

Critical Success Factors in IT Alignment in Public Sector Petroleum Industry of India

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Abstract—This research examines the critical success factors that enable better IT absorption, assimilation, proliferation and to perform the important business functions in some of the large-sized public sector undertakings of key importance in India. There is a shortfall of empirical research in this area in India. Therefore, a study and survey of three important Public sector Indian Petroleum organizations has been conducted. The results have been obtained on the basis of survey, interview and field observational findings of 368 managers of these organizations. Several key important Critical Success factors (enablers and inhibitors) were identified- based upon resource, capability and the cultural view of these organizations. This sector is very important in India due to its economic, industrial and social impact. The findings of this study will help in effectively managing the IT for the better business and competitive advantage. Further this study will entail enablers and inhibitors for other Industry in India. The study is special importance as critical success factors of IT Alignment have been under studied in Indian context. This study highlights several factors of key importance for understanding alignment. Recommendations are provided to help achieving better alignment in these organizations.

Index Terms—Information Technology, Enabler, Inhibitor, Critical Success factors, Business and IT alignment.

I. INTRODUCTION

The alignment has been a major concern for the academics, managers and the research organizations. They have all tried to identify alignment between Business and IT strategies as a pervasive problem and have tried to fix it. In a study conducted by Society for Information Management (SIM) has again identified alignment as the first management concern among all groups surveyed for the Top 10 concerns that included 300 senior IT managers [32]. Though there has been significant research on the strategic use of IT, its alignment and underlining enablers and inhibitors of alignment but most of the existing research literature is largely anecdotal and exploratory [28,18,23]. Besides, most of the existing frameworks are intuitive rather than empirically derived [17]. Therefore, there is a need to empirically investigate the enablers and inhibitors of alignment.

Effective implementation and exploitation of IT is a challenging task. Most of the Indian organizations have yet not exercised their strategic IT option [13]. Further the IT adoption and adaptation is primarily ad hoc [10] in India.

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Also, there are multiple influences including infrastructural, cultural, governance, organizational, business and IT strategies, and geographical settings etc. in the strategic implementation of the IT. It is the interplay among these factors that determines alignment [24]. Therefore, such studies differ significantly and primarily due to the cultural and geographical settings. The Indian organizations are largely unexplored, understudied and IT alignment enablers/inhibitors are not very well understood. Thus, there is a need to carry out studies promoting alignment in Indian organizations. This is so despite the fact that these enablers and inhibitors of alignment has become key management issue for the IT executives in the recent years [24,32]. Understanding these enablers and inhibitors the organizations will help organization to better manage and evaluate IT alignment as well as to ensure realization of the expected benefits from alignment.

II. OBJECTIVES OF THE PAPER

The main objectives of this paper are:

- 1) To determine and analyze various enablers of alignment of IT .
- 2) To study the factors that causes hindrance (inhibitors) to the alignment .

III. ENABLERS AND INHIBITORS OF ALIGNMENT

In the existing research literature greater emphasis has been given on the enablers than the inhibitors. Consequently, there is a relatively shorter list of inhibitors available in literature. But, they are important so as to judge whether the absence of an enabler necessarily serves as an inhibitor or not. Otherwise, the domain of the two is not significantly different. Hence, in order to have a deeper insight of the system this research has considered both of them. The various factors that serve as enablers and inhibitors of alignment along with their citations have been presented in Table I and Table II respectively.

TABLE I. ENABLERS OF ALIGNMENT

Enablers	citation
Existing information technology leadership position (f1)	16,25,26
Extensive computer facilities within the firm (f2)	16,27,28,25,30,8
Strong technical expertise within the firm (f3)	16,27,28,7,25,26
Strong market position of the firm (f4)	16,25
Strong financial position of the firm (f5)	16,25,26
Strong planning capability of the firm (f6)	16,27
Strong Organizational support (f7)	11,9,16
Strong Top management commitment (f8)	27,28,16,34
Senior executives' support for IT (f9)	16,27,34,24
IT involved in the strategy development	27,28,3,33

(f10)	
Close relationship between IT and non-IT people (f11)	1,20,16,23,25,33,19
Prioritization of IT effort (f12)	4
Linking between IT and strategic plans (f13)	27,28,25,14
Sharing of IT resources (f14)	16,15
Business-IT partnership (f15)	4,28,35,14,15
IT takes care of the human factor (f16)	29,5
IT demonstrates leadership (f17)	16,27,18

TABLE II. INHIBITORS OF ALIGNMENT

Inhibitors	Citation
Lack of appropriate planning (f18)	13
Lack of the organizational/Top management support (f19)	23,16,27,28,6
Low perception of the importance of the IT concept (f20)	13,12,19
Difficulties in assessing tangible contribution of IT (f21)	21,22
Complexity of the concept (f22)	23,2
Power and politics in the firm (f23)	2
Budgetary constraints in IT implementation (f24)	35
Other priorities are more important (f25)	13,31

IV. RESEARCH METHODOLOGY

A. Data collection tools

Primary data has been collected through a questionnaire-cum-interview method from the selected respondents. The questionnaire was designed based on the existing research articles and the discussion with the managers serving in the three organizations considered in this study. A total of 25 such factors were identified. To ensure the quality of the instrument the questionnaire was tested for reliability, content validity and sensitivity. The designed questionnaire was pre-tested through subjecting it to the 15 respondents. The questionnaire chosen for the study was found reliable as cronbach's alpha reliability of the scale used was more than 0.85, indicating the goodness of the scale measurements. Content validity of the questionnaire was tested through thorough discussions for comprehensiveness, depth and relevance to the selected organizations and the topic of study. The questionnaire was found to be comprehensive, appropriate and relevant to the study. The responses and the recommendations on the basis of the feedback were incorporated into the final questionnaire. Further, the sensitivity of the questionnaire was found good as the likert scales were used to record the response of the participants.

B. Sampling scheme

The research of the enablers and inhibitors of alignment involved the collection of data from the managers working at various levels within the selected enterprises. For selecting the total number of respondents in these enterprises, the

sample size selection and reaching to the conclusions, the statistical techniques have been followed. The details of the sample selection used in this research are given as under:

C. For the Organization

a) *Universe of study:* Petroleum industry comprises of Oil and Natural Gas Commission (ONGC), Indian Oil Corporation (IOC), Hindustan Petroleum Corporation Limited (HPCL), Bharat Petroleum Corporation Limited (BPCL), Reliance Petroleum Limited and Essar Oil Limited.

b) *Sample Selection:* ONGC, Ankleshwar, IOC, Panipat Refinery, BPCL, Mumbai Refinery.

D. For the Respondents

a) *Universe of study:* All managers working at the three levels in the selected organizations.

b) *Sample Selection:* A number of respondents from the three organizations were selected using stratified random sampling (shown in Table III). The respondents were identified on the basis of their levels/business function in each organization. The primary data were collected via questionnaire-cum-interview with the selected respondents. SPSS statistical tool was used for the statistical analysis. The norms were formalized for the choice of respondents from the participating organizations. These norms were chalked out after detailed discussions with a number of academicians, researchers and industrial experts. It was observed that increase in sample size will affect the results only marginally whereas effort for it will be considerable. The sample size from a stratum was determined on the basis of the following criterion:

- i) 25% of the population where sample size > 100
- ii) 50% of the population where sample size < 100
- iii) 100% of the population where sample size is between 25 to 100.

TABLE III. SAMPLE DISTRIBUTION

COMPANY	Management Level	Total	SAMPLE	ACTUAL #
BPCL	Top	19	10	10
	Middle	110	28	29
	Lower	470	118	89
	Total	599	158	128
IOC	Top Level	16	8	10
	Middle	154	39	40
	Lower	379	95	82
	Total	549	143	132
ONGC	Top	16	8	12
	Middle	339	85	56
	Lower	144	36	40
	Total	499	129	108
Grand Total		1647	430	368

E. Method of collecting the data

The interrogation/communication method of study has been followed. The data has been collected using personal and interpersonal means. The collected data has resulted from self-administered or self-reported instruments personally delivered. The study is cross-sectional as it is carried out once and represents a snapshot of one point in time.

F. Processing of data

The responses of the 368 managers of the selected organizations under study were recorded on five point likert scale with responses ranging from -2 to +2 (-2 = highly inhibiting, -1 = fairly inhibiting, 0 = no contribution, 1 = fairly facilitating, 2 = highly facilitating). The responses of all questionnaires have been collected in the hard copy form. In the majority of the cases, there was a direct interaction with the respondents while filling up the questionnaire.

The responses were screened for ambiguous, illegible and incomplete responses. Unsatisfactory responses were discarded. In some cases there were few missing values. The missing values were assigned after following up the respondent. In a few case, the average value were used for missing values in the questionnaire.

The valid responses were entered in Microsoft Excel software. This dat formed the basis for the corresponding files on the SPSS software. The response files have been subjected to analysis using Microsoft Excel and SPSS features such as the percentages, averages, significance of goodness, correlation and the factor analysis.

G. Analysis and results

The analysis has been made on the basis of the mean scores and the factor analysis techniques. The collected responses were subjected to the factor analysis technique to identify and pinpoint the most important enablers and inhibitors of alignment. The mean scores and the rank-wise arrangement of the factors based on their relative importance has been shown in Table iV.

Principal component analysis and Varimax rotation of factor analysis were applied to extract the more important factors and their relative importance. Two principal components have been extracted along-with the underlying fifteen factors with factor loadings >= 0.45. These principal components explain 35% of the cumulative variance. These are the very important Enablers or Inhibitors to Business and IT alignment. These factors have been grouped into the logical groupings as shown in the Tables V and VI. Detailed statistical analysis reports of the factor analysis are given in the Appendix.

TABLE IV. RANK-WISE ARRANGEMENT OF VARIOUS ENABLERS AND INHIBITORS OF IT

Enablers of IT	Mean enabling Score#	Ran k
Strong Top management commitment *	1.48	1
Strong financial position of the firm	1.44	2
Senior executives' support for IT *	1.18	3
Extensive computer facilities within the firm	1.17	4
IT involved in the strategy development *	1.10	5

Strong market position of the firm	1.00	6
Strong Organizational support *	0.97	7
Strong planning capability of the firm*	0.90	8
Linking between IT plans and strategic plans*	0.83	9
Sharing of IT resources	0.50	10
Prioritization of IT effort	0.48	11
Strong technical expertise within the firm	0.47	12
Existing information technology leadership position	0.46	13
IT demonstrates leadership *	0.39	14
Close relationship between IT and non-IT people *	0.37	15
Business-IT partnership	0.15	16
IT takes care of the human factor	0.07	17
Inhibitors of IT	Mean enabling Score#	Rank
Lack of appropriate planning	-1.04	1
Difficulties in assessing tangible contribution of IT	-1.02	2
Low perception of the importance of the IT concept	-0.90	3
Complexity of the concept	-0.88	4
Lack of the organizational/ Top management support	-0.39	5
Other priorities are more important	-0.38	6
Power and politics in the firm	-0.24	7
Budgetary constraints in IT implementation	-0.20	8

(-2 = highly inhibiting, -1 = fairly inhibiting, 0 = no contribution, 1 = fairly facilitating, 2 = highly facilitating)

TABLE V. FIRST PRINCIPAL COMPONENT

Enablers of IT	
Infrastructure-culture	Competitive internal environment & Strategy
- Strong financial position	- Sharing of IT resources
- Extensive computer facilities	- Prioritization of IT effort.
- Strong market position	- Business-IT partnership
- Strong technical expertise.	
- Existing IT leadership position.	
- IT takes care of the human factor	

TABLE VI. SECOND PRINCIPAL COMPONENT

Inhibitors of IT	
Operational Inhibitors	Strategic and leadership Inhibitors
- Difficulties in assessing tangible contribution of IT.	- Lack of appropriate planning
- Complexity of the concept.	- Lack of organizational/Top management support
- Budgetary constraints in IT implementation.	- Low perception of the importance of the IT concept.

V. SURVEY FINDINGS

The factors marked as ‘*’ in Table IV have quite high mean scores indicating that they are important enablers to alignment. Also the most important enablers have been identified through the factor analysis technique (Refer Tables VII to X). Among the later identified factors, the factors based on the Top management support and the involvements of IT in the Top management’s strategic planning have been eliminated. This is so because most of the managers in these companies strongly feel that the very presence of IT is largely due to the initiative and the commitment of the Top management. Therefore, despite importance being given to IT by the Top management other factors can play much more vital role in IT alignment with the business.

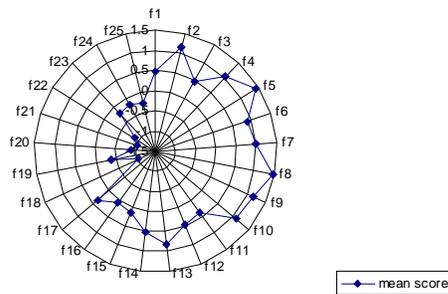


Fig.1 Mean score of enablers and inhibitors

It can be depicted from Table IV and Fig. 1 that the factors ‘lack of appropriate planning’, ‘low perception of the importance of the IT concept’, ‘difficulties in assessing tangible contribution of IT’ and ‘complexity of the IT concept’, are highly important inhibitors for the Information Technology alignment. This clearly shows that the IT has not matured enough in these companies. IT and its benefits must percolate deeper into these companies for better alignment.

The factors ‘prioritizing the IT effort’, ‘emphasizing its importance’, ‘strong technical expertise’, ‘existing IT leadership position’ and ‘IT demonstrates leadership’ etc. are not very important enablers. Similarly, the factors, ‘Power and politics’, ‘Budgetary constraints in IT implementation’ and ‘imparting more importance to other priorities’ are not very important inhibitors of IT. But, these factors can be critical for the IT alignment to business. The negligence of any of them can lead to impaired development of IT, not properly aligned to business. Similarly, emphasizing these factors can enrich and proliferate IT in such a manner that it can contribute a lot to the business and thereby provide competitive advantage.

VI. RECOMMENDATIONS AND CONCLUSIONS

The scores of the Lower level managers were much lower than those at the Top and Middle levels. This shows that the IT and its benefits have not reached at the Lower levels of management. Therefore, focus of these companies must be to emphasize IT at the Lower managerial levels. This is

possible through interaction, meetings, informal group discussions, training and offering incentives for using IT.

There is a strong focus on the individual and level-wise functionality, resulting into the organizational fragmentation which is non-congruous with the strategic objectives of the organization for which the integration is a must. Better sharing of IT resources, process interconnection, cohesion and the data flows among the different functionalities are recommended.

There is a need to emphasize team-work. There is a much greater need of the collaborative effort among the IT and non-IT people in these companies.

The oil sector companies have strong financial and market position. They are able to afford extensive computer facilities. But, IT is regarded as an enabler that automatically provides the competitive advantage. However, IT itself is not a source of competitive advantage rather the advantage is gained through the business facilitated by it. Therefore, focus should be on the management of the Information Technology. The IT initiative must be business driven rather than the technology driven. Moreover, the human aspect of IT must be emphasized.

A non-assessment of the IT related benefits and their possible measurement are persistent problems for the Petroleum sector companies. A greater focus and concerted research efforts are required to measure IT.

There are two principal components for studying enablers and inhibitors of alignment. The first component emphasizes the Infrastructure-Culture and Competitive internal environment & Strategy based factors, as the most important enablers of IT, and the second component underlines the Operational, Strategic, and Leadership factors, as the important Inhibitors to IT. Thus these companies must emphasize the strategy and leadership based factors. These experiences can be highly useful in understanding and monitoring the factors that can support or hinder the development and implementation of Information systems.

VII. LIMITATIONS OF STUDY AND FUTURE DIRECTIONS

The theme of research addresses the issues of enablers and inhibitors of alignment in the Petroleum sector as a whole. However, this study has been confined to only one sector due to time constraints and practical difficulties.

The population being studied is quite dynamic and keeps changing in the organization. A strictly random selection procedure cannot be used because the full listing of the population is impossible. Therefore, the sample drawn is not a truly random sample. However, care has been exercised to select the respondents independently and thus avoid the selection bias as far as possible.

The study focuses itself to the response in terms of the expectations of the managers from IT measured on a 5-point scale. These expectations are not necessarily predictable and robust. In an ongoing process of aligning IT, one must assess simultaneously expectations and perceptions to obtain the gaps in alignment.

The study has been conducted predominantly in just two

regions of the country namely northern and western and the results of the same, if conducted in some other part of the country. This is so because the perceptions and expectations of managers may differ in the different areas of the country. This is important because in a country like India the regions are culturally and economically very diverse.

The study is confined to public sector companies. The perceptions and the expectations of the managers of the private sector companies may be different. Further research may be required to check the enablers and inhibitors of alignment in these cases.

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TABLE VII. FACTOR ANALYSIS FOR ALIGNMENT COMMUNALITIES

	Initial	Extraction
F1	1.000	0.485
F2	1.000	0.507
F3	1.000	0.522
F4	1.000	0.505
F5	1.000	0.349
F6	1.000	0.166
F7	1.000	2.995E*02
F8	1.000	0.107
F9	1.000	9.039E-02
F10	1.000	0.156
F11	1.000	0.474
F12	1.000	0.546
F13	1.000	8.256E-02
F14	1.000	0.427
F15	1.000	0.389
F16	1.000	0.404
F17	1.000	0.430
F18	1.000	0.528
F19	1.000	0.338
F20	1.000	0.589
F21	1.000	0.641
F22	1.000	0.511
F23	1.000	0.209
F24	1.000	0.262
F25	1.000	0.168

TABLE VIII. TOTAL VARIANCE EXPLAINED

Component	Initial Eigenvalues			Extraction sum of squared loadings		
	Total	% of total var.	Cumm. % age	Total	% of var.	Cum. %
1	5.550	22.198	22.198	5.550	22.198	22.198
2	3.366	13.464	35.663	3.366	13.464	35.663
3	2.259	9.036	44.699			
4	1.471	5.886	50.585			
5	1.236	5.943	55.528			
6	1.113	4.453	59.981			
7	0.882	3.530	63.511			
8	0.782	3.127	66.638			
9	0.720	2.879	69.517			
10	0.695	2.781	72.298			
11	0.666	2.665	74.963			
12	0.614	2.455	77.419			
13	0.588	2.354	79.772			
14	0.552	2.206	81.978			
15	0.537	2.148	84.126			
16	0.502	2.022	86.148			
17	0.483	1.932	88.080			
18	0.470	1.879	89.959			
19	0.455	1.820	91.779			

20	0.39 9	1.597	93.376
21	0.38 5	1.540	94.916
22	0.35 6	1.422	96.338
23	0.32 8	1.310	97.648
24	0.31 5	1.259	98.907
25	0.27 3	1.093	100.00

TABLE IX. COMPONENT MATRIX FOR ALIGNMENT

	Component	
	1	2
F1	0.694	5.804E-02
F2	0.700	-0.129
F3	0.722	3.630E-02
F4	0.705	-9.132E-02
F5	0.577	-0.125
F6	0.400	8.087E-02
F7	0.150	8.573E-02
F8	0.239	-0.224
F9	0.282	0.105
F10	0.354	-0.174
F11	0.688	-9.632E-04
F12	0.738	-3.000E-02
F13	0.286	2.749E-02
F14	0.652	4.114E-02
F15	0.623	-1.880E-02
F16	0.606	0.194
F17	0.655	2.741E-02
F18	0.178	0.704
F19	-0.135	0.565
F20	-1.063E-02	0.767
F21	6.503E-02	0.798
F22	7.772E-02	0.711
F23	-6.103E-02	0.453
F24	-6.390E-02	0.508
F25	-5.845E-02	0.405

TABLE X. COMPONENT MATRIX FOR ALIGNMENT

	Component	
	1	2
F1	0.696	2.792E-02
F2	0.694	-0.159
F3	0.722	5.011E-03
F4	0.700	-0.122
F5	0.572	-0.149
F6	0.403	6.348E-02
F7	0.154	7.914E-02
F8	0.229	-0.234
F9	0.286	9.297E-02
F10	0.346	-0.189
F11	0.688	-3.077E-02
F12	0.736	-6.195E-02
F13	0.287	1.507E-02
F14	0.653	1.287E-02
F15	0.622	-4.577E-02
F16	0.613	0.168
F17	0.656	-1.005E-03
F18	0.209	0.696
F19	-0.111	0.570
F20	2.262E-02	0.767

F21	9.952E-02	0.767
F22	0.108	0.707
F23	-4.136E-02	0.455
F24	-4.182E-02	0.511
F25	-4.084E-02	0.408

Extraction method: Principal component analysis, Rotation method: Varimax rotation with Kaiser Normalization. A rotation converged in 3 iterations.