Analysis of Critical Success Factors (CSFs) for Implementation of Enterprise Resource Planning (ERP) in Manufacturing Industry

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Abstract— The dynamics of the implementation of the Enterprise Resource Planning (ERP) system varies according to the nature and type of the industry. Each industry possesses its own unique business processes, information flow systems, human resources, adaptation level to the new systems, and localized requirements. These factors can be visualized and considered by understanding the complete hierarchy and structure of the industry. Due to these issues, 90% ERP implementation is not accomplished within the allocated time and budget consequently the implementation success ratio is only 33%. Also, many organizations were identified as unsuccessful while obtaining the complete benefits of ERP implementation. Therefore, it is required to recognize Critical Success Factors (CSFs) for ERP implementation in different industries. Ongoing research is based on identifying Critical Success Factors (CSFs) for the implementation of the ERP system in the manufacturing industry. In this research, a questionnaire-based instrument is prepared to collect the data from the personnel in the concerned industry and the Principal Component Analysis (PCA) has been applied to the collected data in order to identify the key factors. To recapitulate, the most influential factors are highlighted that play a vital role in the success of the ERP implementation in the manufacturing industry.

Index Terms— Analysis, Critical, Factors, Industry, Implementation, Manufacturing, Success

1 Introduction

THE ERP system is dealing with various organizational business processes such as finance, sales, marketing, human resources, administration, purchase, quality management etc. Therefore, organizations are implementing the ERP system to attain its benefits. Currently, the concentration of research is to stipulate the factors that are determining the failure and success of the ERP projects implementation. The factors which are influencing ERP's success are known as CSFs. Organizations utilize ERP as a powerful tool for the achievement of business goals [4]. It is essential to focus first on success factors [3]. In the 1980s the research work started towards the analysis of CSFs for ERP implementation success [4]. ERP system does not change anything. However, the organization has to change its way of working [8].

Lot of research work is available associated with CSFs analysis for ERP implementation success. This topic and its research methodology are different because it is related to the business process of the manufacturing industry. The research also proposed a model for the successful implementation of the ERP system in the manufacturing industry. Many past studies elaborated the failure rate of the ERP system which can be significantly reduced by adopting the CSFs analysis strategy and further considering its effects on the ERP system [1]. However, most of the researcher did not discuss these factors and their effects in detail [1].

The main objective of this research is to recognize the CSFs for ERP system implementation in the manufacturing industry and propose an implementation model that helps the manufacturing industry to complete ERP implementation projects with success. The main questions of this study are:

- How to identify CSFs for implementation of ERP system in the manufacturing industry?
- How to implement ERP system projects in the manufacturing industry by identifying and using CSFs?
- How to design a successful model for the implementation of ERP system in the manufacturing industry?
- How to gather data about ERP implementation in the manufacturing industry?

To implement the ERP system by utilizing the proposed model, a complete IT infrastructure is required which includes network, servers, operating system, computers, and software supported components. Moreover, ERP consultants, top management and end-users are important for success and continuous improvement.

2 Literature Review

During this research work, 35 research papers/articles, 14 conference papers, and 1 thesis have been reviewed.

The literature for this research is based on the availability of previous research data. In past, the research related to Critical Success Factors for the manufacturing industry was available in a very less quantity. Therefore, the literature review research material for the current research has been selected from the related industries or from general purposes. The literature review method used for CSFs in past studies is a common and valid practice (Fadelelmoula, 2018). Critical Success Factors (CSFs) for the implementation of ERP systems exposed in the research literature are a great deal (Chaushi, Chaushi, & Dika, 2016).

Fadelelmoula (2018) suggests 06 CSFs that are playing a crucial role in Computer Based Information Systems. Wolters et al. (2018) present in their research the project team empowerment and motivation system as CSFs. Ahmed and Sarim (2017) proposed in their research paper the CSFs that are impacting ERP implementation success in Pakistani Small and Medium Sized Enterprises (SMEs). Leandro et al. (2017) enlightened the CSFs for the ERP implementation in the educa-

tional institutions. Chaushi et al. (2016) research paper elaborated the 10 new CSFs in order to get the implementation success. Al-Sabaawi (2015) proposed eight CSFs to ensure the success of ERP initiatives in developing countries. Tarhini et al. (2015) suggested CSFs, which are used frequently and categorize according to stakeholders involved in the ERP implementation. Shanab et al. (2015) research paper explored the major Key Success Factors, which are helpful for the organizations in the ERP implementation success. Jamil and Qayyum (2015) elaborated 34 CSFs. Shatat (2015) investigated in their research study 10 CSFs as the most important. Mathias et al. (2014) presented the 37 CSFs for ERP implementation success in their research article. Gupta et al. (2014) wrote a research paper in which they identified the CSFs and explained their relation to organization management. Almgren and Bach (2014), Ram and Corkindale (2014), Ijaz et al. (2014), Beheshti et al. (2014), Leyh (2014), Amini and Safavi (2013), Schniederjans and Yadav (2013), Alaskari et al. (2013), AlSudairi (2013), Hailu and Rahman (2012), Abdelghaffar (2012), Hasibuan and Dantes (2012), Suganthalakshmi and Muthuvelautham (2011), Moohebat et al. (2011), Aldayel et al. (2011), Dezdar and Ainin (2011), Asemi and Jazi (2010), Doom et al. (2010), Dezdar and Sulaiman (2009), Al-Fawaz et al. (2008), Finney and Corbett (2007), Wu (2007), Achanga et al. (2006), Ehie and Madsen (2005), Colmenares (2004), Boon et al. (2004), Zhang et al. (2003), Lin et al. (2003) Schniederjans and Kim (2003), Wong and Tein (2003), Umble et al. (2003), Al-Mashari et al. (2003), Esteves and Pastor (2001), Fui-Hoon et al. (2001), Somers and Nelson (2001) and Holland et al. (1999) explained the CSFs in their research for the ERP implementation success in different industries.

3 Selected Categories and CSFs

During the literature review, 50 research papers/articles were studied out of which 840 CSFs in 63 categories have been identified in the first step for the current study. In the second step, 117 unique CSFs within 46 unique categories have been segregated. In the third step, 60 CSFs have been selected for the present research out of the 08 categories as per the research requirement.

TABLE 1
IDENTIFIED, UNIQUE AND SELECTED CATEGORIES AND CSFS FOR RESEARCH

Categories	S/N	CSFs Description	Frequency
Organizational	1	Top Management Support and Commitment	47
	2	Business Process Re-engineering	39
	3	Effective Internal and External Communication	36
	4	Employees and Stakeholder Participation	29
	5	Performance Monitoring, Evaluation, and Feedback	28
	6	Project Team Competency and balanced	25
	7	Use of External and Internal Consultants	14
	8	Well Defined Project Budget	12
	9	Empowered Decision Maker	11
	10	Rewards, Recognition and Motivation System	10
	11	Trust and Cooperation between Partners	8
	12	Organizational Structure	7
	13	Steering Committee	7
	14	Business Discipline, Rules, Norms & Values	6
	15	Government Regulations and Policies	4
	16	Political, External, Internal and Competitive Pressures	3
	17	Innovation and Competitiveness	2
Project	18	Project Plan, Schedule, Goals, Objectives, Mission, Vision, Scope & Strategy	42
	19	Project Team Composition	41
	20	Project Management	39
	21	Change Management	33
	22	Project Champion/Manager	27
	23	Formalized and Standardized Implementation Sequence, Approach and Methodology	17
	24	Management Expectations	10
	25	Risk Management	9

	26	User Requirement, Feedback, Satisfaction & Acceptance	5
	27	Multi-site Issues	2
Human	28	Employees Training and Education	50
	29	User Level of Qualification and Friendliness	2
	30	Job Tenure and type	1
	31	Employee Turnover	1
ERP	32	ERP Software Selection	23
	33	ERP Software Development, Configuration, Testing &Troubleshooting	20
	34	ERP Software Reliability, Complexity & Customization	6
	35	Aligned between Organization Culture, Business Plan, Business Process & ERP System	3
	36	Well-designed ERP System interface and Architecture Choices	3
	37	Controlled ROI on ERP implementation	1
	38	ERP System Acceptance and Resistance	1
	39	ERP Benchmarking to identify cutting-edge ERP techniques	1
Technological	40	Legacy Systems	21
	41	IT Infrastructure	16
	42	IT Usage Maturity	14
	43	System Quality, Integration, Perceived, Usefulness, Complexity, learnability, and Reliability	9
	44	System Requirement, Feedback, Satisfaction & Acceptance	4
	45	Network Reliability	1
Cultural	46	Organizational Culture, Environment, Characteristics and Work Climate	17
	47	Culture Change Management	13
	48	National Culture and Functional Requirements	2
Technical	49	Avoid Customization and Troubleshooting	21
	50	Data Analysis, Accuracy, Quality, Integrity, Migration & Conversion	21
	51	Pre-implementation & Post Implementation Evaluation and Analysis	5
	52	Dedicated and Technical Resources	4
	53	Suitability and Attitude to Standardization	3
	54	Robustness, Error Prevention, Support and Maintenance	3
	55	Fast effects	1
	56	Interest groups	1
	57	Announcement	1
Vendor	58	Vendors Support and Partnership	20
	59	Use of Vendor Tools	7
	60	Selection and Proper Management of Vendor	2

Table 1 shows the selected 60 CSFs within the 08 categories. The first column presents the categories; the second column illustrates the number of the CSFs; the third column shows the description of the CSFs and the fourth column depicts the frequency of the CSFs.

4 Preparation of Questionnaire

The questionnaire developed for this study contained 09 parts. The first part includes the basic information of the respondents such as email, name, age, gender, qualification, industry, job category, and ERP system experience whereas remaining 08 parts (presenting each category of CSFs) comprise of the 160 measurement items. In the present research, the ordinal scale is used. The numbers assigned are based on the Likert Scale. In the questionnaire strongly disagree=1, disagree=2, neutral=3, agree=4 and strongly agree=5. The developed questionnaire is based on previous studies and literature.

4.1 Reliability of the Questionnaire

The reliability has been measured for 08 categories by using the Cronbach's Alpha method, where the value should be greater than 0.7 in order for the sample to be reliable. So, the reliability statistics of all factors are greater than 0.7. This shows that the scale is very reliable and there is a high level of internal consistency.

TABLE 2
RELIABILITY STATISTICS

CSFs Categories	Cornbrash's Alpha	Number of Items
Organizational	0.95	37
Project Factors	0.95	35
Human Factors	0.91	11
ERP Factors	0.95	22
Technological	0.94	16
Cultural Factors	0.89	9
Technical Factors	0.94	20
Vendor Factors	0.89	10

Table 2 presents the Cornbrash's Alpha, as CSFs categories wise which is shows that all categories have more than 0.7 reliability

4.2 Data Collection

The data for this research is collected with the help of primary and secondary sources. Primary data was collected using a questionnaire, which has been developed specifically for the present research. Secondary sources include literature, conference papers, and thesis. Krejcie & Morgan, 1970 sampling technique is used to set the sample size for this research. The considered population size is 70 numbers, so the required sample size is 59 respondents. By using 70 population and 59 sample size on the confidence level of 95% with a confidence interval of 5.09%, 50% response rate was required. The target population of the study is the consultants, managers, administrators, and trainers of the ERP system. The convenience sampling technique is used to collect the data for the present study.

5 RESEARCH METHODOLOGY

The methodology for the present research started with the identification of the CSFs from literature review, preparation of the questionnaire on the basis of identified CSFs, questionnaire reliability testing, the collection of data, PCA analysis for factor extraction, and the proposal of a model for ERP system implementation in the manufacturing industry.

6 DATA ANALYSIS

In this section, the results of the important statistical tests of the ongoing research have been discussed.

6.1 Demographic Profile of the Respondents

As a result of the questionnaire survey, the responses have been received from 59 respondents. The response rate is 84.29%. The first section of the questionnaire attempted to investigate the demographic profile of the respondents.

The majority of the respondents in the research are male with a percentage of 83.10%. This shows that out of 59 respondents, 49 respondents were male. On the other hand, only 16.90% who participated in the research were female respondents. This depicts that out of 59 respondents, 10 respondents were female.

Most of the respondents of the research belong to the age group of 35-44 years with a percentage of 45.76% while 28.81% of the respondents in the research belong to the age group of 26-34 years. 11.86% of the respondents were under 25 years. 8.47% of the respondent's age lies between 45-54 years. Moreover, only 5.08% of the respondents' age is above 55 years.

45.76% respondents possess a bachelor's degree, 35.59% have a master's degree and 15.25% respondents have M. Phil degree. However, only 2% of the respondents stated that they have a diploma. Therefore, the data reveals that on average most of the responses for the research are collected from bachelor degree holders.

The majority of the respondents (42.37%) are administrators. 30.51% of the respondents in the present study are consultants. While 18.64% respondents in the present research are managers, only 8.47% of the respondents are educators. Therefore, the majority of the responses are collected from the respondents who are administrators.

The 54.24% respondents belong to the manufacturing sectors. The present study also reveals that 33.90% respondents do not work and have their own businesses. Moreover, 6.78% of respondents belong to the light industry and only 5.08% belong to the heavy industry.

The findings show that majority of the respondents (37.29%) have 6-10 years of experience of using the ERP system and 33.90% of the respondents stated that they have 1-5 years of experience of using the ERP system. In addition to this, 28.81% respondents stated that they have 11-15 years of experience of using the ERP system. This indicates that the data for the present study is collected from people with a different period of experiences.

6.2 Descriptive Statistics

The statistics include the mean values and the standard deviation of all the items. The values are in the desired levels. It is the most widely used measure of essential tendency and also commonly called the average [4].

TABLE 3
DESCRIPTIVE STATISTICS

QIDs	Mean Value	Standard Deviation	QIDs	Mean Value	Standard Deviation	QIDs	Mean Value	Standard Deviation
Q1	4.32	0.92	Q55	4.34	0.90	Q109	4.44	0.65
Q2	4.58	0.75	Q56	4.29	0.70	Q110	4.36	0.78
Q3	4.34	0.94	Q57	4.44	0.70	Q111	4.39	0.62
Q4	4.31	0.90	Q58	4.42	0.70	Q112	4.47	0.68
Q5	4.46	0.82	Q59	4.12	0.89	Q113	4.46	0.68
Q6	4.34	0.84	Q60	4.36	0.69	Q114	4.42	0.68
Q7	4.36	0.71	Q61	4.27	0.74	Q115	4.32	0.78
Q8	4.39	0.79	Q62	4.41	0.67	Q116	4.58	0.56
Q9	4.03	0.96	Q63	4.36	0.69	Q117	4.49	0.63
Q10	4.49	0.63	Q64	4.27	0.85	Q118	4.44	0.57
Q11	4.42	0.75	Q65	4.51	0.65	Q119	4.31	0.73
Q12	4.39	0.70	Q66	4.44	0.77	Q120	4.31	0.75
Q13	4.44	0.65	Q67	4.42	0.65	Q121	4.37	0.69
Q14	4.41	0.87	Q68	4.54	0.70	Q122	4.29	0.83
Q15	4.54	0.63	Q69	4.46	0.77	Q123	4.08	0.86
Q16	4.32	0.86	Q70	4.37	0.72	Q124	4.24	0.73
Q17	4.36	0.74	Q71	4.34	0.66	Q125	4.31	0.75
Q18	4.39	0.70	Q72	4.34	0.69	Q126	4.14	0.90
Q19	4.39	0.77	Q73	4.58	0.65	Q127	4.37	0.83
Q20	4.31	0.79	Q74	4.44	0.62	Q128	4.22	0.83
Q21	4.34	0.73	Q75	4.44	0.70	Q129	3.97	1.03
Q22	4.41	0.72	Q76	4.37	0.87	Q130	3.92	1.12
Q23	4.42	0.72	Q77	4.39	0.74	Q131	4.19	1.06
Q24	4.15	0.93	Q78	4.24	0.75	Q132	4.27	0.85
Q25	4.36	0.78	Q79	4.29	0.87	Q133	4.31	0.79
Q26	4.46	0.65	Q80	4.22	0.87	Q134	4.36	0.89
Q27	4.34	0.86	Q81	4.10	0.90	Q135	4.31	0.84
Q28	4.51	0.68	Q82	4.14	0.88	Q136	4.47	0.70
Q29	4.51	0.63	Q83	4.22	0.95	Q137	4.46	0.73
Q30	4.37	0.85	Q84	4.51	0.65	Q138	4.29	0.77
Q31	4.27	0.85	Q85	4.39	0.72	Q139	4.46	0.65
Q32	4.36	0.80	Q86	4.31	0.62	Q140	4.49	0.65
Q33	4.41	0.81	Q87	4.36	0.76	Q141	4.56	0.62
Q34	4.46	0.63	Q88	4.46	0.65	Q142	4.34	0.73
Q35	4.34	0.82	Q89	4.47	0.60	Q143	4.54	0.60
Q36	4.19	0.96	Q90	4.58	0.56	Q144	4.44	0.60
Q37	4.31	0.84	Q91	4.51	0.60	Q145	4.42	0.62
Q38	4.44	0.82	Q92	4.46	0.65	Q146	4.47	0.63
Q39	4.49	0.68	Q93	4.39	0.67	Q147	4.27	0.83
Q40	4.42	0.59	Q94	4.39	0.62	Q148	4.32	0.88
Q41	4.51	0.63	Q95	4.46	0.65	Q149	4.20	0.83
Q42	4.51	0.68	Q96	4.32	0.86	Q150	4.42	0.75
Q43	4.42	0.79	Q97	4.41	0.65	Q151	4.39	0.85
Q44	4.41	0.77	Q98	4.39	0.74	Q152	4.29	0.89
Q45	4.36	0.85	Q99	4.44	0.79	Q153	4.44	0.84
Q46	4.56	0.57	Q100	4.51	0.65	Q154	4.29	0.85
Q47	4.32	0.90	Q101	4.39	0.72	Q155	4.29	0.74
Q48	4.42	0.70	Q102	4.37	0.87	Q156	4.27	0.87
Q49	4.47	0.60	Q103	4.44	0.68	Q157	4.20	0.87
Q50	4.44	0.68	Q104	4.32	0.86	Q158	4.29	0.77
Q51	4.51	0.75	Q105	4.31	0.82	Q159	4.36	0.71
Q52	4.37	0.89	Q106	4.25	0.86	Q160	4.36	0.83
Q53	4.20	1.03	Q107	4.32	0.73	Q160	4.36	0.83
Q54	4.31	0.93	Q108	4.44	0.70	Valid Number **(List Wise) =59**		

Table 3 shows the standard deviation and the mean value for each item of the questionnaire. As 1 is code as strongly disagree and 5 is coded as strongly agree therefore the highest mean value indicates that most people strongly agree with the statement. On the contrary, the lowest mean value indicates that people strongly disagree with the statement. The mean values of 04 items (Q2, Q73, Q90, Q116) are 4.580, therefore, it can be established that the CSFs related with these items are the highest CSFs for ERP implementation in the manufacturing industries. On the contrary, the mean values of 04 items are the lowest which are Q9, Q81, Q130, and Q129. So this indicates that the CSFs related to these items are the lowest CSFs for the ERP implementation.

6.3 Principal Component Analysis (PCA)

The analysis of current research is performed through SPSS latest version for the Principal Component Analysis.

6.3.1 Commonality

Commonalities in factor analysis indicate the common variance shared by factors with given variables. The value should be greater than 0.4 for the better measurement of factor analysis.

TABLE 4
COMMUNALITY ANALYSIS

QIDs	Extraction	QIDs	Extraction	QIDs	Extraction	QIDs	Extraction
Q1	0.92	Q41	0.86	Q81	0.93	Q121	0.89
Q2	0.96	Q42	0.92	Q82	0.92	Q122	0.95
Q3	0.90	Q43	0.95	Q83	0.93	Q123	0.89
Q4	0.93	Q44	0.92	Q84	0.96	Q124	0.89
Q5	0.95	Q45	0.87	Q85	0.91	Q125	0.87
Q6	0.92	Q46	0.92	Q86	0.92	Q126	0.81
Q7	0.93	Q47	0.94	Q87	0.90	Q127	0.98
Q8	0.83	Q48	0.90	Q88	0.90	Q128	0.96
Q9	0.86	Q49	0.89	Q89	0.94	Q129	0.92

Q10	0.95	Q50	0.93	Q90	0.79	Q130	0.97
Q11	0.92	Q51	0.86	Q91	0.86	Q131	0.92
Q12	0.95	Q52	0.94	Q92	0.91	Q132	0.95
Q13	0.89	Q53	0.93	Q93	0.92	Q133	0.92
Q14	0.92	Q54	0.94	Q94	0.91	Q134	0.95
Q15	0.94	Q55	0.91	Q95	0.86	Q135	0.94
Q16	0.91	Q56	0.91	Q96	0.94	Q136	0.88
Q17	0.93	Q57	0.91	Q97	0.86	Q137	0.89
Q18	0.92	Q58	0.95	Q98	0.94	Q138	0.91
Q19	0.84	Q59	0.81	Q99	0.89	Q139	0.89
Q20	0.91	Q60	0.83	Q100	0.90	Q140	0.95
Q21	0.88	Q61	0.92	Q101	0.87	Q141	0.93
Q22	0.90	Q62	0.93	Q102	0.94	Q142	0.90
Q23	0.91	Q63	0.89	Q103	0.93	Q143	0.91
Q24	0.88	Q64	0.89	Q104	0.95	Q144	0.89
Q25	0.90	Q65	0.92	Q105	0.90	Q145	0.91
Q26	0.91	Q66	0.93	Q106	0.90	Q146	0.92
Q27	0.92	Q67	0.88	Q107	0.87	Q147	0.91
Q28	0.95	Q68	0.95	Q108	0.87	Q148	0.91
Q29	0.94	Q69	0.92	Q109	0.93	Q149	0.90
Q30	0.93	Q70	0.91	Q110	0.93	Q150	0.95
Q31	0.90	Q71	0.91	Q111	0.92	Q151	0.90
Q32	0.93	Q72	0.87	Q112	0.95	Q152	0.83
Q33	0.93	Q73	0.96	Q113	0.94	Q153	0.89
Q34	0.83	Q74	0.92	Q114	0.89	Q154	0.91
Q35	0.93	Q75	0.92	Q115	0.92	Q155	0.94
Q36	0.96	Q76	0.93	Q116	0.90	Q156	0.91
Q37	0.87	Q77	0.97	Q117	0.87	Q157	0.88
Q38	0.92	Q78	0.93	Q118	0.92	Q158	0.89
Q39	0.94	Q79	0.93	Q119	0.88	Q159	0.92
Q40	0.92	Q80	0.86	Q120	0.90	Q160	0.95

Table 4 shows that all the items measured have the values that are greater than 0.4. It also depicts that there is a high commonality, so there is a large amount of variance found in the variables.

6.3.2 Factor Extraction Scree Plot

The figure below represents the scree plot of the factor eigenvalues in relation to the component numbers. It also shows that the first 08 component numbers have eigenvalues greater than 1. These 08 components explain the variations in the data. The figure represents that the eigenvalue begins as a straight line from the 08 component. It depicts that each successive factor is accounted for smaller and smaller amounts of the total variance. Therefore, the remaining components are unimportant.

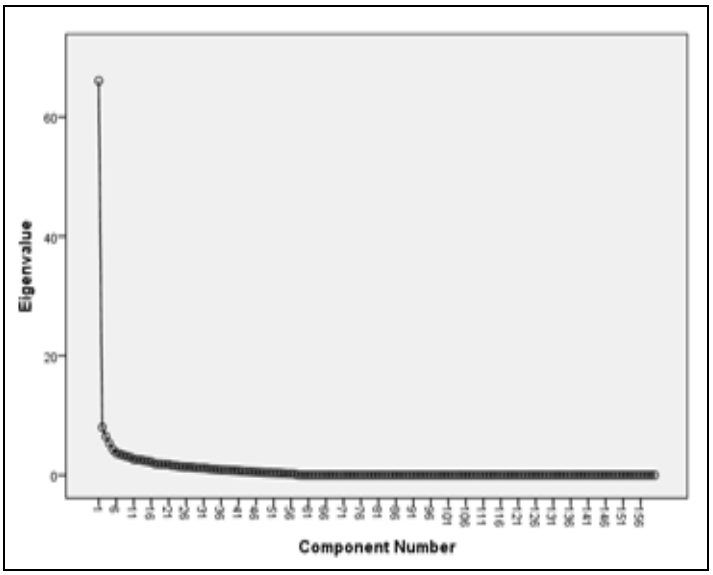

Fig. 1 Scree Plot

Fig. 1 represents that the eigenvalue begins as a straight line from the 08 component. It depicts that each successive factor is accounted for smaller and smaller amounts of the total variance. Therefore, the remaining components are unimportant.

6.3.3 Total Variance Explained

Factors analysis used as the statistic method observed correlated variables and potentially lower level unobserved variables.

TABLE 5
TOTAL VARIANCE EXPLAINED

Components	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	Variance %	Cumulative %	Total	Variance %	Cumulative %	Total	Variance %	Cumulative %
1	66.05	41.28	41.28	66.05	41.28	41.28	24.46	15.29	15.29
2	8.01	5.00	46.28	8.01	5.00	46.28	22.64	14.15	29.43
3	6.50	4.06	50.34	6.50	4.06	50.34	11.39	7.12	36.55
4	5.36	3.35	53.69	5.36	3.35	53.69	11.05	6.91	43.46
5	4.35	2.72	56.41	4.35	2.72	56.41	11.01	6.88	50.35
6	3.70	2.31	58.72	3.70	2.31	58.72	9.41	5.88	56.23
7	3.53	2.21	60.93	3.53	2.21	60.93	6.78	4.24	60.46
8	3.33	2.08	63.01	3.33	2.08	63.01	4.08	2.55	63.01

Extraction Method: Principal Component Analysis.

Table 5 shows the total variance of the factors used in the study. The first columns display the variables of the factor analysis. However, not all 160 factors are retained. It is evident that only 08 sets are retained.

6.3.4 Rotated Component Matrix

The rotated component matrix sometimes referred to as the loadings, is the key output of the principal component's analysis. It contains estimates of the correlations between each of the variables and the estimated components.

TABLE 6
ROTATED COMPONENT MATRIX

QIDs	Component							
	1	2	3	4	5	6	7	8
Q68	0.76							
Q113	0.75							
Q62	0.75							
Q75	0.73							
Q42	0.72							
Q92	0.72							
Q73	0.72							
Q116	0.70							
Q110	0.70							
Q119	0.68							
Q103	0.67							
Q150	0.67							
Q99	0.67							
Q108	0.64							
Q109	0.64							
Q140	0.64							
Q70	0.62							
Q66	0.61							
Q156	0.61							
Q121	0.61							
Q102	0.59	0.53						
Q57	0.59		0.57					
Q71	0.58							
Q142	0.56							
Q144	0.55							
Q94	0.55							
Q158	0.54							
Q97	0.54							
Q114	0.54							
Q138	0.53							
Q82	0.53							
Q152	0.52							
Q96	0.52							
Q59	0.51							
Q38	0.51							
Q44		0.73						
Q32		0.73						
Q43		0.73						
Q45		0.72						
Q14		0.70						
Q31		0.69						
Q33		0.69						
Q127		0.67						
Q148		0.67						
Q27		0.66						
Q54		0.66						
Q128		0.66						
Q69		0.65						
Q80		0.64						
Q134		0.62						
Q147		0.62						
Q112		0.62						
Q51		0.62						
Q53		0.62						
Q79		0.61						
Q101		0.61						
Q83		0.61						
Q106		0.60						
Q55		0.60						
Q76		0.58						
Q87	0.50	0.57						
Q77	0.51	0.57						
Q151		0.55						
Q22		0.55						
Q23		0.55						
Q81		0.53						
Q149		0.53						
Q35		0.53						
Q29		0.52						
Q88		0.52						
Q16		0.52						
Q56		0.51						
Q20		0.50						
Q154			0.68					
Q155			0.65					
Q1			0.65					
Q130			0.63					
Q135			0.59					
Q153			0.58					
Q122			0.56					
Q129			0.55					
Q52			0.54					
Q123			0.54					
Q131			0.53					
Q9			0.50					
Q12				0.67				
Q10				0.61				
Q41				0.60				
Q39				0.59				
Q13				0.54				
Q37				0.54				
Q25				0.53				
Q49				0.51				
Q26				0.50				
Q137					0.69			
Q100					0.63			
Q146					0.59			

Q143					0.57			
Q93					0.56			
Q104					0.55			
Q136					0.52			
Q145					0.52			
Q85					0.52			
Q141					0.51			
Q58						0.63		
Q120						0.60		
Q4			0.52			0.57		
Q3						0.53		
Q2						0.52		
Q7						0.51		
Q125							0.63	
Q30							0.62	
Q6							0.57	
Q47							0.55	
Q132	0.51						0.52	
Q64							0.51	
Q98								0.60
Extraction Method: Principal Component Analysis.								
Rotation Method: Varimax with Kaiser Normalization.								
a. Rotation converged in 16 iterations.								

Table 6 presents the rotated component matrix, which is also known as the loadings, is the key output of the principal component's analysis. It helps to determine what the components signify. The table shows the loadings (extracted values of each item under 8 Set) of the 160 items. So, 117 have been extracted with showing value in the above table, the remaining 43 are shown without any value in all sets, which has been excluded and removed from the table.

6.3.5 Items Isolated

In the above 08 sets, 123 items have been extracted out of which 06 items are found common, which appear in different sets. After removing these 06 common items, the remaining total unique items are 117. So, the 117 items extracted are presenting 57 CSFs but 38 factors are taken on the basis of one CSF extracted by at least two items as given below. Remaining 19 items are extracted by one item as per the data cleansing rules.

TABLE 7
CSFS DESCRIPTION ACCORDING TO EXTRACTED ITEMS

Categories	Extracted Items QIDs	Serial Number	Extracted Factors Description
Organizational	Q2, Q1	1	Top Management Support and Commitment
	Q4, Q3	2	Business Process Re-engineering
	Q7, Q6	3	Effective Internal and External Communication
	Q13, Q12, Q10	4	Performance Monitoring, Evaluation, and Feed Back
	Q16, Q14	5	Project Team Competency and Balanced
	Q23, Q22	6	Well Defined Project Budget
	Q27, Q26	7	Rewards, Recognition and Motivation System
	Q30, Q29	8	Organizational Structure
	Q32, Q31	9	Steering Committee
Project	Q42, Q41, Q39, Q38	10	Project Scope, Plan, Schedule, Goals, Objectives, Mission, Vision, & Strategy
	Q45, Q44, Q43	11	Project Team Composition
	Q49, Q47	12	Project Management
	Q54, Q53, Q52, Q51	13	Change Management
	Q62, Q59, Q58, Q57, Q56, Q55	14	Project Champion/Manager
	Q70, Q69	15	User Requirement, Feedback, Satisfaction & Acceptance
Human	Q77, Q76, Q75, Q73	16	Employees Training and Education
	Q83, Q82	17	Employee Turnover
	Q81, Q80	18	Job Tenure and type

ERP	Q94, Q93, Q92	19	Aligned between Organization Culture, Business Plan, Business Process and ERP System
	Q99, Q98	20	Controlled ROI on ERP implementation
	Q103, Q102, Q101, Q100	21	ERP System Acceptance and Resistance
	Q97, Q96	22	Well-designed ERP System interface and Architecture
Technological	Q110, Q109, Q108	23	IT Infrastructure
	Q113, Q112	24	IT Usage Maturity
	Q116, Q114	25	System Quality, Integration, Perceived, Usefulness, Complexity, Learnability and Reliability
	Q121, Q120	26	Network Reliability
Cultural	Q123, Q122	27	Organizational Culture, Environment, Characteristics and Work Climate
	Q128, Q127, Q125	28	Culture Change Management
	Q130, Q129	29	National Culture and Functional Requirements
Technical	Q132, Q131	30	Avoid Customization and Troubleshooting
	Q136, Q135, Q134	31	Data Analysis, Accuracy, Quality, Integrity, Migration & Conversion
	Q138, Q137	32	Pre & Post Implementation Evaluation and Analysis
	Q141 Q140	33	Dedicated and Technical Resources
	Q143, Q142	34	Suitability and Attitude to Standardization
	Q144, Q145	35	Robustness, Error Prevention, Support and Maintenance
	Q147, Q146	36	Fast effects
	Q149, Q148	37	Interest Groups
Vendors	Q156, Q155, Q154, Q153, Q152, Q151	38	Vendors Support and Partnership

Table 7 describes the CSFs with the detail description extracted by using the PCA analysis. In this case, 38 factors are identified after the complete analysis phase as Critical Success Factors for ERP implementation in the manufacturing industry.

7 CSFs Analysis Results

In this section, as part of the proposed model, the descriptive analysis of the CSFs for ERP implementation in the manufacturing industry is described.

TABLE 8
CSFs DESCRIPTIVE ANALYSIS

S/N	Literature Frequency	Strongly Agreed Responses%	Agreed Responses%	Number of Items Extracted by PCA
1	47	58	35	2
2	39	58	31	2
3	36	53	39	4
4	28	55	33	3
5	25	55	33	2
6	12	50	35	2
7	10	54	33	2
8	7	56	35	2
9	7	57	42	2
10	42	57	35	4
11	41	54	36	3
12	39	55	37	2
13	33	56	31	4
14	27	46	42	6
15	5	53	37	2
16	50	56	36	4
17	1	45	34	2
18	1	42	39	2
19	3	51	42	3
20	1	55	34	2
21	3	55	36	4
22	3	51	38	2
23	16	53	38	3
24	13	52	41	2
25	9	55	35	2
26	1	47	40	2
27	17	42	40	2
28	13	46	37	3
29	2	39	29	2
30	21	49	34	2
31	21	52	37	3
32	4	53	36	2
33	4	60	32	2
34	3	53	38	2
35	3	49	45	2

36	3	49	42	1
37	1	48	33	2
38	20	52	32	6

Table 8 presents the extracted CSFs descriptive results, which includes firstly the serial numbers as per extracted CSFs mentioned in table 7; secondly the literature frequency; thirdly the strongly agreed responses; fourthly the agreed responses and lastly the items extracted by PCA for these factors. As all these analyses have a high side, so it can be said that the CSFs detailed in table 7 are important for the success of ERP implementation in the manufacturing industry.

8 Proposed Model

As part of the current research objectives, the proposed model for ERP implementation is given below:

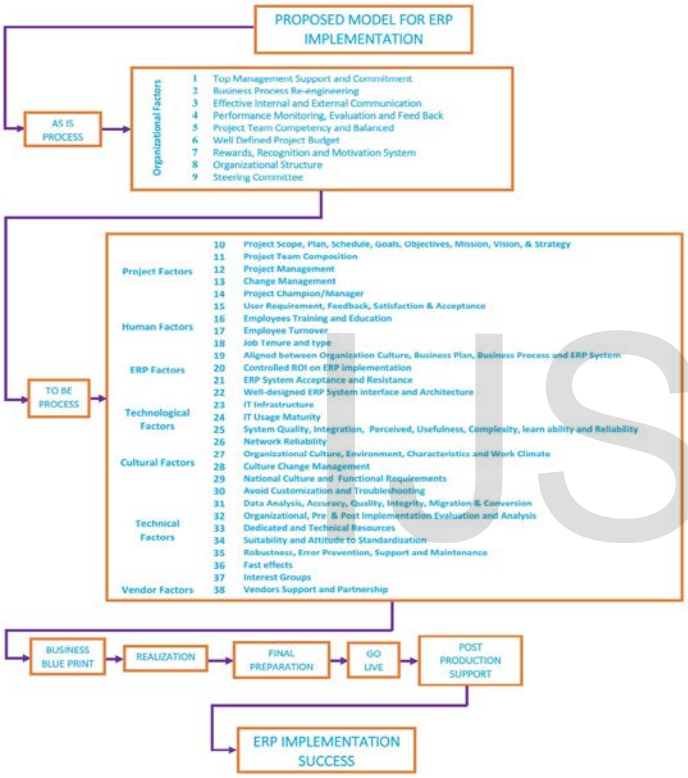

Fig. 2 Proposed ERP Implementation Model

Fig. 2 illustrates the proposed model for ERP implementation in the manufacturing industry. This model contains six phases.

- The first phase is called "AS IS" which used to collect and document the exact business and process information of the industry. The process of this phase will use the identified CSFs as shown in AS IS process of Figure.
- The second phase is "TO BE", all information collected and documented in the first phase will be mapped in the ERP system by using the CSFs shown in AS IS process of the figure.
- The third phase is named "business blueprint", which is used to print the documents and get approved the printed documents from all the stakeholders. "
- The fourth phase is called "realization", which is used to implement all the requirements which are collected in the AS-IS process and mapped in ERP system during the TO BE process with the availability of the approved Business Blueprint document.
- The fifth phase is called the "final preparation", where all required preparation is carried out which includes resolving all critical open issues.
- Lastly, the "Go Live & Support" in which the mapped and tested system transfer from a project-oriented testing environment to live production, operation requires the continuous support, which starts with the assistance of the vendors and the consultants included the internal IT experts of the industry.

9 Conclusion

The current research discovered the CSFs that will protect the ERP implementation success in the manufacturing industries. In this research, the CSFs identified from the literature review further proposed model for ERP implementation success in the manufacturing industry. During the literature review, 840 CSFs identified in the 63 categories, whereas 60 unique CSFs within the 08 unique categories selected for current research. A questionnaire-based survey conducted and collected data from ERP consultants, managers, administrators, and trainers. With the analysis, 38 factors within the 08 categories declared as CSFs for ERP implementation in the manufacturing industry. These 38 CSFs obtained 09 from the organizational category, 06 from the project category, 03 from the human category, 04 from the ERP category, 04 from the technological category, 03 from the cultural category, 08 from the technical category, and 01 from the vendor category. In the results, many respondents are agreed and highly agreed on the selected CSFs. Based on these CSFs, the ERP implementation model proposed with six phase implementation strategy for the manufacturing industry. This research covers the answers of the following questions; how to identify CSFs for implementation of ERP system in the manufacturing industry?; how to implement ERP system projects in the manufacturing industry by identifying and using CSFs?; how to design a successful model for the implementation of the ERP system in the manufacturing industry and how to gather data about the ERP implementation in the manufacturing industry? Therefore, this research will help the ERP specialists and related experts to make the right decision with the help of these updated CSFs for the manufacturing industries.

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