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IMPACT OF INVESTMENT IN INFORMATION TECHNOLOGY FOR ENHANCING THE QUALITY MANAGEMENT IN POWER SECTOR ORGANIZATION

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Abstract
Development of the Power Sector is key to the economic development of a country. Over the past decade, the use of information technology in the power sector has moved from mere data processing covering only a certain areas of operation, to several automated modules. It is now increasingly being adopted as an integrated /interfaced enterprise-wide system touching almost all operational areas and for real time management of networks and delivery system. While the power is the basic driver of the economic growth, the competitiveness of the economy is dependent on the ability to generate good quality electricity at reasonable cost. Although there has been substantial information technology investment in power generation sector, it has not made substantial improvement in quality of power generated. With this thought in mind, this research tries to address the usage of information technology to enhance power quality management in power generation sector . This understanding is essential for any exercise of formulating information technology strategy.

Keywords: Information Technology Investment, Quality Management, Performance, Information Technology usage.

1.0 Introduction

Ever since the emergence of Information Technology as a tool to carry out business transactions and analysis, and with every advancement in the field, it has increased its potential to make the value chain of an enterprise competitive. One of the earliest to point out this potential was Porter et al. (Porter and Millar, 1985). As highlighted by Porter et al. (Porter and Millar, 1985), the influence of Information Technology spreads across all the elements of the value chain of an enterprise. The primary impact of this is in improving the efficiency of the activities and in many instances in reconfiguring the activities (Porter, 1996). The first leads to what can be called "operational excellence" and the second leads to what can be called "strategic differentiation". Overall the impact of Information Technology, on the performance of the enterprise is thought to be positive.

To understand the needs of bringing in operational excellence the first step would be to formulate or understand what would constitute operational excellence. It has been well understood that one of the drivers for operational excellence is the spread of Information Technology. So the second critical element of driving operational excellence would be to understand the penetration or adoption of Information Technology (IT) and its impact on performance of the power sector.

The impact of information Technology on different aspects of business performance has been the focus area of research for some time. The general trend has been to look at the impact at the firm level as well as at the sectoral or industry level. In some instances attempts have been made to even study the impact on the economy as well. The conclusions have been varying, with some bringing out the positive impacts and some indicating not so positive impacts. The underlying causes sited for these differences too have been many.

The improvements in the power sector need to take place at multiple levels. As has been recognized widely, the most critical element would be at the policy level. However, it has been generally understood that although policy changes would drive operational improvements, it is equally important to encourage operational excellence of the power sector separately.

Over the past decade, the use of Information Technology in the power sector in general and in India in particular, has moved from a mere electronic data processing covering only certain areas of the operations, to automation of several activities and functions. IT is now increasingly being adopted as an integrated /interfaced enterprise –wide system touching almost all operational areas and using information and communication technologies for real-time management of networks and delivery system.

With this thought in mind, this research intends to bring in an understanding of what is operational performance in power generation companies in power sector, what are the measures of this performance, what are the possible areas for IT investment and how to measure the impact of this investment in IT on the operational performance of power generation companies.

2.0 Literature Review

Review of literature is done with the objectives of identification of measure of IT to enhance the total quality management and also to identify impact of IT investments in different industries.

Quality Management in Organizations

- This research (Dilrukshi et al., 2008) which is based on the case study of a manufacturing organization stresses the importance of employee involvement and the role of systems in quality management. Total quality management is about installing systems and procedures, including cultural change, involving employees, empowerment, and appropriate leadership. Non-sustainability of TQM is mainly because of the lack of ongoing employee involvement. This article addresses two issues: the importance of employee involvement in the sustainability of TQM in the organization and the benefit of TQM to the organizations and employees.
- The paper (Denis & McAdam, 2003) aims to analyze and evaluate the framework for the dynamics of TQM within organizations. TQM can have a dynamic role in strategy formulation, in addition to the more tactical role of strategy application and deployment. Five-model framework developed during analysis contains the following key points of TQM application, which includes the strategic drivers, TQM profiles, TQM Application Model, TQM environment and TQM lifecycle. These models are interrelated as they are developed through a natural progression of analysis. These models are real world models. The article concludes that the decline of TQM in organization is caused by a number of factors: lack of commitment, replacement of newer and more appropriate TQM approaches, specific organizational requirement caused by market changes.
- The paper (William et al., 2003) in order to understand the dispersion of TQM in small manufacturing firms, classified the research parameters into the following groups: attitude toward quality, measures of importance, uses of team approach, amount of training, documentation of processes, degree of responsibility. Performance measures used by the firm are - per unit production cost, on-time deliveries, customer satisfaction and customer returns, job order specification. In order to measure use-of-team approach, respondents were asked about the number of hours spent on team meetings each week and the amount of specific team training provided. Degree of responsibility results indicate large percentage of the small manufacturers followed the national trend of upgrading their quality systems. The authors conclude that points outlined above should be implemented on a continuous basis, improvement is the responsibility of everybody in the company, everyday and all the time.
- The aim of the paper (McAdam & McLean, 2002) is the use of TQM in electricity companies as “push” or “pull” change methodology. “Push” is the operational improvement of TQM. “Pull” is the strategic or direction giving improvement role .The method includes a case study analysis of five regional electricity companies(REC) which have used TQM as an overarching approach to change. The findings of this study indicate that there is a need to have a balanced portfolio of operational or “push-based” TQM activity that is driven by strategy and pull based TQM planning and activity. All the REC’s must embrace the TQM approach in a bid to satisfy their stakeholder group, albeit in varying degrees of adoption.

Information Technology Usage

- **Aggregate level adoption:** There are many frameworks, which have been used to analyze the impact of Information technology at the aggregate level. When it comes to analyzing this at the firm level, the best frameworks are those which are used for preparing the business case for IT investments since these frameworks use the modeled outcomes to make investment decisions. Reports by McKinsey & Co (MGI Report,2004) bring out general principles as well one specific to manufacturing industry. This approach would be highly applicable to power sector as well.
- **Empowering the employees:** Systems usage is defined as the utilization of information technology for increasing the productivity.(Detmar et al.,1995) Subjective measures used for the study are perception of the number of messages sent on an average day, perception of the number of messages received on an average day, perception of self usage as heavy, moderate, light or nonuse, estimating the number of features. Number of messages sent, received, usage, system features as recorded by computers were the objective measures of the study used by the researcher. The findings of the article (McAfee, 1997) show that enterprise information technology now has accelerating competition because processes can be propagated with much higher fidelity across the organization by embedding it on the enterprise information technology.
- **Industry Specific Usage**: The usage of computers varies across industries. The reason for the variation helps in understanding beliefs that enables people to adopt the mandated system. The reason for the varying adoption shows that when people are cognitively absorbed, they are more likely to see the information system as both useful and ease to use. (Agarwal et al., 2000). Researches on IT usage on manufacturing firms (Chowdary, 2005) identifies wide usage of IT tools in manufacturing industry. CAD, CAPP, CAM, JIT, MRP II, CNC are some of the tools

widely used. This research confirms that manufacturers believe that actual benefits are very close to the perceived benefits. The major roles of IT are knowledge management, e-business, enterprise resource planning, enterprise maintenance and asset management. Some routine IT tools employed are e-mail, Internet access, intranet and collaboration and web enabled applications. These tools have brought about significant enhancements such as improved quality, responsiveness, effective sales and marketing information, increased operational productivity, lower overhead costs, reduced WIP, reduced lead time in procurement, reduced floor space and reduced set-up costs.

- **Influence of regulation:** The regulation and control of a sector has great influence on its performance. The McKinsey & Co (MGI Report,2004) brings out this influence on different sectors in India. It also highlights how the government control of the power sector has a significant influence on the productivity of this sector. The ideas from this research would be inputs for understanding and isolating the impact of protection and government control, in the Indian context.

3.0 Objectives of the Research

As Indian economy gets liberalized the power sector too would undergo transformation. This transformation would be primarily at the policy level, at the operational level in terms of adoption of operational improvement techniques and also likely to be in the application of information technology to address operational and strategic improvements. It is expected that the above transformational initiatives will lead to improvement in the performance of the sector. The objectives would be

- to identify the areas of quality management which are adopted by the adoption of information technology
- to assess the impact of investments in information technology by power generation company.

4.0 Research methodology

Pilot Study

Before conducting a survey, the instrument was given to review for its appropriateness to the power generation company in a state in India. Their feedback is taken for the refinement of research instrument in terms of its length, readability and clarity.

Samples and Collection

This research is done in a power generation company and the organization is chosen based on the following considerations: diversity of operations in terms of power of 126 users. Sampling adequacy was tested using KMO test.(Kelvin Mayor Olkin Test) . The value was found to be0.516, which is an indication of sampling adequacy for the study.

Descriptives characteristics, which are particularly important to the present study, are mean and dispersion. Mean measures central tendency and dispersion measures the distribution of responses to different items. Dispersion in the above table is measured by skewness and kurtosis. It is evident from the table 1 that population distribution has a small standard deviation. Hence, there is homogeneity in the series and the distribution represents the mean. The distribution is normal except the coefficient is negatively skewed. The negative value of Skewness confirms that the IT usage across locations is not uniform. Hence, in many cases, mode is greater than mean, which has resulted in negative skewness. Kurtosis values indicate the distribution is less peaked than the normal curve (Platykurtic).

Table 1: Descriptive

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Power quality management dimensions	126	2.75	5.00	3.9653	0.39464	-0.243	0.715

- Source: author

5.0 Major findings of the research

Information technology influences the businesses operating in manufacturing, insurances and banking to provide better level of process performance (Hammer, 1990). In case of power generation sector IT solutions do not have the diagnostic capabilities for improving efficiency. As indicated by Power sector analysts, the problems facing during information technology implementation are resistance from employees' and a lack of clear strategy. (Power Line, August, 2008). The study has made it clear that power sector needs to focus on either analytical tools or packages such as ERP for enhancing the efficiency of the power quality.

Table 2: Correlation test on Power Quality Variables *Connect Time

	Pearson Correlation	**Sig. (1-tailed)**	**N**
Clarity of work and connect time	0.176	0.001**	104
Better Instruction of Work	0.257	0.002**	111
Plant Load Factor	0.437	0.040*	17
Constancy of Purpose	-0.159	0.113	75
Bringing in change	0.033	0.379	88
Providing employee's knowledge	-0.139	0.114	77
Loyalty of trust	0.112	0.124	78
Improving quality	-0.059	0.300	83
Training	0.125	0.156	68
Visibility	-0.050	0.322	88
Cooperation	-0.126	0.121	88
Education	0.068	0.270	82
Accomplishing transformation	-0.082	0.221	89
Better Upward communication	0.056	0.320	88
Number of failures/TRIPS	-0.052	0.121	84
Better supervisory control systems	-0.035	0.376	84

Source: author
** Correlation is significant at the 1% level.
*Correlation is significant at the 5% level

Earlier research has suggested that IT usage has a strong effect on power quality improvement. However, the variables in the present study fail to support a strong linkage between IT usage and power quality improvement. The study uses several measures of quality management, as listed in **Table 2**. Clarity and instruction of work, indicate to some extent the IT impact. Even though the magnitude is quite small (0.176 and 0.254), it is statistically significant. This suggests that power sector has a more technical focus on IT investments than support factors such as visibility, training, education, cooperation among employees. Insignificant relationship of better quality control with IT impact is an indication of contributions from other exogenous variables.

For a stronger test of hypothesis, multiple linear regression analysis was conducted. As indicated in Table 3, the Power quality dimension indicates a correlation value of 0.101, F-value indicates an amount of association of less than 1.0 and the associated level of significance is 0.332 (P>0.05). **The study indicates IT usage has not made an impact on power quality management.**

Table 3: Multiple Regression Analysis

Statistics	Multiple R	R Square	Adjusted R Square	Standard Error	DW Value	F Value	Sig Value	Perceived IT usage	t value	Sig Level
Power Quality Management	0.101	0.010	0.001	0.574	1.411	0.952	0.332	0.087	0.975	0.332

Source: author

DW statistics at a 1.411 level clearly indicate the lack of penetration of IT and the need for the deployment of IT packages in project locations. Adjusted R square value is 0.001, with a standard error of 0.5743. The results of the test show that there is no significant effect of IT usage on power quality management.

6.0 Discussion

Earlier research work (Gammelgard, 2007), furnishes a method to assess the impact of investments in integrated IT systems on an Australian Power company. The model, being very generic, does not provide a specific IT evaluation method. This research focuses on understanding which total quality management (TQM) measures lead to improvement in power generation quality. Deming (1992) has elaborated on the TQM measures relevant to measuring the performance in manufacturing sector. These measures are adopted to identify the TQM measures for power sector and also to assess the impact of IT usage on these parameters. These measures are incorporated by also taking into account different literatures such as Tripping and control systems (Shashikala et al. , 2008). Among the measures of the power quality, only three variables are significantly influenced by IT investments i.e. better clarity of work (0.176) and better instruction of work (0.254) and PLF (0.437). Process improvement, bringing and accomplishing Transformation (Denis & McAdam,2003), Bringing in change (Dilrukshi et al.,2008), training, co-operation, education, communication (Denis et al., 2003) are some of the other measures of TQM used for assessing the influence of IT investment. The research shows that most of these quality measuring variables have not been influenced by the investments in IT systems.

In case of power sector, a huge amount of operational data are generated especially on the operational performance in an ongoing basis, which need to be stored properly and analyzed for future reference. Such datasets could be used to carry out analysis of different situations including unit tripping, specific problems of various plant systems, plant overhauls etc. For this to happen, it is imperative that along with the data capturing systems, investments need to be made in analytical tools as well. The absence of comprehensive IT strategy to deploy such tools has resulted in low business value from the other IT systems in the present context. The data also indicates the need to have a balanced and portfolio of IT applications/solutions to satisfy all the stakeholders of the organization, although the degree of adoption may vary. (McAdam & McLean, 2002).
Earlier research has suggested that IT usage has a strong effect on power quality improvement. However, the variables in the present study fail to support a strong linkage between IT usage and power quality improvement. The study uses several measures of quality management, as listed in Table 2. Clarity and instruction of work, indicate to some extent the IT impact. Even though the magnitude is quite small (0.176 and 0.254), it is statistically significant. This suggests that power sector has a more technical focus on IT investments than support factors such as visibility, training, education, cooperation among employees. Insignificant relationship of better quality control with IT impact is an indication of contributions from other exogenous variables.

7.0 Conclusion

In this paper, an attempt has been made to establish a relation between investment in information technology and quality of power generated. It has been observed from the previous research that power sector has made substantial improvement in terms of performance through adoption of information technology. The present study fails to establish a strong linkage between IT usage and power quality improvement. However, the present research has developed a framework for measuring the quality of power generation. The results so obtained by deploying the framework has the potential to become a tool for strategic planning of IT investments

8.0 Scope for further research

The power sector unlike many other sectors has very strong operational linkages between the upstream and downstream players in terms of potential to influence the performance of other entities in the value chain. The transmission company operations have strong operational linkages to influence the operational performance of the generation company as well as the distribution company. Similarly the performance of the generation company and the distribution company has strong potential to impact the other two entities. This linkage is reflected in the IT investments as well. For example the IT systems for managing the load and maintenance schedules of a power generation company will be more effective if it has linkages with the IT systems of transmission and generation companies to understand the demand and load patterns. Hence, the research highlights how each of the research outputs can be used in these companies and makes the IT investment impact the business operations of power transmission and distribution companies.

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