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Critical Success Factors in the Development of Strategic Information Systems in Indian Public Sector Organizations: An Inter Organizational Analysis

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Abstract:

A rapidly changing business environment requires firms to develop information systems that are more flexible, responsive, integrative and information rich. At the same time, it is also important to align the information systems with their core businesses processes. Review of literature of this study indicated the clear gaps existing in the development of Strategic Information Systems in general and particular in the Public Sector Undertakings (PSU's) in India. Thus this study has been undertaken in Indian PSU's. Data has been collected from 164 managers who were working at the different levels of management. Five critical success factors namely Corporate Planning; Regular Upkeep of the Machinery; Fire & Safety Audits; Quality Control; Quality Assurance have been found as Critical Success factors for the selected organizations. in particular and the other organizations in general. Based on the findings of the study it is recommended that the organizations must take care of these critical success factors so as to develop SIS which are successful information system and thus enable the organization to get a sustainable competitive advantage.

Keywords: Strategic Information Systems (SIS), Critical Success Factors, Public Sector Undertakings, Management Levels, Information Technology.

1. Introduction

With the changing linkage among the stakeholders the use of Strategic Information Systems is becoming increasingly important to the organizations. Around the world more and more organizations are being forced to apply SIS to compete with the competitors.

The fast development and wide use of information technology have changed the way how the organization's are managed [2:46-52]. However the strategic value of the information systems and impact of these on the business requires a systematic planning, development, implementation and post implementation process to be followed by the organizations. It has also been discussed among practitioners, academicians and researchers in the information systems field that the contribution of large scale IS deployment to superior business performance is predicted on the dynamic alignment of business and information technology (IT) strategies and the underlying architecture and systems that support the strategy execution [3:81-113]. Further, information system development has major risks and uncertainties that make it difficult for the system to achieve goals. Sometimes the costs of achieving them are so high. One problem is the difficulty of establishing information requirements, both for individual end users and for the organization as a whole. So the factors which are critical success factors for an organization must be identified and known to the organization so as to set the bench marks for the information systems to be called as Strategic Information Systems. As the information systems would be called as strategic, if it supports the factors which are critical for an organization.

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2. Review of Literature

Setzekorn [1] emphasized on how manufacturing IT infrastructure and co – ordination strategy mediate business complexities effect on firm productivity performance. The results indicated that organizations developing more manufacturing IT in context of higher business complexity but that this deployment actually decreased resource productivity. However when firms employed higher levels of manufacturing IT they also employed a more cooperative and coordination strategy, which results in higher levels of productivity. Elson and Raymond [4] found out that the data warehouse is an evolving technology that is part of an organization's long-term strategic investment. In this role it is supporting organizations customer relationship management and business intelligence strategies. Haskins [5] concluded that to determine a solid array of planning tools and actions that identify the best business and information technology linkages. Six major constructs were investigated to corroborate the premise that if certain business moving from the commonly used objective measures of success (time and money constraints) to subjective measures. Boyd [6] found out that to create a subjective measurement system that can assist in the successful creation of new information systems that entails achieving the organizational objectives very successfully in the changing business environment.

Rehman [7:34-38] explained that as information is viewed as a strategic resource managing it assumes tremendous importance. Though the spending on IT has increased tremendously but fruits of these large investments have not yet reaped by the corporates. He concluded that top management must make a commitment to information processing approach. In this technology era information of varying quality is being aggregated for business use. Hackeny et. al [27] highlights that the alignment of an organization's systems and technology strategy with its business objectives. By going through the literature on Strategic Information System Planning (SISP) they found that it does not fully mirror contemporary business strategy and contains some fundamentally incorrect assumptions that propose a number of challenges for further research. The paper also highlighted the number of challenges for SISP like managing business change, assessing organizational competencies for sustainable competitive advantage.

Lee and Pai [8:263-280] concluded that the strategic value of information systems and the impact of information technology on business competitiveness have increased the need for effective strategic information system planning. A survey of senior IS executives in Taiwan was used to test the relationships between the constructs in the research model. The results showed that certain factors relating to organizational context and inter group behaviour influenced the success of SISP. Campwell and Kay [14:653-664] the exploratory research presented in study involved six senior IS/IT managers during three two-hour focus group sessions. The focus group sessions were recorded, transcribed and analysed using content analysis. The research suggests that, although practitioners understand that a high level of connection between IS and business planning processes may be dependent on the level of integration between the IS group and other sections of the organization, they are still unable to develop the necessary relationships. It appears that the culture of many organizations is impeding the development of this integration. Gadman and Cooper [15:23-34] explores ways in which the internet and advanced electronic communication systems are enabling a new economy based on the networking of human knowledge. These networks span functional, organizational and national boundaries, allowing people to share data and information to generate new knowledge. Their increasing use and importance as a means of gaining competitive advantage has attracted much attention, especially in the study of leadership and organization development. The study addresses

the fundamental leadership and organizational challenges they face as they attempt to connect people to people and people to knowledge across the borders of business units and countries.

Temtime et. al [16:230-237] concluded that firm size and strategic planning are positively related. Medium firms put more emphasis on strategic issues than do small firms. As the firm size increases (as measured by either number of employees or sales volume) from small to medium and large, they tend to shift from focusing entirely on operational issues to long-term strategic advantage. A further key finding was that computer usage was positively associated with strategic planning. Reddy and Reddy [17:5-16] in this conceptual paper, the researchers attempt to illustrate the common concerns of large, often multinational corporations with their legacy information systems. Over time, many large firms have accumulated a multitude of disparate, often large-scale information systems, each fulfilling a particular competitive need at a particular point in time. The previous sections identify some of the organizational obstacles firms face in trying to adapt monolithic legacy systems to new business requirements. Lau and Pun [18:312-320] the proposed Strategic Information Systems (SIS) model provides an overview of the various modules needed. The study highlights that in particular, an information flow mechanism which can facilitate the effective interchange of data among the various modules is an issue to be addressed if the actual implementation of such a system is desired. Bai and Lee [19:622-632] the results reveal that some factors within the cooperative competence and organizational IS/IT context are significantly related to the quality of the Information Systems Strategic Planning (ISSP) process. This finding shows that as ISSP becomes more complex, especially when organizations introduce e-commerce and e-business strategies, organizations must integrate multiple views of various stakeholder groups. Therefore, an effective coordination mechanism and maintaining a close relationship between CEO and CIO are crucial to improving the quality of the ISSP process. Daniels [20:167-171] to understand the environment and customer behaviour organizations need robust, reliable information. In order to deliver to their chosen strategy, they must configure the organisation (including extended configuration within the industry sector through alliances and collaborative ventures) and the various functional processes to deliver reliably and efficiently. Roberts and Wood [21:115-125] highlights that to a micro enterprise, the amount spent on IS may be a considerable amount and may need considerable justification. A micro enterprise may tend to focus on the narrow efficiency and effectiveness benefits of an IS and may be unaware or discount the wider and larger strategic benefits an IS may deliver. By using IS strategically a micro enterprise can gain a competitive advantage in its industry or market. Bourlakis and Bourlakis [22:389-402] concludes that logistics and information technology strategies are developed and implemented in a parallel way by both local and multinational food multiple retailers in Greece.. The paper proposes that a successful integration process between the logistics and the information technology functions seems to confer a competitive advantage upon retailers' distribution operations. Rondeau et. al [23:93-107] has emphasized that a rapidly changing environment requires firms to adopt a customer driven approach in managing their information systems. Study results indicate that firms with high level of organizational involvement in IS related activities have higher levels of IS management effectiveness. In turn, these higher levels lead to lower levels of end user self reliance in application development and higher levels of end user dependence on IS expertise

Simon [24:1029-1031] through a review of a sample of the existing literature focusing on transparency, a common theme regarding information was observed.

Most research addresses information from a technology/systems perspective not as a basis of creating or modifying corporate strategy. In a corporate environment, information transparency is reached when internal decision makers receive, at their desktop, the internal and external information necessary to make sound business decisions. Jennings and Disney [25:598-614] the results of a study found a relationship between psychological type and planning preferences are reported. The study finds some inconsistent evidence for the importance of psychological type but greater support for the conclusion that the characteristics of strategic situations, rather than a manager's psychological type, determine configuration of the strategic planning process. Arnott et. al (2007) discussed case studies of the development of four systems in large Thai organizations. The analysis of the cases and their comparison to a benchmark study gives rise to the concept of EIS (Executive Information Systems) cultural fit, a concept that adds to our understanding of the reasons for the success and failure of EIS projects in emerging economies. Juhani and Magda [28:35-58] based on its empirical findings, proposed a theoretical model to explain the impact of organizational culture on the deployment of systems development methodologies. Wonseok and Alain [29:239-265] compared two conceptual (resource-centered and contingency-based) and two analytical (linear and nonlinear) approaches that can be used to assess the strategic value of information technology.

To have a quick view of the review of literature the above studies have been summarized in Table 1.

Table 1 Gap Analysis of Review of Literature

Sr. No.	Factors	Author/authors	Outcome	Gaps
1.	IT Infrastructure, Firm Productivity	Setzekorn (2002)	Both factors are positively related	Development of SIS, Public sector undertakings, Success and hindrance factors
2.	Strategic Investment, Data Warehouse	Elson and Raymond (2002)	Support for business intelligence Strategies	Public sector undertakings, organizational environment, Success and hindrance factors
3.	Business and information technology linkage	Haskins (2002)	Recommended planning tools for linkage	Development of SIS, Public sector undertakings,
4.	Information systems and organizational objectives	Boyd (2002)	A subjective measurement system is proposed	Public sector undertakings,
5.	Strategic Resource Management	Rehman (2002)	Information as strategic resource	Planning and development of SIS
6.	Organization systems, technology strategy and business objectives	Hackeny et. al (2003)	Highlights the number of challenges for Strategic Information System Planning	Planning and development, public sector undertakings, organizational environment
7.	Strategic Value of Information Systems, Business Competitiveness	Lee and Pai (2003)	Certain factors relating to organizational context and inter group behaviour influenced the success of SISP	Public sector undertakings, Planning and development of SIS
8.	Aligning Information Systems	Campwell and Kay (2005)	High level of connection between IS and business planning process may be dependent upon the level of integration between the IS group and other sections of the organization	Public sector undertakings, Strategic information system development
9.	Advanced electronic communication system	Gadman and Cooper (2005)	Improved performance is often credited to technological advancement but technology is one of the key component in collaborative strategy	Public sector undertakings, Development of SIS
10.	Firm size, Strategic Planning	Temtime et. al (2003)	Promotion of strategic planning precedes the use of IT in strategic planning	Public sector undertaking, Organizational Environment
11.	Coordination, Organizational Structure	Reddy and Reddy (2002)	Concerns of MNC's about their information systems	Planning and development of SIS, Public Sector Undertakings
12.	Small and Medium Enterprises, Strategic Planning	Lau and Pun (2000)	Proposed a SIS Model	Planning and development of SIS, Public sector undertakings, Organizational environment
13.	Cooperative Competence, Organizational IS/IT Context, Organizational Structure	Bai and Lee(2003)	ISSP becomes more complex when organizations introduce e-commerce and e-business strategy	Public sector undertakings, Organizational Environment
14.	Competitive advantage	Daniels (1998)	Strategic use of IS should be based on the relationships between the various elements in the organization	Public sector undertakings, Development of SIS,
15.	Expenditure on IS	Roberts and Wood (2002)	A successful integration process between the logistics and information technology function confer a competitive advantage	Public sector undertaking,
16.	Organizational involvement & IS Management effectiveness	Rondeau et. al (2006)	Study provided valid and reliable measures for end user involvement in IS activities	Planning and development of SIS, Public Sector Undertakings
17.	Corporate strategy and information transparency	Carol Simon (2006)	Study provided a conceptual framework for the understanding of the issues involved	Public Sector undertakings, Planning and Development of SIS, Critical Success factors
18.	Strategic Planning Process, Psychological type of the managers	Jennings and Disney (2006)	Study highlighted inconsistency in both the factors involved	Critical success factors, Public Sector Undertakings, Planning and development of SIS
19.	Information system development	Arnott et. al (2007)	Study concludes outsourcing and cultural factors should be considered for IS development	Public sector undertakings
20.	Organizational culture, System development methodologies	Juhani and Magda (2007)	The paper proposes a theoretical model to explain the impact of organizational culture on the deployment of systems development methodologies.	Critical success factors, Public Sector Undertakings
21.	Strategic Value of IT, Analytical Approaches	Wonseok and Alain (2007)	Results of the study indicate that investments in growth-oriented applications were directly and positively related to firm revenue.	Critical success factors, Public Sector Undertakings

The survey of related studies revealed has been very limited research in the development aspects of strategic information systems in general and in the public sector undertakings in particular. The existing gap in research in the area of SIS justifies the rationale of the study at hand. The present study has been conducted so as to reduce the existing gap in research in this important area.

3. Objectives of the Study

1. To find out the success factors which are critical in the development of SIS in the selected public sector undertakings.

2. To perform an inter organizational analysis for the critical success factors at the three levels of management of each of the selected organizations.

4. Scope of the Study

The study is confined only to two large Indian public sector enterprises namely Hindustan Machine Tools Limited (HMT) and Bharat Heavy Electricals Limited (BHEL). HMT was incorporated in 1953 by the

Government of India as a Machine Tool manufacturing company, which has been diversified into Watches, Tractors, Printing Machinery, Metal Forming Presses, Die Casting & Plastic Processing Machinery, and CNC Systems & Bearings. Today, HMT comprises six subsidiaries under the ambit of a Holding Company, which also manages the Tractors Business directly. BHEL is the largest engineering and manufacturing enterprise in India in the energy-related/ infrastructure sector, today. BHEL was established more than 40 years ago, ushering in the indigenous Heavy Electrical Equipment industry in India. The company manufactures over 180 products under 30 major product groups and caters to core sectors of the Indian Economy viz., Power Generation & Transmission, Industry, Transportation, Telecommunication, Renewable Energy, etc. These enterprises were selected because of their good performance in the past and they being the early adopters of information systems.

5. Research Methodology

5.1 Universe of the study

a) For the organizations:

All the public sector units in engineering industry comprised the universe of the study. The list given at the website of Cabinet Secretariat of Government of India served as a sampling frame. From the list of total organizations, on the basis of information received from practitioners and academicians in the information system a list of the organizations was prepared which were using the information systems in Public Sector Undertakings (PSU's) .(Refer Appendix 1)

b) For the respondents:

All the managers working at all the three levels of management in the respective organization. The list of employees working at the different levels of management was collected from the selected organizations for the study.

5.2 Sampling technique and sample size

a) For the organizations:

Two public enterprises under the engineering category namely BHEL and HMT were selected on the basis of random sampling technique.

b) For respondents:

An appropriate representative sample of respondents was selected from all the three levels of management for all the functional areas of the selected enterprises. For selecting the respondents stratified random sampling technique has been applied. The details of the sample are given below:

- 50% of the population, where population size <50
- 30% of the population where population size =>50 but <100
- 20% of the population, where population size >100

Distribution of the sample has been given in Table 2

Table 2: Sample Distribution

Organization	Management level	Population	Sample	Actual response	% Age of response rate
HMT	Level – I	35	18	14	77.78
	Level – II	69	21	13	61.90
	Level – III	295	59	51	86.44
	Total	399	98	78	79.59
BHEL	Level –I	34	17	17	100
	Level –II	89	27	17	62.96
	Level –III	368	74	52	70.27
	Total	491	118	86	72.82
	Grand Total	890	216	164	75.92

5.3 Questionnaire design and primary data collection

The various variables were identified on the basis of extensive survey and the study of the literature, which were included in the questionnaire. The discussions with the experts and academician revealed that questionnaire was comprehensive and useful for the organizations. The questionnaire was refined through rigorous pre-testing. The pre-testing of the questionnaire focused on the instrument clarity, question wording and validity. Two rounds of the pre testing have been conducted. In the first round the questionnaire was circulated among a group of prominent academicians and practitioners. Their suggestions were incorporated and questionnaire was revised. In the 2nd round of pre-testing the questionnaire was administered to 20 sampled respondents from each organization and their feedback was incorporated in the questionnaire. The questionnaire was administered to the respondents selected from the three levels of management. The cronbach alpha for all the variables was calculated and it was found 0.856. Five point likert scale has been used in the development of the questionnaire.

5.4 Data Analysis and Findings

The perceptions of all 164 managers from both the organizations under study were gathered on five point scale ranging from –2 to +2. For the analysis of the data collected from the survey SPSS package has been applied.

5.4.1 Critical Success Factors for each organization

Critical Success Factors for each organization has been studied and listed in Table 3.

Table 3: Critical Success Factors for each Organization

N = 164, Average Scores Max. = 5, Min. = 1, Standard Deviation Scores (Max. =1, Min. = 0)

Factors	BHEL (N=86)	HMT (N=78)
Corporate Planning	4.12*(0.72)	4.15*(0.80)
Improved Market Share	4.13*(0.73)	3.60(0.82)
Customer profile Analysis	3.88(0.84)	3.65(0.69)
Sales force Productivity	3.84(0.94)	3.76(0.75)
Response to customer queries	3.68(0.88)	4.00*(0.79)
After Sale Service	3.83(0.87)	3.44(0.81)
Value added Service	4.08*(0.94)	3.79(0.79)
Reduced Variable Cost	3.54(0.88)	4.00*(0.80)
Increased revenue	4.21*(0.63)	3.84(0.72)
Account Receivable terms and timings	3.87(0.96)	3.79(0.76)
Account Payable terms and conditions	3.80(0.94)	3.81(0.73)
Capacity utilization	4.02*(0.65)	3.98(0.67)
Regular upkeep of the machinery	4.00*(0.65)	4.00*(0.80)
Utilization of internal funds	3.86(0.85)	3.62(0.82)
Equity issue management	3.60(0.87)	3.37(0.88)
External borrowing management	3.94(0.91)	3.60(0.87)
Regular deposit of Taxes	4.07*(0.95)	3.81(0.83)
Dealer efficiency	3.92(0.98)	3.78(0.84)
Raw Material Procurement	3.78(0.92)	3.81(0.79)
Inventory management	3.93(0.87)	3.76(0.77)
Fire and safety audits	4.04*(0.92)	4.06*(0.69)
Quality control	4.00*(0.86)	4.02*(0.74)
Quality assurance	4.01*(0.80)	4.01*(0.80)
Maintenance of performance records	3.62(0.81)	3.18(0.75)
Executive compensation	3.90(0.84)	3.41(0.87)
Non monetary incentives	3.94(0.88)	3.72(0.78)
Ensuring better work environment	3.81(0.93)	3.86(0.81)
Knowledge management	3.92(0.80)	3.81(0.68)
Reward to innovations	3.92(0.94)	3.86(0.63)
Employee education and training	3.78(0.87)	3.86(0.67)
Maintenance of pollution control norms	3.78(0.92)	3.88(0.70)
Energy consumption	3.81(1.02)	3.82(0.80)
Others	3.80(0.80)	3.67(0.68)

* 0.05 Level of Significance (Refer Appendix 2 Table 8)

An analysis of Table 3 reveals that the following factors found to be Critical Success Factors (Overall score>= 4.0) for each of the selected organization.

In case of BHEL, Critical Success Factors found are Corporate planning; Improved Market Share; Value added Service; Increased revenue; Capacity utilization; Regular upkeep of the Machinery; Regular deposit of Taxes; Fire and safety audits; Quality control and Quality assurance. On the basis of analysis Critical Success Factors for HMT are Corporate Planning; Response to customer Queries; Reduced Variable Cost; Regular Upkeep of the Machinery; Fire and safety audits; Quality control and Quality Assurance.

In case of HMT, Critical Success Factors found are corporate planning; Response to customer queries; Reduced variable cost; Regular upkeep of the machinery; Fire and safety audits; Quality control and Quality assurance.

The values of ÷2 test also support the above stated findings.

5.4.2 Critical Success Factors – Inter Organizational Level analysis

Inter organizational Level wise analysis for each of the organization has been studied. The scores for the inter level – I analysis have been listed in Table 4.

Table 4: Critical Success Factors of BHEL & HMT – Inter Organizational Level Analysis (L1 of BHEL and L1 of HMT)

Average Scores Max. = 5, Min. = 1, Standard Deviation Scores (Max. =1, Min. = 0)

Factors	BHEL Level-I N = 17	HMT Level-I N = 14
Corporate Planning	4.12*	4.34*
	(0.57)	(0.45)
Improved Market Share	4.18*	4.00*
	(0.86)	(0.85)
Customer profile Analysis	3.80	3.56
	(0.97)	(0.64)
Sales force Productivity	3.76	3.93
	(1.11)	(0.59)
Response to customer queries	4.24*	4.04*
	(0.73)	(0.86)
After Sale Service	3.88	3.32
	(0.73)	(0.83)
Value added Service	4.12*	4.00*
	(0.47)	(0.53)
Reduced Variable Cost	3.82	4.14*
	(0.92)	(0.91)
Increased revenue	4.26*	3.83
	(0.24)	(0.45)
Account Receivable terms and timings	3.83	3.79
	(0.97)	(0.86)
Account Payable terms and conditions	3.59	3.84
	(0.91)	(0.59)
Capacity utilization	4.24*	3.93
	(0.42)	(0.70)
Regular upkeep of the machinery	3.84	4.00*
	(1.00)	(0.53)
Utilization of internal funds	4.00*	3.33
	(0.91)	(1.05)
Equity issue management	3.40	3.36
	(0.82)	(0.97)
External borrowing management	3.94	3.57
	(0.87)	(1.05)
Regular deposit of Taxes	4.18*	4.07*
	(0.98)	(0.88)
Dealer efficiency	3.82	3.86
	(0.92)	(0.91)
Raw Material Procurement	3.82	3.86
	(0.86)	(0.91)
Inventory management	3.88	4.00*
	(0.83)	(1.00)
Fire and safety audits	3.98	4.14*
	(0.97)	(0.52)
Quality control	4.06*	3.87
	(0.64)	(0.74)
Quality assurance	4.12*	3.96
	(0.68)	(0.88)
Maintenance of performance records	3.59	3.50
	(0.77)	(0.63)
Executive compensation	4.00	3.50
	(0.84)	(0.73)
Non monetary incentives	3.71	4.07*
	(0.84)	(0.59)
Ensuring better work environment	3.72	4.29*
	(0.92)	(0.88)
Knowledge management	3.88	3.93
	(0.83)	(0.46)
Reward to innovations	3.83	3.71
	(1.33)	(0.59)
Employee education and training	3.65	3.93
	(0.91)	(0.46)
Maintenance of pollution control norms	3.65	4.36*
	(0.89)	(0.81)
Energy consumption	3.88	3.86
	(0.96)	(0.64)
Others	3.64	3.38
	(1.20)	(0.48)

*0.05 Level of Significance (Refer Appendix 2 Table 8)

An inter level analysis of Level – I the Critical Success factors (Overall score>= 4.0) are given as below:

5.4.2.1 BHEL Vs. HMT: Inter Level Analysis of Level - I

Following are the factors, which are perceived equally Critical Success Factors by Level I of both the organizations.

Corporate planning; Improved Market share; Response to customer queries; Value added service and Regular deposit of the taxes.

The following factors are found as different by managers at Level-I of both the organizations for which the perception of Level I of both the organizations is different.

BHEL: Increased revenue; Capacity utilization; Utilization of internal funds; Quality control; Quality assurance and Executive compensation.

HMT: Reduced variable cost; Regular upkeep of the machinery; Inventory management; Fire and safety audits; Non Monetary incentives; Ensuring better work environment and Maintenance of pollution control norms.

The values of ÷2 test also support the all above stated findings.

From the Inter Level analysis of Level – I it is very clear that there are few factors which are common in both the organizations and these factors are termed as independent factors and the factors which are not common among the two levels are termed as dependent factors on the selected organizations for the study. It can further be interpreted that the factors which are independent in nature i.e. Corporate planning; Improved Market share; Response to customer queries; Value added service and Regular deposit of the taxes are having long term implications for the organizations and they contribute in a major way for the survival and growth of the organization. According to the nature of business and available resources, the dependent factors are also critical as with the change in business environment these factors can play a major role in the survival and growth of an organization.

Table 5: Critical Success Factors of BHEL & HMT – Inter Organizational Level Analysis (L2 of BHEL and L2 of HMT)

Average Scores Max. = 5, Min. = 1, Standard Deviation Scores (Max. =1, Min. = 0)

Factors	Level-II N = 17	Level-II N = 13
Corporate Planning	4.12* (0.64)	4.16* (0.63)
Improved Market Share	4.06* (0.80)	2.62 (0.91)
Customer profile Analysis	3.80 (0.90)	3.85 (0.66)
Sales force Productivity	3.88 (0.71)	3.62 (0.92)
Response to customer queries	4.12* (0.90)	3.69 (0.91)
After Sale Service	3.82 (0.90)	3.77 (0.70)
Value added Service	4.06* (1.00)	4.23* (0.58)
Reduced Variable Cost	3.76 (0.81)	4.23* (0.58)
Increased revenue	4.06* (0.73)	3.82 (0.89)
Account Receivable terms and timings	3.82 (0.86)	3.85 (0.66)
Account Payable terms and conditions	4.00* (0.91)	3.85 (0.66)
Capacity utilization	4.00* (0.77)	4.08* (0.62)
Regular upkeep of the machinery	4.12* (0.83)	4.00* (0.68)
Utilization of internal funds	4.00* (0.84)	4.00* (0.55)
Equity issue management	3.76 (0.81)	3.35 (1.05)
External borrowing management	4.06* (0.80)	3.50 (0.66)
Regular deposit of Taxes	4.12* (0.76)	3.85 (0.77)
Dealer efficiency	4.00* (1.28)	3.69 (1.14)
Raw Material Procurement	3.76 (0.81)	3.75 (0.72)
Inventory management	3.89 (1.07)	3.52 (0.75)
Fire and safety audits	3.98 (0.78)	4.08* (0.62)
Quality control	4.06* (0.80)	4.15* (0.77)
Quality assurance	3.88 (0.71)	4.12* (0.77)
Maintenance of performance records	3.65 (0.68)	3.00 (0.88)
Executive compensation	3.82 (0.78)	3.26 (0.73)
Non monetary incentives	4.00* (0.97)	3.48 (0.61)
Ensuring better work environment	3.76 (1.00)	3.53 (0.70)
Knowledge management	3.80 (0.84)	3.68 (0.74)
Reward to innovations	3.94 (0.94)	4.00* (0.68)
Employee education and training	3.82 (0.86)	3.78 (0.61)
Maintenance of pollution control norms	3.94 (1.00)	3.48 (0.82)
Energy consumption	3.76 (1..11)	3.77 (0.80)
Others	3.85 (0.72)	3.80 (0.64)

*0.05 Level of Significance (Refer Appendix 2 Table 8)

5.4.2.2 BHEL Vs. HMT: Inter Level Analysis of Level - II

The factors which are perceived as equally Critical Success Factors by the managers at Level-II of BHEL and HMT are as following.

Corporate planning; Improved Market share; Value added service; Capacity utilization; Regular upkeep of the machinery; utilization of internal funds and Quality Control.

Following are the factors for which the opinion of the Level – II is different.

BHEL: Response to customer queries, Increased revenue; Accounts payable terms and conditions; External borrowing management; Regular deposit of taxes; dealer efficiency and Non monetary incentives.

HMT: Reduced Variable cost; Fire and safety audits; Quality assurance and Reward to innovations.

The values of ÷2 test also support the all above stated findings.

From above discussion we can reach at the conclusion that there are two categories of factors in both the selected organizations. First category of factors are those which are common in the opinion of the level – II and the second category of factors are those which are different in the opinion of the level –II. We can draw the conclusion that the independent factors which are common in both the selected organizations are those which contribute in a major way in decision making at the middle level of both the organizations. The dependent factors are different because of the nature of business of both the organizations and it is important to note that for the SIS development these factors can play a critical role at the middle level of the management.

Table 6: Critical Success Factors of BHEL & HMT – Inter Organizational Level Analysis (L3 of BHEL and L3 of HMT)

Average Scores Max. = 5, Min. = 1, Standard Deviation Scores (Max. =1, Min. = 0)

Factors	Level-III N = 52	Level-III N = 51
Corporate Planning	4.13* (0.53)	3.85 (0.46)
Improved Market Share	4.13* (0.65)	4.08* (0.69)
Customer profile Analysis	4.04* (0.73)	3.55 (0.74)
Sales force Productivity	3.87 (0.94)	3.75 (0.74)
Response to customer queries	2.60 (0.89)	4.29* (0.73)
After Sale Service	3.79 (0.94)	3.24 (0.76)
Value added Service	4.08* (1.03)	3.12 (0.84)
Reduced Variable Cost	2.00 (0.88)	3.61 (0.84)
Increased revenue	4.31* (0.67)	3.85 (0.74)
Account Receivable terms and timings	3.96 (0.98)	3.78 (0.78)
Account Payable terms and conditions	3.81 (0.94)	3.76 (0.78)
Capacity utilization	3.82 (0.65)	3.94 (0.67)
Regular upkeep of the machinery	4.04* (0.94)	4.00* (0.89)
Utilization of internal funds	3.59 (0.82)	3.53 (0.78)
Equity issue management	3.65 (0.87)	3.41 (0.80)
External borrowing management	3.84 (0.95)	3.73 (0.82)
Regular deposit of Taxes	4.02* (0.99)	3.73 (0.82)
Dealer efficiency	3.92 (0.87)	3.78 (0.72)
Raw Material Procurement	3.77 (0.97)	3.82 (0.76)
Inventory management	4.02* (0.80)	3.76 (0.67)
Fire and safety audits	4.06* (0.93)	4.04* (0.74)
Quality control	3.90 (0.94)	4.12* (0.71)
Quality assurance	4.04* (0.85)	3.96 (0.77)
Maintenance of performance records	3.62 (0.86)	3.05 (0.71)
Executive compensation	3.88 (0.85)	3.47 (0.92)
Non monetary incentives	4.12* (0.78)	3.63 (0.84)
Ensuring better work environment	3.94 (0.98)	3.76 (0.78)
Knowledge management	4.04* (0.73)	3.82 (0.71)
Reward to innovations	4.00* (0.76)	3.86 (0.63)
Employee education and training	3.88 (0.82)	3.88 (0.73)
Maintenance of pollution control norms	3.75 (0.90)	3.80 (0.56)
Energy consumption	3.81 (1.00)	3.82 (0.83)
Others	3.90 (0.71)	3.81 (0.71)

*0.05 Level of Significance (Refer Appendix 2 Table 8)

5.4.2.1 BHEL Vs. HMT: Inter Level Analysis of Level – III

The list of factors for which Level-III of BHEL and HMT think on the similar lines is given as following:

Improved market share; Regular upkeep of the machinery and Fire and safety audits.

Factors for which Level-III of BHEL and HMT is having the different opinion are given in the following list.

BHEL: Corporate planning; Value added service; Customer profile analysis; Increased revenue; Regular deposit of taxes; Inventory Management; Quality assurance; Non monetary incentives; Knowledge management and Reward to innovations.

HMT: Response to customer queries; Quality control.

The values of Ç2 test also support the all above stated findings.

The above inter Level analysis of Level – III clearly indicates that for the independent factors, only those factors are common which are matching according to the industry in which the organizations are doing business and the dependent factors are again different because of the nature of the business which the organizations are doing in the engineering industry.

Table 7: Critical Success Factors

Factors	BHEL & HMT	BHEL	HMT
Corporate Planning	✓		
Improved Market Share		✓	
Customer profile Analysis			
Sales force Productivity			
Response to customer queries			✓
After Sale Service			
Value added Service		✓	
Reduced Variable Cost			✓
Increased revenue		✓	
Account Receivable terms and timings			
Account Payable terms and conditions			
Capacity utilization		✓	
Regular upkeep of the machinery	✓		
Utilization of internal funds			
Equity issue management			
External borrowing management			
Regular deposit of Taxes		✓	
Dealer efficiency			
Raw Material Procurement			
Inventory management			
Fire and safety audits	✓		
Quality control	✓		
Quality assurance	✓		
Maintenance of performance records			
Executive compensation			
Non monetary incentives			
Ensuring better work environment			
Knowledge management			
Reward to innovations			
Employee education and training Maintenance of pollution control norms			
Energy consumption			
Others			

Further, analysis of Table 7 indicates that there are certain factors which are independent to the organizations i.e. these factors are common to both the organizations. Factors include corporate planning; Regular upkeep of the machinery; Fire and safety audits; quality control and Quality assurance. So for these factors there is no need to investigate further as these factors are independent to the organizations. But there are certain other factors which are dependent on the organization and these factors are termed as dependent factors. In case of BHEL dependent factors are improved market share; Value added service; Increased revenue; Capacity utilization; Regular deposit of taxes and in case of HMT these factors are Response to customer queries and Reduced variable Cost.

6. Recommendations of the Study

1. The factors which have been identified in the study could prove highly beneficial to the organizations considering the heavy investment of Strategic Information Systems. So it is recommended that while developing Strategic Information Systems in the organizations, these factors should not be left untouched. Thus this analysis will provide immense benefits to the organizations, as a lot of time, energy and money will be saved.

2. The managers at the different levels of the organizations and working in the different departments are not fully aware and have the common perception about the Critical Success Factors. For Strategic information system to be effective such an indifferent attitude of the managers towards the Critical Success factors is not desirable and organizations should take corrective measures to rectified the attitude.

3. It has been observed that the focus of the Strategic Information System development is on the individual applications function and this leads to level wise fragmentation, which creates incongruence with the strategic objectives of the organization where integration of systems and process is important.

4. It is high time that the organizations must plan to have a full-fledged SIS. This will help the organizations to assess the customer needs and preferences and further help in the management of entire supply chain in an effective and efficient manner.

7. Conclusion

To conclude, in this study, Critical Success Factors for the development of SIS have been found so that organizations can realize the benefit of strategic Information System by using these factors. Level wise analysis has been done to find out how the responses for a particular factor vary at different levels. The Critical Success factors which are independent in selected organizations are Corporate Planning; Regular upkeep of the Machinery; Fire & Safety Audits; Quality Control and Quality Assurance. But there are certain other factors which are dependent on the selected organizations. These factors for BHEL include improved market share; Value Added Service; Increased Revenue; Capacity Utilization and Regular Deposit of Taxes. The dependent factors for HMT include Response to Customer Queries and Reduced Variable cost. The factors found in this study would become the basis of the strategic information systems development. As the information systems in the selected organization should become strategic if they are able to support the factors which are critical to the existence of the organization.

8. Directions for further Research

Since implementation, post implementation processes and the related factors of the product and organizational environment have not been detailed out in the proposed study, these can be studied in an extensive manner. As Strategic Information Systems being the important contributors in the success of an organization, it deserves to be reached out in greater details. Best practices for SIS need to be worked out so as to form a benchmark for many other organizations to follow. The study can further be tested for its applicability across other industries, states and countries. Comparative studies between two countries especially India and some other developed countries can also be undertaken.

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Appendix 1

The sampling frame for the organizations.
The list included the following organizations.

1) The Heavy Engineering Corporation Limited.
2) The Mining and Allied Machinery Corporation Limited.
3) The Engineering Projects (India) Limited.
4) Bharat Heavy Electricals Limited.
5) H.M.T. Bearing Limited.
6) H.M.T. Limited.
7) H.M.T. International Limited.
8) Scooters India Limited.
9) Andrew Yule and Company Limited.
10) Bharat Opthalmic Glass Limited.
11) Bharat Leather Corporation.
12) Cement Corporation of India Limited.
13) Cycle Corporation of India Limited.
14) Hindustan Cables Limited.
15) Hindustan Paper Corporation Limited.
16) Hindustan Photo Films Manufacturing Company Limited.
17) Hindustan Salts Limited.
18) Hooghly Printing Company Limited.
19) Instrumentation Limited.
20) The Mandya National Paper Mills Limited.
21) Nagaland Pulp and Paper Company Limited.
22) National Bicycle Corporation of India Limited.
23) The National Industrial Development Corporation Limited.
24) National Instruments Limited.
25) N.E.P.A. Limited.
26) Rajasthan Electronics and Instruments Limited.
27) Hindustan Newsprint Limited.
28) Damodar Cement and Slag Limited.
29) Tannery and Footwear Corporation of India Limited.
30) Tyre Corporation of India.
31) Praga Tools Limited.
32) Rehabilitation Industries Corporation.
33) Sambhar Salts Limited.
34) Fluid Control Research Institute.
35) Bharat Bhari Udyog Nigam Limited.
36) Bharat Electronics Limited.
37) Bharat Yantra Nigam Limited.

Appendix 2

CHI SQUARE VALUES at 0.05 Level of Significance
Table 8: Critical Success Factors for the Organizations Existence

Factors	Degree of freedom : 4	Management Levels Degree of freedom : 8	
		BHEL	HMT
Corporate Planning	8.68	7.810	13.373
Improved Market Share	19.166	7.897	12.420
Customer profile Analysis	10.676	18.193	18.789
Sales force Productivity	17.526	17.694	14.572
Response to customer queries	10.218	12.627	14.624
After Sale Service	16.763	15.007	19.593
Value added Service	12.445	6.391	16.447
Reduced Variable Cost	13.229	18.215	9.868
Increased revenue	8.983	14.905	8.413
Account Receivable terms and timings	16.720	18.919	19.927
Account Payable terms and conditions	10.211	15.133	3.526
Capacity utilization	7.667	8.338	2.052
Regular upkeep of the machinery	3.306	9.855	6.019
Utilization of internal funds	18.152	12.627	15.907
Equity issue management	14.143	18.012	11.679
External borrowing management	20.590	13.516	19.073
Regular deposit of Taxes	13.895	4.250	18.372
Dealer efficiency	16.393	14.421	18.698
Raw Material procurement	9.979	18.081	18.136
Inventory management	16.223	19.547	12.540
Fire and safety audits	8.487	15.112	14.036
Quality control	6.796	13.379	13.941
Quality assurance	4.592	15.260	12.881
Maintenance of performance records	14.512	18.837	16.556
Executive compensation	12.735	14.237	16.335
Non monetary incentives	12.850	10.627	13.572
Ensuring better work environment	14.306	17.722	12.125
Knowledge management	14.627	14.467	19.915
Reward to innovations	14.867	12.239	11.685
Employee education and training	16.061	18.641	15.218
Maintenance of pollution control norms	16.727	16.045	15.012
Energy consumption	14.991	18.128	19.526
Others	15.480	18.614	18.042