Prioritizing and Ranking Critical Success Factors for ERP Adoption in SMEs

DOI: 10.26573/2012.6.1.2
Volume 6, *Number* 1
January 2012, *pp.* 23-40

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The Enterprise Resource Planning (ERP) Adoption by Small and Medium Enterprises (SMEs) has invoked immense interest in the research community. Though ERP is believed as a key technology enabler and an effective management tool for organizations, the SMEs are faced with cost, resource and time limitations to adopt ERP into their business. Hence it is important to identify certain critical success factors that could be referred by SMEs to gain confidence in adopting ERP. The existing literature was explored and thirty Critical Success Factors (CSFs were identified for SMEs. The ERP adoption journey involves five sequential decision stages/phases namely planning, acquisition, implementation, usage and percolation and extension. We propose a framework to prioritize and rank CSFs using analytical hierarchy process (AHP) one of the widely accepted multi-criteria decision making method (MCDM).

Keywords: ERP Adoption, MCDM, AHP, Critical Success Factors (CSFs), SMEs, Analytical Hierarchy Process

1. Introduction

Enterprise Resource Planning (ERP) primarily means the integration of core processes in a set of given business functions of an organization like accounting, production, inventory, sales and distribution, human resource management, service and maintenance, logistics etc. ERP systems are software solutions for business managers that provide seamless integration of business functions also known as modules within an organization in a consistently visible manner. From its evolution as a mere inventory control package in the 1960s ERP today has been accepted as a driver of operational efficiency and growth of business (Pasha, 2007). ERP systems are always looked upon as large and complex systems and often called for fundamental changes in the current working of an organization. The foundation of the organizational core processes are re-laid during the process of an ERP implementation which affects the reporting and decision-making processes (Holsapple and Sena, 2005). Organizations that implement ERP expect productivity improvements, competitive advantage and meeting customer demands as key business drivers (Scott and Shepherd, 2002). Many ERP systems have failed during

implementation or have resulted in forced abandonment due to the cost and time over-runs rendering an irreparable loss to the organizations (Davenport 1998). Even large corporations have resulted in a complete failure to achieve the business objectives (Peterson, Gelman, Cooke, 2001).

The Indian Industry, in particular, which comprises of many Small and Medium Enterprises (SMEs) in various segments or clusters are also influenced by Enterprise Resource Planning drive. However, the SMEs are constrained by size in terms of finance and business resources and they are hesitant and skeptical towards embracing information technology as a driver for growth (Dwivedy and Harigunani (2008), Misra (2009). SMEs, moreover, are limited in intellectual capital and supportive manpower to drive the strategic IT initiatives of ERP. Hence considering these factors, ERP adoption for SMEs is a complex process.

ERP Adoption is defined as an end-to-end journey of enabling an ERP working environment in any SME. The journey of adoption involves five sequential, but distinct phases namely planning, acquisition, implementation, usage and percolation and extension. These five phases are based on six different stages for adoption and system acquisition decision in the ERP system life cycle (Esteves and Pastor, 1999). The objective of this paper is to prescribe a set of Critical Success Factors (CSFs) to the Small and Medium Enterprises (SMEs) by evaluating some key decision phases for ERP adoption and then prioritize and rank relevant critical success factors in the decision phases. This will enable SMEs to take relevant decisions regarding suitability of ERP to their businesses. In this study we have used Analytical Hierarchy Process (AHP), (Saaty, 1980, Vaidya and Kumar, 2006), one of the methods of Multi-Criteria Decision Making (MCDM) for ranking and prioritizing the CSFs in each of the decision phases and the decision phases as a whole. This paper is divided into five sections. The next section discusses the relevant literature review. Section Three briefly explains Analytical Hierarchy Process as a MCDM tool. Section Four proposes the framework for prioritizing and ranking CSFs for ERP adoption by SMEs and the managerial implication on the prescribed list of CSFs and Section Five lists out the findings and future directions based on the results.

2. Literature Review

Many researchers have identified critical success factors for ERP implementation in SMEs. For instance, Esteves and Pastor (1999), proposed six different stages for adoption and system acquisition decision in the ERP system life cycle. These stages were a) Adoption decision, b) Acquisition, c) Implementation, d) Use and maintenance, e) Evolution and f) Retirement. Oliver and Romm (1999) have also recommended the need for Adoption Decision. Gable and Stewart (1999) investigated certain factors in the ERP context specific to smaller organizations mainly in the implementation area. Sistach *et. al.* (1999) worked on a methodical approach to the acquisition of ERP solutions by SMEs. Tang and Bernroider (2003), in their preliminary empirical study of the diffusion of ERP systems in Austrian and British SMEs presented the work-in-progress of an international research project, wherein, they focused on the early stages of making the adoption decision, there after evaluating and selecting an ERP. Their study attempted to close some of the identified gaps in ERP research with an objective to link the results of the early stages of decision-making to implementation, usage and evolution success. Their

study was restricted to the case of ERP software, but also provided insights into the potential of integrating ERP and other important applications like CRM and SCM.

Laukkanen *et al.* (2005) investigated the relationship of enterprise size to the constraints and objectives of ERP. The survey data was based on forty four companies and revealed that significant differences existed between small, medium-sized and large enterprises in the adoption of ERP system. The author found that smaller companies experience bigger knowledge constraints than their larger counterparts in ERP adoption. Niclas and Marcus (2005), in their study presented an overview on the critical success factors across different stages of ERP life cycle for SMEs. Juell-Skielse (2006) analyzed the organizational effectiveness due to adoption of ERP functions and the related CSFs. Tommaso, (2007) researched the ex-post evaluation of success factors of ERP in SMEs and found that the introduction of ERPs into SMEs cannot be on a sheer reproduction of the experiences with larger companies and represents a new challenge with significant uniqueness to be addressed. His research was specifically targeted to the SMEs, which already completed the process of adopting an ERP system. The objective was evaluation of these experiences ex-post by examining some improvement indicators associated with the ERP project. Bharathi, Parikh, (2009) in their study on building a Unified Theory on CSFs for ERP adoption in SMEs established five decision areas namely Planning, Acquisition, Implementation, Usage and Percolation and Extension include a set of 39 critical success factors which were identified based on some of the important drivers of each of these five decision areas.

Doom and Milis (2009) in their survey on CSFs for ERP implementation in SMEs categorized CSFs into six categories namely vision, scope and goals, culture, communication and support; infrastructure; approach and project management. Some of their key findings amongst others were related to vision and strategic goals of the ERP implementation, senior management support, active user involvement, culture, internal communication, project approach and methodology and a proper mix of users in the project team. Snider, *et. al* (2009), in their case based research analysis of Canadian SMEs identified factors that differentiated between successful and unsuccessful implementations. The practical implication of their study was that managers can better prioritize the implementation efforts and resource management if they were to identify relevant CSFs for SMEs. Some of the factors identified were operational process discipline, small internal team, project management capabilities, external end-users training, lack of formal communication etc. Upadhyay, Parijat and Pranab (2009) made a post implementation study on CSFs for ERP implementation in the Indian context which was targeted to the SMEs which had completed ERP adoption.

Moreover, for quantification of CSFs researchers adopted a number of methodologies like scoring, ranking, mathematical optimization etc. to ERP Projects a summary of which is given in the following Table 1.

These mathematical models may sometimes be ineffective in addressing the unquantifiable attributes prevailing in the real world and may also be difficult for managers to interpret and implement. This is because these models are developed by considering a specific scenario in an industry which may be different to the other industry. Moreover, our paper addresses the ERP adoption in Small and Medium Enterprises (SME) and hence we believe that use of MCDM can provide ease of understanding to the decision-maker in a SME.

This study is an attempt to apply one of the widely used MCDM methods, the AHP to rank and prioritize critical success factors for ERP adoption in SMEs. The expected benefits of this research would be to have an understanding on the role of CSFs in each of the five decision phases of ERP adoption by SMEs. It will provide the decision maker to sequentially approach towards ERP adoption since ranking and prioritizing the CSFs and the decision phases will facilitate confident decision-making.

Table 1 *Methods of evaluating CSFs of ERP*

Methods in Practice	Description
Scoring Method	Lucas and Moore (1976) used this method which was intuitive and too simple to accurately reflect opinions of the decision makers
Ranking Approach	Buss (1983) proposed this approach for comparing computer projects. This method is intuitive.
Non-Linear Programming	Santhanam and Kyparisis (1995, 1996) proposed this model to optimize resource allocations.

This research enables the integration of subjective judgments about CSFs and decision areas with quantifiable numerical data. It also enables participation of the decision maker in learning, debating, revising and refining his decisions.

3. The Analytical Hierarchy Process

The Analytical Hierarchy Process (AHP) was evolved by Thomas L. Saaty (Saaty, 1980). It is a methodology for multi-criteria analysis for decision making that enables decision makers to develop a hierarchical structure and to evaluate a large number of selected qualitative factors in a sequential and systematic manner. It involves structuring the problem and then deriving ratio scales to integrate the perceptions and purposes into a synthesis. Based on the hierarchical model, the AHP provides a method to assign numerical values to judgments which are subjective in nature based on their relative significance. Usually AHP follows a decomposition approach by breaking the total problem into sub-segments in such a manner that each of these sub-segments can be analyzed appropriately in relation to the total problem. The goal of this type of decomposition of the total problem into multiple levels is to facilitate pair-wise comparison of all the elements at each level and further be able to establish a relationship with its previous upper level. The Saaty's scale gives the intensity of significance and their justification. Some researchers have used AHP in ranking Information Systems selection. Schniederjans and Wilson (1991) used AHP to determine the relative weights of attributes along with goal programming for IS selection. Teltumbde (2000) proposed a framework along with Nominal Group Technique to ERP system evaluation. His study focused on some common criteria for ERP evaluation. Vijayakumar, Suresh, Subramanaya (2010) conducted a survey based on AHP to understand the criticalities of factors affecting ERP Implementation.

Taking the AHP methodology as a foundation, this paper attempts to prioritize a set of selected CSFs in each of the decision phases of ERP Adoption by SMEs. AHP methodology is applied on each of the CSFs on the basis of priority value obtained

from the Saaty's Scale. Consequently, this methodology is repeated for the decision phases as well. AHP provides a way of assigning numerical values to subjective judgments on the relative importance of each element and then to synthesize the judgments to obtain which elements have the highest priority. While fixing the intensity of significance both odd number (1, 3, 5…) and even number (2, 4…) values were assigned. For arriving at the weighted averages only spreadsheets (Excel) was used considering the limited number of qualitative factors and comparable pairs, although software like Expert Choice and Super Decision are available to the researchers. The computational details were obtained from Saaty (1980).

The advantages of using AHP in multi criteria decision making scenarios involves simplification of a complex problem into simple pair-wise comparisons, and construction of a hierarchy of goals, criteria and alternatives. It is very useful in complex decision-making. However, care should be taken in deciding the length of the process, which increases with the number of levels and number of pair-wise decisions and hence, the complexity as a whole.

4. The Framework

We identified several critical success factors that could be useful for SMEs. These CSFs were then grouped into five different ERP decision phases. These ERP phases were identified as a) Planning, b) Acquisition, c) Implementation, d) Usage and Percolation and e) Extension. In the following section we explain these phases. The ranking and prioritization is explained by using AHP. The ERP Adoption Model and the CSFs are given below in figure 1.

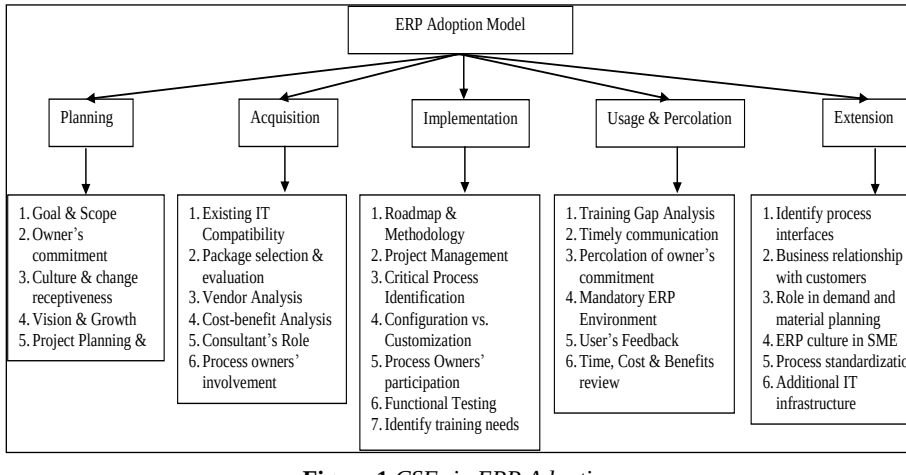


Figure 1 *CSFs in ERP Adoption*

We now briefly explain the considered Decision Phases (stages) and their relevant CSFs.

Planning (PLG)

In planning some of the factors that trigger decisions include the current status of business processes in core functional areas and their integration. Some critical

considerations are, current status of information flow efficiency, scope of ERP to cover mission critical processes, organizational maturity with regard to ERP readiness, and expectations of process owners' from a functional and technological perspective, time taken to go live with ERP and the budgetary requirements and financing pattern for the project.

The success of planning decisions depends upon understanding the factors that bridge the gap between current and desired states of business. These decisions determine the seriousness of the planning phase for which a set of five critical success factors are identified. They are

- Goal and Scope of ERP (GS) relate to internal and external business environment for the SME, status of certain core and customer centric business processes, information flow efficiency and the coverage of business functions considered for integration.
- Proprietor/Partners' Commitment (PPC) defines owner's understanding on the significance of information systems as a strategic enabler for driving growth and expansion.
- Culture and Change Receptiveness (CCR) defines the unit's age, organization's cultural understanding and the receptiveness to accommodate and appreciate change.
- Vision and Growth (VG) defines the owner's passion in the business and their trust about information systems as an enabler of realizing the vision in the long run.
- Project Planning and Scheduling (PPS) explains the expected time horizon for ERP implementation at the SME given the constraints of cost and time. It also relates to the budgetary requirements for the project and selection of the most viable financing pattern. The pair-wise comparisons of these CSFs are shown in Table 2.

Table 2 *Pair wise Comparisons for Planning*

	GS	**PPC**	**CCR**	**VG**	**PPS**	**Weights**	**Rank**
GS	1	0.2	0.25	1	1/3	0.071	5
PPC	5	1	2	4	3	0.419	1
CCR	4	0.5	1	2	2	0.244	2
VG	1	0.25	0.5	1	0.25	0.081	4
PPS	3	1/3	0.5	4	1	0.185	3

Consistency Index 0.046 Consistency Ratio 0.041

The analysis of the critical success factors in planning show that proprietor/partners' commitment is ranked as most important over the other factors.

Acquisition (ACQ)

The factors in this phase relate to the challenging task of finalizing the right solution for the business which is expected to realize the SME's future growth and expansion initiatives. The factors include current status of Information Technology (IT) compatibility, availability of industry specific ERP product vendors and their experience, scope of support before, during and after implementation, the available

ERP delivery models and their standings, successful product implementation in the peer group, requirement and role of an external consultant, guidance and support from SME cluster/industry association and costs (both explicit and hidden) associated with the ERP solution.

The success of Acquisition will be defined by reconciling existing IT infrastructure that would result in the right choice of the product, selection of implementation and knowledge (consultant) partner etc. In order to leverage on these issues a set of six critical success factors were identified. They are

- Existing IT Compatibility (EITC) relates to the status of IT infrastructure and the applications (if any) that are used in the SMEs.
- Software Package Selection and Evaluation (SPSE) is the result of identifying and studying industry-specific ERP products both domestic and international, their applicability in the SME space. It also includes information about the availability and suitability of the ERP delivery models like On-premise, On-demand (SaaS), Open-Source etc to the SMEs.
- Vendor Analysis (VC) is about analysis of the ERP solution provider about the expertise in planning, implementing and supporting the SME-ERP initiative, due-diligence study on vendor's financial, business continuity and disaster management etc.
- Cost-benefit analysis (CBA) defines comparison of expected savings to costs associated with the ERP initiative after taking into consideration the existing IT infrastructure and application (if any), other costs like consulting, package, implementation, migration, upgrades, training and support etc.
- Role of Consultant (RC) defines the business and technical expertise both conceptual and contextual with relevance to the SME domain, studying the availability and extent of possible use of the internal expertise of SMEs to reduce cost of consulting etc.
- Process Owners' Interaction (POI) with the consultant enables both the parties to have clarity on the expectations and outcomes from the ERP initiative.

The pair-wise comparisons of these CSFs are shown in Table 3.

Table 3 *Pair wise Comparisons for Acquisition*

	EITC	**SPSE**	**VC**	**CBA**	**RC**	**POI**	**Weights**	**Rank**
EITC	1	3	2	1	3	2	0.284	1
SPSE	1/3	1	1	0.5	1	2	0.130	4
VC	0.5	1	1	1	1	2	0.156	3
CBA	1	2	1	1	3	1	0.210	2
RC	1/3	1	1	1/3	1	2	0.121	5
POI	0.5	0.5	0.5	1	0.5	1	0.098	6

Consistency Index 0.067 Consistency Ratio 0.054

From Table 3 it can be found that the IT compatibility of the SMEs is ranked highest amongst the chosen six CSFs. On the second place is cost-benefit analysis of

the ERP system in light of both capital and operating expenditure after considering the existing IT infrastructure. Other CSFs will primarily depend upon these two factors.

Implementation (IPL)

This is one of the important decision phases in ERP adoption by SMEs. There are some critical factors that support implementation decisions. These are readiness of implementation roadmap, leading and managing project schedule, tasks and communication, number of process owners' involvement, implementation methodology, stage and extent of end-users' involvement, risk assessment regarding cost, time and efforts of implementation, stage of testing, identification of trainees and preparation of training calendar, documentation responsibility, identification of processes that might change and its extent.

Definition of success here is conversion of plans into actions through proper networking of the above stated factors that drive implementation. The objective of reducing the challenges of implementation decision depends upon a set of seven critical success factors which are

- Road Map and Methodology (RMM) calls for understanding about the expectations and deliverables from ERP by certain key stakeholders like proprietor, process owners (employees) and consultant.
- Project Management (PM) in SMEs involves project scoping, risk assessment on project scope change, identification of project owner in consultation with proprietor, schedule management, change management plan as approved by the proprietor, conflict management and resolution policies etc.
- Identification of Critical Processes (ICP) will enable a strong-hold on the purpose of ERP implementation by identifying the need, extent of reengineering certain processes to enable smooth transition to the ERP processes and also provide clarity on selecting and deploying key personnel based on consultant's advice to support, supervise the ERP initiative.
- Configuration vs. customization (CC) is about studying the degree of standardization of existing processes and issues relating to resource allocation and resource consumption for re-aligning and tailoring SME's processes to ERP defined processes.
- Process owners' participation (POP) defines the extent of involvement of certain key process owners during implementation and testing phase so as to ensure timely reinforcement of project objectives and reduce the gap between expectations and deliverables.
- Functional Testing (FT) enumerates the need for validating the configuration of the system by using actual data (initially, past data and then with live or current data) in certain core functional processes.
- Training Needs Identification (TNI) defines imparting primary training and transitional training to the users.

From Table 4 it can be found that the Configuration vs. Customization issues is ranked first amongst the chosen seven CSFs. It is very crucial to study the gap between the processes from "as-is" (before ERP implementation) and "to-be" (after

ERP implementation) perspectives of ERP. This gap analysis can be narrowed down through process re-engineering.

Table 4 *Pair wise Comparisons for Implementation*

	RMM	PM	ICP	CC	POP	FT	TNI	Weights	Rank
RMM	1	2	2	0.5	1	2	2	0.181	3
PM	0.5	1	1	2	2	3	2	0.192	2
ICP	0.5	1	1	0.5	2	1	2	0.134	4
CC	2	0.5	2	1	2	2	3	0.212	1
POP	1	0.5	0.5	0.5	1	2	1	0.110	5
FT	0.5	1/3	1	0.5	0.5	1	2	0.094	6
TNI	0.5	0.5	0.5	1/3	1	0.5	1	0.077	7

Consistency Index 0.082 Consistency Ratio 0.063

One of the factors associated with gap analysis is data migration from the legacy systems to the ERP system. Project management for ERP implementation is ranked second. It involves the project team composition with the manager's responsibility for scheduling and managing tasks of ERP implementation as well as planning for change management in consultation with the proprietor (owner).

Usage and Percolation (UPN)

These decisions are significant to the success of ERP adoption because they reflect the actual working in an integrated environment by the end-users. Some of the relevant factors include testing the expectation-deliverable gap, shuffling priority lists, feedback loop on end-user training, user information on changed working environment, proprietor/partner's support in end-users' confidence, definition and circulation of ERP usage policy, readiness to problem identification and trouble shooting, mechanism for periodical feedback from end-users, ERP usage discipline between and within departments, and mechanism to track and quantify the implications on financial, human and operational perspectives.

Certain factors like the degree of user acceptance, enhanced efficiency of users, process improvements define success. Six critical success factors have been identified which are

- Training gap Analysis (TA) is relating to the periodical study on degree of routine usage of the ERP system by users.
- Periodical and Timely Communication (PTC) defines how informed were the users on the changed working environment.
- Percolation of owner's Commitment (PC) is to instill confidence in the users of the ERP system and will enable faster percolation of ERP-enabled working in the SME.
- Mandatory ERP Environment (MEE) is about formulating ERP usage policy and circulating to the ERP users in order to bring about ERP usage discipline and standardization in the operating routine.
- Feedback on user's Satisfaction (FS) range from surveying upon initial anxiety and comfort levels of the users to a complete satisfaction of using the ERP system.

- Periodic review on time cost and benefits (P) is to keep track of costs and resources consumed on the ERP working environment and also to quantify the process efficiency from certain customer-centric business processes of the SME.

The table given below contains the analysis of the CSFs.

Table 5 *Pair wise Comparisons for Usage and Percolation*

	TA	**PTC**	**PC**	**MEE**	**FS**	**P**	**Weights**	**Rank**
TA	1	1/3	2	3	1	2	0.186	2
PTC	3	1	2	3	2	3	0.323	1
PC	0.5	0.5	1	1	1/3	0.5	0.087	5
MEE	1/3	1/3	1	1	0.5	0.5	0.081	6
FS	1	0.5	3	2	1	2	0.199	3
P	0.5	1/3	2	2	0.5	1	0.123	4

Consistency Index 0.046 Consistency Ratio 0.037

It is clear from the Table 5 that periodical and timely communication ranks highest amongst the chosen CSFs for Usage and Percolation Decisions. This is important to improve user-awareness of the expected changes from the ERP environment. Gap analysis before and after training is ranked second as it will close the cycle from user-expectation to ERP deliverables. Moreover, it would improve training effectiveness and enable the working environment to freeze priority lists.

Extension (EXT)

These decisions in SMEs are primarily influenced by the larger counterparts in the supply chain. These decisions are helpful in identification of key processes that could be interfaced with that of the large counterparts, technological support by large players and interface requirements of SMEs, influence of ERP adoption on the efficiency of process integration with large players, need for realignment and standardization of processes of SMEs, cost implication for the SMEs due to the integration initiative, and the depth to which process integration should be considered. Success should be measured in terms of realignment and standardization of processes, cost competitiveness for SMEs due to integration etc. A set of six critical success factors identified are

- Identification of Process Interfaces (IPI) relates to the identification of those internal processes of the SME that have a high degree of inter-dependence with its larger counterparts.
- Business Relationship with OEMs (BRO) will determine the extent of technological and financial support a SME can expect from its larger counterparts.
- Role of demand and material planning (RDM) will decide upon the depth of SME's business process integration with its larger customers in supply chain planning, collaborative inventory management and forecasting etc.
- ERP culture in SME (ECS) defines the impact of ERP adoption in providing process efficiency and the SME's readiness to support integration of external processes

- Extent of process standardization (E) will decide the need for additional process alignment to sensitize the users on information flow over material flow.
- Analysis of additional IT infrastructure (AII) will highlight the cost implications for the SMEs in extending their processes to their channel (supply chain) partners. It also takes into consideration the channel partners' web-interfaces to the SMEs in ensuring faster and integrated information flow.

Table 6 *Pair wise Comparisons for Extension*

	IPI	**BRO**	**RDM**	**ECS**	**E**	**AII**	**Weights**	**Rank**
IPI	1	0.5	1	1/3	0.25	0.5	0.080	6
BRO	2	1	2	0.5	2	1	0.192	3
RDM	1	0.5	1	0.5	2	1/3	0.113	5
ECS	3	2	2	1	2	2	0.290	1
E	4	0.5	0.5	0.5	1	0.5	0.121	4
AII	2	1	3	0.5	2	1	0.205	2

Consistency Index 0.085 Consistency Ratio 0.069

From Table 6 it is evident that in order to support extension decision to the supply chain partners, the CSF relating to ERP culture and practice in the organization is ranked at number one from amongst the chosen CSFs. This is fundamental to build upon integration of inter-organizational supply chain processes. The next important CSF is relating to the cost implication for the SME during such integration initiative. All other factors can be related through these two CSFs.

Consolidated Ranking of the Critical Success Factors

Here the important task was to use AHP to rank the selected five decision phases so as to justify the related significance between them from an SME viewpoint. The Table 7 explains the same.

Table 7 *Evaluating the Decision Phases*

	PLG	**ACQ**	**IPL**	**UPN**	**EXT**	**Weights**	**Rank**
PLG	1	1	1	2	2	0.249	2
ACQ	1	1	3	2	2	0.310	1
IPL	1	1/3	1	2	1	0.174	3
UPN	0.5	0.5	0.5	1	2	0.143	4
EXT	0.5	0.5	1	0.5	1	0.124	5

Consistency Index 0.061 Consistency Ratio 0.054

It can be inferred that acquisition decisions are critical than others. It can be understood that the most critical decision relating to ERP adoption for SME is

relating to acquiring the ERP itself. Considering the SMEs limitations on expertise and experience, acquiring the right kind of ERP is the most complex decision. Moreover, acquisition includes the right mix of software solution, product vendor and the implementation partner.

Secondly, there was a need to prepare consolidated ranking of the selected CSFs in order to prepare the consolidated ranking list of CSFs across all the five decision phases. This will enable an overall understanding about the significance of the selected CSFs across the five stages of ERP adoption.

The ranking table based on the five phases is presented in the following Tables 8 through Table 12.

Table 8 *Planning Phase: Weight: 0.249*

Critical Success Factors	Absolute Score	Weighted Score
Goal and Scope of ERP (GS)	22	0.018
Proprietor's/Partner's Commitment (PPC)	1	0.104
Culture and Change Receptiveness (CCR)	4	0.061
Vision and Growth (VG)	20	0.020
Project Planning and Scheduling (PPS)	7	0.046

Table 9 *Acquisition Phase: Weight: 0.310*

Critical Success Factors	Absolute Score	Weighted Score
Existing IT Compatibility (EITC)	2	0.088
Software Package Selection and Evaluation (SPSE)	8	0.040
Vendor Analysis (VA)	5	0.048
Cost-Benefit Analysis (CBA)	3	0.065
Role of Consultant (RC)	9	0.038
Process Owner's Interaction (POI)	14	0.030

Table 10 *Implementation Phase: Weight: 0.174*

Critical Success Factors	Absolute Score	Weighted Score
Road Map and Methodology (RMM)	13	0.031
Project Management (PM)	12	0.033
Identification of Critical Processes (ICP)	19	0.023
Configuration vs. Customization (CC)	10	0.037
Process Owners' participation (POP)	21	0.019
Functional Testing (FT)	24	0.016
Training Needs Identification (TNI)	27	0.013

Table 11 *Usage and Percolation Phase: Weight: 0.143*

Critical Success Factors	Absolute Score	Weighted Score
Training gap Analysis (TA)	16	0.027
Periodical and Timely Communication (PTC)	6	0.046
Percolation of owner's Commitment (PC)	28	0.012
Mandatory ERP Environment (MEE)	29	0.012
Feedback on user's Satisfaction (FS)	15	0.028
Periodic review on time cost and benefits (P)	23	0.018

Table 12 *Extension Phase: Weight: 0.124412*

Critical Success Factors	Absolute Score	Weighted Score
Identification of Process Interfaces (IPI)	30	0.010
Business Relationship with OEMs (BRO)	18	0.024
Role of demand and material planning (RDM)	26	0.014
ERP culture in SME (ECS)	11	0.036
Extent of process standardization (E)	25	0.015
Analysis of additional IT infrastructure (AII)	17	0.026

The consolidated ranking table covering all the critical success factors and their decision phases are presented in the following Table 13.

Table 13 *Consolidated Ranking Table of CSFs*

Decision Phase/Stage	CSFs	Rank
Planning	Proprietor/Partner's Commitment	1
Acquisition	Existing IT Compatibility	2
Acquisition	Cost-Benefit Analysis	3
Planning	Culture and Receptiveness of SME	4
Acquisition	Vendor Analysis	5
Usage and Percolation	Periodical and Timely Communication	6
Planning	Project Planning and Scheduling	7
Acquisition	Software package selection and evaluation	8
Acquisition	Role of Consultant	9
Implementation	Configuration vs. Customization	10
Extension	ERP Culture in SME	11
Implementation	Project Management	12
Implementation	Road map and Methodology	13
Acquisition	Process owners' interaction	14
Usage and Percolation	Feedback on user's satisfaction	15
Usage and Percolation	Training Gap Analysis	16

Extension	Analysis of additional IT infrastructure	17
Extension	Business relationship with OEM	18
Implementation	Identification of mission critical processes	19
Planning	Vision and Growth	20
Implementation	Process owner's participation	21
Planning	Goal and Scope of ERP	22
Usage and Percolation	Periodic review of time cost and benefits	23
Implementation	Functional Testing	24
Extension	Extent of process standardization	25
Extension	Role of demand and material planning	26
Implementation	Training needs identification	27
Usage and Percolation	Percolation of owner's commitment	28
Usage and Percolation	Mandatory ERP Environment	29
Extension	Identification of process interfaces	30

Managerial Implications on the prescribed set of 10 CSFs

This paper not only ranks the selected CSFs for SMEs but also prescribes a set of 10 CSFs that can be point of conceptual reference to the SMEs. This set can be used by decision-makers to identify, anticipate and analyze its relevance to their organizational units. Considering the SMEs limitations of expertise, time and cost this list can be of more value particularly to those SMEs who are currently passing through the any of the first three phases of ERP adoption i.e., planning, acquisition and implementation phases. This ranking has been applied to a comprehensive list of CSFs for ERP adoption identified from the work done by earlier researchers. Hence, it is believed that the prescribed list of CSFs can be a primary source of reference to decision-makers in the SMEs. This paper can also be used as a launch-pad for further empirical researches on the same direction, which could bring out similarities and differences in the perceptions of the decision-makers across different SMEs clusters and geographies. In other words the rankings and prescription list could vary if it is tested with those SMEs who are already ERP-enabled for quite some time (say 5 to 10 years). In such case, it can be expected that CSFs from subsequent adoption phases namely Usage and Percolation and Extension can take higher priority and hence alter the ranking lists for a SME.

5. Findings and Future Directions

From the above consolidated table if we consider the top ten rankings most of them are dominated by the CSFs relating to acquisition and planning decisions. In fact it can be found that 5 out of 6 CSFs in the acquisition decision stage are listed in the top ten. Acquisition decisions are very complex because SMEs do not have the expertise to take the right mix of factors relating to reconciling their existing IT compatibility with ERP product offering, arriving at the balance between costs and expected benefits etc. Moreover, the role of consultant should percolate throughout the adoption cycle. CSFs relating to Planning and Implementation decisions are crucial for ERP adoption but an SME perspective they are less complicated than

acquisition decisions. This is because planning decision is driven by a single decision-maker. The business experience of the owner will justify the growth perspective of the SME as to whether or not to invest in ERP. The culture and readiness to ERP will also depend on the proprietor. Similarly scope of ERP during implementation decision is not a big challenge considering the size of the organization.

Based on our analysis using AHP, the present study prescribes a set of 10 CSFs that are very significant for ERP adoption in a SME. These are owners' commitment, current IT compatibility of the unit, cost-benefit analysis, culture and change receptiveness, vendor analysis, periodical and timely communication, project planning and scheduling, software product selection and evaluation, role of consultant, configuration vs. customization issues.

The prioritization and ranking of CSFs for ERP adoption by SMEs is done based on the CSFs identified and recommended based on earlier research work. This paper is only an attempt to use a justifiable yet simpler methodology like AHP for ranking the CSFs. The assignment of ranks is intuitive and not derived out of an empirical research. The growing attention on ERP for SMEs in general and in the Indian context in particular, identification, prioritizing and ranking the CSFs will provide a strong foundation to build further empirical research on testing the validity of our ranking with the practical context to Indian SMEs. In other words the findings of this research can be tested empirically on certain SME clusters in Indian to reconcile the validity of conceptual research to contextual research.

6. Acknowledgements

The authors express their thanks to the reviewers for their valuable suggestions to improve this research paper. I take this opportunity to express my special thanks to Dr. Urvashi Rathod, Professor, Symbiosis Centre for Information Technology for her advice during the initial stages of this paper.

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