Embedding Research Culture through field-based Soft TQM assignments in Engineering Curriculum: A mixed methods study

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***Abstract*—This study explores the Soft Total Quality Management (TQM) practices in the manufacturing sector of Coimbatore, India, through a field-based research methodology. As part of a TQM course in the Mechanical Engineering undergraduate program, students were tasked with identifying and analysing local manufacturing companies to gain practical insights into the application of TQM principles. The research methodology employed a mixed-methods approach, combining unstructured interviews and structured surveys (90 companies). The interviews helped in-depth exploration of various TQM components, including leadership, employee involvement, and continuous improvement. Soft TQM, focusing on the human-centric aspects such as leadership, employee involvement, and culture, was used as the guiding lens for the analysis. Structured surveys provided standardized quantitative data on specific aspects of Soft TQM, focusing on people and relationships. The study also aimed to assess the impact of firm size, ownership focus, and market reach on TQM practices. The findings suggest that while there are no significant differences between family-owned businesses and private limited companies. Companies with a national market focus exhibit higher mean values across all TQM constructs compared to those with a regional market focus. This research emphasizes the importance of practical, field-based learning in TQM education and highlights the factors influencing the effectiveness of these practices in the manufacturing sector**

***Keywords*— Soft TQM, Informational Interviewing, Field based study, Manufacturing sector, Assignment TQM Course.**

***JEET Category*—Research**

I. INTRODUCTION

TOTAL Quality Management (TQM) represents a comprehensive approach to improving organizational performance through a focus on quality in all aspects of business operations. As a key component of modern management education, TQM provides students with the practical knowledge and skills necessary to apply quality management principles effectively within real-world settings. This study was conducted as part of a TQM course within the Mechanical Engineering undergraduate program, aiming to bridge the gap between theoretical knowledge and practical application through a field-based research methodology.

Coimbatore, a prominent industrial hub known for its extensive manufacturing activities, was selected as the setting for this research. Students in the course were tasked with identifying and analysing manufacturing companies in this region to explore the implementation of TQM practices. By engaging directly with industry professionals, students were able to gain hands-on experience and insights. According to Pavan (2024) research culture is defined as the student's "inclination to think critically, engage in scholarly activities, and view research as an essential component of their education." "In this assignment, research culture also refers to the attitudes, ethics, professionalism, and methodological discipline that students develop while engaging in real-world data collection, interacting with industry professionals.The research methodology employed in this study included unstructured interviews (for comprehension) while structured surveys to gather comprehensive data on TQM practices. The qualitative interviews allowed for an in-depth exploration of various TQM components. In contrast, the structured surveys provided standardized quantitative data on specific aspects of Soft TQM, focusing on people and relationships rather than technical processes.

The study aimed to assess the impact of different factors—such as firm size, ownership focus, and market reach—on TQM practices. By examining these variables, the research sought to determine whether significant differences exist in the implementation and effectiveness of TQM practices across different organizational contexts.

This research emphasises the importance of practical, field-based learning in understanding and applying TQM principles and highlights the factors that influence the effectiveness of these practices in the manufacturing sector. While numerous studies examine TQM practices in large corporations, limited empirical work explores how field-based assignments using Soft TQM frameworks shape student understanding and reflect on firm performance. This study attempts to bridge this gap.

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II. Review of Literature

Informational Interviewing

Vande Griek et el. (2020) describes informational interviewing as "a proactive approach to career exploration and development, where individuals seek out professionals to discuss career paths, industry trends, and specific job functions. This form of interview is educational and exploratory, aimed at acquiring practical knowledge." Bal, & Arikan (2020) define it as "a career development tool used to obtain valuable insights into a particular industry, role, or organization through dialogue with someone currently working in that field. The purpose is to learn and build relationships, not to secure employment."

Field-based assignments

Field based assignments refer to educational tasks that require students to engage in activities outside the traditional classroom setting, often in real-world environments relevant to their field of study. These assignments are designed to provide hands-on experience and practical application of theoretical knowledge by immersing students in actual work or research settings. Labudde et. al. (2002) defines field-based assignments as "learning experiences that take place in real-world settings, allowing students to apply classroom knowledge to practical situations. These assignments enhance students' understanding by providing opportunities for direct interaction with the subject matter in its natural context." Creswell (2017) describes field-based assignments as "educational tasks that involve data collection, observation, or engagement in environments directly related to the student's area of study. The purpose is to bridge the gap between theory and practice by immersing students in settings where they can experience and analyze real-world phenomena."

Mixed methods approach for TQM Assignment

Mixed-method research integrates both qualitative and quantitative research approaches to provide a comprehensive understanding of a research problem. When combining field-based assignments, informational interviewing, and survey-based research, the mixed-method approach allows for a rich and nuanced exploration of a topic by leveraging the strengths of each method. While Field-Based Assignments involve students meeting and discussing with professionals from the manufacturing sector, in real-world environments to collect data or observe phenomena, in this case Soft Total Quality Management (TQM) practices in manufacturing firms. This approach is particularly useful for gathering detailed, contextual information that may not be fully captured through surveys alone Creswell (2017). Informational interviews are unstructured or semi-structured, allowing for open-ended responses that can reveal deeper insights into how individuals perceive and implement certain practices, like TQM. This method is valuable for understanding the subjective experiences of individuals and for gaining a detailed understanding of specific aspects of the research topic that may not be visible through observation alone Labudde et. al. (2002). Survey-Based Research is typically quantitative, involving the collection of structured data through questionnaires or standardized instruments. In the context of Soft TQM research, surveys might be used to quantify the extent to which specific practices are adopted across different firms or to measure the impact of TQM practices on firm performance. The data collected can be statistically analyzed to identify trends, correlations, and patterns Babbie (2020).

When these three methods are combined in a mixed-method approach, they provide a more holistic understanding of the research problem. For instance, field-based assignments might reveal the unique challenges faced by manufacturing firms in implementing TQM, while informational interviews could provide deeper insights into the personal experiences and opinions of professionals working within those firms. The survey data could then be used to quantify the prevalence of these challenges and experiences across a larger sample, providing a broader context for the qualitative findings. While the entire engineering curriculum focuses on technical skills, there are very few courses that focus on other soft skills and work place skills among students. This study is an attempt to help students get an understanding of the other business aspects that will affect TQM. This combination of qualitative depth and quantitative breadth helps in better understanding. This research paper attempts to discuss the quantitative analysis of data collected from companies. The results of qualitative data gathered is not reported in this paper due to some methodological pitfalls.

Soft TQM: A Conceptual Clarification

Soft TQM refers to the elements of quality management that centre on people and organizational culture, rather than just formal systems and tools. This approach highlights the importance of leadership styles, employee engagement, open communication, organizational values, training, teamwork, and empowerment

Studies of Prajogo & McDermott (2005) divides TQM into “soft” and “hard” aspects. The “soft” side includes factors such as top management commitment, employee involvement, and a customer-centred mindset. They found that these people-focused practices play a crucial role in shaping organizational culture and enhancing quality performance.

Lewis et al. (2006) emphasizes that soft TQM is built around human resource practices, such as leadership support, staff training, and participative management. Their findings suggest that these aspects are vital for embedding quality into daily routines and that relying solely on rigid systems or tools (hard TQM) is insufficient for sustained improvements. Informational interviewing is a valuable technique for engineering students seeking to gain insights into the practical applications of Soft Total Quality Management

Informational Interviewing for Soft TQM Practices

Informational interviewing is a valuable technique for engineering students seeking to gain insights into the practical applications of Soft Total Quality Management (TQM) within manufacturing industries, particularly when exploring the softer components of a TQM framework, such as leadership, communication, and employee involvement. According to Benjamin (2019), these interviews allow students to directly engage with manufacturing professionals who possess knowledge and competencies in Soft TQM principles in the corporate world. This interaction helps students deepen their understanding of how soft TQM components, often seen as

abstract concepts in academic settings, are operationalized in a business environment (Koh & Low, 2010).

By interviewing professionals, students can gather qualitative data on how leadership styles influence TQM adoption, how effective communication strategies enhance quality outcomes, and how fostering a culture of continuous improvement and employee empowerment can lead to sustained organizational success (Javaid et el., 2021). These interviews also provide an opportunity for students to ask questions that reveal the challenges and successes that professionals face in integrating soft TQM elements into their daily operations Dale (2016). The nuanced insights gained from these conversations can bridge the gap between theoretical knowledge and practical application, helping students better appreciate the complexity and interdependencies of TQM components (Flynn & Saladin, 2006). Furthermore, informational interviews can help students build professional networks within the manufacturing industry, which can be beneficial for future career opportunities (Basu et.el., 2018). It serves as a platform for students to be proactive learners (Evans & Lindsay, 2010). As students listen to the experiences of professionals, they can also refine their own perspectives on how soft TQM components can be tailored to fit different organizational contexts, thus enriching their overall comprehension of TQM (Prajogo&Sohal, 2006).

Students can also identify potential mentors who can guide them as they transition from academic learning to professional practice (Hackman &Wageman, 1995). The insights gained from these interviews can be documented and analysed to contribute to academic research or personal projects focused on improving TQM frameworks (Ulmer, 2008).

Components of Soft TQM Practices

Leadership

Leadership in the context of TQM is crucial for fostering a culture of quality throughout an organization. According to Deming (1986), effective leadership involves creating an environment where continuous improvement is valued and where leaders are committed to guiding and supporting their teams in implementing TQM principles. Leadership sets the tone for quality initiatives and plays a pivotal role in motivating employees to achieve excellence in their work (Oakland, 2011).

Training

Training is a fundamental component of TQM that ensures employees have the necessary skills and knowledge to contribute to quality improvement efforts. Juran (1988) emphasizes that continuous training helps in embedding quality awareness across all levels of an organization, leading to more effective implementation of TQM practices. Proper training programs empower employees to take ownership of quality and engage in problem-solving activities Dale (2016).

Employee Management

Employee management under TQM focuses on involving employees in decision-making processes and fostering a sense of ownership over their work. Hackman and Wageman (1995) argue that effective employee management enhances job satisfaction and productivity, as employees who are actively engaged in quality initiatives are more motivated to contribute to the organization's success. This management style is integral to building a committed and capable workforce.

Information and Analysis

Information and analysis are critical for making informed decisions in TQM. As stated by Flynn, Schroeder, and Sakakibara (1995), the effective use of data and statistical tools enables organizations to identify areas for improvement and track the impact of quality initiatives. Accurate and timely information is essential for monitoring progress and adjusting quality processes (Evans & Lindsay, 2010).

Supplier Management

Supplier management in TQM involves developing strong relationships with suppliers to ensure that the materials and services provided meet the organization's quality standards. According to Lascelles and Dale (1989), collaboration with suppliers is essential for achieving consistent quality in the final product, as suppliers play a key role in the supply chain. Effective supplier management leads to better quality inputs and reduces variability in the production process.

Process Management

Process management is central to TQM as it focuses on optimizing and controlling the processes that produce goods or services. Garvin (1987) highlights that well-managed processes lead to increased efficiency, reduced waste, and improved product quality. Process management involves mapping out each step in the production process and continuously monitoring it for opportunities to enhance performance (Oakland, 2011).

Customer Focus

Customer focus is a core principle of TQM that emphasizes meeting and exceeding customer expectations. As Deming (1986) notes, understanding customer needs and preferences is essential for delivering products and services that satisfy customers and build long-term loyalty. Customer feedback is a valuable source of information for identifying areas where quality can be improved (Juran, 1988).

Continuous Improvement

Continuous improvement, also known as Kaizen, is the practice of constantly seeking ways to enhance processes, products, and services. Imai (1986) argues that continuous improvement is a critical element of TQM, as it drives incremental changes that collectively lead to significant quality enhancements over time. This practice encourages employees at all levels to contribute ideas for improvement, fostering a culture of innovation and excellence (Oakland, 2011).

Innovation Performance

Innovation performance in TQM is related to how effectively an organization can integrate new ideas and technologies into its operations to improve quality. According to Prajogo and Sohal (2006), organizations that prioritize innovation within their TQM frameworks tend to achieve higher levels of quality and competitiveness. Innovation in processes and products is key to maintaining a competitive edge in the market.

Employee Performance

Employee performance in TQM is measured by how well employees contribute to the organization's quality goals. Hackman and Wageman (1995) suggest that when employees are aligned with the company's TQM objectives and receive appropriate training, their performance improves, leading to better overall organizational outcomes. High employee performance is linked to increased productivity and enhanced quality of work.

Firm Performance

Firm performance in the context of TQM refers to the overall success of an organization in achieving its quality and business objectives. As noted by Hendricks and Singhal (1997), organizations that effectively implement TQM practices typically see improvements in financial performance, customer satisfaction, and operational efficiency. Firm performance is the ultimate measure of how well TQM principles are integrated into the organization's strategy and operations.

III. Methodology

In the context of a Total Quality Management (TQM) course within the Mechanical Engineering undergraduate program, a practical research methodology was implemented to provide students with hands-on experience in the application of TQM practices. This methodology involved a field-based assignment where students were required to identify one or two manufacturing companies located in the industrial hub of Coimbatore, a region known for its extensive manufacturing activity. According to Labudde et. al. (2002), field-based assignments like these allow students to apply theoretical knowledge in real-world settings, enhancing their learning through direct engagement with industry practices. 67 Students were trained to approach companies for data collection, identify and meet the appropriate respondents, and schedule appointments with industry professionals. They also improve their communication and articulation skills by clearly explaining their research requirements to the company, along with essential interviewing skills. In addition, they learn to avoid issues such as leading questions, double-barrelled questions, and ambiguity while designing or administering surveys. Students are further sensitized to ethical data-collection practices, confidentiality, and professionalism throughout the research process.

A. Sampling and Participant Selection

Students were tasked with independently identifying companies within the Coimbatore manufacturing sector. The selection of companies was based on their relevance to the course material, particularly in terms of their engagement with TQM practices. Yin (2009) suggests that purposive sampling, such as this, is crucial for case studies, ensuring that the selected participants or companies are most likely to provide relevant and insightful data. The companies chosen varied in size and industry focus, ensuring a diverse range of perspectives on TQM implementation Creswell & Poth, (2016). Once the companies were identified, students were required to secure appointments with relevant company officials, such as quality managers or production heads, who were directly involved in the application of TQM within the firm Denzin & Lincoln (2011).

To examine the influence of firm characteristics on the implementation of Soft TQM practices, the following null hypotheses were formulated:

$H0_1$: There is no significant difference in Soft TQM practices between medium-sized and large firms.

$H0_2$: There is no significant difference in Soft TQM practices between family-owned and privately-owned firms.

$H0_3$: There is no significant difference in Soft TQM practices between firms with regional market focus and those with national market focus.

Each hypothesis was tested across eleven constructs of Soft TQM: leadership, training, employee management, information and analysis, supplier management, process management, customer focus, continuous improvement, innovation performance, employee performance, and firm performance.

Statistical analysis was conducted using independent-samples t-tests at a 5% level of significance ($\alpha = 0.05$). Rejection of the null hypothesis indicates significant differences across firm characteristics.

B. Data Collection Approach

The data collection process involved a dual approach: unstructured interviews and structured surveys. Initially, students conducted unstructured interviews with the company officials. This qualitative method, as described by Kvale (2012), allows for an open-ended exploration of the firm's TQM practices, enabling students to delve deeply into areas such as leadership commitment to quality, employee involvement, continuous improvement processes, and customer satisfaction strategies. The unstructured nature of the interviews facilitated a conversational flow, allowing students to probe into specific aspects of TQM that might not be covered in a more rigid interview format Brinkmann (2015).

Qualitative results were collected but excluded in this version due to space/methodological concerns. Although the qualitative data were not presented, the assignment carried out by students incorporated informational interviewing and helped in deepening their understanding of the industry practices. As noted by Creswell and Plano Clark (2011), a study qualifies as mixed-methods when both qualitative and quantitative data are collected and integrated, even if one is not fully reported.

Following the interviews, students collected quantitative data using a structured, validated instrument provided by the course faculty. The instrument had two parts characteristics of the company and questions pertaining to People and relationships component of the TQM Framework. Firm characteristics included questions like Firm Size (medium, large), Ownership focus (family owned and private), market reach (local, national reach). These three characteristics are explained below:

Firm Characteristics

Based on firm size, companies were categorized into medium and large enterprises. Medium enterprises typically employ between 50 and 250 individuals, boasting larger production capacities and a wider variety of products, often catering to national markets with some ability to export. In contrast, large enterprises have more than 250 employees, featuring substantial production facilities equipped with advanced machinery and a robust presence in both national and international markets.

Based on ownership focus, family-owned businesses are often traditional and long-established firms that prioritize continuity, with leadership typically passing through generations. In contrast, private limited companies are generally smaller or medium-sized enterprises with restricted public ownership, concentrating on controlled growth and potentially seeking partnerships or investments to facilitate their development.

Based on market reach, companies with a local market focus primarily serve the Coimbatore region or its neighbouring areas, emphasizing the fulfilment of regional demand with localized products. Conversely, firms with a national market focus operate distribution networks throughout India, creating goods that address the broader needs of the Indian market.

Survey Instrument

Soft TQM (Total Quality Management) focuses on the human and organizational aspects of quality management, emphasizing the importance of people, culture, and leadership in achieving quality goals. Unlike Hard TQM, which is more concerned with systematic processes, tools, and techniques (such as statistical process control and quality improvement methods). The scales from which the data was collected is presented in the table below.

Questionnaire Reliability

The data thus collected was tested for reliability using SPSS version 26. Cronbach's alpha is a statistical measure used to evaluate the internal consistency or reliability of a set of items in a survey or test, indicating how closely related they are in measuring the same construct. Values range from 0 to 1, with higher values suggesting acceptable reliability.

IV. Results and Discussion

One of the objectives of the study was to assess if there is difference in the TQM constructs across Firm size, Ownership focus and market reach. To test the same, the following hypothesis

TABLE I
RELIABILITY OF CONSTRUCTS WITH SOURCE

Construct name	Scale	No.of items	Reliability Alpha
Leadership	Cua et al. (2001)	6	0.735
Training	Saraph et al. (1989), Rahman / Bullock (2005), /Fuentes et al. (2004)	4	0.601
Employee Management	Cua et al. (2001), Rahman/ Bullock (2005), /Fuentes et al. (2004)	8	0.850
Information and Analysis	Saraph et al. (1989)	5	0.655
Supplier management	Kannan and Tan (2004)	4	0.684
Process management	Cua et al. (2001) /Saraph et al. (1989)	6	0.767
Customer focus	Rahman & Bullock (2005), Chong & Rundus (2004), and Fuentes et al. (2004)	7	0.630
Continuous improvement	Fuentes et al. (2004)	2	0.637
Innovation performance	Prajogo & Sohal (2004):	2	0.631
Employee performance	Fuentes et al. (2004) & Rahman & Bullock (2005)	3	0.529
Firm performance	Kaynak (2003) & Fuentes et al. (2004)	5	0.753

Testing of difference in Soft TQM Practices across Medium and Large Firms

The results of t test for firm size is depicted in the below table:

H_a: There is significant differences in the Soft TQM Elements between a) Firm Size (medium, large), b) Ownership focus (family owned and private), c) market reach (local, national reach). H1: $\mu 1 \neq \mu 2$.

The T-test results indicate that firm size does not significantly impact various constructs related to Total Quality Management (TQM). For leadership, training, employee management, information and analysis, supplier management, process management, customer focus, continuous improvement, innovation performance, employee performance, and firm performance, there are no significant differences between medium and large firms. This suggests that both firm sizes tend to have similar practices and outcomes in these areas, implying consistency in management practices and prioritization across different firm sizes. Overall, the results reflect that TQM practices related to people and relationships are uniformly applied, regardless of firm size.There are no significant differences in leadership practices between medium and large firms, suggesting both types of companies emphasize leadership in a similar manner.

TABLE II
TESTING FOR DIFFERENCE ACROSS MEDIUM AND LARGE FIRMS

TQM - People and Relationships	Firm Size	Mean	Sig.	t	Sig.	H0 A/R
Leadership	M	3.50	0.61	-.06	.94	A
	L	3.51			.94	
Training	M	3.44	0.11	.53	.59	A
	L	3.35			.57	
Employee Management	M	3.62	0.00	1.18	.24	A
	L	3.43		1.29	.19	
Information and analysis	M	3.51	0.01	.74	.46	A
	L	3.39		.79	.42	
Supplier Management	M	3.42	0.00	-.46	.64	A
	L	3.50		-.51	.60	
Process Management	M	3.38	0.18	-.05	.95	A
	L	3.39		-.05	.95	
Customer Focus	M	3.70	0.01	1.55	.12	A
	L	3.37		1.70	.09	
Continuous Improvement	M	3.46	0.05	.50	.61	A
	L	3.35		.54	.59	
Innovation Performance	M	3.50	0.26	.072	.94	A
	L	3.48		.075	.94	
Employee Performance	M	3.47	0.16	.99	.32	A
	L	3.29		1.09	.28	
Firm Performance	M	3.47	0.26	-.75	.45	A
	L	3.60		-.78	.43	

A – Null hypothesis Accepted

Training programs appear to be comparable in both sizes, indicating a similar investment in employee development. While there are slight differences in mean scores, the lack of statistical significance implies that employee management practices are largely alike across firm sizes. Information management and analysis approaches also seem similar, showing that firm size does not greatly affect data-driven decision-making. Supplier management strategies do not differ significantly between medium and large firms, likely due to

comparable market demands. Process management practices are standardized across both sizes, as reflected in nearly identical means. Although medium firms show a slightly higher mean for customer focus, the lack of significance indicates equal prioritization across both sizes. Continuous improvement practices are similar, with both firm sizes emphasizing ongoing development. Innovation performance appears comparable across medium and large firms, suggesting size does not significantly impact innovation. Employee performance is similar between both sizes, indicating that firm size may not significantly affect output or efficiency. The lack of significant differences in firm performance scores points to similar overall business outcomes despite variations in resources or scale.

Testing of difference in Soft TQM Practices between Medium and Large Firms

TABLE III
TESTING FOR DIFFERENCE BETWEEN
FAMILY OWNED BUSINESS AND PRIVATE FIRMS

TQM - People and Relationships	Ownership	Mean	Sig.	t	Sig. (2-tailed)	H0 A/R
Leadership	FOB	3.52	0.74	0.06	0.96	A
	Private	3.51				
Training	FOB	3.41	0.43	0.04	0.97	A
	Private	3.40				A
Employee Management	FOB	3.56	0.57	0.06	0.95	
	Private	3.55				A
Information and analysis	FOB	3.45	0.69	-0.18	0.86	A
	Private	3.48				
Supplier Management	FOB	3.36	0.88	-1.22	0.23	A
	Private	3.57				
Process Management	FOB	3.36	0.13	-0.41	0.69	A
	Private	3.43				
Customer Focus	FOB	3.59	0.62	0.14	0.89	A
	Private	3.56				
Continuous Improvement	FOB	3.33	0.64	-0.89	0.38	A
	Private	3.52				
Innovation Performance	FOB	3.50	0.17	0.06	0.95	A
	Private	3.49				
Employee Performance	FOB	3.36	0.91	-0.53	0.60	A
	Private	3.45				
Firm Performance	FOB	3.45	0.97	-0.89	0.37	A
	Private	3.60				

A – Null hypothesis Accepted

Based on the t-test results provided, there are no statistically significant differences between family-owned businesses (FOB) and private businesses in terms of their TQM (Total Quality Management) practices and performance measures. For all the TQM dimensions and performance indicators, the significance (Sig.) values are greater than the commonly used alpha level of 0.05, indicating that the differences in means between the two groups are not statistically significant. The t-values and their corresponding two-tailed significance (Sig. (2-tailed)) further confirm that the null hypothesis (H0) of no difference in means between FOB and private businesses cannot be rejected for any of the variables. In summary, the results suggest that family-owned businesses and private businesses in the given sample have similar approaches to leadership, training, employee management, information analysis, supplier management, process management, customer focus, continuous improvement, innovation performance, employee performance, and firm performance. The ownership structure does not appear to be a significant factor in differentiating these TQM practices and outcomes.

Testing of difference in Soft TQM Practices across Market Reach

Based on the results of the two independent t-tests, there are statistically significant differences in the mean values of all TQM constructs and performance measures between companies with a regional market focus and those with a national market focus.For each construct, the significance (Sig.) values are less than 0.05, indicating that the differences in means between the two groups are statistically significant at the 95% confidence level. The negative t-values and their corresponding two-tailed significance (Sig. (2-tailed)) values of 0.00 confirm that the null hypothesis (H0) of no difference in means can be rejected for all variables.

TABLE IV
TESTING FOR DIFFERENCE BETWEEN
REGIONAL AND NATIONAL FOCUS

Constructs	Market Focus	Mean	Sig.	T	Sig.	H_0 A/R
Leadership	Regional	3.32	0.59	-4.23	0.00	R
	National	4.01				
Training	Regional	3.25	0.15	-3.26	0.00	R
	National	3.81				
Employee Management	Regional	3.34	0.14	-4.90	0.00	R
	National	4.11				
Information and analysis	Regional	3.30	0.54	-3.75	0.00	R
	National	3.90				
Supplier Management	Regional	3.29	0.83	-3.44	0.00	R
	National	3.89				
Process Management	Regional	3.21	0.28	-3.50	0.00	R
	National	3.85				
Customer Focus	Regional	3.34	0.49	-4.17	0.00	R
	National	4.21				
Continuous Improvement	Regional	3.15	0.54	-4.62	0.00	R
	National	4.14				
Innovation Performance	Regional	3.25	0.09	-4.33	0.00	R
	National	4.12				
Employee Performance	Regional	3.19	0.46	-4.28	0.00	R
	National	3.95				
Firm Performance	Regional	3.32	0.65	-4.18	0.00	R
	National	4.06				

A – Null hypothesis Accepted

The results suggest that companies with a national market focus have higher mean values for leadership, training, employee management, information and analysis, supplier management, process management, customer focus, continuous improvement, innovation performance, employee performance, and firm performance compared to companies with a regional market focus. These findings have important implications for managers and policymakers:

Companies aiming to expand from regional to national markets should focus on enhancing their TQM practices,

particularly in the areas of leadership, employee management, customer focus, and continuous improvement.

Policymakers supporting SMEs should consider providing targeted assistance and training programs to help regionally focused firms develop their TQM capabilities and transition to serving national markets.

Future research should explore the specific mechanisms by which market focus influences TQM implementation and firm performance, as well as the contextual factors that may moderate these relationships.

In summary, the t-test results highlight the importance of market reach as a strategic factor that shapes a firm's TQM practices and performance outcomes. Companies aspiring to serve broader national markets should prioritize strengthening their TQM systems.

Comparison with earlier Studies

Linking Results with Discussion

The results show no significant differences in Soft TQM practices across firm size and ownership type, suggesting these internal factors do not influence people-centric quality initiatives. This supports prior studies (Flynn et al., 1995; Prajogo & Sohal, 2006) emphasizing culture and strategy over structure.

However, firms with national market reach reported significantly higher Soft TQM adoption. This aligns with Deming (1986) and Javaid et al. (2021), highlighting that broader markets demand stronger leadership, employee involvement, and innovation. Thus, external market orientation plays a key role in shaping TQM practices.

Differences in Soft TQM Across Firm Size (Medium vs. Large)

The absence of significant differences aligns with Flynn et al. (1995) and Hackman & Wageman (1995), who note that soft TQM practices like leadership and employee involvement are more influenced by culture than size. Both firm types appear to adopt similar quality frameworks.

Differences Based on Ownership Focus (Family-Owned vs. Private Firms)

The similarity in TQM adoption across ownership types supports Prajogo & Sohal (2006), suggesting that strategic orientation, not ownership structure, drives TQM implementation. Family-run firms may now be professionalizing their quality practices in response to market demands.

Differences Based on Market Reach (Regional vs. National Firms)

Significant differences favoring national firms align with Deming (1986) and Javaid et al. (2021), who associate broader markets with stronger quality systems. National firms likely institutionalize soft TQM more deeply to meet diverse customer expectations and scale efficiently.

While Survey from participating companies on soft TQM practices were collected, a simple 4 item survey was collected at student after completion of their assignments to understand about the effectiveness of the assignment. The mean values were found to be above 4 for all the statements. The survey included the following items The field-based TQM assignment helped me understand the softer elements of TQM (Mean 4.21).The industry interaction and interview process enhanced my understanding of real-world manufacturing and quality practices (Mean 4.37).The structured questionnaire provided by the faculty was useful and easy to administer during the company visit (Mean 4.06).Overall, this assignment improved my communication and professional engagement skills with industry personnel (Mean 4.42).

As already mentioned there were a few methodical pitfalls because of which the qualitative interview results are not disclosed in this study. However, students experience on the assignment were collected and is given below. Some students liked the experience of learning from the shop floor

"The field-based TQM assignment gave me real exposure to how quality management works in this company. Talking directly with production managers helped me understand how leadership and continuous improvement actually happen on the shop floor—something we can't get from textbooks."

A few students liked that their assignment helped them improve their confidence

"Conducting the interview and completing the questionnaire made me more confident in interacting with industry professionals. I could connect theory with practice, especially in areas like employee training and process management, which deepened my understanding of TQM."

A few students shared that their communication and analytical skills improved

"This assignment was a turning point for me. Visiting a real manufacturing unit and discussing quality practices made TQM concepts come alive. It also improved my communication and analytical skills, which I know will help in my career."

V. Implications of the Study

The research study implemented a practical methodology within a Total Quality Management (TQM) course for Mechanical Engineering undergraduates, focusing on field-based assignments to examine Soft TQM practices in manufacturing firms in Coimbatore. The study aimed to assess differences in Soft TQM practices across various factors including firm size, ownership focus, and market reach.

The study's t-test results indicate that firm size—whether medium or large—does not significantly impact the TQM constructs related to people and relationships. This uniformity suggests that Medium and large firms exhibit similar TQM practices across leadership, training, employee management, and other areas. This implies that both types of firm's value and implement TQM practices similarly, leading to consistent management approaches regardless of company size.

The lack of significant differences across TQM dimensions means that the effectiveness and emphasis on TQM practices are not influenced by firm size. This suggests that TQM practices related to leadership, employee involvement, and

continuous improvement are uniformly applied across different sizes of firms.

Firms of different sizes are utilizing their resources in a similar manner when it comes to TQM, which might reflect well-established and standardized practices within the industry.

The t-test results show no significant differences in TQM practices between family-owned businesses (FOB) and private limited companies. This result leads to several implications with regard to Ownership Structure The study indicates that ownership structure does not significantly affect TQM practices. Both family-owned and private businesses apply similar TQM strategies, suggesting that ownership type is not a determining factor in the effectiveness of TQM.The similarity in TQM practices across different ownership types implies that the principles of TQM are robust enough to be effectively implemented irrespective of whether a business is family-owned or privately held. This consistency in practices could reflect a universal approach to TQM within the manufacturing sector, independent of ownership structures.

However, the results reveal significant differences in TQM practices between companies with regional and national market focuses. This differentiation suggests the following:

Enhanced TQM Practices for National Firms: Companies with a national market focus generally exhibit higher mean values in all TQM dimensions compared to those with a regional focus. This implies that firms aiming to serve broader markets tend to invest more in TQM practices, including leadership, customer focus, and continuous improvement.

Implications for Higher Education Institutions

The integration of field-based assignments into a Total Quality Management course demonstrates how engineering education can be enriched through practical exposure. Moving beyond conventional classroom methods, this approach encourages students to engage directly with industries, collect data, and reflect on real-world practices. Such involvement promotes critical thinking, deepens conceptual understanding, and helps connect academic content with its application. Additionally, it enhances active learning and improves collaboration between institutions and the industrial sector. This model supports outcome-based education goals and equips students with essential skills for professional and workplace readiness.

Students get trained in approaching companies for data collection, identifying and meeting with the appropriate respondent, taking appointments from the professionals, developing communication and articulation skills by explaining their requirements to the company and interviewing skills. The learn to avoiding leading questions, double-barreled questions, ambiguity. They are also exposed to ethical data collection practices like avoiding leading questions, double-barreled questions, ambiguity etc.,

Overall, the study highlights the significance of market reach as a key determinant of TQM practices, while firm size and ownership focus appear less influential. The study demonstrated the feasibility of embedding live industrial projects into a TQM course and helped students bridge theoretical knowledge with practical application through immersion.

Conclusion

The research study conducted within the Total Quality Management (TQM) course has provided valuable insights into the application of TQM practices within the manufacturing sector of Coimbatore. While this study aims to bridge classroom learning with real-world exposure, future researchers may consider investing more time in preparing students to confidently engage with industry professionals. Students should be trained in essential skills such as professional communication, industry etiquette, asking insightful questions, and effectively presenting their ideas during such interactions. It is important that engineering education not only focus on building technical expertise, but also improve student's business acumen and workplace competencies. Limitations of the study include the omission of qualitative data from analysis due to design limitations. Future studies could integrate thematic analysis of interviews for a more comprehensive understanding.

The study's findings are particularly significant when considered in the context of regional research. The results indicate that firm size and ownership focus have minimal impact on TQM practices related to people and relationships. This uniformity across medium and large firms, as well as family-owned and private businesses, suggests that TQM principles are applied consistently within these dimensions, regardless of the specific regional characteristics of Coimbatore.

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