete transparency. The partial interpretations of link lead to multiple interpretations by different users. This also remains silent on reasoning of links thus leading to limitations in answering 'why' in theory building. Hence interpretive matrix to interpret links is used, which is directly applied on structural model. This indicates interpretation of relationships on pair of elements in cells. This can be done by answering the question 'why' the relationship exists between two elements. Thus total interpretive structural model can be developed by showing the interpretation of relations by the side of the link joining the pair of elements having relation.

In order to convert ISM into TISM, interpretive matrix can be developed by fully interpreting each paired association with an aim to find how directional relationship operates in the structure by answering query 'why' as mentioned above. For paired comparison, the i^{th} element is judged against individually to all elements from $(i+1)^{th}$ to n^{th} element. If there are n elements, there will be altogether n(n-1)/2 paired comparisons. Given that each pair of elements (i, j) may have 2 possible direction links i->j or j->i, it result into in all n(n-1) rows in the knowledge base. For each link, answer could be 'Yes' or 'No' and if it is 'Yes' then is further interpreted thus building 'interpretive Logic- Knowledge Base'. We have derived our inspiration to use TISM in our present work as an extension of ISM after reviewing some of the works carried out by scholars like Singh and Sushil[2] and Prasad and Suri[32].

9. Limitations and Scope for Future Research Work

The research work conducted has used 10 CSFs, while some more variables can be relevant to develop the ISM model. The ISM model developed is based on expert opinion of few people and therefore some amount of bias in this work cannot be discounted. The research work have developed theoretical structural model using TISM and ISM, but these models have not been statistically validated using techniques like structural equation modeling (SEM), Multiple Regression, Moderating and Mediating Regression, etc., which can be scope for future research work.

10. Conclusion and Managerial Discussion

In this present research work TISM and ISM based model has been developed for ascertaining the CSFs of ERP implementation in a small and medium scale company in Indian context. In this research work an attempt has been made to identify the relevant CSFs of ERP implementa-

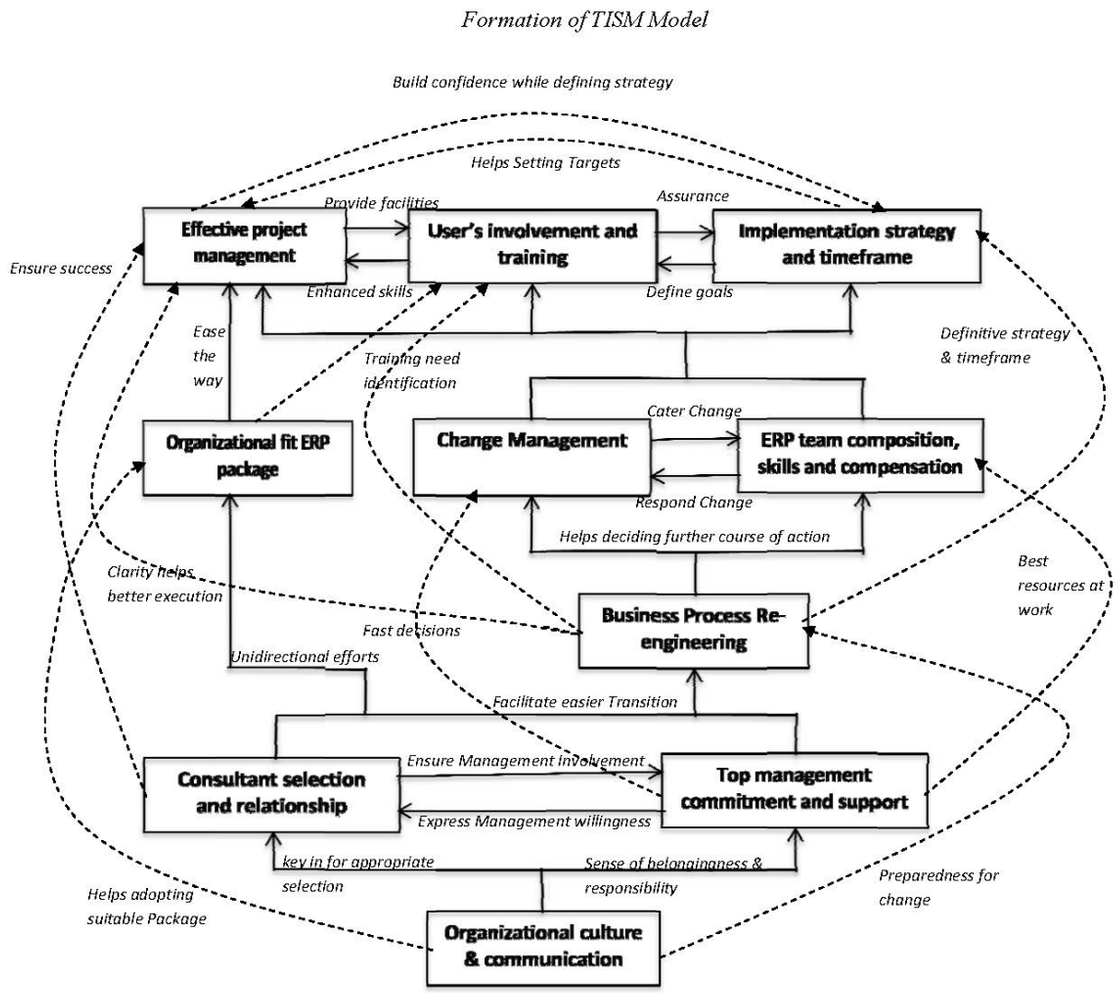

Figure 3. Total interpretive Structural Model of CSF's in ERP Implementation.

tion. Although a large amount of literature is available on CSFs of ERP implementation, no study has been done to understand the interactions among these CSFs. The contribution of this research work is the development of contextual relationships among the identified variables through a systematic framework.

A major finding of this research work is that "Top management Commitment and Support (V1) and Organizational Culture &Communication (V3)", are strongest CSFs, which have strong driving and weak dependence power and lie at the bottom of the ISM hierarchy. This can help the top management in deciding on the priority and focus on these variables, which would lead to the desired outcome of successful ERP implementation and enhanced firm performance and efficiency across the organization.

When ISM model & MICMAC analysis results are linked with the company, it has provided a valuable insight towards ERP implementation process. The several interesting findings of study and ISM model suggest that 'Organization Culture and Communication' along with 'Top Management Commitment and Support' and 'Consultant Selection and Relationship' are at the root of other CSFs and have great influence on other success factors. On other hand 'Effective Project Management', 'User's Involvement and Training' and 'Implementation Strategy and Timeframe' are the factors with low driving power and high dependence. They are at the top of ISM model. According to their positions in the driving power and dependence diagram, the factors need serious attention and considerations in the process of successful implementation of ERP.

The ISM model has been upgraded to the TISM by including the interpretations in each relation. This makes the model entirely interpretive, thus building the knowledge base of logical interpretations of all relations. The ISM and TISM modeling of the variables strengthens the practical views of ERP implementation team and depicts a clear picture about the significance of different enablers. The different enablers can thus be identified and dealt with utmost care for the successful implementation of ERP in a small and medium enterprise in the Indian context.

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