How the Quality Management Systems Impacts the Organizational Effectiveness?: Application of PLS-SEM and fsQCA Approach

Kumar, Parvesh
Mechanical Engineering Department, National Institute of Technology

Singhal, Sandeep
Mechanical Engineering Department, National Institute of Technology

Jimmy, Kansal
Scientist at SASE, Defence Research and Development Organization

https://doi.org/10.5109/6792808

出版情報：Evergreen. 10 (2), pp.626-639, 2023-06. 九州大学グリーンテクノロジー研究教育センター
バージョン：

How the Quality Management Systems Impacts the Organizational Effectiveness? : Application of PLS-SEM and fsQCA Approach

Parvesh Kumar[1*], Sandeep Singhal[1], Jimmy Kansal[2]

[1]Mechanical Engineering Department, National Institute of Technology, Kurukshetra, India

[2]Scientist at SASE, Defence Research and Development Organization, Chandigarh, India

E-mail: parveshkamboj14@gmail.com

(Received November 19, 2022; Revised March 23, 2023; accepted April 21, 2023).

Abstract: The aim of this study was to examine the impact of Quality Management (QM) enablers, such as leadership, people management, policy & strategy, and QM processes (educational, administrative), on the organizational effectiveness (OE)". The data was collected from 365 heads and faculty professionals of Indian engineering educational institutions (EEIs). SmartPLS and fsQCA 3.0 software was used to test the relationships between the variables. The results were based on fuzzy qualitative comparative analysis (fsQCA), which looked at different combinations that could be used to improve OE. Earlier studies have mostly tried to look at the direct link between QM enablers and organizational effectiveness. Our results show, on the other hand, that QM processes act as a bridge between QM enablers and organizational effectiveness. There is hardly any research that has looked into how quality management enablers, quality management processes, and organizational effectiveness are linked. This study tries to figure out how they work together in EEIs. By using both direct and configurational methods, the study helps improve the quality of organizational (engineering education) matters. Analysis shows the fsQCA calibration procedure value of 0.50 which represents a crossover point between the two extremes. The consistency scores vary from 0.60 to 0.69 and that the consistency values of the three causal conditions are more than 0.65. The overall constancy of the solution was 0.81, with the full solution and a portion of the complete solution having constancy greater than or equal to 0.80. Finally, the use of fsQCA shows that there are many ways to improve quality policies, leadership and top management commitment, and quality management processes that lead to more effective organizations.

Keywords: QMS, engineering education, organizational effectiveness, PLS-SEM, fsQCA

1. Introduction

Indian technical education is confronted with numerous obstacles in terms of transformation, industry demands for rapidly absorbent techno graduates with an open mentality, and the development of creative skills among them[1)]. Learners are captivated by competition-based learning because it allows them to work on unique ideas. It arouses curiosity, which leads to divergent solutions[2)]. The problem statement simulates the process of developing a viable solution in a supportive way. There has been a lot of discussion in the last decade about the problems in engineering education. There is a focus on how to improve its quality and implement it in an engineering education environment[3)]. It is now widely accepted, not only in India, but all over the world, that developing purely specialized professional skills does not meet the needs of employers seeking new engineers. Revisions to educational requirements for engineering education and training were drafted in 2020[4)]. It is now more flexible for academic institutions and departments to design their own curricula and programmes. Therefore, it has become critical that graduates acquire a specific set of cultural and professional competencies that are shared by everyone. These departments are usually responsible for drafting curricula, which includes determining what subjects are taught, how much time is spent on each one, and how many competencies are required for each discipline [1)]. In most engineering educational standards, there is a quality assurance component. To add to that, graduates of third-generation institutions are expected to be ready to participate in the certification of processes and technological equipment[5)].

Quality management processes and enablers are frequently used by researchers to describe and examine an organization's ability to manage its quality.

Management of educational, administrative, and learner-relationship QM processes is a set of tasks aimed at improving the modest benefit as well as the effectiveness of the organization[6]. In order to achieve significant expansion in QM processes, QM enablers are needed. Preliminary research has shown that QM facilitators have a direct or indirect impact on QM procedures. Studies in the recent literature recognize the need for more research into how multiple quality management enablers interact in order to successfully use QM processes in emerging economies, such as India[7]. There aren't many studies looking at how these QM enablers affect the actual QM processes themselves. In addition, a quality indexed literature database containing terms "leadership," "people management," "policy & strategy," and "quality management" is used to support the claim[8]. Among eleven research on leadership and commitment, six studies on people management, and inadequate studies on policy and strategy with QM, this evaluates the fallouts of these studies. In all of these trials, the techniques were equivalent[9]. The impact of leadership, people management, and policy & strategy cannot be definitively proven due to a lack of suitable studies and a cohesive experimental resistance. Thus, prior research has recommended that QM enablers be subjected to subjective inspection as a means of accelerating QM processes. According to previous research, implementing a quality management system increases an organization's effectiveness (OE). Assuming a link between quality management capabilities and OE, future studies should focus on the link between QM processes and OE, particularly in quality-intensive organizations like EEIs[10]. QM has long been acknowledged as a powerful tool for enhancing the productivity of human resources, but there is a lack of research on how it may be used in EEIs to increase the organizational effectiveness (OE). Despite the fact that quality management (QM) is elevated in EEIs, the standards for performance measurement in engineering educational institutions (EEIs) are either lacking or unstable. EEIs, in particular rising thrifts, must look at other aspects that can improve policymaking for facilitating quality management (QM)[3].

Ragin's (1987) fuzzy-set qualitative comparative analysis (fsQCA) is widely recognised as the go-to method for conducting asymmetric analyses in regression models[12]. The use of fsQCA has increased dramatically in recent years, particularly in the fields of education and research within the social sciences.

The study advances and cartelizes methodology by re-examining the connections between QM enablers, QM processes, and OE using a combination of symmetric and asymmetric analytic approaches, filling in the gaps in the existing literature[11]. Previous research has primarily concentrated on symmetrical correlational strategies that contain a single net effect model when it comes to the characteristics that distinguish QM processes[12]. Whereas the usage of asymmetric techniques appears to be insufficient in QM research studies, there appears to be a significant lack of focus on the amalgamations of causally connected basic exploration. The asymmetric approach (fsQCA) detects statistical patterns that symmetric procedures overlook. The results of the fsQCA will provide a comprehensive management model to assist in the discovery of causal instructions that successfully prime for enhanced outcomes[13]. The effects between theoretical concepts were measured using multi-item constructs, and many of these studies used fsQCA to analyse these relationships[14].

Researchers typically compute sums of items in a set to incorporate the corresponding measures in the fsQCA. In light of these issues, it is encouraging that fsQCA can be used to supplement the findings of PLS-SEM by bringing together symmetric and asymmetric perspectives in a single analysis and taking into account the inherent measurement error in the measures[15]. The purpose of this multi-method approach is to shed light on the intricate interplay between antecedent and key target constructs, allowing for a more complete understanding of the relationships between them.

In QM talks, the fsQCA is a complex technique that may be used to analyse the grouping of conditions that will result in improved OE. The net impact model just offers individual effect variables, ignoring how various combinations of elements could result in a better result [14]. The use of fsQCA is therefore required to investigate the grouping of factors (leadership, people management, and policy & strategy) that lead to enhanced QM processes (educational, administrative, and learner relationship management processes), which might lead to improved OE in the EEI environment[15]. The study used a combination of symmetric and asymmetric statistical techniques to strengthen the idea of QM. The application of fsQCA will reveal how the interactions of leadership, people management, policy & strategy, and QM processes result in equifinal ways for increasing OE. The study confirmed that EEI top management should select a combination of leadership, people management, policy & strategy, and precise dimensions of QM processes to enhance organizational effectiveness[16].

Based on the identified gaps, the study will attempt to answer the following research problems (RP).

RP1. Is there an impact of QM enablers (such as leadership-LD, people management-PM, and policy & strategy-PS) on QM processes (such as educational-EP, administrative-AP, and learner relationship management processes-LR) in Indian EEIs?

RP2. Is there any direct impact of QM processes (i.e. educational, administrative and learner relationship management processes) on OE in EEIs of India?

RP3. What effective configurations are available to attain higher OE?

2. Conceptual Framework

In order to demonstrate the interdependence of leadership, people management, strategy and policy, and QM processes and OE, research on QM processes and OE should follow an approach based on the Malcolm Baldrige theory, the EFQM model[17], and the TQM excellence model[18]. A number of Kiran's recommendations for increasing organizational effectiveness (OE) were outlined in his research[10] in which he emphasized the importance of giving knowledge workers more freedom in their work while also providing opportunities for them to learn on the job. Consequently, there will be no enforceable link between the stages that are explained and the QM systems, processes, and infrastructure[16].

fsQCA was used for the asymmetrical modelling strategy. The fsQCA method, which is based on Boolean algebra, allows for the generation of seven possible combinations of causal conditions leading to an outcome (entrepreneurship intentions) [11]. Calibration of data variables measured by Likert scales, construction of the fuzzy truth, and counterfactual analyses are all performed in accordance with the recommendations in Fiss (2011) and Ragin (2008) when conducting fsQCA analyses of configuration models. In addition, when used together, PLS-SEM and fsQCA make it easier to evaluate a model's predictive ability within the bounds of its meticulous theoretical and logical construction[14].

2.1 Leadership impact on quality management processes

In order to attain excellence in the engineering education system, top management must devote a larger portion of their time and effort to the implementation of QMS practices and fundamental ideas. To thrive in today's world, Susanto & Danar argue that colleges must have leaders who can generate vision, articulate policy, and implement strategy[19]. There are numerous institutions where the president or chief academic officer assumes responsibility for Quality Management Systems (QMS), whereas in others, a vice-president, director or dean assumes this role[20].

The vice chancellor and senior executive, as stated by[20] are accountable for leadership, and the commitment to excellence permeates all aspects of the university. Vision for future competitiveness, goal communication, administrative dedication, corporate commitment and management, learner relationship management, a focus on the learning process, and performance management are all essential components of effective educational leadership[21]. Mishra &Singh asserts that the quality of leadership determines the success or failure of any effort to effect change[15]. Without widespread application of leadership, a college or university has little chance of flourishing.

$H_{1,2,3}$. The Leadership has positive impact on quality management system processes (i) educational, (ii) administrative and (iii) learner relationship management.

2.2 People management impact on quality management processes

Those who employed in educational institutions are collectively referred to as "human resources" in the field of higher education[22]. Academic staff (those whose primary role is teaching or research or supporting teaching or research), professional support staff (academic, health, and social support), management and administrative staff, and support staff involved in maintenance and operations are all part of this category[23].

People are important in all aspects of the quality management process, and each individual's contribution is critical[24]. According to past research, HR, leadership, and strategy are critical for managing excellence in businesses. According to the new HRM perspective, people management has a direct influence on the implementation of strategic organizational aims and activities, which helps to increase organizational efficiency[25]. All employees should be allowed to participate in team discussions and share their expertise. This helps quality management by ensuring that departments can function efficiently and effectively, which in turn promotes a more effective organization by strengthening departments and groups within the organization[26]. It is everyone's responsibility to enhance the image of an organization in the eyes of its customers, stakeholders and anyone else who may be affected by the company's actions[27].

$H_{4,5,6}$. People management has positive impact on quality management system processes (i) educational, (ii) administrative and (iii) learner relationship management.

2.3 Policy & strategy impact on quality management processes

Staff policy and resource and process management must be guided by the policy and strategy. Policy and strategy, as confirmed by (ALNasser, Yusoff, & Islam, 2013), are pivotal among the three enablers[28]. Two other studies, by (ALNasser et al., 2013) and (Garstenauer et al., 2014), echo this conclusion, showing that strategic planning and human resource management[25] go hand in hand. The positive impact of the "policy and strategy" construct on "educational processes," "infrastructure management," and "administrative services" was confirmed in this empirical study [3].

$H_{7,8,9}$. Policy & strategy has positive impact on quality management system processes (i) educational, (ii) administrative and (iii) learner relationship management.

2.4 Quality management system processes and organizational effectiveness

$H_{10,11,12}$ QM processes (i) educational, (ii) administrative and (iii) learner relationship management have a significant and positive impact on organizational effectiveness.

2.5 Asymmetric modeling

$H_{13.}$ Varied combination of QM enablers (leadership, people management and policy & strategy) and QM processes (educational, administrative and learner relationship management processes) associated with organizational effectiveness (Figure 1).

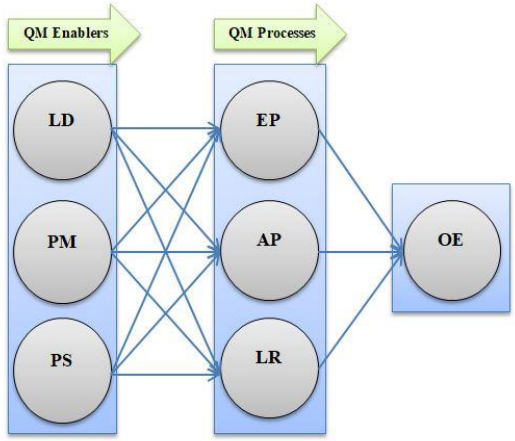

Fig. 1: Construct relationship model

3. Research Methodology

3.1 Design of questionnaire and survey

Staff members (academics and administrators) from public and private engineering educational institutions involved in the growth, training, and research of numerous disciplines participated to this study. Administrative members, such as department heads, deans, and coordinators, play a critical role in the day-to-day operations of educational practices for students[29]. The survey approach was chosen for the process of collecting data from India's two most important regions (Delhi and NCR)[17]. The convenience sample technique, which is often employed in QM studies, was utilized to distribute 452 questionnaires to respondents from a total of twelve public and twenty-three private institutions between March 2022 and July 2022. There were a total of 452 questionnaires that were distributed in 35 engineering educational institutions, and a total of 378 questionnaires were recorded for an 83.63 percent response rate. After eliminating the 13 questionnaires that were found to be invalid, the research was conducted using the remaining 365 questionnaires. The profiles of the respondents are presented in Table 1.

Table 1. Profile of the respondents

Demographics variables	**Frequency**	**Percentage**
Region		
Delhi	155	42.5
NCR	210	57.5
Age		
21-30	76	20.8
31-40	112	30.7
41-50	120	32.9
51-60	57	15.6
Gender		
Male	242	66.3
Female	123	33.7
Professional Experience		

0-10	87	23.8
11-20	155	42.5
21-30	79	21.6
31-40	44	12.1
Work Area		
Admin.	93	25.5
Teaching	272	74.5
Designation		
Administrators	93	25.5
Professor	54	14.8
Associate Professor	69	18.9
Assistant Professor	132	36.2
Lecturer	17	4.6

3.2 fsQCA model analysis measures

According to symmetric associations, low or high values of an independent variable are continually communicating with low or high standards of an endogenous variable, and both these standards and the endogenous variable's low or high standards are equally essential and passable criteria[14]. Asymmetric associations suggest that high standards of an exogenous variable, at least to some extent, are adequate but not essential prerequisites for high standards of an endogenous variable[30]. It implies that the same effect could be caused by a number of different combinations of causative factors. PLS-SEM is applied for symmetric analysis in this research because it is better suited to assessing complex path models that cannot be analyzed by a covariance-based structural equation model[14].

PLS-SEM is used to test the validity and reliability of the hypotheses. PLS-SEM uses symmetrical analysis to assess the exogenous variable's net influence on the model[14]. The asymmetrical approach investigates complex causal structures such as the grouping of exogenous variables that can result in a given outcome[31]. The fsQCA aids in distinguishing between causation elements that contribute to the same outcome. Therefore, H5 is analyzed using the fsQCA. The asymmetric solution has the advantage of allowing investigators to examine how factors combine to generate formations with the required and appropriate specific basic effects[31].

Both symmetric and asymmetric approaches, which were used in the investigation, contribute to the analysis in complementary ways. The findings of the PLS-SEM method are supplemented by the fsQCA method in order to give a better knowledge of the linked structures of variables[30]. The findings of the fsQCA analysis, which categorizes the combination of quality management enablers and the dimensions of quality management procedures in order to obtain a significant amount of OE, support the conclusions of the PLS-SEM study[14]. Both (Krysko-Jr et al., 2020) and (Zavadskas et al., 2021) argued that fsQCA is a contemporary method for assembling an understanding of relationships as well as management issues and complications [30), 12)].

4. Data interpretation and Results

The research uses 43 different measurement items that were derived from earlier research studies; however, in order to make them applicable to the environment of the EEI, some minor adjustments were made[20]. The following three magnitudes are used to assess OE: two items of institute result[32], three items of student result [33] and two items of people result[34]. The items are graded using a Likert scale with a maximum of five points, as shown in Table 2, where a score of one indicates "strongly disagree" and a score of five indicates "strongly agree" [35].

4.1 Measurement model evaluation

The measurement model is developed so that the reliability and validity of the constructs and the components of those constructs can be assessed[36]. Five items had to be removed during the evaluation in order to justify the indicated factor loading value of 0.6. According to the criteria established by Hair et al., the α coefficient and composite reliability values of all the

constructs is above the suggested value of 0.70 and average variance extracted (AVE) values of the five constructs satisfy the suggested values of 0.50 using 38 items in the final assessment model. Table 3 demonstrates both the convergent validity and reliability that have been established. Table 4 presents the findings of the discriminant validity analysis performed according to the recommendations made by Fornell and Larcker (1981).

Table 2. Source of QMS variable and dimensions

Variable	**QMS Dimensions**	**No. of items**	**Source**
Quality management enablers	Leadership	5	[37]
	People management	5	[38]
	Policy & strategy	4	[39]
Quality management processes	Educational processes	5	[7]
	Administrative Processes	6	[3]
	Learner relationship management	5	[2]
Organizational effectiveness	People results	4	[34]
	Student results	4	[33]
	Institute results	5	[32]

Table 3. Factor loadings, reliability and convergent validity

	A	**α**	**CR**	**AVE**
Leadership		.83	.827	.62
LD1	.61			
LD2	.78			
LD3	.79			
LD4	.73			
People management		.89	.899	.67
PM1	.77			
PM2	.73			
PM3	.81			
PM4	.69			
Policy & strategy		.91	.866	.58
PS1	.61			
PS2	.81			

PS3	.61			
PS4	.68			
Educational processes		.80	.808	.56
EP1	.80			
EP2	.77			
EP3	.79			
EP4	.69			
EP5	.71			
Administrative Processes		.87	.873	.66
AP1	.65			
AP2	.84			
AP3	.76			
AP4	.62			
Learner relationship management		.91	.916	.62
LR1	.77			
LR2	.74			
LR3	.83			
LR4	.85			
Organizational effectiveness		.88	.884	.56
People results				
PR1	.79			
PR2	.69			
PR3	.63			
PR4	.71			
Student results				
SR1	.76			
SR2	.79			
SR3	.85			
SR4	.81			
Institute results				
IR1	.70			

IR2	.96			
IR3	.63			
IR4	.72			
IR5	.80			

Table 4. Discriminant validity analysis using Fornell and Larcker (1981)

	LD	**PM**	**PS**	**OE**	**EP**	**AP**	**LR**
LD	.787						
PM	.730	.818					
PS	.701	.669	.761				
OE	.711	.692	.705	.748			
EP	.657	.755	.665	.670	.748		
AP	.628	.668	.591	.690	.669	.812	
LR	.663	.647	.703	.658	.652	.675	.787

4.2 Structural model evaluation

To test the validity of the 12 hypotheses, the structural model is analyzed. The QM enablers that directly affect QM processes are evaluated first, followed by the QM processes' direct effects on OE. The significance of direct paths was examined and the standard error was estimated using a bootstrap resampling method (R). The hypothetical assumptions for the direct relationships are summarized in Table 5.

Table 5. Hypothetical assumptions for the direct relationships

Hypotheses	**Relationship**	**Path coefficient (β)**	**SD**	**t-value**	**p-value**	**Support**
H_1	LD → EP	0.29	0.030	2.89*	0.004	Yes
H_2	LD → AP	0.34	0.079	2.90*	0.000	Yes
H_3	LD → LR	0.04	0.090	1.03	0.398	No
H_4	PM → EP	0.41	0.021	4.07*	0.001	Yes
H_5	PM → AP	0.23	0.077	3.82*	0.005	Yes
H_6	PM → LR	0.40	0.110	4.09*	0.000	Yes
H_7	PS → EP	0.08	0.079	0.91	0.301	No
H_8	PS → AP	0.26	0.074	4.06*	0.000	Yes
H_9	PS → LR	0.39	0.087	3.73*	0.001	Yes
H_{10}	EP → OE	0.08	0.131	0.98	0.197	No
H_{11}	AP → OE	0.39	0.133	3.88*	0.001	Yes
H_{12}	LR → OE	0.11	0.076	1.37	0.131	No

Note: Significant at: $p < 0.05$

Table 5 demonstrates that leadership has a substantial impact on both the educational and administrative procedures for quality management (path coefficient-β = 0.29, t value = 2.89, p value = 0.004 and path coefficient-β = 0.34, t value = 2.90, p value < 0.001, respectively). The quality management learner relationship management method is said to be unaffected by leadership (path coefficient-β = 0.04, t value = 1.03, p value = 0.398). As a result, H1, H2 are accepted and H3 is rejected.

People management has significant influence on the quality management educational processes (path coefficient-β = 0.41, t value = 4.07, p value = 0.001), on the quality management administrative processes (path coefficient-β = 0.23, t value = 3.82, p value = 0.005), and on the quality management learner relationship management process (path coefficient-β = 0.40, t value = 4.09, p value < 0.001). As a result, H4, H5 and H6 are accepted.

Policy and strategy's impact on the quality management educational processes is insignificant (path coefficient-β = 0.08, t value = 0.91, p value = 0.301), but has substantial positive effects on the quality management administrative processes (path coefficient-β = 0.26, t value = 4.06, p value < 0.001), and the quality management learner relationship management process (path coefficient-β = 0.39, t value = 3.73, p value = 0.001). Thus, the hypotheses H8, H9 is accepted and H7 is rejected.

It is observed that administrative processes for quality management have a substantial impact on organizational effectiveness (path coefficient-β = 0.08, t value = 0.98, p value = 0.197), while the quality management educational processes (path coefficient-β = 0.11, t value = 1.37, p value = 0.131), and the quality management learner relationship management approach has little impact on organizational effectiveness. As a result, H10 and H12 are rejected, whereas H11 is supported.

4.3 Multigroup analysis

The investigation concluded with an assessment of the considerable inequalities that existed in the relationship between administrative staff and academics. The comparison of the influence of PM on AP was the only one in which the differences were found to be statistically significant. It was determined that none of the other differences in the hypothesized relationships had any significant bearing on the matter. As a result, we can categorically state that there is no substantial difference in the connection between administrative and academic employees. Indeed, data suggests that the effects of relationships for both kinds of employees are relatively equal.

4.4 The fsQCA approach

The fsQCA is then used to investigate the prerequisite requirements (enablers and dimensions of QMS processes) in order to explicate organizational effectiveness.

- **Calibration:** The calibration procedure constitutes the first stage of the fsQCA analysis[14]. Scores on fuzzy sets can range anywhere from 0 to 1. Since all possible values are between 0 and 1, a case with a membership score of 1 is completely included in a fuzzy set, while a case with a membership score of 0 is completely excluded from the set (fully out of the set). The value 0.50 represents a crossover point between the two extremes.
- **Necessary conditions:** The analysis of necessary conditions seeks to determine whether or not a single condition is consistently present (or absent) whenever the result is shown (or absent). (Rasoolimanesh et al., 2021) proposed using a consistency level of 0.9 for causal factors, which indicates that the result (such as OE) can be justified all by itself. Table 6 shows that the consistency scores vary from 0.60 to 0.69 and that the consistency values of the three causal conditions are more than 0.65. Most of the time, the causes are the requirements, but none of our conditions can explain why knowledge workers do what they do on their own.
- **Solution:** The results of the fsQCA utilizing [14] for measuring organizational effectiveness are shown in Table 7. The overall constancy of the solution was 0.81, with the full solution and a portion of the complete solution having constancy greater than or equal to 0.80. There is equifinality since there are multiple solutions that are sufficient for the organizational effectiveness, and the two solutions (QM enablers and dimensions of QM processes) have a unique combination of situations. As a result, the H5 hypothesis is supported. According to the findings of the fsQCA analysis, organisational effectiveness (OE) was dependent on people management as well as policy and strategy, both of which were present in two different configurations. A score of 0.59 for fsQCA solution coverage means that two causal condition configurations are responsible for 59% of the effectiveness of the organization. The proposed range of 0.25–0.90 is accommodated by it.

Table 6. Consistency score

	Outcome OE	
Conditions	**Consistency**	**Coverage**
LDC	0.685224[a]	0.643191
~LDC	0.594713	0.660113
PMC	0.632353	0.635204
~PMC	0.592956	0.639307
PSC	0.684888[a]	0.652192
~PSC	0.599998	0.640926
EPC	0.628776	0.668868
~EPC	0.675875	0.644678
APC	0.657884[a]	0.686567
~APC	0.677870	0.676540
LRC	0.673839[a]	0.647155
~LRC	0.640968	0.644749

Note(s): ~ implies that a condition does not exist. [a]Meets the 0.65 consistency benchmark for normally required conditions

Table 7. Results of fsQCA intermediate solutions

Condition	**Outcome: OE**	
Quality management enablers	1	2
Leadership		
People management	●	⊗
Policy & strategy		●
Quality management processes		
Educational processes	⊗	⊗
Administrative Processes	⊗	
Learner relationship management		
Raw coverage	0.42	0.43
Unique coverage	0.13	0.15
Consistency	0.82	0.82
Solution Coverage 0.59		
Solution Consistency 0.81		

Note(s): ● denotes presence of a condition. ⊗ denotes absence of a condition. Blank space signifies "do not care."

Predictive validity

Predictive validity demonstrates a model's ability to forecast results across several datasets[7]. For the purpose of analyzing the predictive validity, the sample used in this research was divided into two subsamples. Modeling subsample 1 with the fsQCA and comparing its findings to those of the entire sample are two uses for this analysis. The results of the first subsample show that the solution has a constancy of 0.82, which is very close to the results of the entire sample. For instance, a high score on the predictive validity test indicates success in organizational effectiveness with process management, educational, and administrative tasks. Table 7 shows the algorithm PM*EPC*APC fallouts for subsample 1 (consistency: 0.82) are found to be the same as the findings from the entire sample. The PM*EPC*APC example is then put through its paces with the holdout sample serving as the control (subsample 2). A nearly identical asymmetric relationship can be seen in the second subsample (consistency: 0.82). This demonstrated that the predictive validity was established.

5. Discussion

Relationships between QM enablers (leadership, people management, and policy & strategy), dimensions of QM processes (educational, administrative, and learner relationship management), and OE in Indian EEIs are investigated. According to the findings of the research, policy and strategy have a moderate impact on the QM process dimensions, while leadership has a moderate impact on the QM process dimensions. People management, on the other hand, has a significant impact on the QM process dimensions. In addition, we find evidence of quality management processes' moderating effect on organizational effectiveness.

This research confirms the importance of leadership in achieving goals and realizing benefits for both individuals and organizations. Leadership has a large, positive, partial effect on QM procedures[40]. If the leaders of an EEI can establish a bond that is mutually beneficial, then their followers will have a greater propensity to share information, comprehend the information that is shared with them, and pass along information that is relevant to the situation. The results of this study are consistent with those of other research[41].

It is also recognized that organizational characteristics have a significant impact on the efficiency of QM procedures in EEIs, with leadership standing out as particularly useful in providing a compass by which employees may more reliably navigate the complex terrain of their duties within the organization[42]. Therefore, educational institutions entrust their pedagogical, administrative, and learner relationship management operations to their top management[43]. New facilities for incremental improvement are another goal of EEIs, which will be established and maintained through the harmonization of procedures spanning human resources, education, administration, and learner relationship management.

Policy and strategy must serve as a guideline for developing staff policies and managing resources and processes. (Sahney et al., 2010) supports the importance of policy and strategy among the three enablers[27]. This finding is supported by[4] Kumar et al. and Aichouni et al [42] confirming the link between policy and strategy and people and resource management. This empirical investigation validated the "policy and strategy" construct's strong positive influence on areas such as "educational services," "administration services," "learner relationship management," "people management," and "infrastructure management."

This research suggests two ad hoc recipes (configurations) that could aid businesses in improving their OE. Solution 2 emphasizes the importance of the policy and strategy aspect in achieving better OE, complementing the leadership combination used in Solution 1. The research also shows that high OE is the result of a combination of factors, including leadership and policy & strategy, which exhibit stable patterns of equifinality. According to Table 7, forty percent of all possible scenarios (which includes policy and strategy) can be suitable for high OE. Leaders aren't the only ones interested in high OE; when the right kind of policy and strategy is in place, too, businesses tend to succeed. The results provide support for the idea that there are multiple approaches to OE archiving and add weight to the need for the use of fsQCA in QM literature[14].

6. Conclusion

In this study, the relationship between quality management enablers (leadership, people management, and policy and strategy), quality management processes, and organizational effectiveness (OE) in EEIs was investigated. A preliminary investigation of EEIs in India was carried out as a means of gauging the practicability of the theoretical framework. Both symmetric and asymmetric methods were used to analyze the data. The results showed a direct relationship between the QM enablers and the QM processes, as well as a direct relationship between the QM processes and OE. The asymmetric (fsQCA) approach did a good job of demonstrating the equifinality relationship. According to the findings of the research, various combinations of EEIs can produce exceptionally high levels of OE.

This research contributes significantly to our knowledge by shedding light on aspects of QM processes and OE that have been glossed over in the prior literature on leadership, people management, policy, and strategy. This study empirically studied the link between leadership, people management, policy and strategy, and QM processes in response to[44] need for greater research

into the different quality management enablers that could improve QM processes and OE in diverse organizational contexts[45]. Improved QM processes and OE are required results for any business, and the importance of QM enablers (leadership, people management, and policy & strategy) to achieving these goals has been well recognized. Such assumptions are of supplementary value to EEIs and other technical education institutions. This research has the potential to advance the fields of management, leadership, policy, and strategy as well as quality management (QM) and organizational effectiveness (OE) literature. To begin, this research will add to the existing body of work in the QM area on the topic of QM enablers[18]. Secondly, the findings provide a testing ground for the integration of organizational QM competency theory[46]. Finally, this research adds to the body of knowledge around Ringle's management theory[47] by highlighting the significance of QM processes in OE.

According to the findings of the study, an increase in the number of QM enablers and QM processes led to an increase in OE in EEI. Leadership, management of people and processes, policy and strategy, and quality management systems are of utmost significance in an educational establishment. According to the findings, it is abundantly clear that each of the investigated variables makes a significant contribution to the output of EEI. It is also essential for locating immaculate inevitabilities in the theoretical framework to pursue the simultaneous study of both perspectives.

This research follows the current pattern of combining symmetric and asymmetric statistical methods to give a unique view of organizational concerns in the QM field [30]. For example, the fsQCA does a more thorough job of investigating organizational possibilities and limits than conventional symmetric approaches[14]. The benefits of using fsQCA outweigh the drawbacks of symmetrical approaches, which are unable to categorize a combination of characteristics that could aid in achieving the desired outcome. This work contributes to the state of the art in QM research, which is still lacking the application of fsQCA, by extending a procedural perspective in order to identify the causal contribution, as opposed to the configuration of conditions, to the outcome of interest. As a result, this work contributes to the state of the art in QM literature by categorizing the many configurational situations under which one can attain improved OE.

Previous works often highlight the significance of QM in EEIs[20]. Subsequent research has acknowledged the importance of the study's findings, which shed light on the roles that leadership, people management, and policy & strategy play in technical educational organizations [48]. However, the prior research is scant and lacks an evaluation of their involvement in effective QM activities that boost OE in EEIs. The empirical findings of this study fill a vacuum in the existing literature by illuminating the proactive role of QM enablers in enabling QM processes, which in turn results in an increase in OE, and so has important managerial implications for EEIs. In addition, the results showed that elevating QM enablers would improve people management, knowledge activity rewards, and the organization's culture in a way that would allow it to better leverage its QM resources to boost OE and overall performance. Management at EEIs that want to boost performance and gain a competitive edge should priorities quality management processes and employee productivity, as well as put more effort into people management, top management commitment, and leadership style. They should also learn to deal with the uncertainty that comes with developing new policies and strategies.

Nomenclature

AP	Administrative Processes
AVE	Average Variance Extracted
EP	Educational Processes
EEIs	Engineering Educational Institutions
EFQM	Europium Foundation for Quality Management
fsQCA	Fuzzy Qualitative Comparative Analysis
HR	Human Resource
HRM	Human Resource Management
IR	Institute results
LD	Leadership
NCR	National Capital Region
OE	Organizational Effectiveness
PLS	Partial Least Square
PM	People Management
PR	People Results
PS	Policy & Strategy
QM	Quality Management
QMS	Quality Management Systems
RP	Research Problems
SD	Standard Deviation
SEM	Structural Equation Modeling
SR	Student Results
TQM	Total Quality Management

References

1) A. P. Pandi, P. V. R. Sethupathi, and D. Jeyathilagar, “Quality sustainability in engineering educational institutions - A theoretical model,” *Int. J. Product. Qual. Manag.*, **18** (*2/3*) 364–384 (2016). doi:10.1504/IJPQM.2016.076715.
2) N. Van Nhon, “Integrated QMS ISO 9001 and EOMS ISO 21001 to help educational institutions on

their continuous improvement path - Best practices," **20** (*15*) 1–6 (2018).
3) R. V. Mulay and V. T. Khanna, "An empirical study on quality improvement in higher education institutions with reference to selected processes," *Qual. Manag. J.*, **28** (*1*) 41–56 (2020). doi:10.1080/10686967.2020.1848367
4) P. Kumar, S. Singhal, and J. Kansal, "Quality Management System Practices Performed in ISO 9001 Certified Engineering Educational Institutions : A Critical Analysis of Indian Universities," *J. of Eng. Edu. Transf.,* **36** (*1*) 1–9 (2022).
5) A. Pal Pandi, D. Jeyathilagar, and V. Kubendran, "A study of integrated total quality management practice in engineering educational institutions," *Int. J. Manag. Sci. Eng. Manag.* **8** (*2*) 117–125 (2013). doi:10.1080/17509653.2013.798949.
6) P. Kumar, S. Singhal, and J. Kansal, "Impact of Quality Management System Dimensions on Organizational Effectiveness of Engineering Institutions in India," *J. of Sci. Ind. Res.*, **81** (*2*) 148–155 (2022). doi:10.56042/jsir.v81i02.54827.
7) S. Burli, V. Bagodi, and B. Kottursheṭtar, "TQM dimensions and their interrelationships in ISO certified engineering institutes of India," *Benchmarking*, **19** (*2*) 177–192 (2012).
8) A. Mateos-Ronco and J. M. Hernández Mezquida, "Developing a performance management model for the implementation of TQM practices in public education centres," *Total Qual. Manag. Bus. Excell.*, **29** (*5-6*) 546–579 (2018).
9) P. B. Sakthivel and R. Raju, "Conceptualizing total quality management in engineering education and developing a TQM educational excellence model," *Total Qual. Manag. Bus. Excell.*, **17** (*7*) 913–934 (2006).
10) R. S. Kiran, P. Madarvalli, and J. A. Chandulal, "Competency based Training and Development for Engineering Students," *Int. J. Eng. Res. Appl.*, **1** (*2*) 246–250 (2005).
11) R. S. Sakataven, S. A. Helmi, and M. Hisjam, "Lean implementation barriers and their contextual relationship in contract manufacturing machining company," *Evergreen*, **8** (*2*) 499–508 (2021).
12) V. A. Krysko-Jr, J. Awrejcewicz, and M. V. Zhigalov, "On the mathematical modeling of symmetric/asymmetric multi-layer orthotropic shells," *Int. J. Non. Linear. Mech.*, **120** (*1*) 1–30 (2020).
13) A. Kumar, R. Giri, S. Mishra, and N. Gupta, "Productivity Improvement of HLLS Using Lean Technique in Assembly Line of an Automotive Industry," *Evergreen*, **9** (*2*) 356–366 (2022).
14) S. M. Rasoolimanesh, C. M. Ringle, M. Sarstedt, and H. Olya, "The combined use of symmetric and asymmetric approaches: partial least squares-structural equation modeling and fuzzy-set qualitative comparative analysis," *Int. J. Contemp. Hosp. Manag.*, **33** (*5*) 1571–1592 (2021).
15) A. Mishra and M. Singh, "Influence of technology in learning macro skills of English in a multicultural classroom: A case study of students' perception," *Evergreen*, **8** (*1*) 13–22 (2021).
16) B. Sayeda, C. Rajendran, and P. S. Lokachari, "An empirical study of total quality management in engineering educational institutions of India: Perspective of management," *Benchmarking*, **17** (*5*) 728–767 (2010).
17) J. Kansal, S. Singhal, and P. Kumar, "Integration of Quality and Knowledge Management in Indian R & D Organizations," *Soc. of oper. mgmt,* **18** (*1*) 889–893 (2014).
18) A. Honarpour, A. Jusoh, and K. Md Nor, "Total quality management, knowledge management, and innovation: an empirical study in R&D units," *Total Qual. Manag. Bus. Excell.* **29** (*7–8*) 798–816 (2018).
19) D. A. Susanto, "Implementation of Standards in International Trade: Benefit or Barrier? A Case Study from Indonesia," *Evergreen*, **9** (*3*) 619–628 (2022).
20) G. Sunitha and J. Avanija, "Program assessment and evaluation for continuous quality improvement," *J. Eng. Educ. Transform.*, **34** (*3*) 42–55 (2021).
21) J. C. Sá, A. Amaral, L. Barreto, F. Carvalho, and G. Santos, "Perception of the importance to implement ISO 9001 in organizations related to people linked to quality-an empirical study," *Int. J. Qual. Res.*, vol. **13** (*4*) 1055–1070 (2019).
22) J. Kansal and N. Jain, "Development of Competency Model and Mapping of employees Competencies for Organizational Development: A New Approach," *J. Sci. Ind. Res.*, **78** (*1*) 22–25 (2019).
23) J. Kansal and S. Singhal, "Development of a competency model for enhancing the organisational effectiveness in a knowledge-based organisation," *Int. J. Indian Cult. Bus. Manag.*, **16** (*3*) 287–301 (2018).
24) J. Kansal, N. Jain, P. K. Satyawali, and A. Ganju, "Competency Mapping in Knowledge Based Organizations," *Int. J. Manag.*, **3** (*2*) 279–290 (2012).
25) A. Garstenauer, T. Blackburn, and B. Olson, "A knowledge management based approach to quality management for large manufacturing organizations," *EMJ - Eng. Manag. J.*, **26** (*4*) 47–58 (2014).
26) L. Bravi, F. Murmura, and G. Santos, "The ISO 9001:2015 quality management system standard: Companies' drivers, benefits and barriers to its implementation," *Qual. Innov. Prosper.*, **23** (*2*) 64–82 (2019).
27) S. Sahney, D. K. Banwet, and S. Karunes, "Organizational culture, Sri Lanka, public sector organizations, total quality management, hospitals: An administrative staff perspective in the Indian

context," *TQM J.*, **22** (*1*) 56–71 (2010).
28) A. ALNasser, R. Z. Yusoff, and R. Islam, "Relationship between hard total quality management practices and organizational performance in municipalities," *Am. J. Appl. Sci.*, **10** (*10*) 1214–1223 (2013).
29) V. Singh, A. Kumar, and T. Singh, "Impact of TQM on organisational performance: The case of Indian manufacturing and service industry," *Oper. Res. Perspect.*, **5** (*7*) 199–217 (2018).
30) E. K. Zavadskas, J. Antucheviciene, and Z. Turskis, "Symmetric and asymmetric data in solution models," *Symmetry.*, **13** (*6*) 1–10 (2021).
31) I. Ali, M. Ali, and S. Badghish, "Symmetric and asymmetric modeling of entrepreneurial ecosystem in developing entrepreneurial intentions among female university students in Saudi Arabia," *Int. J. Gend. Entrep.*, **11** (*4*) 435–458 (2019).
32) H. Ma, Y. Peng, and Y. Shi, "The effect of information technology and knowledge management capability on R&D process performance," *J. Knowledge-based Innov. China*, **1** (*1*) 43–55 (2008).
33) F. J. Fernández Cruz, I. Egido Gálvez, and R. Carballo Santaolalla, "Impact of quality management systems on teaching-learning processes," *Qual. Assur. Educ.*, **24** (*3*) 394–415 (2016).
34) A. Bujor and S. Avasilcai, "Open innovation in creative industries. Part I: Innovation and design," *IOP Conf. Ser. Mater. Sci. Eng.*, **400** (*6*) 1–8 (2018).
35) P. Kumar, S. Singhal, and J. Kansal, "A Critical Model for Achieving the Global Quality in ISO 9001 Certified Engineering Educational Institutions," **79** (*9*) 810–813 (2020).
36) A. Honarpour, A. Jusoh, and K. M. Nor, "Knowledge management, total quality management and innovation: A new look," *J. Technol. Manag. Innov.*, **7** (*3*) 22–31 (2012).
37) L. Wanza, J. F. Ntale, and M. K. Korir, "Total Quality Management Practices on Performance of," *Int. J. Bus. Manag. Rev.*, **5** (*8*) 43–70 (2017).
38) J. Kansal, N. Jain, P. K. Satyawali, and A. Ganju, "Competency Mapping in Knowledge Based Organizations," *Int. J. Manag.*, **3** (*2*) 279–290 (2012).
39) A. A. Laghari, H. He, A. Khan, N. Kumar, and R. Kharel, "Quality of experience framework for cloud computing (QoC)," *IEEE Access*, **6** (*1*) 64876–64890 (2018).
40) J. Lu and Z. Hao, "Analysis on Quality Evaluation of Higher Engineering Education from the Perspective of Outcome-based Education," *J. Eng. Sci. Technol. Rev.*, 15 (*4*) 96–103 (2022).
41) V. Agrawal, S. Agarwal, and A. M. Agrawal, "Modelling of factors of e-learning: An ISM approach," *Int. J. Contin. Eng. Educ. Life-Long Learn.* **30** (*3*) 327–349 (2020).
42) M. Aichouni, N. A. Messaoudene, A. Al-Ghonamy, and M. Touahmia, "An empirical study of quality management systems in the Saudi construction industry," *Int. J. Constr. Manag.*, **14** (*3*) 181–190 (2014).
43) K. Rehmani, Y. Ahmad, A. Naseem, and T. H. Syed, "Do they really coexist? An empirical analysis of a conjoint implementation of Quality Management System and High Performance Work System on organizational effectiveness," *PLoS One*, **15** (*3*) 1–20 (2020).
44) P. Smith, "Where is practice in inter-organizational R&D research? A literature review," *Manag. Res.*, **10** (*1*) 43–63 (2012).
45) N. Africano, A. S. Rodrigues, and G. Santos, "The main benefits of the implementation of the quality management system in higher education institutions in angola," *Qual. Innov. Prosper.*, **23** (*3*) 122–136 (2019).
46) Y. N. Kofanov, M. K. Obushcharova, and K. V. Volodina, "Development and implementation of integrated quality management systems in Russia," *Proc. 2017 Int. Conf. "Quality Manag. Transp. Inf. Secur. Inf. Technol.* 428–431 (2017).
47) C. M. Ringle and M. Sarstedt, "Gain more insight from your PLS-SEM results the importance-performance map analysis," *Ind. Manag. Data Syst.*, **116** (*9*) 1865–1886 (2016).
48) A. Pal Pandi, P. V. Rajendra Sethupathi, and D. Jeyathilagar, "The IEQMS model for augmenting quality in engineering institutions – an interpretive structural modelling approach," *Total Qual. Manag. Bus. Excell.*, **27** (*3-4*) 292–308 (2016).