The Impact of TQM Adoption on the Operational Performance of the Indian Cement Manufacturing Industry: A Conceptual Framework

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Abstract. The adoption of modern technology augments operational excellence by reducing power consumption, wastage, and maintenance cost within environmental emission tolerance. This research aims to identify the effects of total quality management practices in cement manufacturing units for any operational improvement. Based on the current literature review, a conceptual TQM model is proposed, including the five fundamental dimensions- top management support, quality management system, information and analysis, statistical quality technique, and quality organization and their effect on operational improvements. Data were collected from 150 respondents working in the cement industry at a different managerial level, using the method EFA, CFA, and SEM on the registered responses. The conceptual dimensions were represented through five core hypotheses. This is one of the studies that develops and validates the initiative of TQM framework, which leads to operational enhancement of the Indian cement industry. This work is conducive to the researcher, quality experts, and technical analysts in manufacturing industries pursuing optimal performance excellence. The conducted work enunciates theoretical and practical implications for augmenting the wholesome know-how of the selected and leading cement manufacturing units. The constraint conceded in the study pave the way for further research in the field of TQM.

Keywords: Quality System Improvement (QSI), Statistical Quality Techniques (SQT), Information and Analysis, Operational Performance, SEM

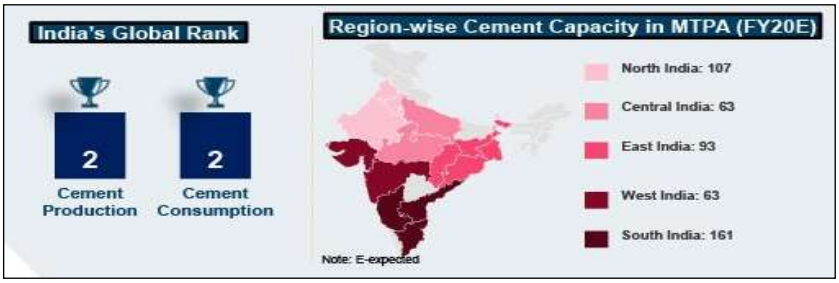
Introduction

The Indian cement industry is very competitive in nature that is looking for sustainable manufacturing, attractive & quality packaging, process improvement, profitable business, and customer satisfaction (Das, 2018; Dubey et al., 2015). To overcome current and upcoming challenges organizations using many quantitative and qualitative tools (Rathore et al., 2020). According to (Mueller & Carter, 2005) Total quality management (TQM) is an acceptable instrument worldwide for achieving the said target, especially in the manufacturing industry. TQM is an ongoing process for continual improvement, reducing defects, and augment profitability (Yacob et al., 2019). Basically, total quality management is a combination or set of tasks that help in organizations' growth of organizations, but the impact of TQM in the Indian cement industry is still not very mature and debatable (Calvo-Mora et al., 2015).

In the word of (Lin et al., 2017; Nair & Choudhary, 2016), the major principal of TQM are- (a) commitment of top management with PDCA cycle, (b) employee strength by training, awareness, and idea generation, (c) continual improvement by defining measurement, processes, cross-functional approach, (d) customer-supplier relationship, timely delivery, (e) process orientation by identifying the critical operation parameters, analysis/ comparison with the

benchmark, (f) fact base decision by systematic and defined approaches, an open forum for communication within the organization and all stakeholders. Scholarly evidence (Pambreni et al., 2019; Tiwari, 2017) stated that TQM focuses on a long-term change to meet the requirements for sustainable manufacturing and new product development according to the need of the customers at an affordable price and sustain profitability.

.The major cement industry players are Ultra tech cement, Ambuja Cement, JK Cement, Ramco Cement, Wonder, ACC Cement. If it is observed state-wise, the southern region has around 33% installed capacity, 22% by northern region, 19% by eastern, western region contributed around 13% and followed by central region. A few unfamiliar manufacturers, i.e., Lafarge-Holcim, and Heidelberg Cement, have set resources into the country in the recent past. A substantial factor that facilitates the growth of this sector is the quick accessibility of raw materials for producing cement, such as limestone, ash, and coal (Jun et al., 2004; Sinha & Dhall, 2020).Similarly, the eastern conditions of India are probably going to be undiscovered business opportunities for cement corporations and could add to their core concern in the future.



Source: Report of IBEF, 2020

Fig: 1 Global and Region-Wise Capacity of Cement Manufacturing

The paper proposes a conceptual framework that connects different QMP with the operational performance of cement manufacturing industries in India. The descriptions of TQM and implementation preserved in this study are unswerving with those who approved it (Erdil, N.O., Aktas, C.B., Arani, 2018; Srima et al., 2015; Talapatra et al., 2018). TQM has subsumed as a multidimensional concept in contrast to the above studies and performance is a unidimensional construct that is defined concerning the quality outcome at cost-effective measures.

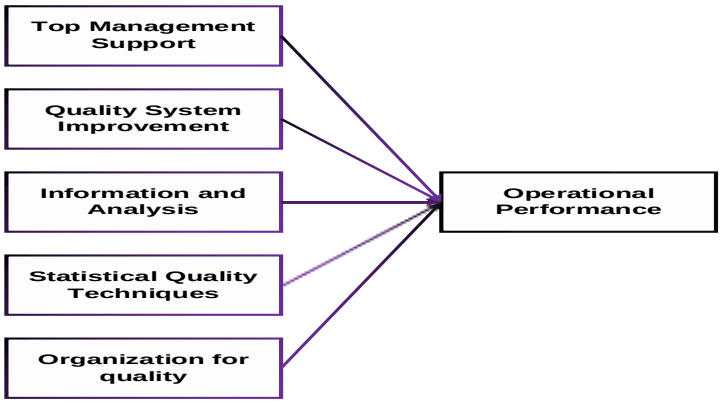


Fig: 2 Conceptual Model for TQM for Operation Improvement

Besides, the remaining part of the study is arranged as follows: section 2 outlines the literature review, theoretical constructs, and development of hypotheses. The research design and methodology adopted in this study are covered in section 3. The analysis and findings were delineated in section 4. Likewise, section 5 exhibits the theoretical and practical connotations of the study. Finally, section 6 concludes the article and summarizes the limitations and the perspective.

Literature Review

Relevant literature was collected from various reliable sources viz. books, top rating journals, annual reports, white papers, etc. to understand the nexus of TQM and related inside. (Tanninen et al., 2010) emphasized that TQM may influence organizational performance by adopting two major practices, viz. enhancing the internal environment that increases production efficiency and reduces waste, enhancing the rate of return on investment. The other one mainly focused on customer satisfaction which improves the brand value and develops the trust between customers and the organization, resulting in sales increment and market volume.

Past studies like (Pambreni et al., 2019; Timans et al., 2016) able to explored the term operational accomplishment and associated constructs pertaining to wholesome quality management practices, particularly in cement industries. (Baird et al., 2011) explored principles of quality instruments that may be conducive to developing and implementing the alternative model of AI-based TQM, which helps improve and sustain the firm financial and operation standard.Yet, the literature says that there is a dearth of articles studying the integration of these quality management concepts (Balakrishnan, A., & Maiti, 2017; Ruben, R. Ben, Vinodh, S., Asokan, 2018; Singh, M., Kumar, P., Rathi, 2019). In emerging nations, it is claimed that additional efforts should be given to match the awareness of TQM implementation and waste elimination (Calvo-Mora et al., 2015; Naciri et al., 2020). . Thus, the research question of the study:

RQ.1 What are major TQM initiatives and construct to influence the operating performance of the selected cement industry?

RQ.2 How to consider the standard estimates in examining the real-life performance faced by the cement manufacturing units?

Theoretical Constructs and Development of Hypotheses. Diverse total quality management and operational performance were examined by (Hietschold et al., 2014). The results were surveyed to find out the degree to which they are embraced with top management support, quality system improvement, information and analysis, SQT, and organization for quality. These factors were exerted to determine the impact on the operative performance of the cement industry (Ju et al., 2006).

Table 1: Total Quality Management (TQM) and Execution Measures

Constructs	**Literature review for TQM**	**Finding and Executive Measures**
Top Management Support	(Aquilani et al., 2017; Hung et al., n.d.; Sabella et al., 2014)	Top management firmly supports quality enhancement, organizations use resources to perform tasks optimally, management emphasizes the importance of seeking customer loyalty, and managers share a quality approach.
Quality System Improvement	(Basu & Bhola, 2016; Ganguly et al., 2019; Goharshenasan & Shahin, 2017; Talapatra et al., 2018; Timans et al., 2016)	The business has outlined quality standards, and the quality system is a continuous improvement. Management has stringent reporting requirements and has simple guidelines for working. Understanding quality, supplier certification, Routine internal and external audit, customers feedback is prominent

Information and Analysis	(Aquilani et al., 2017; Eniola et al., n.d.; Jyoti et al., 2017; Pantouvakis et al., 2016; Psomas & Jaca, 2016; Tortorella et al., 2019)	It is concluded that vital information is distributed, and businesses collect and evaluate relevant data for profit promotion. Business usages knowledge to enhance its main processes and output. The units have specific data about the competitive activities and identify areas of development. Systematic Model designing for communication, technical service, customer complaints are handled.
Statistical Quality Techniques	(Addis, 2019; Bouranta et al., 2019; Neyestani, n.d.; Nguyen et al., n.d.; Westgard et al., n.d.)	Cards and statistics are used to calculate & track efficiency and promote the use of data science. Employees engage in a training program related to statistical techniques, analysis for better process improvement through data analytics.
Organization for Quality	(Cool et al., n.d.; Ganguly et al., 2019; Kirouac et al., 2017; Robinson et al., n.d.; Vereycken et al., 2019; Yacob et al., 2019)	The organization has a process management system and methods. Promote interdepartmental discussion to get common objectives and processes are constantly being improved coordination of creating change, control, quality circle, and achieving manufacturing excellence.

Hypotheses for the Research

Based on the literature review and conceptual model, the following hypotheses are formulated for the research work:

H_1: There is subsume association between top management commitment & operational performance.

H_2: There is an association between the quality management system & operational performance.

H_3: There is a relationship between information process and operational performance.

H_4: Statistical Quality Techniques are positively correlated with manufacturing achievement.

H_5: Organization process management is concomitant with operational performance.

Research Design and Methodology. This research is based on primary and secondary data and deals with the procedure that is used to carry out the study with a structured and scientific approach. The judgmental sampling technique was used to collect the data from respondents (engineers) who have been working in the cement plants for the last couple of years in the northern region of India. In quality supervision, numerous researchers have used questionnaires as an instrument to conduct the empirical study (Srima et al., 2015; Wali et al., 2003).

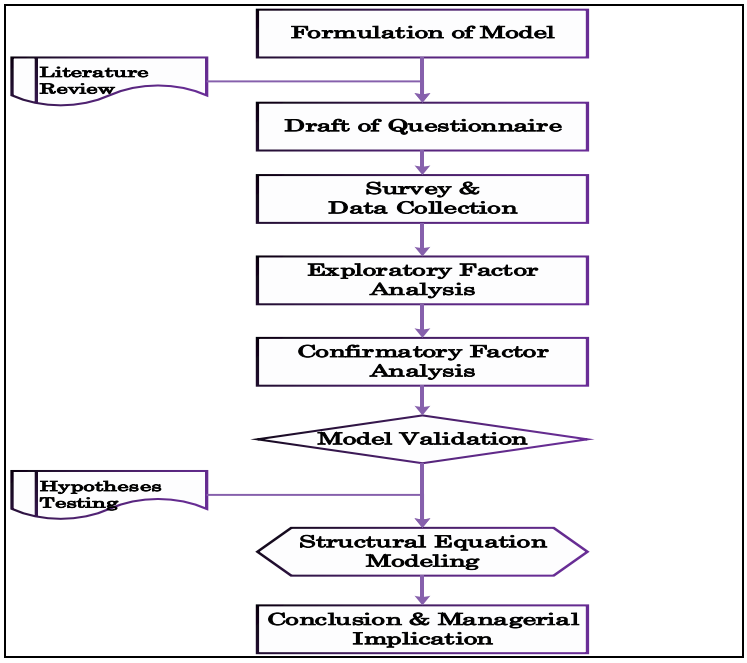


Fig: 3 Methodology of Research

The questionnaire has two parts: The first part comprises general questions viz. gender, management level, function/role, experience, product classification, and questions on the working profile of the quality engineers working in the plants. Section second covers five constructs of TQM, having 16 statements in total. The objective of this part is to measure the insights of the respondents who were associated with QM. The actors were asked to figure on Likert five-point scale. The research framework consists of a literature review, formulation of the model, drafting of a valid questionnaire, data collection, application of statistical techniques (EFA, CFA), hypotheses testing followed by model validation, and SEM.

Data Analysis and Interpretation

The descriptive analysis between the impact of total quality management dimension and effect on the operational performance was analyzed using SPSS, AMOS version 22.

Demographical Analysis

The below table outlines that the survey involved 85.3 % males and 14.7 % female respondents. The majority of the defendants were from different cement organizations, viz. JK Laxmi Cement (14.00 %), Shree Cement (14.70 %), Ultratech Cement (25.30%), India cement (19.00%), JK Cement (29.30%) and other cement organization hold (4.00 %) share. The respondents taken were from top management (12.00%), middle management (35.30%), and junior management (52.70%). The relevant actors were taken from different job profiles operation & maintenance (42.00 %), quality control & assurance (14.70%), working in cement packing unit (12.70%), sales & logistics (9.30%) and commercial department (21.30%).

Table 2: Demographical Profile of the Respondents

Particulars	Measure	Freq.	%	Total %
Gender	Male	128	85.30	85.30
	Female	22	14.70	100.00
Organization Name	J K Laxmi Cement	21	14.00	14.00
	Shree Cement	22	14.70	28.70
	Ultratech Cement	38	25.30	54.00

	India Cement	19	12.70	66.70
	J K Cement	44	29.30	96.00
	Other	06	04.00	100.00
Management Level	Junior Management	79	52.70	52.70
	Middle Management	53	35.30	88.00
	Top Management	18	12.00	100.00
Function/Role of Respondent	Operation & Main.	63	42.00	42.00
	Quality Control & Assurance	22	14.70	56.70
	Packing Unit	19	12.70	69.40
	Sales & Logistics	14	09.30	78.70
	Commercial & Other	32	21.30	100.00
Respondent Experience	0-5 Years	45	30.00	30.00
	5-10 Years	42	28.00	58.00
	More than 10 Years	63	42.00	100.00

Explanatory Information for the Data. Table 3 articulates the variables of various constructs selected from the literature review, i.e., top management support, quality system improvement, information and analysis, statistical quality technique, quality organization, and operational performance. All the variables have recorded mean values of more than 3.00 and less than 5.00.

Table 3: Overview of Constructs and Variable Code

Constructs	**Codes**	**Items**	**X**	**σ**
Top Management Support	TMS_1	General management firmly supports quality enhancement.	3.67	1.138
	TMS_2	Management uses resources to perform tasks optimally.	3.96	1.129
	TMS_3	Management stresses the importance of seeking customer loyalty.	3.81	1.202
	TMS_4	Managers share quality goals in the employees	3.71	1.291
Quality System Improvement	QSI_1	Business has clearly outlined quality standards.	3.58	0.963
	QSI_2	Our quality system is continually improved.	3.78	0.869
	QSI_3	Management has stringent reporting requirements.	3.98	0.996
	QSI_4	Company has simple guidelines for working.	4.10	1.178
Information and Analysis	IA_1	Vital information is submitted and distributed to employees.	3.15	1.124
	IA_2	Business collect and evaluate data for predictive analysis.	3.61	1.325
	IA_3	Business uses knowledge to enhance its main processes and output.	3.74	1.145
	IA_4	Firm has meticulous data to measure competition and identify areas of improvement.	3.52	1.309

Statistical Quality Technique	SQT_1	Business Card and stat. are employed to calculate and track efficiency.	3.17	0.988
	SQT_2	Authorities promote the use of data science.	3.23	0.856
	SQT_3	Statistical tools are operated widely in business.	3.16	0.911
	SQT_4	Personnel engages in T&D programs related to statistical practices.	3.56	1.015
Quality Organization	QO_1	The company has a well-defined managerial development.	3.99	0.982
	QO_2	Application of framed MIS/BIS	4.01	0.935
	QO_3	Interdepartmental discussion to get shared objectives.	3.35	1.026
	QO_4	Practices are constantly being improved.	3.59	0.949
Operational Performance	OP_1	Limiting operating costs and robust manufacturing output	3.96	0.845

Measurement Model. The measurement model exhibited a good fit parameter viz. λ^2 =212.28, df=174, λ^2 /df (CMIN/df) =213, at significant level p=0.38. As illustrated in table 5, the factor loading, Cronbach alfa, AVE, and composite reliability of all factors were highly significant. The Cronbach α and C.R. were more than 0.70, indicating that the estimation of the frame is all reliable (Calvo-Mora et al., 2015). The values of AVE higher than 0.50 approve that more than 50% of the variance of the constructs is due to its variables. Since all the variables have high factor loads (above 0.708) and the construct reliability is higher than 0.565, which again indicates that the constructs were precise in model building (Arifin & Yusoff, 2016; Mansouri, S.A., Lee, H. and Aluko, 2015)

Table 4: Goodness-of-Fit for Operational Performance

Fit Statistics	Threshold Value	Obtained
Chi-square test significance	-	212.89
D-F	-	175
G-F-I	>0.8	0.884
A-G-F-I	>0.8	0.847
N-F-I	>0.9	0.888
R-F-I	>0.9	0.866
Comparative Fit Index	>0.8	0.978
'Tucker Lewis' Indies	>0.9	0.974
RMSEA	>0.005	0.038

Table 5: Validity and Reliability test of Model

Codes	Factor-loading	Cronb. α	AVE	CR
TMS_1	0.792	0.938	0.701	0.903
TMS_2	0.850			
TMS_3	0.861			
TMS_4	0.842			

QSI_1 QSI_2 QSI_3 QSI_4	0.755 0.751 0.858 0.718	0.790	0.596	0.855
IA_1 IA_2 IA_3 IA_4	0.794 0.708 0.729 0.774	0.781	0.565	0.839
SQT_1 SQT_2 SQT_3 SQT_4	0.710 0.780 0.776 0.760	0.779	0.573	0.843
QO_1 QO_2 QO_3 QO_4	0.812 0.849 0.791 0.824	0.817	0.671	0.891

Since all the AVE parameters were above the squared-correlation-coefficient of the associated constructs, the discriminant validity of all constructs is confirmed (Anderson, J.C. and Gerbing, 2005). The discriminant validity signifies the degree to which a latent variable is diverse from other latent variables in the chosen model. Further, the factor correlation among dormant items should be less than the square root of AVE of each construct (Aykol & Leonidou, 2015; Kumar & Dadhich, 2014). With these all values, it has been confirmed that the model estimate meets the criteria of reliability, the validity of substance, convergent validity, and discriminant validity. In this way, it was succeeded by the testing of the structural equation model.

Table 6: Discriminant Validity of the Constructs

Latent Variables	AVE	TMS	QO	QSI	IA	SQT
TMS	0.701	0.736				
QO	0.671	0.554	0.772			
QSI	0.596	0.132	0.243	0.752		
IA	0.565	0.527	0.581	0.461	0.757	
SQT	0.573	0.191	0.179	0.305	0.196	0.819

Figure 5 delineates the respective regression weights of the standard estimate of the selected model, which comprises five factors and their wholesome effect on the OP of the model.

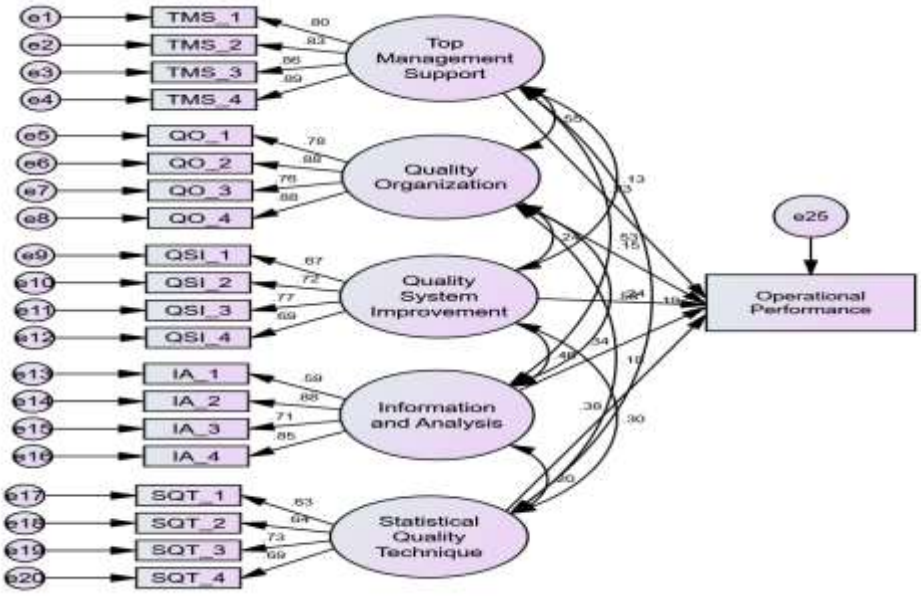


Fig: 4 Standardized Estimates of CFA Model

Hypotheses Testing: Structural Equation Modelling. In this step, access the impact of all five TQM dimensions on dependent constructs, i.e., operational improvements. The measurement model was transformed into the structural model to test the proposed hypotheses using IBM SPSS and AMOS 20. The estimated standard error, critical ratio, and respective p-values revealed a constructive and meaningful relationship between total quality management- TMS, QO, QSI, I&A, and SQT with operational performance.

Table 7: Regression Weights of Factors

Code		Path	Esti.	S-Er.	C-R	P
TMS_1	<---	Top Management Support	1.00			
TMS_2	<---	Top Management Support	1.03	.092	11.25	***
TMS_3	<---	Top Management Support	1.14	.096	11.90	***
TMS_4	<---	Top Management Support	1.27	.103	12.33	***
QO_1	<---	Quality Organization	1.00			
QO_2	<---	Quality Organization	1.07	.092	11.64	***
QO_3	<---	Quality Organization	1.01	.104	9.74	***
QO_4	<---	Quality Organization	1.08	.094	11.56	***
QSI_1	<---	Quality System Improvement	1.00			
QSI_2	<---	Quality System Improvement	1.34	.184	7.29	***
QSI_3	<---	Quality System Improvement	1.27	.166	7.64	***
QSI_4	<---	Quality System Improvement	1.26	.180	7.04	***
IA_1	<---	Information and Analysis	1.00			
IA_2	<---	Information and Analysis	1.59	.209	7.62	***
IA_3	<---	Information and Analysis	1.15	.171	6.75	***
IA_4	<---	Information and Analysis	1.52	.204	7.51	***
SQT_1	<---	Statistical Quality Technique	1.00			
SQT_2	<---	Statistical Quality Technique	1.03	.170	6.11	***

Code		Path	Esti.	S-Er.	C-R	P
SQT_3	<---	Statistical Quality Technique	1.21	.183	6.63	***
SQT_4	<---	Statistical Quality Technique	1.17	.183	6.40	***
OP_1	<---	Top Management Support	0.16	.041	3.97	.001
OP_1	<---	Quality Organization	0.12	.049	2.44	.015
OP_1	<---	Quality System Improvement	0.23	.059	3.92	.002
OP_1	<---	Information and Analysis	0.29	.068	4.33	.001
OP_1	<---	Statistical Quality Technique	0.32	.056	5.78	.003

***- supported at 0.05.

The simplified SEM model outlined hypothesized associations among the latent variables. The estimates of standardized regression weights were used to understand the proposed disposition, as signified by (Dupré & Crevecoeur, 2014) (see table 7). The calculated p-value of all five projected hypotheses was TMS (0.001), QO (0.015), QSI (0.002), IA (0.001), and SQT (0.003) were momentous as p<0.000.

Table 8: Summary of the Hypotheses Testing

SN	Hypotheses	Findings
H1	Top Management Support influences sustainable operational performances in selected industries, (β = 0.16, Standard Error (SE) = 0.041, critical ratio (CR) =3.971)	Supported (p<0.05)
H2	There is an encouraging association between Quality Organization and operational performances. (β = 0.12, Standard Error (SE) = 0.206, critical ratio (CR) =4.714)	Supported (p<0.05)
H3	Quality System Improvement practices improves the operational performance of the concern. (β = 0.23, Standard Error (SE) = 0.059, critical ratio (CR) =3.922)	Supported (p<0.05)
H4	Noteworthy contrast between Information and Analysis and operational performances, (β = 0.29, Standard Error (SE) = 0.068, critical ratio (CR) =4.335)	Supported (p<0.05)
H5	Statistical Quality Techniques enhance the operating performance of selected industry, (β = 0.32, Standard Error (SE) = 0.056, critical ratio (CR) =5.789)	Supported (p<0.05)

Table 8 depicts the summary results that outlined that all five total quality management dimensions have a notable impact on the OP of the Indian cement industry. Hence, formulated hypotheses were supported and accepted.

In the instance of the first hypothesis, the unstandardized β coefficient of the path (TMS-OP) was 0.232, which is statistically noteworthy at (p<0.05), signifying that authority support and commitment are of paramount importance to attain the objective of optimum production with minimum interference. The assistance of top management is also conducive to fetch sustainable growth without forfeiting the profit margin. Previous studies have addressed the same (Alofi & Younes, 2019; Erdil, N.O., Aktas, C.B., Arani, 2018; Yeng et al., 2018).

For the second hypothesis, β coefficient of the unstandardized path (QO-OP) was 0.126, statistically noteworthy as the calculated value is less than 0.05. This insinuating that firms that have executed TQM might realize superior operational efficiency performance during the production process. This conclusion agrees with previous findings of (Sinha &

Dhall, 2020), who explored an optimistic and significant determinant of TQM in manufacturing firms.

In the context of the third hypothesis, the unstandardized β coefficient of the path (QSI-OP) is 0.236, which is subsumed significantly ($p<0.05$). The outcomes indicate that the production units have an enunciation of the quality standards & working guidelines, predictive analysis for continuous improvement, and stringent reporting system to augment quality improvement. This infers that the third hypothesis is confirmed, and there is considerable literature (Alofi & Younes, 2019; Yeng et al., 2018) that apparently bestows the symbiotic effect of QSI on operational efficiencies.

Information and analysis practices have a statistically corroborated and have a direct effect on the performance part as the unstandardized β coefficient of the path (IA-OP) was 0.29, ($p<0.05$). The fourth hypothesis was also confirmed, and the study enunciated that the vital information was presented and distributed well in time to employees through proper MIS. These conclusions corroborate previous studies by (Haldar, 2019; Talapatra et al., 2018), who authenticated that a company had precise information to classify areas of enhancement.

SQT were identified to have a noteworthy and have a direct impact on the operating performance because β coefficient of the unstandardized path (SQT-OP) was 0.32 at ($p<0.05$), suggesting that statistical measures were indispensable to overall performance. Likewise, a control chart, Pareto chart, benchmarking, process mapping, matrix diagram, and histogram can track production efficiency. This is consistent and relevant with the findings of (Benzaquen & Charles, 2020; Nair & Choudhary, 2016), who tested and subsumed the role of SQT in quality manufacturing practices.

Conclusion

The study delves to analyze the nexus between QMP approaches and their effect on operating performance. This research is aimed at helping to establish a quality management theory. The researcher began by defining a set of practices and quality management statements exhibited in the literature. The conceptual model of overall performance has been formed that links with top management practices, quality organization, quality system improvement, information & analysis, and statistical quality techniques. An empirical study proposed five hypotheses by selecting 20 items in the model specified. The model was then tested on a sample of 150 respondents of five major cement industry players using the path analysis method. The outcomes emphasized the relative importance of selected variables for enhancing the performance of the industry. This study gives a clear indication of the advantages of recognizing the essential elements of TQM and of synergies in the process of producing excellent performance. This study contributes a clear indication of the benefits of recognizing the crucial constructs of TQM and the process of creating excellent performance by virtue of associating said practices. Practically, the findings of the study expanded the literature on TQM by exploring its dimensions that improve the operational performance within the context of Indian cement organizations.

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