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Impact of Quality Management System Dimensions on Organizational Effectiveness of Engineering Institutions in India

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The aim of this study was to examine the role of Quality Management System (QMS) dimensions and to analyse interrelationships and their combined impact on the organizational effectiveness of engineering institutes of India. This study was carried through an extensive literature survey, descriptive and exploratory research, case studies and interviews. A pilot-tested structured questionnaire investigates three hundred and sixty-five faculty members from fifty engineering institutes of India's National Capital Region (NCR). Fifteen hypotheses have been analysed through quantitative data analysis, regression analysis using SmartPLS 3.0 software. The findings of the complete investigation indicated the correlation between eight QMS parameters, which positively and significantly affect the quality of engineering institutes. The study shows eight critical quality factors that need attention from the top management to establish quality in engineering education. The enablers include leadership, people, processes, infrastructure and policies. The results mainly focus on people results, user results and key performance results. The findings also reveal that leadership enabler positively impacts people results, institute results, and social satisfaction. The institute's top management leadership and policy & strategy were the main driving forces for developing a sound QMS in engineering educational institutes. The research can be utilized as a base model to assess the interrelationships of QMS dimensions and their impact on organizational effectiveness in any engineering institution in India.

Keywords: Engineering educational institutions, European foundation for quality management (EFQM), ISO 9001-2015, PLS-SEM, SmartPLS-3

Introduction

There can be no doubt that engineering graduates have a lasting impact on the expansion of the industrial and service sectors. The "Make in India" project requires highly skilled and competent graduates in order to succeed and manufacture cutting-edge future items. In this direction, the Indian Institutes of Technologies (IITs), National Institutes of Technologies (NITs), and other public and private technological universities are doing a phenomenal job.[1] But the matter of concern is; only 5–10 percent of total engineers produced in India are from these reputed institutes. More than 90 percent are from such institutes that are in dire need of quality improvement. The majority of them are affiliated with different central and state universities and teach the affiliating university's curriculum.[2] These universities are not very optimistic about adapting changes according to the job market and don't want to change the quality of teaching & learning. Also, these colleges focus mainly on undergraduate programs, and their post-graduate programs are often weak. As a consequence of the above-stated points, they lack a quality education system.

In addition, these institutes also lack planned effort in the direction of quality education and research. The quality assurance and accreditation efforts of these institutions can be characterized by "compliance" rather than "improvement" tools.[3] They don't give much importance to regional development offices, which can help them, study the local market and better understand the economic players. Due to this, they also lack entrepreneurial and innovative approach. There was no program or model for quality assurance in the education system; hence, Indian National Board for Accreditation (NBA) was established in September 1994 to accredit the programs that fulfil the pre-defined criteria. It is not mandatory; therefore, many programs in different engineering colleges are still working without accreditation from the NBA.[4] Implementing ISO has been recognized as a successful and productive tool in attaining a competitive advantage in the market.

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Organizations have a mission and set goals for themselves that they want to achieve. The degree to which they can achieve their specified goals is a measure of their effectiveness.[5] Organizational Effectiveness (OE) is a marker of the effectiveness of an organization regarding the achievement of its set of objectives.[6]

The EFQM methodology was the first to emphasise organisational results in a complete quality based self-assessment framework.[7] It recognizes that there are many routes to achieve effectiveness and that visionary leadership can achieve excellent results through people, infrastructure, partnerships, resources, and processes put together. The critical assumption in this model is that the key performance results are derived through five enabler's viz. leadership, people, policy & strategy, partnership, and resources and processes.

The majority of countries have implemented an ISO-based quality management system or used it as the framework for their national quality assurance systems.[8] Many organizations have been compelled to join the quality movement and apply various quality enhancements in their planning and management procedures due to growing competition.[9] As a result, both practically and conceptually, the importance of QMS is underlined as the most critical factor in the performance and survival of manufacturing and service firms.[10] The art of managing the whole to attain excellence is characterized as QMS. Engineering education may achieve and maintain excellence using QMS practices.[10] Leadership and customer focus are the two most critical QMS dimensions. The student is the crucial customer of education and the service recipient who acquires knowledge and information.[11] The EFQM-based QMS is thought to be an effective instrument for improving educational quality and student happiness. Several authors have put together work to explain and justify how quality management approaches and methods may help institutions to improve. There is strong agreement that implementing QMS requires a systematic strategy or methodology. The MBNQA framework and the European Foundation for Quality Management (EFQM) model have established the standard for most quality awards in many countries.[12] These frameworks are often used by enterprises as a self-evaluation tool to improve performance. Some empirical evidence reveals that the enabling agents of EFQM Excellence Model have interrelationships based on the concept that these criteria are part of the QMS philosophy's distinctiveness.[13] The goal of this study was to analysis the QMS dimensions and their interrelationships for the enhancement of organizational effectiveness using SEM.

Research Methodology

The research is empirical and based on a cross-sectional research design.[14] The population of this study included faculty members, students, and stakeholders from several ISO 9001:2015 accredited engineering institutes in Delhi-NCR, India. The study focuses on the investigation of quality management system dimensions and their interrelationships in order to improve organisational effectiveness.

Identification of Variables

Independent variables: leadership-LDR, people management-PMT, policy and strategy-PSY, infrastructure management-IMT, processes and services-PSS.

Dependent variables: people results-PRS, user results-URS, key performance results-KRS

Hypothesis Designed

Based on the EFQM quality dimensions, the following hypothesis emerges from this theoretical consideration and available empirical shreds of evidence of literature:

$H1_{1a}$ There is a significant impact of leadership on the people results.

$H1_{1b}$ There is a substantial impact of the leadership on the user results.

$H1_{1c}$ There is a considerable impact of leadership on the key performance results.

$H2_{2a}$ There is a positive impact of people management on the people results.

$H2_{2b}$ There is a significant impact of people management on the user results.

$H2_{2c}$ There is a substantial impact of people management on the key performance results.

$H3_{3a}$ There is a considerable impact of the Policy and strategy on the people results.

$H3_{3b}$ There is a significant impact of the Policy and strategy on the user results.

$H3_{3c}$ There is a considerable impact of the Policy and strategy on the key performance results.

$H4_{4a}$ There is a positive and significant impact of Infrastructure management on the people results. $H4_{4b}$ There is a substantial impact of Infrastructure management on the user results.

$H4_{4c}$ There is a significant impact of Infrastructure management on the key performance results.

$H5_{5a}$ There is a positive impact of the Processes and services on the people results.

$H5_{5b}$ There is a significant impact of the Processes and services on the user results.

$H5_{5c}$ There is a significant impact of the Processes and services on the key performance results.

Design of Survey, Sampling, and Data Collection

The questionnaire was developed based on a modified EFQM concept of excellence. Numerous specialists in associated domains evaluated EFQM-based research instruments. The pilot study was conducted at eight ISO 9001:2015 certified institutes of Delhi-NCR with a sample of 130 respondents. The designed tool indicated satisfactory results of the pilot study. Thus, a revised final research instrument based on a five-point Likert scale was developed for the entire study. The survey questionnaire included eight factors and 43 measurements graded on a five-point Likert scale with endpoints of "strongly disagree = 5" and "strongly agree = 1”. The AICTE approved private, and state engineering universities of Delhi-NCR were selected for the data collection purpose.[14] The questionnaires were distributed to top management, faculty members, students, and other stakeholders through Google forms and emails. The questionnaires were given to approximately 452 respondents in 50 engineering universities, out of which 378 responded. The data were visually examined, and the responses with incomplete data in the case of some of the respondents were discarded, and finally, the clean data worked out to be 365. The valuable response rate was, therefore, 80.5 percent.

Result and Discussions

The data was analyzed using SmartPLS 3.0 software package.[15] PLS-SEM is a new data analysis method for business, management, and social science research that can handle small sample sizes and non-normal data.[16] When testing conceptual frameworks and involving complicated model structures, this technique is more appropriate. The analysis in PLS-SEM is divided into two stages: measurement model specification and structural model evaluation. According to the measurement model specification, only constructs with good indicator loading, convergent validity, Composite Reliability (CR), and discriminant validity will be used in the structural model.[17] The purpose of structural model evaluation is to examine the relevance of path coefficients using the bootstrapping technique. Fig. 1 shows the theoretical constructs for correlation and regression designed based on objectives and hypotheses.

Measurement Model Assessment

Five items (LDR3, PMT7, IMT17, IMT20, and PSS21) were eliminated from the study as part of the measurement model review due to low factor loadings (0.600).[(16)] Initially, the model comprised 43 indications. During the analysis, the indicators with low factor loading were removed from the measurement model. After that, the model's factor loading was re-run until it reached a level above or near 0.60. As a result, the final measurement model had 38 indicators. Cronbach's alpha and composite reliability were employed in the analysis to examine the constructs' reliability. The CRs exceeded the recommended value of 0.700.[(18)] Cronbach's alpha for each construct was more significant than 0.700. Because the Average Variance Extracted (AVE) was more effective than 0.500, convergent validity was acceptable.[15] The data in Table 1 shows the constructs' reliability and validity results, as well as their factor loadings.

Discriminant validity is about differentiation in the constructs. So, all the eight constructs should be statistically different, and to establish this, we go for discriminant validity. There are three criteria to ascertain discriminant validity, i.e. Fornell & Larcker criterion, cross-loadings, and Heterotrait-Monotrait Ratio (HTMT).[15] In this study, the discriminant validity was evaluated using the Fornell & Larcker criterion and cross-factor loadings method. The Fornell and Larcker criterion was used to measure discriminant validity. The Table 2 below demonstrates that the square root of AVE, the

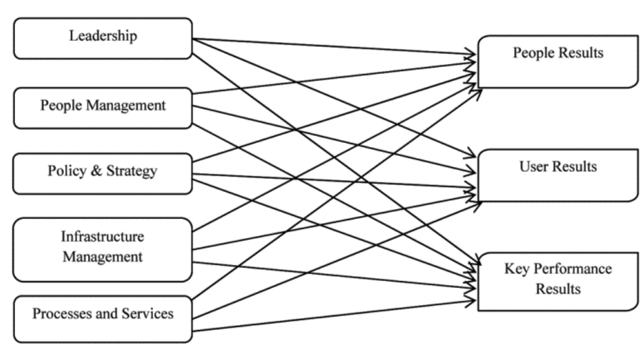

Fig. 1 — Schematic of correlation of enablers and results

Table 1 — Loadings, Reliability, and Validity

	Loadings	Cronbach alpha	Composite Reliability	AVE
IMT16	0.897	0.848	0.908	0.767
IMT18	0.805	—	—	—
IMT19	0.921	—	—	—
KRS36	0.883	0.922	0.936	0.650
KRS37	0.895	—	—	—
KRS38	0.865	—	—	—
KRS39	0.789	—	—	—
KRS40	0.719	—	—	—
KRS41	0.829	—	—	—
KRS42	0.741	—	—	—
KRS43	0.702	—	—	—
LDR1	0.872	0.845	0.896	0.683
LDR2	0.836	—	—	—
LDR4	0.813	—	—	—
LDR5	0.783	—	—	—
PMT10	0.886	0.909	0.936	0.785
PMT6	0.833	—	—	—
PMT8	0.891	—	—	—
PMT9	0.930	—	—	—
PSS22	0.849	0.909	0.932	0.734
PSS23	0.930	—	—	—
PSS24	0.918	—	—	—
PSS25	0.915	—	—	—
PRS26	0.921	0.899	0.925	0.713
PRS27	0.857	—	—	—
PRS28	0.872	—	—	—
PRS29	0.811	—	—	—
PRS30	0.820	—	—	—
PSY11	0.835	0.925	0.947	0.816
PSY12	0.887	—	—	—
PSY13	0.814	—	—	—
PSY14	0.812	—	—	—
PSY15	0.870	—	—	—
URS31	0.862	0.878	0.911	0.672
URS32	0.795	—	—	—
URS33	0.804	—	—	—
URS34	0.786	—	—	—
URS35	0.850	—	—	—

construct was more significant than the inter-construct correlation.[17] Discriminant validity using cross-factor loading method revealed that the entire factor loading values are more influential than their cross-loadings (see Table 3). Hence, the results of both ways establish the discriminant validity.

Structural Model Assessment

The structural model depicts the research frameworks hypothesised outcomes (see Fig. 2). The

Table 2 — Discriminant validity using Fornell & Larcker criterion

	IMT	KRS	LDR	PMT	PRS	PSY	PSS	URS
IMT	0.876							
KRS	0.777	0.806						
LDR	0.709	0.738	0.827					
PMT	0.761	0.712	0.807	0.886				
PRS	0.741	0.706	0.721	0.811	0.857			
PSY	0.739	0.759	0.739	0.848	0.798	0.844		
PSS	0.710	0.741	0.700	0.784	0.751	0.721	0.903	
URS	0.782	0.702	0.733	0.846	0.740	0.768	0.869	0.820

R^2, Q^2, and significance of paths are used to evaluate a structural model. The strength of each structural path specified by the R^2 value for the dependent variable determines the model's quality. R^2 should be equal to or greater than 0.1.[(15)] The results in Table 4 show that all R^2 values are over 0.1. Hence, the predictive capability is established.

Further, Q^2 establishes the predictive relevance of the endogenous constructs. A Q^2 above zero shows that the model has predictive relevance. The results show that there is significance in the prediction of the constructs (see Table 4).

The findings presented in Tables 4 & 5 show that, except for $H3_{3a}$ PSY→PRS ($\beta = -0.031$, $t = 0.438$, $p = 0.662$), $H4_{4a}$ IMT→PRS ($\beta = 0.007$, $t = 0.191$, $p = 0.848$ and $H4_{4b}$ IMT→URS ($\beta = -0.055$, $t = 1.433$, $p = 0.152$) all other hypotheses were positive and significant. Therefore, hypotheses $H1_{1a}$, $H1_{1b}$, $H1_{1c}$, $H2_{2a}$, $H3_{3b}$, $H3_{3c}$, $H4_{4c}$ $H5_{5a}$, $H5_{5b}$, and $H5_{5c}$ are accepted, $H2_{2b}$ & $H2_{2c}$ are partially accepted while hypotheses $H3_{3a}$, $H4_{4a}$ and $H4_{4b}$ are rejected. The detailed summary of hypothesis was presented in the Table 5.

Findings and outcomes from hypotheses testing and t-values and p-values of variables were examined as part of this research. The PLS-SEM approach was used to examine the hypothesized correlations. The findings of this study extend the literature in several ways.

First, this research highlights the importance of QMS enablers, such as leadership, people management, policy and strategy, infrastructure management, and processes and services, in facilitating quality-related activities at an engineering educational institution.[19] The study's findings show that these enablers have a considerable and favourable impact on quality management and continuous improvement procedures. Leadership, policy and strategy, and processes and services were essential variables in these researchers' effective

Table 3 — Discriminant validity – cross-loadings

	IMT	KRS	LDR	PMT	PRS	PSY	PSS	URS
IMT16	0.897	0.421	0.382	0.483	0.479	0.418	0.451	0.369
IMT18	0.805	0.500	0.431	0.334	0.483	0.567	0.401	0.368
IMT19	0.921	0.481	0.316	0.465	0.353	0.384	0.457	0.383
KRS36	0.313	0.883	0.368	0.312	0.538	0.454	0.441	0.313
KRS37	0.304	0.895	0.466	0.476	0.297	0.335	0.320	0.338
KRS38	0.405	0.865	0.394	0.248	0.394	0.251	0.281	0.240
KRS39	0.331	0.789	0.485	0.439	0.330	0.254	0.334	0.270
KRS40	0.264	0.719	0.381	0.345	0.492	0.488	0.426	0.438
KRS41	0.377	0.829	0.477	0.356	0.472	0.469	0.361	0.493
KRS42	0.455	0.741	0.414	0.318	0.360	0.327	0.444	0.343
KRS43	0.470	0.702	0.482	0.210	0.227	0.241	0.391	0.430
LDR1	0.406	0.365	0.872	0.326	0.609	0.534	0.445	0.667
LDR2	0.302	0.316	0.836	0.461	0.585	0.575	0.380	0.356
LDR4	0.335	0.289	0.813	0.382	0.553	0.477	0.650	0.431
LDR5	0.201	0.368	0.783	0.512	0.340	0.366	0.539	0.494
PMT10	0.399	0.382	0.358	0.886	0.479	0.508	0.461	0.572
PMT6	0.497	0.474	0.362	0.833	0.373	0.338	0.322	0.477
PMT8	0.289	0.399	0.373	0.891	0.500	0.470	0.520	0.504
PMT9	0.378	0.414	0.447	0.930	0.398	0.352	0.342	0.301
PMT22	0.382	0.381	0.480	0.312	0.309	0.331	0.849	0.498
PSS23	0.434	0.466	0.521	0.484	0.422	0.584	0.930	0.331
PSS24	0.310	0.331	0.383	0.387	0.326	0.313	0.918	0.432
PSS25	0.368	0.353	0.441	0.354	0.491	0.439	0.915	0.569
PRS26	0.296	0.374	0.375	0.476	0.921	0.332	0.390	0.324
PRS27	0.328	0.430	0.543	0.397	0.857	0.543	0.254	0.532
PRS28	0.241	0.378	0.412	0.429	0.872	0.507	0.417	0.356
PRS29	0.394	0.341	0.349	0.583	0.811	0.584	0.336	0.533
PRS30	0.203	0.355	0.204	0.585	0.820	0.336	0.236	0.241
PSY11	0.351	0.345	0.400	0.345	0.347	0.835	0.506	0.355
PSY12	0.280	0.334	0.341	0.377	0.245	0.887	0.566	0.238
PSY13	0.244	0.484	0.337	0.422	0.367	0.814	0.367	0.463
PSY14	0.365	0.362	0.313	0.585	0.412	0.812	0.370	0.391
PSY15	0.386	0.383	0.319	0.330	0.372	0.870	0.432	0.307
URS31	0.258	0.494	0.485	0.432	0.290	0.417	0.402	0.862
URS32	0.297	0.372	0.357	0.386	0.333	0.396	0.310	0.795
URS33	0.383	0.341	0.590	0.477	0.221	0.607	0.571	0.804
URS34	0.431	0.385	0.360	0.491	0.389	0.497	0.262	0.786
URS35	0.269	0.403	0.401	0.561	0.300	0.523	0.602	0.850

implementation of QMS processes. According to structural relationships, leadership strongly influences all other enablers (see Table 4). Processes and services (administrative services, educational processes) are dependent on sound and transparent policies and managerial leadership. The policy and strategy must serve as a guide for establishing staff policies and managing resources and processes. According to the findings, there is a weak link between people management and key performance outcomes.[9] This could be because administrative activities are separated from teaching faculty in ISO recognized engineering institutes. Teaching and non-teaching professionals must receive enough training on new methods, tools, and technology following industry needs to convey relevant knowledge to students. The adoption of ISO assures that management identifies and meets faculty training needs by delegating them to workshops and relevant sectors. This component helps to improve the efficiency of the teaching and learning process.

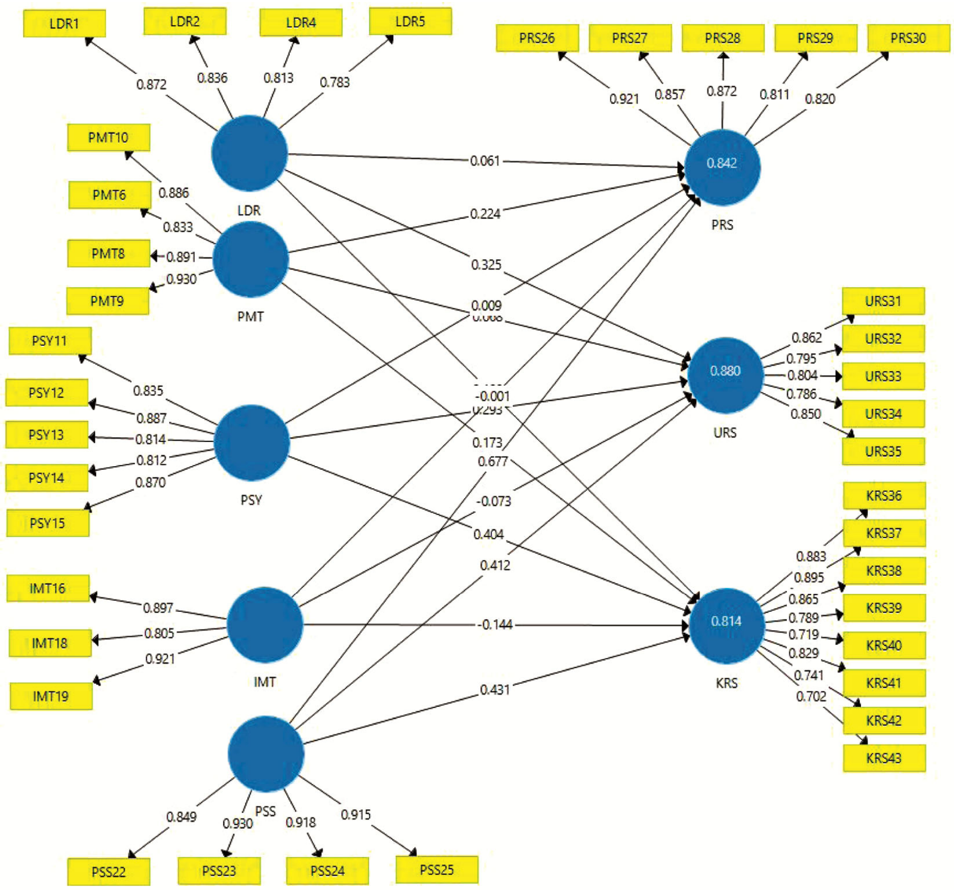

Fig. 2 — Structural model

Table 4 — Structural relationships

	Original Sample (β)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
LDR -> KRS	0.141	0.046	3.082	0.002
LDR -> PRS	0.182	0.032	5.713	0.000
LDR -> URS	0.318	0.028	11.300	0.000
IMT -> KRS	−0.140	0.047	2.982	0.003
IMT -> PRS	0.007	0.039	0.191	0.848
IMT -> URS	−0.055	0.038	1.433	0.152
PMT -> KRS	0.116	0.060	1.917	0.056
PMT -> PRS	0.107	0.053	2.018	0.044
PMT -> URS	0.077	0.042	1.835	0.067
PSY -> KRS	0.385	0.051	7.522	0.000
PSY -> PRS	−0.031	0.071	0.438	0.662
PSY -> URS	0.232	0.051	4.510	0.000
PSS -> KRS	0.466	0.055	8.444	0.000
PSS -> PRS	0.715	0.070	10.175	0.000
PSS -> URS	0.459	0.045	10.142	0.000
	R^2	Q^2		
PRS	0.842	0.607		
URS	0.880	0.583		
KRS	0.814	0.516		

Second, the current study discovered that the practical application of QMS practices has a considerable impact on engineering educational institutes' performance. This finding further indicates that implementing a QMS at an engineering institute can increase research productivity, student engagement, curriculum design, and environmental responsiveness.[17]

Finally, according to QMS assumptions, the causal research proved a strong association between enablers and results. The considerable proportion of variance explained by the enablers in the outcomes construct and the high value of the regression coefficient suggest that enabler criteria must be coordinated to practically impact results criteria. Top management must be aware of this critical association between quality management techniques and results to start quality improvement activities in their firms. To get significantly better results, leaders of ISO-certified institutes must concentrate on improving "sensitive" parts of quality management (leadership, people management). The worldwide approach of the study aided in a better

Table 5 — Summary of hypothesis

Sr. No	Hypothesis	T value	P value	Results	Interpretation
1	$H1_{1a}$ There is a significant impact of the LDR on the PRS.	5.713	0.000	Accept $H1_{1a}$ Reject $H0_{1a}$	Top management's leadership and commitment have a significant impact on employee outcomes. Teaching, non-teaching, and research staff satisfaction have all increased significantly.
2	$H1_{1b}$ There is a significant impact of the LDR on the URS.	11.300	0.000	Accept $H1_{1b}$ Reject $H0_{1b}$	Top management's leadership and commitment have a significant impact on user outcomes. The image of the institute in the community or society has improved significantly. The rate of student failure has decreased substantially.
3	$H1_{1c}$ There is a significant impact of the LDR on the KRS.	3.082	0.002	Accept $H1_{1c}$ Reject $H0_{1c}$	Top management's leadership and commitment have a favourable impact on key performance measures. The number of research articles published by students and faculty has increased significantly.
4	$H2_{2a}$ There is a significant impact of PMT on the PRS.	2.018	0.044	Accept $H2_{2a}$ Reject $H0_{2a}$	There is a significant impact of people management on the people results. It helps identify the staff's present and future needs regarding knowledge, competencies and skills.
5	$H2_{2b}$ There is a significant impact of PMT on the URS.	1.835	0.067	Partial accept $H2_{2b}$ Reject $H0_{2b}$	People management is a partially significant variable in assessing the organizational effectiveness as indicated by the user results (t value is close to 1.96).
6	$H2_{2c}$ There is a significant impact of PMT on the KRS.	1.917	0.056	Partial accept $H2_{2c}$ Reject $H0_{2c}$	People management is a partially significant variable in assessing organizational effectiveness as indicated by the key performance results (t value is close to 1.96).
7	$H3_{3a}$ There is a significant impact of the PSY on the PRS.	0.438	0.662	Accept $H0_{3a}$	There is no positive relationship in the organizational effectiveness results between policy and strategy and people results.
8	$H3_{3b}$ There is a significant impact of the PSY on the URS.	4.510	0.000	Accept $H3_{3b}$ Reject $H0_{3b}$	There is a significant impact of the Policy and strategy on the user results. The institute's policies and procedures are in line with its mission, vision and values.
9	$H3_{3c}$ There is a significant impact of the PSY on the KRS.	7.522	0.000	Accept $H3_{3c}$ Reject $H0_{3c}$	There is a significant impact of the Policy and strategy on the key performance results.
10	$H4_{4a}$ There is a significant impact of IMT on the PRS.	0.191	0.848	Accept $H0_{4a}$	There is no significant relationship in all the organizational effectiveness results between infrastructural management and people results.
11	$H4_{4b}$ There is a significant impact of IMT on the URS.	1.433	0.152	Accept $H0_{4b}$	There is no significant relationship in all the organizational effectiveness results between infrastructural management and user results.
12	$H4_{4c}$ There is a significant impact of IMT on the KRS.	2.982	0.003	Accept $H4_{4c}$ Reject $H0_{4c}$	There is a significant impact of Infrastructure management on the key performance results. The institutes are making appropriate investments in developing the institute's policy, strategy and continuous improvement.
13	$H5_{5a}$ There is a significant impact of the PSS on the PRS.	10.175	0.000	Accept $H5_{5a}$ Reject $H0_{4c}$	There is a significant impact of the processes and services on the people results. The institute makes efforts addressed to identifying and analyzing key processes and actions.
14	$H5_{5b}$ There is a significant impact of the PSS on the URS.	10.142	0.000	Accept $H5_{5b}$ Reject $H0_{5b}$	There is a significant impact of the processes and services on the people results.
15	$H5_{5c}$ There is a significant impact of the PSS on the KRS.	8.444	0.000	Accept $H5_{5c}$ Reject $H0_{5c}$	There is a significant impact of the processes and services on the key performance results.

understanding of QMS in the context of engineering education.

Conclusions

The current research contributes to the EFQM based quality management literature by identifying key quality enablers to facilitate organizational effectiveness in the engineering educational environment. According to the conclusions of this study, top management and leadership commitment, people management, infrastructure management, and policy and strategic management are all required for the successful application of QMS principles in engineering education. To encourage, shape, and sustain QMS practises among their employees, policymakers and administration of engineering educational institutions should develop a strategic plan to provide supportive leadership, foster a collaborative culture, and implement an incentive or reward system. Top management or administration, for example, must have a clear vision for QMS adoption in their businesses and communicate it to other members, highlighting the relevance of QMS practises for individual and organisational effectiveness. In addition, a well-focused strategic plan, a dedicated team, and appropriate funds to support QMS initiatives should be in place. On the other side, learning culture can be created in engineering educational institutions by awareness, transparency, tolerance, collaboration, and other activities such as frequent conferences, symposia, and blended possibilities. This study fills in the gaps and is unique in that it contributes to the EFQM-based QMS literature by highlighting how quality management procedures influence the success of engineering institutions through top management commitment, policy and strategy, and processes and services.

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References

1 Pandi A P, Sethupathi P V R, Jeyathilagar D & Rajesh R, Structural equation modelling for analyzing the relationship between IEQMS criteria and performance of engineering institutions, *Int J Enterp Netw Manag*, **7** (2016) 87–97.

2 Joshi S, Arindom R, Dikshit T, Anish B, Deep A G & Pallav P, Conceptual paper on factors affecting the attitude of senior citizens towards the purchase of smartphones, *Indian J Sci Technol*, **8** (2015) 83–89.

3 Pujar S M & Bansode S Y, MOOCs & LIS education: A massive opportunity or challenge, *Ann Libr Inf Stud*, **61** (2014) 74–78.

4 Pandi A P, Sethupathi P V R & Jeyathilagar D, Quality sustainability in engineering educational institutions - A theoretical model, *Int J Product Qual Manag*, **18** (2016) 364–384.

5 Kansal J & Jain N, Development of Competency Model and Mapping of employees Competencies for Organizational Development: A New Approach, *J Sci Ind Res*, **78** (2019) 22–25.

6 Kansal J, Singhal S & Kumar P, Integration of Quality and Knowledge Management in Indian R & D Organizations, *Proc Int Conf Soc Opr Manag* (Indian Institute of Technology, Roorkee) 2014, 889–893.

7 Sahney S, Designing quality for the higher educational system, *Asian J Qual*, **13** (2012) 116–137.

8 Chouhan VS & Srivastava S, Understanding Competencies and Competency Modeling - A Literature Survey, *IOSR J Bus Manag*, **16** (2014) 14–22.

9 Kansal J, Jain N, Satyawali P K & Ganju A, Competency Mapping in Knowledge Based Organizations, *Int J Manag*, **2** (2012) 279–290.

10 Kumar P, Singhal S & Kansal J, A Critical Model for Achieving the Global Quality in ISO 9001 Certified Engineering Educational Institutions, *J Sci Ind Res*, **79** (2020) 810–813.

11 Leiber T, Impact evaluation of quality management in higher education: a contribution to sustainable quality development in knowledge societies, *Eur J High Educ*, **8** (2018) 235–248.

12 Kumar V & Gupta D K, Continuing professional education on digital library in India: A study, *Ann Libr Inf Stud*, **63** (2016) 203–214.

13 Kansal J & Singhal S, Application and validation of DMAIC six sigma tool for enhancing customer satisfaction in a government R & D organization, *Int J Qual Res*, **11** (2017) 931–944.

14 Latif K F, Pérez A & Sahibzada UF, Corporate social responsibility (CSR) and customer loyalty in the hotel industry: A cross-country study, *Int J Hosp Manag*, **89** (2020) 1–13.

15 Ringle C M & Sarstedt M, Gain more insight from your PLS-SEM results the importance-performance map analysis, *Ind Manag Data Syst*, **116** (2016) 1865–1886.

16 Iqbal A, Latif F, Marimon F, Sahibzada UF & Hussain S, From knowledge management to organizational performance: Modelling the mediating role of innovation and intellectual capital in higher education, *J Enterp Inf Manag*, **32** (2019) 36–59.

17 Latif K F, Latif I, Farooq Sahibzada U & Ullah M, In search of quality: measuring Higher Education Service Quality, *Total Qual Manag Bus Excell*, **30** (2019) 768–791.

18 Kansal J, Singhal S & Khurana A, Design of an Instrument to Measure the Performance of ISO 9001 Based Quality Management Systems in Knowledge Based Organizations, *J Sci Ind Res*, **76** (2017) 767–770.

19 Sharma N, Akhter Y & Mir S A, Science Education in India: A Misnomer for Scientific Temper, *J Sci Temper*, **8** (2020) 135–145.