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Factors affecting ERP (Enterprise resource planning) package application for Indian power Discoms & post implementation performance analysis

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Abstract
Power Sector being a crucial framework of any successful economy, hence needs to be an efficient ingredient. Thus a special attention is laid by the government of India on the electricity distribution industry to improve their operational and business competence in recent RAPDRP (Regulated Accelerated Power Development and Reforms Programme) plan of govt of India thrust has given to modernisation of Electricity Distribution System
ERP (Enterprise Resource Planning) system implementation is one of them, which act as a most important enablers in providing an environment for integration of utility applications.
ERP implementation Project success depends on meeting the some factors which is commonly known as CSF (Critical Success Factor). Some of such factors are common in nature whatever the Business Domain is but some factors are definitely Industry Specific and Country specific.
The current research study is based on seeking such Industry Specific i.e. Power Discom (Power Distribution Business) specific success factors of ERP implementation in Indian Scenario & also for understanding the Post implementation Financial Success measurement.
An opinion survey was conducted among the employees of Indian Utlities for their valued response on such identified CSF's. A statistical tool also used for identifying the most Critical ones for ERP implementation Further Study may be conducted on application of such critical success factors and their outcome.

Keywords: ERP Implementation, Indian Power Discoms, RAPDRP Critical success facors (CSF)

1. Introduction
ERP can be viewed as a software solution that addresses the organisation needs after considering overall process view of the organisation in order to meet the organisational goals after tightly integrating all functions of an enterprise.
Organizations are providing great attention and exercising extra thinking for making their ERP systems more effective and efficient but even so not all ERP implementations have yielded the desired results. Factor that impacts the success of an ERP implementation is also know a Critical Success factors (CSF's).
Indian power discoms is passing through a critical phase Presently most of the Power distribution companies (known as Discoms) are cash strapped in spite of highly monopolistic business model with continuous product demand and cost plus fixed tariff approach. They are not even able to earn a minimum rate of return (ROR). The power sector has accumulated a huge deficit, because of the deteriorating financial performance. The reasons are improper business processes and weakness in maintaining documentary records.
ERP application is expected to consolidate the business operations of the Indian Power Dicoms and also increase the business efficiency by reducing the losses.
There are around 50(fifty) Power Distribution Companies in India including private initiatives out of which about 40% Discoms have completed ERP Implementation process and some are in the process of Implementation and some are yet to start their process.
Hence someone need to measure the most critical success factors of ERP implementation which will guide the Discoms which not yet started the process or just started. There are no specific research was conducted so far relating to Critical Success factor of ERP implementation for Indian Power Distribution Companies along with success measurement for those who have already implemented the ERP.

2. Literature Review
A) Articles based on "Critical success factors of ERP Implementation in Indian power Discoms"

a. "Need and Challenges of ERP Implementation in Discoms "- Amit Gupta –Addl.Chief Engineer of Madhya Pradesh Madhya khetra Viduyt Vitaran company Ltd., Bhopal.
   The researcher tried to find out the most demanding success factors of ERP Implementation in Power discoms like MPMKVC But the researcher not tried to collect information from similar or other Discoms in India to arrive at a conclusion for further study.
b. "Analysing Progress and Success Factors for ERP implementation in Indian Power industry –A case study on HPPCL "- Ved Prakash Sharma Research Scholar, Dept. Of Computer Science Himachal Pradesh University, Shimla.
   Researcher tried to find out the most demanding success factor of ERP implementation specific to HPPCL only.
   Research Gap- No further study has not been conducted on other power discoms in order to arrive at a

concrete identification of CSF's of ERP Implementation in Indian Power Discoms

c. "Information Technology Implementation in Indian Power Distribution "– a case study- Company: BSES (Bombay Sub –Urban Electricity Supply Company), Delhi. –Sri Dhrubaji Mandal of MDI Gurgaon under guidance of Prof. Mahadeo jaiswal Chairperson –Process Renovation Project MDI, Gurgaon.
   - In The current study, researcher tried to find out the IT methodology Road map of IT implementations in BSES & listed some crucial success factor of ERP implementation in organisation like BSES.
   - **The Research Gap-** Researcher concentrated upon a specific power discom like BSES, but other utilities who have implemented the ERP is not considered in the current study.

B) Articles based on Other Industries.

There are so many research were conducted towards Critical Success factor determination of ERP implementation in other parts of world Researcher has reviewed more than 50(Fifty) articles but there is no specific research was conducted on Power Distribution Companies. Every Industry having their own Characteristics based on ownership pattern and geographical positioning, which may impact these Critical Success Factors References of such articles reviewed by researcher is provided at the end.

3. Overall Research Gap

Researcher have analyzed vast no. Of articles Journal publications, web based information and found that there are no specific research study conducted regarding Critical Success factor of ERP Implementation for Indian Power Distribution company's.

4. Research Objective

a) To identify the most crucial Success factors for the effective ERP Implementation in Indian power distribution Companies commonly known as Discoms.

b) To identify the awareness of ERP Security issues among the ERP Consultants & users, of Indian Power Discoms

5. Research Methodology

The research process involved the following steps:

- 1st a Literature review was undertaken in order to get a idea of Critical Success Factors considered for ERP implementation considered by other Researchers and why.
- 2nd a questionnaire was constructed on Critical Success Factors related to ERP implementation in Indian Power Discom based on subject Knowledge and Experience of Researcher.
- 3rd In depth Interviews has been conducted with Different Project Managers Of Different IT Companies like TCS, IBM India, Accenture etc in order to establish a Success factors of ERP Implementation Project in Indian Power Discom.
- 4th The questionnaire designed as said in point 2 (two)was sent to different key persons like Project Managers, Power users department heads who belongs to Different Indian Power Distribution Companies who have implemented ERP during 2000- 2015.

The responses was analysed with a statistical tools in order to identify the most critical success factors based on their opinion or responses.

After reviewing different articles as mentioned researcher have identified 40 Critical Success Factors (CSF) related with ERP Implementation process in Indian Power Discoms and grouped them into 8 different groups based on their nature named as **a.** Management Related Factors. **b.** HR Related Factors. **c.**Process Related Factors. **d.** Project Related Factors. **e.**Technology & Business Related Factors. **f.** Infrastructure Related Factors. **g.** Miscellaneous Factors. **h.** Security Related Factors.

Subsequently these Success factors measured in 5 Point Likert Scale (Agree, Strongly Agree Disagree, Strongly Disagree Neither Agree or Disagree) while sending to target groups for their opinion.

Table 1 shows such identified Critical Success Factors (CSF) of ERP Implementation for Indian Power Discoms.

Table 1: List of Success Factors

VAR00001**	Clearly Defined Goal & scope of Implementation	Mgmt. Related Factors
VAR00002	Top Management Involvement & Support	
VAR00003	Inter Departmental Coordination.	
VAR00004	Organization Culture Improvement required towards ERP Adaptability.	HR Related Factors
VAR00005	Conducting Change Management programmes across the locations.	
VAR00006	Simple & Efficient Communication between ERP Implementation Team & User Group.	
VAR00007	User Involvement & Training	
VAR00008	Effective Business process Re-engineering	Process Related Factors
VAR00009	Availability of Standard Operating procedure of Client Business.	
VAR00010	Simple & Integrated Business Process design in ERP.	
VAR00011	Rigorous Testing of Business scenarios along with Integrated Testing Before ERP Go Live.	
VAR00012	ERP readiness assessment before Project Implementation starts.	Project Related Factors
VAR00013	Proper Project Planning	
VAR00014	Full Time Involvement of Client's (where ERP to be implemented)Project Team	
VAR00015	Efficient handling of Project Risks & Exceptions.	
VAR00016	Availability of In-house support Team am of Client(where ERP to be Implemented)	
VAR00017	Continuity of same implementation team of Implementer from start to finish	
VAR00018	Project Team composition of Client(where ERP to be Implemented)	
VAR00019	Availability of In-house Development Team	

VAR00020	Efficient Integration between different Business Functions within ERP & Outside of the ERP system.	
VAR00021	Support from ERP vendor.	Technology & Business Related Factors
VAR00022	Quality of Legacy data in terms of Accuracy & Completeness	
VAR00023	Availability of existing legacy MIS reports	
VAR00024	Conversion of Legacy system data base structure as per ERP requirement.	
VAR00025	Minimum Customization	
VAR00026	Network connectivity across the locations	Infrastructure related
VAR00027	Age profile of End Users	Miscellaneous Factors
VAR00028	Pilot Run & parallel Processing for a limited period	
VAR00029	Business & Technical knowledge of ERP consultant.	
VAR00030	Post implementation Audit is required to assess the objective fulfillment of ERP implementation.	
VAR00031	Measuring Key Financial / performance indicators of pre & post Implementation scenario is required to assess the benefit of ERP investment.	
VAR00032	Periodical review of Functional and Technical settings of ERP helps to bring Operational excellence	
VAR00033	Consideration of ERP security Measures during or after Go live is essential.	Security Related Factors
VAR00034	ERP security is essential to protect your Data	
VAR00035	Data security is required as per importance of data	
VAR00036	ERP security helps to Compliance with Laws & regulations/Statutory Obligations.	
VAR00037	ERP security enhances trust & relationships among customers Business Partners & stake holders	
VAR00038	Identification of suitable business / Systems controls during ERP implementations is an Important task, in order to ensure Success.	
VAR00039	User Access to ERP system need to be based on Job Roles & also to be based on best practices of ERP system	
VAR00040	Default settings of a ERP system may create a security threat	

** This no. has been generated by SPSS Tool for each Success Factor

6. **Analysis of Primary Data (Survey)**

Researcher conducted a survey among all the employees attached with the different Indian Power Utilities of India including State & Private Utilities/Discoms etc. A survey tool named as Survey Monkey is used to conduct this survey which lasted for 13 months between March'16 to April'17

The survey link was sent to more than 1000 peoples across the India, who are working with different Power Distribution companies.

Total response received 354 Out of which 225 responses were Complete which was considered for further analysis.

Before sending the survey link to core users/ users of Power Discoms a pilot survey was conducted by sending the question ere to the IT consultants who were working with Major IT companies in India like Infosys, TCS, IBM & HP and also well experienced in the area of ERP implementation specific to Indian scenario.

Table 1: Profile of Survey Respondents

Variable	Catagories	No. of Respondents
Industry Segment	a. Power Generation	62
	b. Power Transmission	12
	c. Power Distribution	177
	d. Both (a,b, c)	48
	e. Others (IT & Mgmt. Consulting)	55

Following facts were observed during the Survey:

Snapshots from Survey

a. Following states have implemented the ERP solution with a aim to integrate the business operations and to improve their Financials
Chattisgarh /Gujarat / Maharastha / Madhyapradesh / West Bengal / Andhrapradesh / Himachal Pradesh / Telengana/ Delhi

b. Only 29% of total respondents belongs to organisation who having annual turnover is more than 50000 crores.
c. In 82% cases SAP-ERP is implemented
d. Out of total companies surveyed in 50% cases ERP was implemented before year 2011.
e. In Most the cases ERP implementation process covered with in 1-2 yrs.
f. Out of total complete responses received in 52% cases respondents answered positively about the application of ERP security during / after the ERP implementation.

7. Results & Discussions

For arriving at key CSF factors of ERP Implementation specific to Indian power Distribution Companies a Statistical weighted analysis of the responses & also Factor Analysis of the survey responses have conducted

The following table describe the success factors measured using eight (8) broad parameters like related to management of the company, human resources, process, project, technology & business, Security factors and other miscellaneous factors. We have used weighted arithmetic score results to measure its relative importance. Response from each factor is collected through a number from strongly agree (5) to strongly disagree (1). In the weighted mean each point of the response to be averaged with assigned weight. The weights are determined through the relative importance of each quantity on the average score.

Table 2: Overall ranking of ERP Implementation Success Factors

Success Factors	Grouping Of Factors	Total	Rank
Clearly Defined Goal & scope of Implementation	Management Related Factors	4.6730	1
Top Management Involvement & Support		4.5975	2
Inter Departmental Coordination.		4.5283	8
Organization Culture Improvement required towards ERP Adaptability.	HR Related Factors	4.5283	7
Conducting Change Management programmes across the locations.		4.4465	21
Simple & Efficient Communication between ERP Implementation Team & User Group.		4.4843	13
User Involvement & Training		4.5346	5
Effective Business process Re engineering	Process Related Factors	4.4843	12
Availability of Standard Operating procedure of Client Business.		4.4214	27
Simple & Integrated Business Process design in ERP.		4.4465	18
Rigorous Testing of Business scenarios along with Integrated Testing Before ERP Go Live.		4.5094	10
ERP readiness assessment before Project Implementation starts.	Project Related Factors	4.4465	19
Proper Project Planning		4.4025	29
Full Time Involvement of Client's (where ERP to be implemented)Project Team		4.4277	25
Efficient handling of Project Risks & Exceptions.		4.3019	36
Availability of In-house support Team am of Client(where ERP to be Implemented)		4.4403	24
Continuity of same implementation team of Implementer from start to finish		4.3270	34
Project Team composition of Client(where ERP to be Implemented)		4.5283	6
Availability of In-house Development Team		4.3019	35
Efficient Integration between different Business Functions within ERP & Outside of the ERP system.	Technology & Business Related Factors	4.4465	20
Support from ERP vendor.		4.4403	22
Quality of Legacy data in terms of Accuracy & Completeness		4.4277	26
Availability of existing legacy MIS reports		4.2956	37
Conversion of Legacy system data base structure as per ERP requirement.		4.3836	30
Minimum Customization		4.0314	40
Network connectivity across the locations	Infrastructure Related factors	4.5786	4
Age profile of End Users	Miscellaneous Factors	4.1006	39
Pilot Run & parallel Processing for a limited period		4.3585	33
Business & Technical knowledge of ERP consultant.		4.4969	11
Post implementation Audit is required to assess the objective fulfillment of ERP implementation.		4.3648	32
Measuring Key Financial / performance indicators of pre & post Implementation scenario is required to assess the benefit of ERP investment.		4.4403	23
Periodical review of Functional and Technical settings of ERP helps to bring Operational excellence		4.4025	28
Consideration of ERP security Measures during or after Go live is essential.		4.5849	3
ERP security is essential to protect your Data	Security Related Factors	4.4591	15
Data security is required as per importance of data		4.4780	14
ERP security helps to Compliance with Laws & regulations/Statutory Obligations.		4.3711	31
ERP security enhances trust & relationships among customers Business Partners & stake holders		4.4528	16
Identification of suitable business / Systems controls during ERP implementations is an Important task, in order to ensure Success.		4.4528	17
User Access to ERP system need to be based on Job Roles & also to be based on best practices of ERP system		4.5157	9
Default settings of a ERP system may create a security threat		4.2390	38

From Table No.2 Only Top Ten factors having strong weight age have considered as most critical success factors (CSF) of ERP Implementation in Indian Power Distribution Companies, which are as below:

Table 3: Top Ten Ranking

Success Factors	Weighted Average	Rank
Clearly Defined Goal & scope of Implementation	4.6730	1
Top Management Involvement & Support	4.5975	2
Consideration of ERP security Measures during or after Go live is essential.	4.5849	3
Network connectivity across the locations	4.5786	4
User Involvement & Training	4.5346	5
Project Team composition of Client(where ERP to be Implemented)	4.5283	6
Organization Culture Improvement required towards ERP Adaptability.	4.5283	7

Inter Departmental Coordination.	4.5283	8
User Access to ERP system need to be based on Job Roles & also to be based on best practices of ERP system	4.5157	9
Rigorous Testing of Business scenarios along with Integration Testing Before ERP Go Live.	4.5094	10

7.1 Factor Analysis of Survey Responses

The researcher has also conducted the Factor Analysis the statistical Tool for analysing the responses received from the Survey for identifying the relationship between the Success factor derived from survey responses

Table 4: Factor Analysis of All success Factors

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.846
Bartlett's Test of Sphericity	Approx. Chi-Square	3051.563
	df	780
	Sig.	.000

Kaiser-Meyer-Olkin (KMO) test measures sampling adequacy for each variable in the model and for the complete model. KMO returns values between 0 and 1. A rule of thumb for interpreting the statistic:

- KMO values between 0.8 and 1 indicate the sampling is adequate.

Factor Analysis to be recommended suitable, as the Bartlett's Test of Sphericity is less than 0.05.

Table 5: Total Variance

Total Variance Explained										
Component		Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
		Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Dimension	1	11.373	28.432	28.432	11.373	28.432	28.432	3.556	8.890	8.890
	2	2.870	7.176	35.608	2.870	7.176	35.608	3.450	8.625	17.514
	3	2.092	5.229	40.837	2.092	5.229	40.837	3.105	7.763	25.278
	4	1.901	4.754	45.591	1.901	4.754	45.591	3.009	7.523	32.800
	5	1.613	4.032	49.623	1.613	4.032	49.623	2.576	6.439	39.239
	6	1.486	3.715	53.338	1.486	3.715	53.338	2.328	5.820	45.059
	7	1.249	3.124	56.462	1.249	3.124	56.462	2.286	5.714	50.773
	8	1.205	3.013	59.475	1.205	3.013	59.475	2.201	5.502	56.275
	9	1.109	2.772	62.247	1.109	2.772	62.247	1.859	4.648	60.923
	10	1.106	2.766	65.013	1.106	2.766	65.013	1.636	4.090	65.013
	11	.991	2.477	67.489						
	12	.929	2.323	69.812						
	13	.883	2.208	72.021						
	14	.828	2.069	74.090						
	15	.817	2.041	76.131						
	16	.778	1.945	78.076						
	17	.670	1.675	79.751						
	18	.636	1.590	81.341						
	19	.600	1.501	82.841						
	20	.556	1.389	84.231						
	21	.538	1.346	85.577						
	22	.525	1.314	86.890						
	23	.466	1.164	88.054						
	24	.446	1.115	89.170						
	25	.414	1.034	90.204						
	26	.410	1.025	91.229						
	27	.370	.926	92.154						
	28	.355	.886	93.041						
	29	.346	.864	93.905						
	30	.320	.800	94.705						
	31	.307	.767	95.472						
	32	.292	.729	96.201						
	33	.262	.654	96.856						
	34	.242	.605	97.461						
	35	.223	.557	98.019						
	36	.195	.487	98.505						

	37	.166	.415	98.920						
	38	.156	.391	99.311						
	39	.146	.365	99.676						
	40	.130	.324	100.000						

Extraction Method: Principal Component Analysis

Table 6: Rotated Component Matrix

	Component									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
VAR00003	.785									
VAR00007	.735									
VAR00011	.578									
VAR00005	.575									
VAR00021										
VAR00029										
VAR00036		.700								
VAR00030		.665								
VAR00034		.638								
VAR00028		.603								
VAR00038		.598								
VAR00026										
VAR00035			.794							
VAR00039			.706							
VAR00037			.690							
VAR00033			.597							
VAR00006										
VAR00020				.776						
VAR00024				.594						
VAR00018				.564						
VAR00008				.525						
VAR00012				.510						
VAR00027					.727					
VAR00023					.615					
VAR00031					.552					
VAR00025					.538					
VAR00013						.748				
VAR00032		.509				.568				
VAR00015						.536				
VAR00017										
VAR00014							.745			
VAR00022							.672			
VAR00010										
VAR00016								.606		
VAR00009								.577		
VAR00002								.573		
VAR00004									.672	
VAR00001									.613	
VAR00019										.706
VAR00040										.577

Extraction Method Used: Principal Component Analysis.
Rotation Method Used: Varimax with Kaiser Normalization.
Rotation converged in 14 iterations.

Table 7: Success Factors Grouping

Factor	Individual variables	Grouping Factor
I	3= Inter Department Co ordination	Inter Department coordination enhances with strong user involvement in training & testing
	7= User Involvement & Training	
	5= Conducting Change Mgmt. Program me	
	11= Rigorous Testing of Business Scenarios	
II	36= ERP security & Compliance	Parallel Processing of ERP & legacy system for time being enhance Business controls & Security.
	30= Post Implementation Audit	
	34= ERP data Security	
	28= Pilot run & parallel processing	

	32= Periodical review of Functional & Technical settings	
	38= Identification of suitable business controls	
III	35= Data security	Data & ERP security can be achieved through user access as per job roles
	39= User access as per job roles	
	37= ERP security for trust enhancement among stakeholders	
	33= ERP security measures during / after go live is essential	
IV	20=Successful Integration within ERP & with outside system	ERP Integration check along with readiness assessment.
	24= Conversion of Legacy system data as per ERP requirement	
	18= Project team Composition of Client	
	08= effective Business process reengineering	
	12= ERP readiness assessment before implementation	
V	27= Age Profile of users	Post implementation operational & financial success depends on Min. customization & user age profile
	23= Availability of existing MIS reports	
	31= Measuring key Financial & Technical performance indicators	
	25= Minimum Customization	
VI	13= Proper Project planning	Periodical review of ERP settings for Efficient Project planning & Risk management
	15= Efficient handling of Project Risks	
	32= Periodical review of Functional & Technical settings	
VII	14=Full time involvement of clients project team members	Full time involvement of client's project team will ensure quality data for project success
	22= quality of legacy data in terms of completes	
VIII	2= Top Management Support	Top mgmt involvement & support
	9= Availability of Standard operating Procedure	
	16= In House support team	
IX	01= Clearly defined goal & scope of Implementation	ERP Implementation goal setting enhances organizational culture.
	04= Org culture improvement towards ERP adaptability.	
X	19- Availability of In house Development team	In House support team with ERP Security awareness
	40- Default setting of ERP system – A security threat.	

7.2 Points Identified From Factor Analysis

a) Inter Department coordination enhances with strong user involvement in training & testing.
b) Parallel Processing of ERP & legacy system for time being enhance Business controls & Security.
c) Data & ERP security can be achieved through user access as per job roles.
d) ERP Integration check along with readiness assessment.
e) Post implementation operational & financial success depends on Min. customization & user age profile.
f) Periodical review of ERP settings for Efficient Project planning & Risk management.
g) Full time involvement of client's project team will ensure quality data for project success.
h) Top mgmt involvement & support.
i) ERP Implementation goal setting enhances organizational culture.
j) In House support team with ERP Security awareness

8. Analysis of Financial Impact on ERP Implementation

The primary objective behind any ERP implementation is to improve the Management efficiency This is true in case of Indian Power discom also The following Financial Ratios have been identified by the Researcher for measuring the Financial performance of the Indian Power Discoms on post ERP Scenario.

a) Inventory Turnover Ratios
b) Debtors Turnover Ratios
c) Debt Equity Ratio.
d) Financial Charges Coverage Ratio.
e) Interest Coverage Ratio.

9. Conclusion

Around **60%** Indian Power Discoms not yet implemented the ERP solution to integrate their business. If they adopt the structured manner and give importance the said evaluated Critical Success factors of ERP implementation it is expected that they will achieve the success in their efforts, though there are other invisible issues which may effect the whole process Hence there are further scope on research on this area also indicated.

10. Limitations

Research was conducted among the employees of Indian

Power Discoms who were either directly or indirectly associated with ERP implementation Process. The current research survey was done primarily through a survey tool named as Survey monkey.com. Researcher tried to cover all the state power distribution companies along with private players in the power distribution segment. But due to non-availability of response from all the key employees of Power distribution companies even after repeated reminders and phone call. Researcher restricted the time span, coverage & its analysis.

11. Scope for Further Research

More in depth study may be conducted by covering all the employees of the concerned Power Distribution companies and impact of such critical success factors may be further reviewed after applying the same in those cases where ERP is in the process of implementation or to be implemented.

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