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Influence of Quality Systems on Work Performance: A Survey of Indian Engineering Professionals

Archana Kuchroo Chandra [1st] , Dr. Teena Bagga [2nd] , Dr. B. K. Srivastava [3rd]

[1st] Research Scholar, Amity Business School, Amity University Uttar Pradesh, India.
[2nd] Professor, Amity Business School, Amity University Uttar Pradesh, India.
[3rd] Professor, Bridge School of Management, Gurugram, Haryana, India

achandra5@amity.edu, tbagga@amity.edu, beejoysrivastava@gmail.com

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***Abstract* - The aim of the paper is to evaluate the influence of quality systems on work performance with specific focus on engineering professionals. Much has been researched about relationship between quality management and organizational performance. Present study aims at exploring the outcome with respect to engineering profession. Various quality models and performance models were explored in different engineering sectors followed by a survey among engineering firms in India. Statistical findings suggest that there is substantial correlation between implementation of quality systems and work performance in engineering firms. The study has pointed out some key differences in impact of quality systems on work performance between engineering profession and generalized study.**

Index Terms - Engineering profession, Work Performance, Quality Systems, KPIs.

INTRODUCTION

Quality has been in focus for decades. Growth in businesses has given rise to many new issues and challenges that could not be imagined many years ago. Control on quality of business i.e. production, service, operations etc is one of the biggest challenges in today's highly competitive business environment. To overcome this problem, lot of quality control mechanisms were initiated. Total Quality Management (TQM) and Quality Management Systems (QMS) thus came into being [1]. Literature review indicated that previous studies on implementation of quality processes outline two conclusions. Firstly, that when properly implemented, Quality Management System undeniably improves performance [2]. This study has found evidence in the literature suggesting that adopting and developing specific characteristics of occupational culture may facilitate enhancing its implementation, by reducing the barriers associated with it [3]. Globalization has almost mandated organizations to follow uniform standards to stay in competition. However implementation of Quality Systems has different outcomes in different organizational sectors. For engineering firms the key performance indicators are different from service or other sectors. The outcomes cannot be measured on the same scale across all sectors. There is an occupational gap between quality management and quality engineering and the role of occupational culture cannot be ignored [4]. This has given rise to need for sector specific uniformity of processes.

While much has been written about the benefits of TQM to improve organizational performance; flaws in implementation of TQM as a result of underlying aspects of occupational culture remained less researched. Review of literature has revealed substantial disagreement on the nature of association between occupational culture and implementation of quality practices. Association of TQM with different types of organizational cultures has been studied by some researchers. Effective implementation of quality systems requires a culture that is competent enough to support the quality practices [2].

Even though quality organizations have come up with standards customized for specific sectors, there still is a long way to go to customize it further to sub sectors [15]. With recent advances in quality engineering the study aims to evaluate how various elements of quality systems influence the performance in engineering profession. Therefore the present study examines the association between quality systems and work performance based on the above arguments for engineering firms.

QUALITY MANAGEMENT

Quality paradigm has evolved since World War II and penetrated every organizational sector and every facet of the sector. Several quality implementation models and tools have been developed by Quality Gurus. Total Quality Management (TQM), Deming Model of TQM based on 14 points which focus upon continuous improvement, adoption of new philosophy, cease reliance on mass inspection, minimize total cost, on the job training, institute leadership, drive out fear, break barriers between departments, Remove barriers, institute education and self improvement [6,24,25,26]; Malcolm Baldrige Criteria for Performance Excellence focused on six key systems of Leadership System, Strategic Planning System, Operations Focus System, Workforce Engagement System, Knowledge Management System, Customer Management System [7]; European Foundation for Quality Management (EFQM) is based on nine criteria categorized under Enablers which are derived from organizational activities and Results from organizational achievements. [8]. ISO standards for Quality Management is based upon eight principles ie., Customer focus, leadership, people involvement, process approach, systematic approach to management, continual improvement, factual approach to decision making, mutually beneficial supplier relationship [9].

With implementation of quality systems, engineering and manufacturing organizations are expected to shorten cycle, improve accountability, enable faster adaptations with new regulations, streamline supply chain and improve security and safety [10]. American Society of Civil engineers has developed codes and checklists for structural engineering, [11].

From the above literature, following constructs were found to be most suitable for the present study.

Constructs of Quality Systems taken up for the survey:

- Customer focus
- Process approach
- Continuous improvement
- Information management
- Training and development
- Risk Assessment

WORK PERFORMANCE

All research related to organizational behavior has considered performance as a dependant variable since performance is always a result of variables like, organizational culture, job satisfaction, self efficacy, quality processes [12]. Quality management has been proposed as one of the fundamental drivers of performance [13,14]. Some researchers have labeled TQM as a management style and shifted focus to tools and measurement for establishing high performance index. Some studies that have linked quality management with performance are summarized in Table 1.

Quality Practice	Performance	Author
Customer focus Management commitment Employee involvement Training Rewards Supplier relationship	Added employee value Added value content Added value per fixed asset Added value per labor cost	Abdullah and Tari [15]
Customer focus Continuous improvement Leadership Strategic planning Employee suggestions Feedback Customer involvement Supplier involvement	Customer satisfaction Delivery and lead time Unit cost of manufacturing Conformance to product specifications	Phan et al. [16]
Supplier participation Supplier selection Leadership Strategic planning Customer focus Analysis People and process management	Product quality	Prajogo and Brown [17]
Leadership Customer focus Analysis HRM Process management Supplier management	Organizational Effectiveness Financial results Market results	Sila [18]

***Table 1**: Summary of linkage of Quality practices with performance metrics by various researchers*

WORK PERFORMANCE IN ENGINEERING PROFESSION

- Performance metrics in engineering profession cover additional dimensions; to mention a few : Tier based engineering transactions, monitored KPIs, reduced number of transaction analysis; ensuring reproducible results, load ramping, visualization, and identification of bottlenecks [19].

Author	*Engineering Performance parameters*
Thomas, S. R. [20, 21, 22]	Work Hours Quantity Engineering Productivity
stepsize.com [23]	Team Sport Engineering tools Lead time Documentation

***Table 2**: Performance metrics in engineering profession identified by researchers*

Following indicators were taken up for the present study for measuring work performance in engineering firms.

- Team Sport
- Engineering tools
- Lead time: time needed from feature description to feature implementation in the production environment. Measures smoothness of process. Indicators: less friction, ownership, clarity in specifications

- Documentation

RESEARCH METHODOLOGY

Based on the constructs of each of the variables i.e. Quality Systems and Work performance in engineering profession, a measurement questionnaire was developed. Questions were framed keeping in mind the sample respondents and intended analysis. The questionnaire was validated through pilot survey. The items of the questionnaire were revised based on information gathered from analysis of pilot survey. Final survey responses of 266 respondents were analyzed. The respondents were employees of Quality certified and non certified engineering based firms in India.

Respondents belonged to civil engineering, electric engineering, chemical engineering, mechanical engineering and biomedical engineering firms. Details of respondents from each type are presented in Table 3

Organization	No of respondents	Percentage
Civil Engineering	56	22%
Electric Engineering	41	15%
Chemical Engineering	21	8%
Mechanical Engineering	78	29%
Biomedical Engineering	70	26%

Table 3*: Organization wise distribution of respondents*

ANALYSIS AND FINDINGS

The questions regarding implementation of quality systems were asked on a seven point Likert scale. The results are presented in Table 4.

Constructs of QS	Mean Score	Standard Deviation
Customer focus	5.53	1.31
Process approach	4.39	1.45
Continuous improvement	4.58	1.52
Information management	4.49	1.52
Training and development	4.36	1.49
Risk Assessment	4.68	1.33

Table 4*: Values of measurement scales of Quality Systems*

Table 4 shows reasonably limited scores with high standard deviations for all values indicating considerable variations in responses. Highest score is received by Customer Focus.

To see the correlation between the scores on constructs of quality systems and outcome of quality implementation in terms of work performance Pearson correlation was calculated between the values of quality systems and performance scale. Results of Pearson correlation are presented in Table 5.

Constructs of QS	Pearson correlation	Significance level
Customer focus	0.409**	0.000
Process approach	0.316**	0.000
Continuous improvement	0.526**	0.000
Information management	0.534**	0.000
Training and development	0.563**	0.000
Risk Assessment	0.564**	0.000

Table 5*: Correlation between values of quality systems and performance scale*

Significance level: ***p<0.01*

The table shows a significant correlation between the all constructs of quality systems and those of work performance of engineering professionals. The finding supports the perception that adoption of specified constructs of quality systems supports successful implementation of quality practices. Further to check the individual effects of the constructs on work performance, means of each construct were compared with ANOVA and Eta. For team sport the results were significant. The results were found to be significant for team sport and lead time. The results are presented in Table 6

KPIs	Mean (users)	Mean (non users)	ANOVA sig	Eta squared
Team Sport	4.54**	3.90**	0.006	0.029
Engineering tools	4.92*	4.38*	0.015	0.023
Lead time	5.32**	4.42**	0.005	0.029
Documentation	4.98*	4.36*	0.017	0.027

Table 6*: Correlations between KPIs of WP and QS; *P<0.05; **p<0.01*

To check the difference in outcomes of implementation of QS constructs on KPIs of work performance, correlations of the questions on quality systems and effectiveness of KPIs chi-square, phi, Cramer's V and contingency coefficient were tested. Significant correlations were found for positive association for team sport and documentation. Table 7 presents the effects of QS constructs on KPIs of Work performance.

The study shows that a significant correlation exists between implementation of Quality Systems and Work Performance in Engineering Profession. Therefore, quality managers in engineering firms must work together with process owners to enable smooth implementation of quality procedures. For this managers need to have a deep knowledge and

Work Performance	Users (%)	Non-users (%)
Team Sport	49.8	28.9
Engineering tools	14.11	6.9
Lead time	21.9	24.4
Documentation	48.8	18.1
Tests	*Value*	*Significance Level*
Pearson Chi-square	23.24	0.000
Phi	0.306	0.000
Cramer's V	0.306	0.000
Contingency coefficient	0.292	0.000

Table 7*: Effects QS constructs on KPIs of Work performance*

understanding of their processes to be effectively able to implement quality systems.

CONCLUSION

Overall results indicate that Quality System has positive influence on work performance of engineering firms. To survive in the highly competitive market and demand for high quality product, engineering companies must focus their efforts on quality procedures. The findings to the study suggest that quality systems can accentuate team sport; engineering tools, lead time and documentation; therefore can prop up overall production performance. Engineering firms must further develop techniques for effective implementation of quality systems in individual processes. Once appropriate techniques are identified for specific processes, firms can maintain a competitive advantage in the market.

LIMITATIONS & SCOPE OF FUTURE RESEARCH

The investigation was restricted to engineering firms in India. Since organizational culture often varies across borders, the results may vary from country to country.

The study has not been able to draw any comparison with other industry.

RECOMMENDATIONS FOR FUTURE RESEARCH

It is suggested that similar comparative study be carried out individually for manufacturing, IT and service sectors by first identifying the differences in prevailing cultures. This would give a clearer picture of influence of quality systems on work performances in different sectors.

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AUTHOR INFORMATION

Archana Kuchroo Chandra, Research Scholar, Amity Business School, Amity University Uttar Pradesh, India.
Dr. Teena Bagga, Professor, Amity Business School, Amity University Uttar Pradesh, India.
Dr. B. K. Srivastava, Professor, Bridge School of Management, Gurugram, Haryana, India