ROLE OF INNOVATIVE SUPPLY CHAIN PRACTICES AND TOTAL QUALITY MANAGEMENT (TQM) ON PERFORMANCE OF INDIAN CEMENT MANUFACTURING FIRMS -AN EMPIRICAL STUDY

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Abstract: In extremely turbulent situation when world faces major economic crisis then particularly Indian manufacturing sector had major set back. In such situation some of Indian cement sector has demonstrated healthy performance through innovative supply chain practices. In this study author conducted an empirical study to understand how innovative practices in supply chain in combination with TQM (Total Quality Management) can help firm to reduce cost and improve customer satisfaction which in turn reflect high profitability and better market share. Out of five proposed model four model is accepted and fifth model is not supported by regression analysis. The findings clearly reveal that Indian cement Industry is quite in nascent stage to adopt Innovative supply chain practices.

Keywords: Supply Chain Innovation, TQM, Cement Industry

Introduction

India is the second largest producer producer of Cement after China. Because of its ideal geographical position and other advantages like abundant availability of raw materials and cheap labour. India is in ideal position to increase exports particularly to its neighbouring countries like Bangladesh, Sri Lanka, Middle East countries, Africa and South East Asian countries. At present, 65-70% of our cement and clinker trade is with the neighbouring countries like Bangladesh, Nepal, Sri Lanka and UAE. With port facilities, transport infrastructure and bulk transportation India will be able to increase its export of cement and clinker considerably and also to diversify its export of cement and clinker trade is with the neighbouring countries like Bangladesh, Nepal, Sri Lanka and UAE. With port facilities, transport infrastructure and bulk transportation India will be able to increase its export of cement and clinker considerably and also to diversify its export markets. Bangladesh is a major target of Indian export. Export to Bangladesh is taking place by rail, road and sea. Through better coordination between the Railway Authorities of both the countries, opening up of more entry points and storage facilities at the international border, constructing new jetties and providing better equipped carriers, export can be stepped up substantially.

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State of technology, energy conservation and environmental pollution:

Cement Industry has been in existence in India for over eight decades. From the initially available wet process technology the industry has travelled through semi-dry and the latest energy efficient dry process technology. Recent plants have been erected with state-of-art technology comparable to those available in the world. The earlier cement plants that came into existence were mostly of small kiln capacities of 300 to 600 tpd based either on wet or dry process, however, the new plants set up later were of the order of 3000 tpd or more exclusively of dry process. Kilns of the capacities 5000 to 7000tpd are also in operation now. At present 91% of the total kiln capacity comprise dry process, 7% wet process and the remaining 2% on semi-dry process based technologies. The average kiln capacities under each of these categories are 2358 tpd, 421 tpd and 609 tpd respectively. About 72% of the industry's capacity comes from the plant with a total capacity of one million tonne and above at a single location. Indian cement industry has been actively pursuing various avenues to improve its productivity and energy efficiency. There has been all-around upgradation of technology in all sections of the plant like mining, process, equipment and machinery, packaging and transportation. Adoption of modern techniques like photogrammetry and remote sensing has enabled the industry to discover virgin limestone. Advanced equipment like hydraulic excavators, surface miners, large wheel loaders and mobile crushers have helped the industry in increasing its productivity considerably. The modern raw material evaluation and management system starts from computerised mine planning through on-line bulk material analysis to automated X-ray analysis and process computers to control the weigh feeders. Expert systems based on 'fuzzy logic' are used to control the operation of kilns and mills to ensure that the process systems operate at optimum levels of energy efficiency all the time. Energy efficient technologies are being adopted for a new as well as for retrofits, modernisation and expansion of existing plants. A number of cement plants in the country are now equipped with double string preheater towers with precalciners, vertical roller mills, roller presses, high efficiency fans and motors with slip power recovery systems. Besides this, the software approach involving detailed process diagnostic studies and energy audits are used successfully by almost every large and medium sized cement plant in the country.

The quick facts of Indian Cement Industry are:

- The Industry recorded an exponential growth with the introduction of partial decontrol in 1982 culminating in total decontrol in 1989.
- The capacity, which was 29 Mn.t in 1981-82, rose to 219 Mn.t at the end of FY09.
- While it took 8 decades to reach the 1 st 100 Mn.t capacity, the 2 nd 100 Mn.t was added in just 10 years.
- India ranks second in world cement producing countries.

- The Industry has been facing a chronic problem of insufficient availability of the main fuel coal, driving the manufacturers to resort to use of alternatives at steep cost.
- Taxes and Government levies on cement are high compared to countries in Asia pacific region.
- Cement Industry, which was branded as the highest polluter of environment, now meets the pollution standards, and no longer a polluter today.
- Contributes to environmental cleanliness by consuming hazardous wastes like Fly Ash (around 30 Mn.t) from Thermal Power Plants and the entire 8 Mn.t of Slag produced by Steel manufacturing units.
- As a part of Corporate Social Responsibility (CSR), the Cement Industry employs around one lakh people and takes care of the social needs not only of the employees but also adopts several villages around the factories providing free drinking water, electricity, medical and educational facilities.
- The Cement Industry produces a variety of cement to suit a host of applications matching the world's best in quality.
- Exports Cement/Clinker to around 30 countries across the globe and earns precious foreign exchange.
- The core sector Cement Industry deserves due support from the Government by avoiding imposition of high levies and duties, making available various inputs like fuel, power, transport etc. at reasonable prices and in required quantities and help its growth and improve competitivity both in domestic and international markets (Source: Cement Manufacturers Association Report, 2011)

The objective of this study is:

- To study the impact of Innovative supply chain practices and TQM (Total Quality Management) on performance of Indian Cement Firm.
- To identify top five Innovative supply chain practices adopted by Indian cement firms during last two years.

Literature review

During literature review author came to the conclusion that there is hardly any empirical work carried out by the researchers to investigate how Innovative supply chain practices affect the firm performance however there are enough literature available on TQM and firm performance. Here author divide literature review into three section. In first section author dedicate to identify innovative supply chain practices. In the second section author focuses on impact of TQM (Total Quality Management) on firm performance and in the third section author explores the financial and non-financial measures of firm performance.

Supply Chain Innovation:

Supply chain innovations are meant to steadily improve the supply chain performance [1]. The industry initiatives like VMI (vendors managed Inventory), ECR (Efficient Customer Response), CPFR (Collaborative Planning, Forecasting & Replenishment),postponement strategy are the recent innovations in supply chain which has improved the supply chain performance. There are many examples like HUL (Hindustan Unilever Limited), TVS Logistics, Godrej, ACC Limited, Ambuja Cement, Lafarge and many more examples which has reduced the Total Inventory in Days which is one of the measure for measuring supply chain performance which also reflect the working capital performance. In an interesting survey published in "Supply Chain Digest" in the year 2010 based on survey conducted on top ten supply chain innovations of all-time are given below:

(1) Toyota Production System [2]
(2) Continuous Replenishment adopted by P& G's which laid the foundation of ECR(Efficient Customer Response) and CPFR (Collaborative Planning, Forecasting and Replenishment)
(3) Ocean Shipping Container which was incidentally discovered by Malcom Mclean and was first implemented in 1956 has reinvented the global logistics practice. In fact the concept of multimodal transportation took shape after the introduction of steel container.
(4) Economic Order Quantity [3] was popularized by [4] after he wrote and article in the year 1934.
(5) Ford Production System (1913) which was pioneered by Henry Ford revolutionized the production system by introducing assembly line production [4]. This invention has improved the production rate at much lower cost.
(6) The Universal Product Code (UPC) in the 1974 has changed the way supply chain practiced.
(7) FedEx Tracking system in the year 1980 has really drove the idea that "information was as important as the package itself," and was foundation of our current supply chain visibility systems and concepts.
(8) Distribution Requirements Planning (DRP) in the year 1970 by Martin in Abbots Lab which today laid the foundation of today supply chain practices.
(9) 3 M's Transportation Load Control Center in the year 1982 is now popular as LCC which has remarkable contribution in the field of transportation planning.
(10) Taylorism (1880) is referring to the pioneer work of Frederick Taylor towards scientific approach towards manufacturing [5].

However there is hardly any literature available, focusing on role of Innovative supply chain practices and firm performance. However some work(s) based on effect of supply chain on firm performance has been taken based on judgment that innovative supply chain practices bear same attributes of supply chain hence impact will be also similar. The only difference will be the magnitude of the impact may differ based on author discussion with experts during the

biennial supply chain management conference held at IIM-Bangalore during 7th January and 8th January, 2011.The performance metrics is represented in tabulated format as:

Factors	Performance Measures	Authors
Key success factors	Delivery fulfillment, No damages in the order of the customer Time of order confirmation, Responsiveness to urgent orders Responsiveness to claims	Cavaco and Themido (2000)
Strategy	Availability and reliability of the customer service, Acceptable costs for the level of foreseen service, Investment and financial control, Productivity and operational improvement,Projects with customers and suppliers	Carvalho et al. (2001) Kellen (1992)
Logistics objectives	Delivery lead time	Van Amstel and D'Hert (1996)
	Trust deliveries	Bowersox and Closs (1996)
	Flexibility	NEVEM-workgroup (1989)
	Stock level	
Organizational way of Production	Delivery lead time	NEVEM-workgroup (1989)
Logistics priorities	Fast and reliable deliveries, Customer service quality,Flexibility Responsiveness, Service innovation, Cost	Fawcett and Smith (1995)
Competitive priorities of Firms	Cost, Service/quality,Productivity,Time	Carvalho et al. (2001)
Results/determinants of results	Measures related with results: competitiveness, financial performance	Fitzgerald et al. (1991)
	Measures related with determinants of the results: quality, flexibility, resource utilization and innovation.	

Table 1. Leading factors in the selection of performance measures

Source: *Adapted from Ferreira, Joao et.al (2007) and same is redefined in the work by Dubey(2010)*

TQM and Firm Performance:

Previous researches investigated the impact of TQM to the Business Performance Management of manufacturing and services industries. TQM and business performance have positive significant relationship [6][7][8][9][10][11] [12]. The correlation is based on three concepts underpinning the theory of management. These are organization management (OM), organization change management (OCM), and organization development (OD). OM refers to the management of organizational activities towards meeting customers' requirements while addressing many aspects of an organization collectively. OM is used for referring to improving efficiency and effectiveness of an organization [13]. OCM is mainly for improved results of many fronts covering the entire aspects of organizational performance measures. Planned and emergent changes are two categories of change reviewed under this theory. Planned change is further divided into two sub-categories, namely evolutionary and revolutionary. Under each of these sub-categories are various approaches [14]. OD is a common approach to managing change in organizations and OD programs are to improve the functioning of the total organization, educating all stakeholders how to continuously improve their own functioning [15]. These theories are useful for the current study as they have some relationship commonalities the theory OCM, OM and OD within research frameworks of soft dimensions of TQM and performance (leadership, policy and strategy, people result, processes quality management, partnership and resources, information and analysis, society result, human resources focus, customer requirement and satisfaction, and business performance) to support the understanding of the concepts used. Total Quality Management (TQM) practices and performance in cement industries have important relationships (i.e. leadership, policy strategy, process quality management, information analysis, human resources, customer requirement and satisfaction) to assure and enhance the level of performance of business management through the effective and efficient application of TQM high performance, including processes for continuous improvement and implementation of the quality system and procedure in accordance with the customers' requirements and role regulatory international authority requirement[16]. Traditionally, performance measurement is defined as the process of quantifying effectiveness and efficiency of action. In other words, measuring performance means transferring the complex reality of performance into a sequence of limited symbols that can be communicated and reported under similar circumstances [17].In modern business management, performance measurement assumes a far more significant role than quantification and accounting [18]. Performance measurement can provide important feedback information to en-able managers to monitor performance, reveal progress, enhance motivation and communication, and diagnose problems [19][20].According to Venkataraman and Vansudevan (1986), there are two major is-sues associated with the operationalization of organizational performance. First, what constitutes the

construct of the firm performance? [21]. In other words, how researchers can define the performance of the organizations. Second, there are still several questions such as what are the data sources that should be used in measurement of this construct. Should archival (or secondary) measures be used or can respondent (or primary) data be used as reliable. Organizational performance or effectiveness is a multifaceted phenomenon that is difficult to comprehend and measure [22]. Venkatraman (1990) also emphasizes that it is impossible to obtain any consensus on developing measure of organizational effectiveness since there is no universal theory of organizations[23]. Researcher have argued that no one single measure is inherently superior to another and the definition that a researcher adopts is based on the disciplinary framework adopted for the study [24]. Performance may vary according to whose viewpoint is taken (e.g., customers or stockholders), the time period observed, criteria used, and so on. According to Hitt and Ireland, different fields of study should use different measures of organizational performance because of the difference in their research questions. For measuring a firm's performance, objective and subjective measures have been used. The objective measures include measures such as return on assets, market share, sales, export proportion, growth rates in domestic and export sales growth. Similar measures are used by previous researcher [25]. Similarly, the subjective measures of performance include management's perceptions of productivity, profitability, market share, and customer satisfaction relative to competitors.

Company performance

It has been long debated issue that how to measure firm performance and over the years but in traditional economic theory major emphasis on market power and industry structure as determinants of firm performance [26][27][28][29].For measuring a firm's performance, Financial and non-financial measures have been used. The financial measures include such as return on assets (ROA), market share, Return on Investment (ROI), Operating Profit of Firm (EBIDTA), growth rates in domestic and export sales growth. Similar measures are used by previous researcher [30]. Similarly, the non-financial measures of performance include management's perceptions of productivity, profitability, market share, and customer satisfaction relative to competitors. The possibility of using non-financial performance measures was suggested by Dess and Robinson if the accurate objective measures are unavailable. Subjective measures of performance have been used by several researchers [31][32].

Table 2.1 provides the review of performance measures that have been used in competitive advantage research.

Author	Performance measures used in research
Snow, Charles.C and Hrebiniak, Lawrence.G	Return on Assets (ROA)

(1980)	
Hitt, M.C, Ireland, D.R and Stadter, G (1982)	Return on capital (ROC) sales volumes and earning per share
Hitt, M.C and Ireland, D.R (1985)	Market return (derived from geometric mean annual stock return; geometric mean annual risk free rate and beta measure of systematic risk) Return on Investment (ROI)
Droge, C. and Vickery, S. (1994)	Market share and market share growth Return on Sales (ROS), Sales per employee; Return on Asset (ROA);
Sharma, Bishnu. and Fisher, Tom. (1997)	Market share; Sales; Export proportion, growth rates in domestic; Export sales growth; Perceived performance: productivity, profitability; customer satisfaction; market share); Sales volume;
Li, Ling. X. (2000)	EBIDTA Market share
Akimova, Irina. (2000)	Profit Sales volume; Market share; cash flow
Nguyen (2008)	ROA, ROE, Profit-Before-Tax, Market Share, Sales Growth

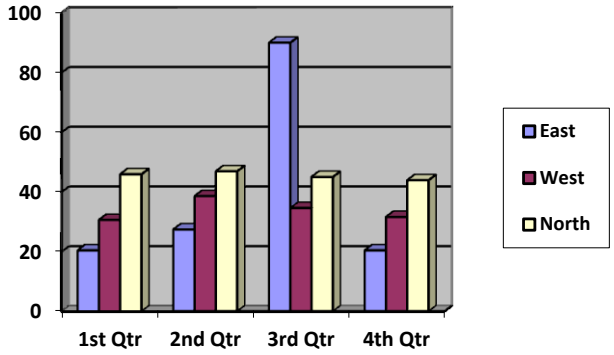
Table 2.1: Performance measures used in empirical competitive advantage research

Source: Authors own compilation based on available literature

Conceptual framework, measurement instrument development and data collection

Earlier researchers has attempted to study the impact of one functional area competence on a firm's overall performance [33][34][35][36][37]. Recent studies show that only when a firm can concert its functional area competencies can be more competitive on the market place [38][39][40][41][42]. Many re-searchers have concluded that desired level of performance cannot be achieved in organizations which fail to respond effectively to relevant environmental demand [43][44][45][46][47][48]. There has been a study conducted by Hayes & Wheelwright where he has shown how manufacturing competency can help a firm to improve the firm performance [49]. The discussions which we had so far clearly motivate us to conduct research in this direction where we hardly found any study to our knowledge available in EBSCO database, Emerald and Elsevier, author(s) proposes conceptual framework for the present research is designed as shown in

Figure 3.1.



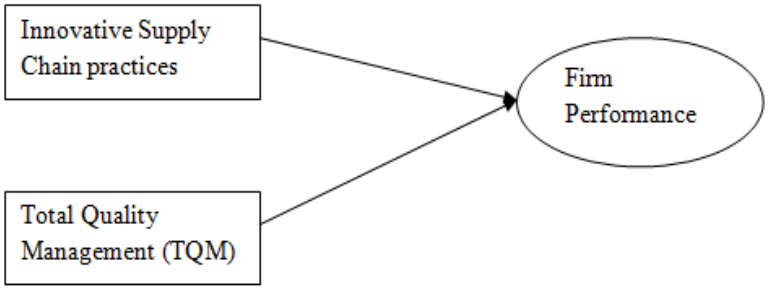


Figure 3.1: A conceptual model of the relationship between Innovative supply chain practices, TQM (Total Quality Management) and firm performance.

The specific hypothesis is presented as follow:

Hypothesis 1: There is a positive relationship between the innovative supply chain practices and firm performance.

Hypothesis 2: There is a positive relationship between the TQM (total Quality Management) and firm performance.

Measurement instrument development

To conduct survey research, an instrument for this study scientifically developed. To begin with, a review of the extensive literature on the four main concepts - including manufacturing, marketing, logistics, human resource and firm performance were done to identify the key items of each variable which has been used to design questionnaire.

Independent variables

Independent variables were identified in the conceptual framework presented in the previous section. They include the Innovative supply chain practices and

Total Quality management.

Dependent variables:

Earlier studies reflect that there is no standard measure of the firm's performance [50][51][52][53][54]. Commonly used approaches include: market based indicators and financial based indicators. Asian companies hesitate to disclose their financial data [55].

Expert opinion

In order to refine the questionnaire developed by the researcher(s) expert opinion has been very useful. Total twenty experts were invited to refine and validate measures for each concept. They are four academic faculties from economics and management department of NIT(National Institute of Technology),IIT(Indian Institute of technology), IIM(Indian Institute of management) ,UPES,ACLM(Asian Council of Logistics Management), CII (Confederation of Indian Industry), CMA(Cement Manufacturers Association) who specializes in the Innovative Supply Chain Practices and The expert's opinion has helped to further refine the questionnaire.

Questionnaire instrument:

The respondents were asked to response on questionnaire provided to them. The first part was related to the Innovative Supply Chain Practices and Total Quality management. In this section, a total of eighteen statements were used to measure Innovative Supply chain Practices and TQM and in second part there are five statements on firm performance divided into two category i.e. financial and non-financial performance. The respondents were asked to indicate the degree to which their firms would employ the practices commonly seen in the four functional areas.

Data collection and assessment

Data collection

There is no collected data source from previous research conducted on the same content and context as those of this study. Primary data is therefore imperative for the study. Primary data for this study was gathered from manufacturing companies located in India.

Target population and sample design

This study focused on the cement manufacturing companies in India. The manufacturing companies in India were identified through database of CMA (Cement Manufacturers Association). It provides the list of companies operating in India, their contact address, their type of business, and their type of ownership. Here 65 manufacturing companies were randomly chosen that includes both integrated cement manufacturing unit, Grinding unit and mini cement plant to send

the questionnaires.

The survey

A mail survey was conducted during December 2010 to February 2011. Data collection proceeded by calling randomly the targeted respondents in order to confirm their mail-address, inform them about the study and to encourage them to respond. A total of 250 questionnaires were then sent by mail to the 250 manufacturing companies. Each mail includes a letter of introduction, a questionnaire and a mailed back written address envelop with a stamp for respondent to mail back when they complete the questionnaire. Consequently 125 questionnaires were mailed back at gross response rate of 50%.

Data assessment

Data examination and exploration

Data entry started with the development of a coding plan for the question items in the questionnaire. This plan was used to define variables in SPSS 16. The next step was the key-in of questionnaire responses in the defined SPSS 16 data spreadsheet. The database was examined and had indicated that the missing values were distributed at random. According to Hair, this situation of missing data was acceptable for multivariate data analysis[56].

KMO and Barltlett's test		Innovative Supply Chain Practices & TQM	Firm performance
KMO Measure of Sampling Adequacy		0.68	0.67
Barltlett's test of Sphericity	Approx Chi-Square	Negligible	118.328
	d.f	231	10
	Significance	.000	.000

Table 3.1: KMO and Barltlett's test for functional competencies and performance

	Initial	Extraction
SI1	1.000	.789
SI2	1.000	.796
SI3	1.000	.812
SI4	1.000	.823
SI6	1.000	.722
SI7	1.000	.785
TQM1	1.000	.881
TQM2	1.000	.776

TQM3	1.000	.811
TQM4	1.000	.810
TQM5	1.000	.780
TQM6	1.000	.799
TQM7	1.000	.777
TQM8	1.000	.690
TQM9	1.000	.696
TQM10	1.000	.834
TQM11	1.000	.821
Extraction Method: Principal Component Analysis.		

Table 3.2: Communalities

The KMO and Bartlett's test results shown in Table. 3.1 indicate the suitability of the data for factor analysis. Kaiser-Meyer-Olkin Measure of Sampling Adequacy is 0.68 for Independent variables and 0.67 for dependent variables which is greater than 0.5. This indicates that a factor analysis will be useful with the data. The value of significance level is 0.000, which is less than 0.05. So there is a significant relationship among the variables. The Table 3.2 shows initial extraction indicates that the communalities are very high, which indicate that the extracted components represent the variables well.

The Cronbach's Alpha was calculated for each functional and performance construct and shown in Tab.3.2.All the items in these functional constructs exceeded the item-to-total correlation criteria of 0.35. At the same time, the Cronbach's Alpha for these constructs was 0.71 (Innovative Supply Chain Practices); 0.89 (TQM) respectively, which indicates that they highly met the requirement by Nunnally (1978)[57].

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.849	.834	17

Table 3.3: Reliability analysis of Independent variables

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
SI1	68.6160	35.658	.062	.	.856
SI2	68.5440	35.847	.026	.	.858
SI3	68.3360	36.709	-.118	.	.862
SI4	68.4960	33.155	.429	.	.843
SI6	68.4560	33.750	.386	.	.845

SI7	68.4800	33.800	.337	.	.847
TQM1	68.5760	33.020	.475	.	.841
TQM2	68.6400	31.926	.575	.	.836
TQM3	68.8080	32.463	.509	.	.839
TQM4	68.7040	33.081	.431	.	.843
TQM5	68.7840	32.122	.563	.	.837
TQM6	68.8240	29.791	.662	.	.830
TQM7	68.8960	29.029	.620	.	.832
TQM8	68.9840	29.338	.624	.	.832
TQM9	68.8560	30.302	.633	.	.832
TQM10	68.7680	30.760	.645	.	.832
TQM11	68.8480	30.259	.657	.	.830

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.547	.604	5

Table 3.4: Reliability analysis of Dependent variable

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
PERF1	17.2960	1.613	.432	.295	.422
PERF2	17.4640	1.654	.538	.499	.387
PERF3	17.3520	1.585	.491	.462	.391
PERF4	17.3120	1.974	.131	.042	.586
PERF5	17.2640	1.664	.130	.029	.649

The Cronbach's Alpha value for the performance is 0.547 which is lower than 0.7 however this cannot be ignored in the present context. In summary, the values of item-to-total correlation and Cronbach's Alpha found for each construct indicated that each construct was strongly reliable measure.

Data analysis and hypothesis testing

Factor analysis

In this research, a total twenty-two variables of functional competencies and five variables of organizational performance were identified from the literature. As

suggested by Hair, factor analysis should be used to analyze and create a new set of variables [58].

Significance of the factor loadings

In interpreting the factor analysis solution, a decision must be made regarding which factor loadings are worth considering. Factor loading are the correlations between original variables and the factors. The magnitude at which the factor loadings are significant depends on the sample size and the tolerance of two types of errors. It is represented in Table 4.1 for the beneficial of the readers.

No	Factor loading	Sample size needed
1	.30	350
2	.35	250
3	.40	200
4	.45	150
5	.50	120
6	.55	100
7	.60	85
8	.65	70
9	.70	60
10	.75	50

Table 4.1: Guidelines for identifying significant factor loadings based on sample size

Note: Significance is base on a .05 significant level (α) and a power level of β=0.80

Source: Hair et al., 1998, p.112 and Nguyen(2008) [59][60].

As shown in Table 4.1, for significance, a sample size of 100 requires a loading value of at least 0.55. Similarly, a loading of 0.50 demands a larger sample size of 120. Obviously, no entry is available for the sample size of 125.Hence based on researcher decision that any value between 0.45 and 0.5 will be considered.

Factor Analysis of Innovative Supply Chain Practices and TQM

Tab. 4.1: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.747	33.807	33.807	5.747	33.807	33.807
2	2.862	16.834	50.641	2.862	16.834	50.641

3	2.372	13.954	64.595	2.372	13.954	64.595
4	1.373	8.075	72.670	1.373	8.075	72.670
5	1.049	6.171	78.841	1.049	6.171	78.841
6	.754	4.434	83.276			
7	.660	3.885	87.161			
8	.496	2.917	90.078			
9	.444	2.611	92.689			
10	.309	1.816	94.505			
11	.210	1.238	95.743			
12	.178	1.049	96.792			
13	.150	.881	97.673			
14	.129	.761	98.433			
15	.114	.672	99.105			
16	.093	.547	99.652			
17	.059	.348	100.000			
Extraction Method: Principal Component Analysis.						

Table 4.1 shows that 5 variables out of 18 variables explain more than 78% of the total variance. The rotated component matrix of seven variables is shown in the Table 4.2. The loadinds of all the variables are quite high showing strong

4.2: Factor Analysis of Performance variables

	Initial	Extraction
PERF1	1.000	.564
PERF2	1.000	.751
PERF3	1.000	.713
PERF4	1.000	.073
PERF5	1.000	.054
Extraction Method: Principal Component Analysis.		

Tab. 4.2: Communalities Matrix

Here communalities matrix shows that three variables have high extraction however two variables have low extraction i.e market share and sales growth. On the other hand Tab.4.4 explains that one component has eigen value greater than

one while other variables has value lesser than one, hence only one component is extracted. The Return on Asset(ROA) explains 43.079 % of the total variance.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.154	43.079	43.079	2.154	43.079	43.079
2	.996	19.910	62.989			
3	.971	19.411	82.400			
4	.550	11.005	93.405			
5	.330	6.595	100.000			
Extraction Method: Principal Component Analysis.						

Tab.4.4: Total Variance

Innovative Supply Chain Practices and TQM

A five-point Likert scale was used in this study to measure the competencies of different functional activities, from '1' indicating very weak, to '5' indicating very good. Innovative Supply Chain Practices and TQM was analyzed.

Simple Regression Analysis:

Simple regression analysis with Innovative Supply Chain Practices and TQM as independent variables and firm performance as dependent variables were conducted as shown as:

Model 1: OLS, using observations 1-125
Dependent variable: PERF1

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	4.48605	0.652558	6.8746	<0.00001	***
SI1	-0.124969	0.120677	-1.0356	0.30274	
SI2	-0.381188	0.121415	-3.1396	0.00219	***
SI3	0.288331	0.130395	2.2112	0.02915	**
SI4	0.530729	0.113262	4.6859	<0.00001	***
SI6	-0.553455	0.10964	-5.0479	<0.00001	***
SI7	0.00819623	0.135684	0.0604	0.95194	
TQM1	-0.176516	0.145319	-1.2147	0.22716	
TQM2	0.1681	0.115143	1.4599	0.14724	
TQM3	-0.0315008	0.109087	-0.2888	0.77332	
TQM4	-0.169383	0.104306	-1.6239	0.10734	
TQM5	0.547792	0.115816	4.7298	<0.00001	***

TQM6	-0.135691	0.084481	-1.6062	0.11118	
TQM7	0.183731	0.0784957	2.3407	0.02110	**
TQM8	-0.331462	0.0678624	-4.8843	<0.00001	***
TQM9	-0.246387	0.0842238	-2.9254	0.00420	***
TQM10	0.358634	0.098331	3.6472	0.00041	***
TQM11	0.0297427	0.0932564	0.3189	0.75040	

Mean dependent var	4.376000	S.D. dependent var	0.486329
Sum squared resid	13.37779	S.E. of regression	0.353590
R-squared	0.543856	Adjusted R-squared	0.471385
F(17, 107)	7.504416	P-value(F)	7.81e-12
Log-likelihood	-37.69745	Akaike criterion	111.3949
Schwarz criterion	162.3045	Hannan-Quinn	132.0768

Model 2: OLS, using observations 1-125
Dependent variable: PERF2

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	4.5736	0.584444	7.8256	<0.00001	***
SI1	0.0325762	0.10808	0.3014	0.76369	
SI2	-0.306144	0.108741	-2.8153	0.00580	***
SI3	0.108087	0.116784	0.9255	0.35677	
SI4	0.249403	0.101439	2.4586	0.01555	**
SI6	-0.168162	0.0981959	-1.7125	0.08970	*
SI7	-0.158367	0.121521	-1.3032	0.19530	
TQM1	0.2229	0.130151	1.7126	0.08968	*
TQM2	0.0796138	0.103124	0.7720	0.44181	
TQM3	-0.248374	0.0977004	-2.5422	0.01245	**
TQM4	-0.0240188	0.0934184	-0.2571	0.79759	
TQM5	0.409299	0.103727	3.9459	0.00014	***
TQM6	-0.145935	0.0756628	-1.9288	0.05641	*
TQM7	-0.0251572	0.0703023	-0.3578	0.72117	
TQM8	-0.0327041	0.0607789	-0.5381	0.59164	
TQM9	-0.0560685	0.0754324	-0.7433	0.45893	
TQM10	-0.264132	0.0880671	-2.9992	0.00337	***
TQM11	0.237435	0.0835222	2.8428	0.00536	***

Mean dependent var	4.208000	S.D. dependent var	0.407510
Sum squared resid	10.73078	S.E. of regression	0.316682
R-squared	0.478886	Adjusted R-squared	0.396092
F(17, 107)	5.784082	P-value(F)	3.88e-09

Log-likelihood	-23.91746	Akaike criterion	83.83491
Schwarz criterion	134.7446	Hannan-Quinn	104.5168

Model 3: OLS, using observations 1-125
Dependent variable: PERF3

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	3.83697	0.716195	5.3574	<0.00001	***
SI1	0.29586	0.132445	2.2338	0.02757	**
SI2	-0.379815	0.133255	-2.8503	0.00524	***
SI3	-0.101993	0.143111	-0.7127	0.47759	
SI4	0.322624	0.124307	2.5954	0.01077	**
SI6	-0.121154	0.120332	-1.0068	0.31629	
SI7	0.149464	0.148915	1.0037	0.31779	
TQM1	-0.0359062	0.159491	-0.2251	0.82231	
TQM2	-0.0821391	0.126372	-0.6500	0.51710	
TQM3	-0.181925	0.119725	-1.5195	0.13158	
TQM4	0.133766	0.114478	1.1685	0.24521	
TQM5	0.480383	0.12711	3.7793	0.00026	***
TQM6	-0.34348	0.0927195	-3.7045	0.00034	***
TQM7	0.027947	0.0861506	0.3244	0.74627	
TQM8	-0.0924802	0.0744803	-1.2417	0.21707	
TQM9	0.158408	0.0924372	1.7137	0.08948	*
TQM10	-0.176141	0.10792	-1.6321	0.10559	
TQM11	0.0574063	0.102351	0.5609	0.57605	

Mean dependent var	4.320000	S.D. dependent var	0.468353
Sum squared resid	16.11419	S.E. of regression	0.388072
R-squared	0.407566	Adjusted R-squared	0.313441
F(17, 107)	4.330057	P-value(F)	1.17e-06
Log-likelihood	-49.32899	Akaike criterion	134.6580
Schwarz criterion	185.5676	Hannan-Quinn	155.3399

Model 4: OLS, using observations 1-125
Dependent variable: PERF4

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	3.77588	0.766209	4.9280	<0.00001	***
SI1	-0.0786787	0.141694	-0.5553	0.57987	
SI2	-0.418554	0.14256	-2.9360	0.00407	***
SI3	0.404265	0.153104	2.6405	0.00952	***

SI4	0.264957	0.132987	1.9923	0.04888	**
SI6	-0.185442	0.128735	-1.4405	0.15265	
SI7	0.228083	0.159314	1.4317	0.15516	
TQM1	-0.103519	0.170628	-0.6067	0.54534	
TQM2	0.0726047	0.135196	0.5370	0.59236	
TQM3	-0.00130158	0.128086	-0.0102	0.99191	
TQM4	-0.0700926	0.122472	-0.5723	0.56831	
TQM5	-0.167085	0.135987	-1.2287	0.22188	
TQM6	0.213592	0.0991943	2.1533	0.03354	**
TQM7	0.148179	0.0921666	1.6077	0.11084	
TQM8	-0.00599181	0.0796814	-0.0752	0.94020	
TQM9	-0.229746	0.0988923	-2.3232	0.02206	**
TQM10	-0.289432	0.115456	-2.5069	0.01368	**
TQM11	0.333109	0.109498	3.0421	0.00296	***

Mean dependent var	4.360000	S.D. dependent var	0.481932
Sum squared resid	18.44334	S.E. of regression	0.415172
R-squared	0.359606	Adjusted R-squared	0.257861
F(17, 107)	3.534394	P-value(F)	0.000031
Log-likelihood	-57.76667	Akaike criterion	151.5333
Schwarz criterion	202.4430	Hannan-Quinn	172.2152

Model 5: OLS, using observations 1-125
Dependent variable: PERF5

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	5.17651	1.26468	4.0932	0.00008	***
SI1	-0.0452586	0.233875	-0.1935	0.84692	
SI2	-0.184809	0.235305	-0.7854	0.43395	
SI3	0.0700606	0.252708	0.2772	0.78213	
SI4	-0.0755493	0.219504	-0.3442	0.73139	
SI6	-0.217854	0.212486	-1.0253	0.30755	
SI7	0.294047	0.262959	1.1182	0.26597	
TQM1	-0.356323	0.281633	-1.2652	0.20855	
TQM2	0.273241	0.22315	1.2245	0.22346	
TQM3	-0.0074009	0.211414	-0.0350	0.97214	
TQM4	-0.126324	0.202148	-0.6249	0.53336	
TQM5	0.299352	0.224455	1.3337	0.18514	
TQM6	-0.264125	0.163727	-1.6132	0.10964	
TQM7	0.194455	0.152127	1.2782	0.20393	
TQM8	0.0346258	0.131519	0.2633	0.79284	

TQM9	-0.0909347	0.163228	-0.5571	0.57862	
TQM10	-0.118601	0.190568	-0.6224	0.53503	
TQM11	0.160214	0.180733	0.8865	0.37735	

Mean dependent var	4.408000	S.D. dependent var	0.696720
Sum squared resid	50.24636	S.E. of regression	0.685268
R-squared	0.165232	Adjusted R-squared	0.032605
F(17, 107)	1.245843	P-value(F)	0.242821
Log-likelihood	-120.4063	Akaike criterion	276.8127
Schwarz criterion	327.7223	Hannan-Quinn	297.4946

The research model shows that the p-statistics where it is less than 0.05 the hypothesis is accepted and where it is greater than 0.05 is rejected. Thus here model is not supported as the value of p is higher than 0.05.Thus regression analysis shows that model 5 is supported hence it is rejected.

Summary

Regression analysis and findings clearly indicates there are some variables in Innovative Supply Chain practices and some variables in TQM (Total Quality Management) shows very weak correlation which indicates that Cement Industry in India particularly have not leveraged these tool effectively and efficiently. They have acquired these tools but it will take some years down the line to realize some tangible benefit. Here model 5 that is effect on EBIDTA is not supported. It by and large indicates that initial assumption of researcher based upon recent focus on operating profit of a firm (EBIDTA) is not supported here is probably that either innovative supply chain practices is not yet practiced due to lack of awareness as well TQM benefits are also not fully leveraged. There is an immense need for creating awareness and training so that this particular sector can leverage maximum benefit.

Research Limitations:

There are some limitations that need to be mentioned. Future studies are likely to benefit if some limitations of the present study are examined. First, studies on samples are seldom conducted without any intention to generalize the results to the whole population to which the samples belong [61]. Not all sampling techniques allow this generalization. The most known, comprehensive and pervasive technique is perhaps the simple random sampling in which each possible sample of a given size is equally like to be the one selected [62]. Second, perceptual performance was used in the study instead of objective measure. Although previous studies showed a positive association between objective and perceptual performance, the latter is not able to fully reflect the real firm performance [63][64]. However, causality cannot be established without longitudinal data. Future research effort is urged to collect longitudinal data to confirm the causal

relationship between four function's competencies and firm performance. Lastly, firm performance may be affected by various other extraneous variables not accounted for in this study. It would be beneficial to examine the myriad of firm performance by taking external conditions like the economic and legal situation into account.

Acknowledgement

Author specially expresses his thanks to two anonymous referees for their suggestions to improve this manuscript. It would be incomplete without expressing my gratitude to Editor and her Editorial team who took entire pain in coordinating with me during entire review process. It would be ungrateful on my part if I do not express my deep gratitude to my University Vice Chancellor Dr.Parag Diwan for providing all kind of support right from providing encouragement and motivation and to my respected teachers Prof.Tripti Singh, Prof.Geetika, Prof.Janat Shah, Prof.O.P.Gupta and Prof. Celik Parkan who took entire pain to support me during research. I am equally very grateful to my student Neha and Saurabh Tiwari who took great pain to support me during difficult moment of my career.

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ROLA INNOWACYJNYCH PRAKTYK W ŁAŃCUCHU DOSTAW I ZARZĄDZANIA PRZEZ JAKOŚĆ A WYDAJNOŚĆ INDYJSKICH PRZEDSIĘBIORSTW WYTWARZAJĄCYCH CEMENT – BADANIE DOŚWIADCZALNE

Streszczenie: W wyjątkowo niespokojnych czasach, kiedy świat stawia czoła poważnemu kryzysowi gospodarczemu, szczególnie indyjski sektor wytwórczy doświadczył poważnego zahamowania. Pomimo takiej sytuacji, część indyjskiego sekora cementu wykazała dobrą wydajność dzięki zastosowaniu innowacyjnych praktyk w łańcuchu dostaw. W nieniejszej pracy autor przeprowadza badanie w celu zrozumienia jak innowacyjne praktyki w łańcuchu dostaw w połączeniu z zarządzaniem przez jakość (TQM) może pomóc przedsiębiorstwu zredukować koszty i poprawić satysfakcję klienta, co z kolei znajduje odzwierciedlenie w wysokiej rentowności i większym udziale w rynku. Z pięci zaproponowanych modeli cztery zostały zaakceptowane, a piąty model nie jest wspierany przez analizę regresji. Wyniki jasno wykazują, że przemysł indyjskiego cementu znajduje się w stanie sprzyjającym zastosowaniu innowacyjnych praktyk w łańcuchu dostaw.

创新供应链的实践与全面质量管理（TQM）在印度水泥制造公司业绩的实证研究中的作用

摘要：在极其动的局势中，世界面临着重大的经危机，特别是印度制造业遭受重大挫折。在这情况下，印度水泥行业已成功地通过一些创新的供实践来得到良好的回升表现。在项研究中作者进行了证研究，以了解如何在供创新的做法与TQM（全面质量管理）组合，可以帮助企业降低成本，提高客满意度而这反过来又反映高盈利能力和较好的市场份额。在五项建议模式下四项建议模式被接受，其原因是五项建议模式不能以回归分析法的得到支持。结果清楚地表明，印度的水泥行业是初阶段采用创新的供应链的做法。