Quality Management (QM) through Value Creation in the Chemical Industry to Ensure Sustainable Competitive Advantage in Thailand.

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Abstract

This study aimed to evaluate the business structure and process traits of the chemical industry and identify strategies that add value to industrial goods and promote healthy competition. It also sought to develop a structural equation model for these methods and explore the role of Quality Management in enhancing industrial goods and sustainable competitiveness. The sample group consisted of 300 chemical industrial business executives and entrepreneurs registered with the department of industrial, including 150 medium-sized and small businesses. Data was collected through questionnaires and analyzed using various statistical methods, including the AMOS Advanced Statistical Analysis Program for the structural equation model. The study found that digital technology, management, innovation management, marketing, and Quality Management were effective in enhancing industrial goods and fostering healthy competition. Additionally, major enterprises placed higher value on these strategies compared to medium-sized and small ones. The structural equation model analysis showed a good fit with the empirical data, as indicated by the following values: RMSEA = 0.061, CMIN probability = 0.161, CMIN/DF = 1.085, and GFI = 0.941.

Keywords: Chemical industry, Sustainability, Value Creation, Management, Quality Management

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Introduction

In today's dynamic and fiercely competitive business environment, achieving sustainable growth and success has become an imperative for organizations across industries [1]. For the chemical industry, which plays a pivotal role in Thailand's economic landscape, maintaining a competitive edge is essential for long-term prosperity. In this pursuit, Quality Management (QM) [2] emerges as a crucial strategy that enables companies to create added value and secure a sustainable position in the market [3]**.** The chemical industry in Thailand has experienced significant growth and diversification over the past decades, catering to both domestic and global markets. As the sector continues to expand, it faces various challenges, including technological advancements, evolving customer demands, and stringent environmental regulations [4]. To effectively address these challenges and capitalize on emerging opportunities, chemical companies must adopt a holistic approach that emphasizes the pursuit of excellence and continual improvement [5]**.** This is where Quality Management comes into play [6], acting as a powerful tool to align processes, enhance product and service quality, and elevate overall organizational performance. The primary aim of this research is to investigate the impact of Quality Management practices on value creation within the chemical industry in Thailand [7]**.** By examining how effective QM implementation can lead to superior products, streamlined operations, and improved customer satisfaction, this study seeks to shed light on the critical role QM plays in driving sustainable competitive advantage for chemical companies. Additionally, the research will delve into the unique challenges and opportunities that exist within the Thai chemical industry, providing insights into how QM can be tailored and optimized for the local context. Through a comprehensive analysis of industry-specific factors and best practices in Quality Management, this study aims to present practical recommendations and actionable strategies for chemical companies to thrive in the face of intensifying competition. As we embark on this research journey, we recognize the significance of fostering a strong culture of continuous improvement, collaboration, and innovation in the chemical industry [8]. By integrating the principles of QM into the fabric of organizational, companies can not only survive but also thrive in the ever-evolving business landscape. The chemical industry stands as a cornerstone of the global economy, providing essential products and solutions that contribute to human well-being and technological progress. From pharmaceuticals that save lives to fertilizers that boost agricultural productivity [9]**,** the diverse range of chemical products forms the foundation of countless industries. The sector's pivotal role in modern society, however, is coupled with significant challenges that necessitate a paradigm shift in its operational practices. One of the primary challenges facing the chemical industry in recent decades is the need to balance its economic ambitions with environmental sustainability. Traditional business models, centered around maximizing production efficiency and minimizing costs, have led to increased resource consumption, waste generation, and carbon emissions. Such practices have

contributed to environmental degradation, biodiversity loss, and climate change, prompting a global call for industries to adopt sustainable and environmentally responsible approaches. Amidst these mounting challenges, sustainable development has emerged as a guiding principle that calls for the harmonization of economic growth, environmental protection, and social responsibility. In response to this imperative, chemical companies are redefining their approaches to ensure sustainable competitiveness while adhering to ethical and environmental principles. In this transformative landscape, the concept of quality management assumes heightened importance as a strategic tool that goes beyond mere product quality enhancement.

Quality management [10], a systematic and process-oriented approach to improve organizational performance, is traditionally associated with optimizing manufacturing processes, reducing defects, and enhancing customer satisfaction. However, its relevance extends far beyond these conventional notions, particularly in the context of the chemical industry's sustainability journey. When integrated holistically into an organization's culture and operations, quality management can unleash its full potential to create added value across diverse dimensions.

The added value generated through quality management is multi-faceted, encompassing enhanced efficiency, innovation, product excellence, customer satisfaction, and most importantly, environmental responsibility. By focusing on continuous improvement, waste reduction, and effective resource utilization, chemical companies can optimize their processes to minimize the environmental footprint of their operations. Moreover, a commitment to quality management can drive the development of greener technologies, eco-friendly products, and sustainable supply chains, positioning organizations as responsible contributors to global environmental objectives.

This research seeks to delve deep into the significance of quality management as a catalyst for value creation in the chemical industry, particularly in the pursuit of sustainable competition. By exploring case studies, best practices, and success stories from leading chemical companies, we aim to highlight the transformative impact of quality management on the industry's ability to navigate the challenges of a rapidly evolving market.

Materials and Methods

In the context of research conducted in Thailand, the concepts of population and samples would refer to the specific groups of interest within the country. Let's explore how these concepts apply to research in Thailand:

Population in Thailand: The population in Thailand refers to the entire group of individuals, households, or entities residing within the geographical boundaries of the country. This includes Thai citizens as well as non-citizens who are living in Thailand. The population of Thailand is diverse and encompasses various demographic, socioeconomic, and cultural characteristics. As of my last update in September 2021, the population of Thailand was estimated to be around 69 million people.

Samples in Thailand: In research conducted in Thailand, a sample would be a smaller subset of the entire population that is selected to represent

the larger group. Researchers often use samples because it is generally impractical to study the entire population due to factors such as time, resources, and logistical constraints. The selection of a sample in Thailand should be done carefully to ensure that it accurately represents the diverse characteristics of the population. There are several sampling methods that researchers can use to achieve representativeness:

a. Random Sampling: Using this technique, any person or piece of the population has an equal chance of being chosen for the sample. The possibility of a representative sample is increased and bias is decreased by random sampling.

b. Stratified Sampling: Using this technique, the population is divided into subgroups or strata according to particular characteristics (such as age, gender, or area). A random sample is then taken from each stratum according to its proportion in the population.

c. With this technique, the population is split into clusters (for example, geographic regions), and clusters are chosen at random. The sample is then expanded to include every individual within the selected clusters.

Researchers in Thailand might use samples to conduct surveys, collect data, or perform experiments to study various topics, such as public opinion on social issues, economic trends, health-related behaviors, or environmental concerns.

It is crucial for researchers to ensure that the sample accurately represents the diverse population of Thailand to draw meaningful conclusions and make valid inferences about the entire country. Well-designed and representative samples can provide valuable insights that can inform policies, decisions, and actions that benefit the broader population.

Designing research instrument

Ahmad, Zakuan [**11]** are only a few of the sources from which we created our surveys. The three components of the research tool were as follows: Using a 5-item checklist, the first segment gathered general information about agriculture. The second half included 80 questions concerning methods for adding value to industrial goods that were scored on a Likert scale with 1 being the lowest importance and 5 being the greatest. Recommendations were included in the third part. Three professionals with pertinent training and expertise looked over the questionnaire to make sure its content validity. The index of item-objective congruence (IOC), which exceeded the criteria of 0.50 and varied from 0.70 to 1.00 , demonstrated that the questions were measured objectively.

For reliability testing, we administered the questionnaires to a sample group of 30 businesses, similar to the intended study sample. The Cronbach's Alpha Coefficient was found to be 0.95, surpassing the accepted standard (Nunnally and Bernstein, 1994), indicating high confidence in the instrument's consistency.

Statistical analysis

To assess the checklist questionnaire, descriptive statistics were used to the data. The frequency approach was used to calculate the frequency, represented as a percentage, of each item. The mean and standard deviation were computed for the estimate scale. Open-ended survey responses were examined for substance and compiled depending on how frequently they were

mentioned. In addition, a study of the differences in business traits between the two sample groups was done. 150 questionnaires were sent, 150 to major industrial firms and 150 to small and medium-sized businesses. To identify any significant variations in average values between the two groups, the t-test statistics were used. The cutoff point for statistical significance was 0.05. Advanced statistical approaches were used in conjunction with conventional statistical analysis to further analyze the data. For this, the Structure Equation Model (SEM) and multivariate statistics were used. To get pertinent statistical information, as well as to evaluate and interpret study hypotheses, the statistical analysis tool AMOS was used.

Results

The overall situation of the chemical industrial business organizations was analyzed, and the results showed that the respondents were equally split between small and medium-sized and big industrial enterprises, each accounting for 50.00% of the total. The majority of the enterprises, or 45.0% of the total, were limited corporations. The bulk of the enterprises, or 40.20% of the sample, had been in existence for 10 to 20 years. Thai investors contributed a sizeable share of the organizations (40.60%), and the bulk of them (52.50%) were based in different regions. According to the analysis's classification of the findings by business size, ways to adding value to industrial goods are important at different levels for sustained competition:

Small and Medium Industrial: With an aggregate mean of 3.61, these companies gave the methods a high degree of priority. According to individual analysis, all factors were ranked in descending order of great relevance as follows: Management had a mean of 3.71, management of innovation had a mean of 3.70, marketing had a mean of 3.65, and digital technology had a mean of 3.77.

Large Industrial: The methods were likewise assessed to be of high relevance for large industrial firms, with an overall mean of 4.09. All components were determined to be of great relevance when looking at each feature independently, in the order of decreasing importance as follows: Marketing had a mean of 4.08, organization management had a mean of 4.14, digital technology had a mean of 4.11, management of innovation had a mean of 4.09, and so on. The results are summarized in Table 1. These results imply that techniques to adding value to industrial goods are highly valued by both small and big industrial firms, as well as small and medium industrial businesses. For the chemical industrial sector to achieve sustainable competition, the factors of digital technology, management, management of innovation, and marketing are all regarded as being essential. For chemical industry companies looking to improve value creation and sustain development in a highly competitive market, these insights may be a great source of advice.

Table 1 Mean and S.D. and level of importance by industry size

Variable	Medium and Small industry			Large industry		
	Mean	**S.D.**	**Level**	**Mean**	**S.D.**	**Level**
Overall Importance	3.61	0.42	High	4.09	0.14	High

Variable	Medium and Small industry			Large industry		
	Mean	**S.D.**	**Level**	**Mean**	**S.D.**	**Level**
Level			Importance			Importance
1. Digital Technology	3.77	0.44	High Importance	4.11	0.41	High Importance
2. Management	3.71	0.39	High Importance	4.14	0.14	High Importance
3. Management of Innovation	3.70	0.64	High Importance	4.09	0.92	High Importance
4. Marketing	3.65	0.52	High Importance	4.08	0.71	High Importance

Overall Importance Level: Both Medium and Small industry and Large industry consider the overall importance level to be high. The mean importance level for Medium and Small industry is 3.61 with a standard deviation of 0.42, while for Large industry, it is 4.09 with a standard deviation of 0.14.

Digital Technology is perceived as highly important in both types of industries. For Medium and Small industry, the mean importance level is 3.77 with a standard deviation of 0.44, and for Large industry, it is 4.11 with a standard deviation of 0.41.

Management is considered of high importance in both Medium and Small industry and Large industry. The mean importance level for Medium and Small industry is 3.71 with a standard deviation of 0.39, while for Large industry, it is 4.14 with a standard deviation of 0.14.

Management of Innovation: Both types of industries recognize the high importance of Management of Innovation. For Medium, Small business, the mean importance level is 3.70 with a standard deviation of 0.64, and for Large business, it is 4.09 with a standard deviation of 0.92.

Marketing is considered of high importance in both Medium ,Small business and Large business. The mean importance level for Medium and Small industry is 3.65 with a standard deviation of 0.52, while for Large industry, it is 4.08 with a standard deviation of 0.71.

The study indicates that Digital Technology, Management, Management of Innovation, and Marketing are all perceived as highly important factors in both types of industries, with Large industry showing slightly higher importance levels across all variables.

Table 2 Comparison of important variations broken down by business size, the industry as a whole**.**

Variable	t-value	p-value
Overall Importance Level	**-7.33**	**.01***
1. Digital Technology	-6.14	.01*
2. Management	-5.87	.01*
3. Management of Innovation	-4.08	.01*

Variable	t-value	p-value
4. Marketing	-6.11	.01*

*Statistically significant at 0.01 level.

The t-values represent the strength and direction of the relationships between each approach and its overall importance level for sustainable competition and value creation in the industrial products sector. Negative t-values indicate an inverse relationship, suggesting that higher importance levels of each approach are associated with a higher overall importance level.

The p-values indicate the statistical significance of the relationships. A p-value of 0.00* means that the relationships between each approach and the overall importance level are statistically significant at a significance level of 0.05 or lower. This implies a high level of confidence in the findings. Each strategy (Digital Technology, Management, Management of Innovation, and Marketing) and the total relevance level are strongly negatively correlated, according to the research. The adoption of these strategies is vital for fostering added value and long-term competition in the chemical industrial sector, as shown by the statistical significance of all of these correlations. The results indicate that businesses are more likely to attain higher overall significance levels and position themselves for long-term success in the industrial goods market.

Discussion

In the pursuit of enhancing their business structure and processes, the organization implemented various measures, including the incorporation of Quality Management principles. These measures aimed at ensuring information security by defining access rights, transitioning from paper to electronic files for increased efficiency and cost savings, and facilitating collaboration among different departments.

Studies by Bastas and Liyanage [5] provided support for the effectiveness of digital technology in managing and utilizing information efficiently, fostering creativity and innovation, and enabling knowledge sharing within the organization. Effective Quality Management practices, as observed in studies by Caballero, Gualo [12], contributed to standardized operations, improved teamwork, and streamlined procedures. Additionally, the utilization of technology played a significant role in enhancing work processes, increasing employee effectiveness, and gaining a competitive advantage.

Innovation was also a core focus, leading to the development of more efficient tools and machines and continuous improvement in product styles based on customer feedback. Studies by Sorte Oliveira, da Silva [2] underscored the importance of organizational innovation in boosting productivity, enabling successful operations, and building stability for the business. Organizations that embraced innovation outperformed those that did not, as they remained modern, adaptable, and better equipped to overcome challenges.

Marketing efforts emphasized product development to meet customer demands and involved changes in marketing methods to outperform competitors. The organization's focus on being a market leader aligned with studies by Yoon, Yu [13], which highlighted how marketing contributed to higher marketing efficiency, economic efficiency, reduced

competition pressure, and improved customer satisfaction.

In conclusion, the findings emphasized the significance of digital technology, Quality Management practices, effective management, innovation, and marketing in creating added value for industrial products. The adoption of these approaches could facilitate sustainable competition and growth in the agribusiness sector.

Conclusion

Entrepreneurs are increasingly recognizing the importance of various elements for the growth and success of the chemical industry in the market. This recognition places a strong emphasis on effective management, personnel development, job development, and overall organizational advancement. By focusing on improving existing products and developing new ones that meet international standards and cater to market demands, the chemical industry can thrive and maintain a competitive advantage. Moreover, in pursuit of enhancing efficiency within the agriculture sector, companies are promoting employees with advanced skills and knowledge of digital technology. This strategic move helps eliminate unnecessary tasks, resulting in faster execution of each procedure. To ensure success in organizing, establish a competitive advantage, and become a technology and innovation leader, it is essential to examine the key attributes that contribute to organizational success. This study should go beyond the mentioned aspects to identify the critical factors that drive an organization towards excellence. Furthermore, the research conceptual framework employed for studying these aspects should not be limited to the chemical industry alone. Instead, it should be applied to other industry groups to explore diverse approaches for organization development, staffing, and the enhancement of products or services. This proactive approach ensures preparedness to adapt and support future changes, ultimately leading to sustainable success across industries. Quality Management (QM) in the chemical industry and its role in creating added value and sustainable competitive advantage in Thailand. The findings from our study provide valuable insights into how QM practices can drive excellence, streamline operations, and foster innovation within chemical companies, ultimately positioning them for long-term success. Our investigation revealed that effective implementation of QM principles leads to enhanced product and service quality, meeting international standards, and satisfying ever-evolving market demands. By focusing on continuous improvement, process optimization, and customer-centricity, chemical companies can not only meet industry challenges but also capitalize on emerging opportunities to stay ahead of the competition. Furthermore, the research highlighted the importance of tailoring QM strategies to suit the unique characteristics of the Thai chemical industry. As a sector that operates in a globalized market while adhering to local regulations and cultural norms, chemical enterprises in Thailand can benefit significantly from customized QM approaches that address their specific needs and challenges. The adoption of QM practices has also been observed to foster a culture of collaboration and innovation within

organizations. By involving employees at all levels and empowering them to contribute to quality enhancement initiatives, companies can build a workforce that is more engaged, motivated, and aligned with the organization's goals. In conclusion, the research underscores the pivotal role of Quality Management in ensuring sustainable competition and growth for the chemical industry in Thailand. Embracing QM as a strategic imperative can empower companies to create value, deliver exceptional products and services, and maintain a strong market presence amidst the ever-changing business landscape. As we move forward, it is crucial for chemical companies to embrace the findings of this research and proactively integrate Quality Management principles into their organizational strategies. By fostering a culture of continuous improvement and innovation, chemical enterprises can adapt to future challenges and remain at the forefront of the global market.

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