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Innovation and Tqm Performance of Selected Automobile Parts Manufacturing Industry in Guangdong China: Inputs for A Strategic Roadmap for Continuous Improvement

Kun Li

[1] Adamson University, Manila, 1000, Philippines
[2] Manila Tytana Colleges, Pasay, 1300, Philippines

Abstract: The automotive industry is in the wave of technological change, and the rise of new energy vehicles requires continuous innovation of traditional automotive parts. TQM practice affects innovation, and in order to improve innovation, it is necessary to correctly identify the areas that perform well or need improvement. One way to identify these areas is through surveys of satisfaction with TQM practice and innovation. Few studies analysis TQM impact on innovation focus on automotive parts manufacturing industry. This study takes automotive parts manufacturing industry of Guangdong Province as the research object, explores the relationship between TQM practice and innovation, and fills the gaps in the literature mentioned above. By analyzing TQM practice's extend and innovation's level, explore the influence of different elements TQM practice on each dimension of innovation, and study the significance of TQM practice on each dimension of innovation. Finally, according to the research results, continuous improvement strategic roadmap of automotive parts manufacturing industry is put forward. The roadmap enables company to improve operational performance, enhance product quality, and build a sustainable competitive advantage in the global automotive supply chain. The quantitative data were collected from 342 respondents who participated in the survey of automotive parts manufacturing managers in Guangdong Province. The quantitative data were analyzed by mean value, variance and regression analysis, supplemented by SPSS 26.0 software. The quantitative results show that there is a complex relationship between TQM practice and innovation in automotive parts manufacturing industry. The conclusion and influence are discussed.

Keywords: TQM, Innovation, Strategic Roadmap, Continuous Improvement.

1. Introduction

1.1. Background of the Study

Guangdong is a major province of automobile, especially new energy vehicles, with a relatively complete industrial chain of vehicle and parts research and development, design, production and sales. At present, the distribution of automobile parts manufacturing industry in Guangdong Province is relatively scattered, and important automobile parts are formed mainly by joint ventures of multinational automobile parts giants and narrow-capital enterprises.

"14th Five-Year Plan" pointed out that adhere to innovation-driven development, in-depth implementation of manufacturing power strategy, enhance the competitive advantage of the manufacturing industry, promote the high-quality development of the manufacturing industry, and now the TQM practice and innovation performance is more and more attention. Automobile parts manufacturing industry is one of the key directions in the process of industrialization in China. It is of great practical significance to study the influence of TQM practice in automobile parts manufacturing industry on innovation performance.

As the most representative management control program in the industrial era, can TQM promote enterprise innovation? Some foreign scholars have studied it, but there are still some controversies about its relationship in these literatures. Some scholars believe that organizations cannot avoid major innovations to enhance core competitiveness; Some people also believe that the relationship between TQM and innovation is complicated, the environment is different, and the conclusion is not the same, and the influence of TQM on innovation depends on the composition of its specific elements.

Does the level of TQM practice really become an important factor restricting the innovation of China's automobile parts manufacturing industry? What are the reasons for this? At present, the empirical studies in this field at home and abroad mainly discuss the overall relationship between the two, TQM is currently widely used in the manufacturing industry.

This paper will take the automobile parts manufacturing industry of Guangdong Province as the research object, discuss the impact of TQM on innovation, and explore which variable in TQM has the greatest impact on innovation, so as to provide guidance for organizations to concentrate resources for effective innovation management and formulate management strategy combinations under different internal and external environmental influences. At the same time, it provides a theoretical basis for the suitability of TQM's promotion to the R&D departments and innovative organizations of the automobile parts manufacturing industry in Guangdong Province, and makes investment in the strategic roadmap for continuous improvement of the automobile parts manufacturing industry in Guangdong Province.

1.2. Statement of the Problem

The main purpose of this study is to propose the influence of TQM practice on innovation in Guangdong automobile parts manufacturing industry on the basis of the survey results.

Specifically, from the perspective of the relevant managers of the automobile parts manufacturing industry in Guangdong Province as respondents, the influence of TQM practice on innovation was determined to provide a theoretical basis for the suitability of TQM promotion to the R&D departments and innovative organizations of the automobile parts manufacturing industry in Guangdong Province.

In summary, the researchers attempted to answer the following specific questions:

(1) What is the extent of TQM practices in the automobile parts manufacturing industry in Guangdong Province in terms of:

1.1 Leadership;
1.2 Personnel Management;
1.3 Customer Focus;
1.4 Strategic Plan;
1.5 Process Management; and
1.6 Information Analysis?

(2) What is the level of Innovation in the automobile parts manufacturing companies in terms of:

2.1 Technological Innovation;
2.2 Product Innovation;
2.3 Service Innovation; and
2.4 Process Innovation?

(3) Do the TQM practices significantly influence Innovation in the automobile parts manufacturing companies?

(4) What strategic roadmap for continuous improvement can be proposed for the automobile parts manufacturing industry in Guangdong China?

1.3. Hypotheses

In summary, the hypothesis proposed in this paper is as follows:

Ho1 - TQM do not significantly influence Innovation in the automobile parts manufacturing companies.

1.4. Scope and Limitations

This study takes the existing automobile parts manufacturing industry in Guangdong Province as the research object. Businesses that have been operating since 2019 until 2024 are still operating, meaning they were in the market before the COVID-19 pandemic began and have not ceased operations. These entrepreneurs better explained the challenges they encountered and how they became resilient in their operations and continued to be sustainable. Data were collected from first-line and above manager of manufacturing process, procurement, production and infrastructure management departments of relevant small and medium-sized automobile parts manufacturing enterprises in Guangdong Province, through in-depth interviews with selected participants.

Some limitations of the study are as follows: The number and universality of the research samples are still insufficient. This paper mainly focuses on 342 research samples of automobile parts manufacturing industry in Guangdong Province, which leads to the limitation of the universality of the samples. Although the samples are strictly screened, the survey does not involve the past situation of the existing automobile parts manufacturing industry in Guangdong Province, which may mistake the simultaneous phenomenon for a causal phenomenon. When studying TQM and enterprise innovation, data on enterprise innovation mainly come from questionnaire data, which are subjective rather than publicly disclosed objective data, which will have a certain impact on the research results of this paper. And then the study will only be focusing on TQM practices and level of innovation of automobile parts manufacturing industry only. To study the relationship between the two, we can also study the relationship between the two through mediate variables, that is, from the perspective of mechanism. However, this paper does not analyze from the perspective of mechanism, which is difficult to provide specific strategy guidance for enterprises.

1.5. Related Literature

Wang Yulin (2020) concluded through research that the methods for enterprises to implement TQM mainly include strengthening the supervision of various links such as product planning, design, manufacturing, auxiliary and use, so as to improve product quality. Chen Qingkun (2020) proposed that the application of TQM in enterprises must meet the requirements of "three all and one more". For the practical operation of TQM, scholars have proposed specific and operable studies on the TOM of the whole process, the quality management of all personnel, the TOM of all elements and the quality management of multiple methods.

Dinu Vasile (2020) scholars believe that TQM is a method aimed at continuous quality improvement and performance to satisfy or exceed expect of customer, and it is a method to lead organizations of quality-centered, as it is the primary driving force that can guide organizations towards business excellence. Meanwhile, on account of the all members part, the efficiency of long-term activities was pursue, the practical satisfaction of customers, and facilitate the members come from the organization and society. By analysis the relation with innovation and TQM, scholar Sciarelli, M., Tani, M (2022) believes that quality management can promote innovation management strategically and create an organizational environment conducive to innovation. Li Shuhua (2021) believes that it is essential for the enterprises develop to sustainable and healthy to integrate the concept of TQM with the tolerance of corporate culture through the application of scientific management methods, so as to build a system of quality management that belongs to the enterprise itself. The healthy development of the enterprise economy benefits from the fine management of the product quality of the enterprise, and the improvement of the quality management system will be further improved High customer satisfaction, improve the economic benefits of enterprises.

Many studies have pointed out that innovation ability is an important source of sustainable advantages for enterprises in the ever-changing development situation (Zhang Lu et al., 2021), and total quality management is one of the most important factors affecting innovation (Zhang Zhiqiang, 2021; Sukumar, S, 2018).

There is a view that there is a positive correlation between TQM and innovation (Lebedeva & Yakovlev, 2021; Sirisan, 2020) pointed out that the internal and external factors affecting enterprise innovation activities are related to the practice of TQM, such as employee motivation, team cooperation, continuous improvement and customer focus. Only by continuous improvement can enterprises continuously improve the quality level, meet the ever-increasing market requirements, promote innovation to achieve leadership and excellence, and meet the potential demand of the market, from passive to active, from gradual to radical innovation (China Quality Association, 2020).

Another view is that from different perspectives, TQM is

negatively correlated with innovation (Moura& Dogan, E, 2022) or no significant relationship exists (Antunes, 2018; Firman, al., 2020). Due to the different types of innovation introduced, progressive innovation is favored over radical innovation (Zhang., 2023). organizations that implement TQM are more likely to become imitators or followers because TQM does not motivate organizations to consider radically innovative products (Honarpour et al., 2018). Van Looy, A., & Poels, G. (2020) also pointed out that TQM practices will form organizational inertia, which may crowd out radical innovation as organizational inertia becomes entrenched and repetitive.

2. METHODS

2.1. Research Designs

This study mainly adopts quantitative research method, aiming at comprehensively and deeply exploring the relationship between TQM practice and innovation in Guangdong automobile parts manufacturing industry, and providing reference and guidance with practical application value for enterprise practice. The questionnaire contains questions specific to TQM practice, covering each key dimension of TQM practice to comprehensively assess the actual situation of the enterprise in TQM practice, and questions designed to measure the level of innovation of the enterprise, including different types of innovation such as technological innovation, product innovation, service innovation and process innovation.

2.2. Data Management

2.2.1. Data according to source

Quantitative data will be used in the study design, specifically to examine the degree of TQM practice, the level of innovation, and whether TQM affects innovation. Quantitative data will also determine a comparative analysis of the auto parts manufacturing industry in Guangdong Province.

Collect and analyze the data of questionnaire survey and conduct quantitative analysis. In the quantitative stage, questionnaire survey will be adopted to collect quantitative data on TQM's practice level, innovation level, basic information of respondents and their enterprises, including employment information, establishment time, scale, ownership, research and development status of enterprises. Also in the quantitative stage, the impact of TQM practice on innovation is analyzed.

2.2.2. Data according to methods

This paper adopts a 4-point Likert scale, 1-4 indicates the degree of conformity between the questions and the actual situation of the company, 1 is strongly disagree, 2 is disagree, 3 is agree, 4 is strongly agree. Likert scales usually consist of a series of statements or questions, each followed by a series of response options that indicate a different intensity of attitude. These response options are usually presented in numbers or text to reflect how much respondents agree with the statement or question. The attitude score is usually calculated by converting the response rating for each statement or question into a number and then adding the numbers for all statements or questions to get the total score. The higher the total score, the higher the respondents' agreement with the measurement object.

2.3. Sampling Design

2.3.1. Sample Population

The development of the automobile industry has formed six large-scale industrial bases in China, including the Yangtze River Delta, the Pearl River Delta, the central, southwest, Northeast and Bohai industrial bases, and the output value of automobile parts accounts for about 80% of the whole industry. The research objects cover Guangzhou, Zhongshan, Shantou, Chaoshan, Meizhou, Dongguan and other Pearl River Delta regions, which ensures the geographical coverage of the survey.

2.3.2. Respondents

The respondents mainly chose first-line or above managers of the enterprise, with a total of 342 people. According to the ratio of first-line managers, middle managers and senior managers of the enterprise, the ratio is about 6:3:1, and the distribution table is shown in Table 1.

2.3.3. Research Instrument

The research tool used in this study is a questionnaire to collect TQM practice, innovation and other relevant data of enterprises related to the automobile parts manufacturing industry in Guangdong Province. In order to obtain quantitative answers, this questionnaire is a closed type of questions.

2.4. Statistical Treatment

Since the data will be obtained through surveys, quantitative data analysis should first be carried out using the following methods :(1) Statistical processing of the data to answer the questions described in Chapter 1; (2) Frequency and percentage will be used for the statement in the first part of the questionnaire, which describes the company profile; (3) The Mean and SD will be used to answer the statements in questions 1, and 2, which describe the level of TQM practice and innovation; (4) Regression analysis will be used to answer research questions 3, and hypothesis statements 1. Because the researchers wanted to find the relationship between TQM practice and innovation from the perspective of respondents, regression analysis were used, and model errors were reduced.

3. Results

3.1. Extent of TQM Practices

The extent of TQM practice is analyzed from six aspects: leadership, personnel management, customer focus, strategic plan, process management and information analysis.

Table 1. Extent of TQM Practice in terms of Leadership

Variable	Mean	SD	Adjectival Rating	Interpretation
Our senior leadership is actively involved in quality management and process improvement	2.99	1.01	Agree	Moderately Practiced
Our senior leadership has established a realistic quality policy and quality objectives	3.0	1.07	Agree	Moderately Practiced
Our senior leadership encourages employees to actively participate in quality management and improvement activities	2.96	1.08	Agree	Moderately Practiced
Our senior leadership empowers employees to solve quality problems	3.05	1.03	Agree	Moderately Practiced
Overall	3.00	.95	Agree	Moderately Practiced

Table 1 shows the extent to which TQM practices are measured from a leadership perspective. The table shows that items 1, 2, 3 and 4 have been appropriately practiced (M = 2.99, 3.00, 2.96, 3.05; SD = 1.01, 1.07, 1.08, 1.03). This shows that leaders are actively involved in quality management, established the quality policy and quality objectives, encourage employee participation, and empower employees to solve quality problems. On the whole, the table shows that enterprises implement leadership appropriately (M = 3.00; SD =.95), reflecting respondents' widespread belief that despite senior leadership involvement in quality management and improvement, there is still have room for growth.

The standard deviations for items 1, 2, 3, and 4 ranged from 1.01 to 1.08, slightly above the threshold for a 4-point scale.8, suggesting some heterogeneity in the responses, with some respondents rating leadership above or below average.

Table 2. Extent of TQM Practice in terms of Personnel Management

Variable	Mean	SD	Adjectival Rating	Interpretation
We conduct organization-level training and planning for all employees, including career planning	2.99	1.05	Agree	Moderately Practiced
Our organization is able to communicate effectively "from top to bottom" and "from bottom to top"	2.99	1.05	Agree	Moderately Practiced
We regularly evaluate employee satisfaction and propose relevant strategies to improve satisfaction	3.02	1.04	Agree	Moderately Practiced
We actively improve organizational performance from the employee standpoint	2.99	1.06	Agree	Moderately Practiced
We provide a healthy, safe and highly beneficial working environment for all employees	3.03	1.05	Agree	Moderately Practiced
Overall	3.01	.93	Agree	Moderately Practiced

Table 2 shows the extent to which TQM practices are measured from a personnel management perspective.

The table shows that items 1, 2, 3, 4 and 5 have been appropriately practiced (M = 2.99, 2.99, 3.02, 2.99, 3.03; SD = 1.05, 1.05, 1.04, 1.06, 1.05). This indicates that organizations train and plan for all employees at the organizational level, including career planning, communicate effectively from top to bottom and from bottom to top, evaluate employee satisfaction regularly and propose corresponding strategies to improve employee satisfaction and actively improve organizational performance, and provide a healthy, safe and highly rewarding work environment for all employees. The appropriate level of practice may be due to resource constraints (e.g., money, time, manpower) in implementing the measures. For example, while a certain level of staff training and planning is undertaken, it may not be possible to devote sufficient resources to reach the level of widespread practice. The heterogeneity of SD may be caused by individual cognitive differences, intra-organization differences and measurement differences. For example, some employees may be satisfied with aspects such as training, communication and working environment, while others may think that there is still much room for improvement. This difference in individual cognition will lead to the dispersion of data, which will increase the standard deviation.

On the whole, the table shows that enterprises have implemented personnel management appropriately (M = 3.01; SD =.93), which means that the surveyed companies are relatively good in the implementation of personnel management, and respondents have some heterogeneity in the implementation of personnel management.

Table 3. Extent of TQM Practice in terms of Customer Focus

Variable	Mean	SD	Adjectival Rating	Interpretation
Our internal staff can effectively communicate and understand customer needs and expectations	2.87	1.03	Agree	Moderately Practiced
We invite customers to participate in the design process of our products	2.89	1.01	Agree	Moderately Practiced
We are always in close contact with our customers and provide them with convenient means of communication	2.93	1.04	Agree	Moderately Practiced
We have a clear and effective process for resolving customer complaints	2.94	1.03	Agree	Moderately Practiced
We regularly evaluate customer satisfaction and propose strategies to improve it	2.91	1.05	Agree	Moderately Practiced
Overall	2.90	.90	Agree	Moderately Practiced

Table 3 shows the extent to which TQM practices are measured from a customer focus perspective. The table shows that items 1, 2, 3, 4 and 5 have been appropriately practiced (M = 2.87, 2.89, 2.93, 2.94, 2.91). This indicates a level of agreement in the leadership's efforts to understand customer needs, engage customers in design, maintain close relationships, resolve complaints, and assess customer satisfaction. However, the standard deviations obtained for items 1, 2, 3, 4, and 5 (SD = 1.03, 1.01, 1.04, 1.03, 1.05) are all slightly above the 4-point threshold.8. This suggests some heterogeneity in the responses, with some respondents rating customer focus above or below average. On the whole, the table shows that enterprises implement moderately in customer focus (M = 2.90; SD =.90), which means that most respondents perform moderately well in implementing customer focus, but there is some heterogeneity among respondents in implementing customer focus.

Table 4. Extent of TQM Practice in terms of Strategic Plan

Variable	Mean	SD	Adjectival Rating	Interpretation
We have a company purpose that is discussed throughout the company and supported by employees	2.92	1.02	Agree	Moderately Practiced
We have a comprehensive and systematic planning process to set and test short-term and long-term goals	2.90	1.03	Agree	Moderately Practiced
We have developed and deployed quality strategic objectives and quality strategic plans	2.87	1.03	Agree	Moderately Practiced
We have normative documents that cover all business operations and are clearly described and agreed upon by senior leadership	2.95	1.03	Agree	Moderately Practiced
Overall	2.91	.91	Agree	Moderately Practiced

Table 4 shows the extent to which TQM practices are measured from a strategic plan perspective.

From the perspective of mean, the table shows that items 1, 2, 3 and 4 are properly practiced (M = 2.92, 2.90, 2.87, 2.95; SD = 1.02, 1.03, 1.03, 1.03). This indicates a degree of consensus among respondents on the existence of company objectives, a comprehensive planning process, quality strategic objectives and quality strategic plans, and normative documents for business operations agreed upon by senior leadership. The degree to which the company's purpose is practiced, the integrity of the planning process, the comprehensiveness of stakeholder considerations, and the validity of written statements may all contribute to the degree to which these items are practiced appropriately.

From SD analysis, we can see that items 1, 2, 3 and 4 are all slightly above the threshold of the 4-point scale of.8, indicating some heterogeneity in the responses, with some respondents rating the strategic plan above or below the average.

From a comprehensive point of view, the table shows that enterprises implement strategic plan appropriately (M = 2.91; SD =.91), which means that most respondents received some approval for implementing the strategic plan, but not high approval. Respondents have some heterogeneity in the implementation of strategic plans.

Table 5. Extent of TQM Practice in terms of Process Management

Variable	Mean	SD	Adjectival Rating	Interpretation
We have adopted the quality management of the product manufacturing process	2.98	1.06	Agree	Moderately Practiced
We design simple and effective processes in the factory to prevent errors	2.97	1.08	Agree	Moderately Practiced
The organization's clear, standardized and documented process guidelines are well understood by our employees	2.98	1.04	Agree	Moderately Practiced
We make extensive use of statistical techniques to improve processes and reduce variation	2.95	1.06	Agree	Moderately Practiced
We strive to build long-term relationships with our suppliers	2.98	1.07	Agree	Moderately Practiced
We use a supplier rating system to select suppliers and monitor their performance	2.90	1.08	Agree	Moderately Practiced
Overall	2.96	.95	Agree	Moderately Practiced

Table 5 shows the extent to which TQM practices are measured from a process management perspective. The table shows that items 1, 2, 3, 4, 5 and 6 have been properly practiced (M = 2.98, 2.97, 2.98, 2.95, 2.98, 2.90; SD = 1.06, 1.08, 1.04, 1.06, 1.07, 1.08). This indicates a general consensus among leaders on the design of simple processes to prevent errors, an understanding of clear and documented process guidelines, and the use of statistical techniques to improve processes. However, the standard deviation is between 1.04 and 1.08, slightly higher than the threshold of the 4-point scale.8. This suggests some heterogeneity in the responses, with some respondents rating process management above or below average.

On the whole, the table shows that enterprises have implemented process management appropriately (M = 2.96; SD =.95), which means that most respondents still have room for improvement in implementing process management. Respondents have some heterogeneity in the implementation of process management.

Table 6. Extent of TQM Practice in terms of Information Analysis

Variable	Mean	SD	Adjectival Rating	Interpretation
We have an effective performance measurement system to track overall organizational performance	3.01	.97	Agree	Moderately Practiced
We can always prepare and provide the latest data and information on organizational performance to those who need it	3.04	.95	Agree	Moderately Practiced
Senior management meets regularly to review organizational performance and use it as a basis for decision making	3.08	.97	Agree	Moderately Practiced
We are actively pursuing a competitive benchmarking program to measure our performance against industry "best practices"	3.01	.99	Agree	Moderately Practiced
Overall	3.04	.80	Agree	Moderately Practiced

Table 7. Overall Extent of TQM Practice in all areas

Variable	Mean	SD	Adjectival Rating	Interpretation
Leadership	3.00	.95	Agree	Moderately Practiced
Personnel Management	3.01	.93	Agree	Moderately Practiced
Customer Focus	2.91	.90	Agree	Moderately Practiced
Strategic Plan	2.91	.91	Agree	Moderately Practiced
Process Management	2.96	.95	Agree	Moderately Practiced
Information Analysis	3.04	.80	Agree	Moderately Practiced
Overall	2.97	.57	Agree	Moderately Practiced

Table 6 shows the extent to which TQM practices are measured from an information analysis perspective. The table shows that items 1, 2, 3 and 4 have been appropriately practiced (M = 3.01, 3.04, 3.08, 3.01; SD =.97,.95,.97,.99). This indicates that respondents generally agree with having an effective performance measurement system, providing up-to-date data and information on organizational performance, and actively pursuing competitive benchmarking programs. However, the standard deviation is between.95 and.99, slightly higher than the threshold of.8 on the 4-point scale. This suggests some heterogeneity in the responses, with some respondents rating the information analysis above or below average. In summary, the table shows that enterprises have implemented information analysis appropriately (M = 3.04; SD =.80), which means that most respondents are above average in implementing information analysis and not extensive. Respondents have a more unified view of the extent to which organizations practice TQM in information analysis.

Table 7 shows the extent to which TQM practices are measured from all angles. The table shows that leadership, personnel management, customer focus, strategic plan, process management and information analysis are practiced to an appropriate degree (M = 3.00, 3.01, 2.91, 2.91, 2.96, 3.04; SD =.95, .93, .90, .91., 95, .80). This indicates that respondents generally agree that organizations implement TQM practices to some extent, but not widely. On the whole, the table shows that enterprises implement TQM Practice appropriately (M = 2.97; SD =.57), which means that most respondents show a high level of consistency and balance in their TQM practice.

3.2. Level of Innovation

The level of enterprise innovation is analyzed from four aspects: technology innovation, product innovation, service innovation and process innovation.

Table 8. Level of Innovation in terms of Technological Innovation

Variable	Mean	SD	Adjectival Rating	Interpretation
The form of our products or services is constantly updated	3.07	.87	Agree	Moderate Level of Innovation
We constantly improve the production process to improve production efficiency	3.09	.83	Agree	Moderate Level of Innovation
We are usually at the forefront of technology	3.08	.83	Agree	Moderate Level of Innovation
Overall	3.08	.74	Agree	Moderate Level of Innovation

Table 8 shows the extent to which the level of innovation is measured in terms of technological innovation. The table shows the appropriate level of innovation for items 1, 2 and 3 (M = 3.07, 3.09, 3.08; SD =.87, .83, .83). This indicates that the company has made some efforts in updating products/services, processes and technology, but not at a high level. Product or service form updates, process updates and technological frontier are all factors that affect its score, for example, it may only be a small improvement on the basis of an existing product or service, rather than the launch of an entirely new and disruptive product or service form.

However, the standard deviation is between.83 and.87, slightly higher than the threshold of.8 on the 4-point scale. This suggests some heterogeneity in the responses, with some respondents rating technological innovation above or below average.

On the whole, the table shows that the technological innovation level of enterprises is at the medium level (M = 3.08; SD =.74), which means that the level of technological innovation in most enterprises is not very high. Respondents have a more unified view of the level of innovation in the organization in terms of technological innovation.

Table 9. Level of Innovation in terms of Product Innovation

Variable	Mean	SD	Adjectival Rating	Interpretation
Our new product has a high degree of novelty	3.24	.78	Agree	Moderate Level of Innovation
We use recent technological innovations in our new products	3.24	.80	Agree	Moderate Level of Innovation
We develop new products very quickly	3.22	.80	Agree	Moderate Level of Innovation
We have brought a large number of new products to market	3.30	.75	Strongly Agree	High Level of Innovation
We identify new market opportunities and launch innovative products that are in demand	3.30	.77	Strongly Agree	High Level of Innovation
Overall	3.26	.64	Agree	High Level of Innovation

Table 9 shows the extent to which the level of innovation is measured in terms of product innovation. It can be seen from the overall data analysis that the innovation level of items 1, 2 and 3 is appropriate (M = 3.24, 3.24, 3.22; SD =.78,.80,.80), the innovation level of items 4 and 5 is high (M = 3.30, 3.30; SD =.75,.77). This indicates moderate performance in terms of product novelty, use of the latest technological innovations, speed of product development, and high levels of innovation in terms of bringing a large number of new products to market and having a large number of unique new products. The standard deviation is between.78 and.80, not higher than the threshold of.8 on the 4-point scale. This suggests that there are more unified views in the answers. Overall, the table shows that the enterprise is at a high level of product innovation (M = 3.26; SD =.64), which means that most companies have a high level of product innovation. Respondents have a more unified view of the level of innovation in the organization in terms of product innovation.

Table 10. Level of Innovation in terms of Service Innovation

Variable	Mean	SD	Adjectival Rating	Interpretation
Our service concept is constantly updated	3.06	.82	Agree	Moderate Level of Innovation
There is a high degree of innovation in our technical services	3.02	.87	Agree	Moderate Level of Innovation
Our service experience is very satisfactory	3.04	.82	Agree	Moderate Level of Innovation
We continuously optimize the service process effectively	3.01	.90	Agree	Moderate Level of Innovation
We have a high desire for continuous improvement	3.04	.84	Agree	Moderate Level of Innovation
Overall	3.03	.67	Agree	Moderate Level of Innovation

Table 10 shows the extent to which the level of innovation is measured in terms of service innovation. From average analysis alone, the innovation level of items 1, 2, 3, 4 and 5 is appropriate (M = 3.06, 3.02, 3.04, 3.01, 3.04; SD =.82,.87,.82,.90,.84). This indicates that the company has a certain degree of innovation in service concept, technical service, service experience, service process optimization, and continuous improvement willingness, but the level is not high. Limited novelty of service renewal, insufficient technical service innovation, room for improvement of service experience, limitations of service process optimization, and insufficient continuous improvement may be the reasons for the appropriate level of innovation. For example, it may be an improvement on an existing service model, rather than an entirely new service concept.

From the perspective of comprehensive mean and SD, the table shows that the service innovation level of enterprises is at a medium level (M = 3.08; SD =.74), which means that the level of service innovation in most enterprises is not very high. Respondents have a more unified view of the level of innovation in the organization in terms of service innovation.

Table 11. Level of Innovation in terms of Process Innovation

Variable	Mean	SD	Adjectival Rating	Interpretation
Our company is highly competitive in technology	2.99	.88	Agree	Moderate Level of Innovation
We quickly grasp the latest techniques in the innovation process	2.98	.83	Agree	Moderate Level of Innovation
We update the technology in the innovation process	3.06	.88	Agree	Moderate Level of Innovation
Our processes, processes and technologies change rapidly	3.06	.88	Agree	Moderate Level of Innovation
Overall	3.02	.75	Agree	Moderate Level of Innovation

Table 11 shows the extent to which the level of innovation is measured in terms of process innovation.

Each data can be obtained in combination with each other, and the innovation level of items 1, 2, 3 and 4 is appropriate (M = 2.99, 2.98, 3.06, 3.06; SD =.88,.83,.88,.88). This indicates that there is a certain innovation in the technical competitiveness of enterprises, including the latest technological innovation, constantly updated technology, rapid process change, but the level is not high. The appropriate level of innovation can be caused by limited technological competitiveness, get up to speed on the latest technology, the limitations of process and technological change, for example, the company may have a certain technological advantage in some fields, but it is not in a leading position in the overall market. The standard deviation is between.83 and.88, slightly higher than the threshold of.8 on the 4-point scale. This suggests some heterogeneity in the responses, with some respondents rating process innovation above or below average. On the whole, the table shows that the technological innovation level of enterprises is at a medium level (M = 3.02; SD =.75), which means that the level of process innovation in most enterprises is not very high. Respondents have a more unified view of the level of innovation in the organization in terms of process innovation.

Table 12. Overall Level of Innovation

Variable	Mean	SD	Adjectival Rating	Interpretation
Technological Innovation	3.08	.74	Agree	Moderate Level of Innovation
Product Innovation	3.26	.64	Agree	High Level of Innovation
Service Innovation	3.03	.67	Agree	Moderate Level of Innovation
Process Innovation	3.02	.75	Agree	Moderate Level of Innovation
Overall	3.10	.43	Agree	Moderate Level of Innovation

Table 12 shows the extent to which the level of innovation is measured from all angles. The table shows that the innovation level of technology innovation, service innovation and process innovation is appropriate (M = 3.08, 3.03, 3.02; SD =.74,.67,.75), the innovation level of product innovation is high (M = 3.26; SD =.64). This indicates that respondents generally agree with the level of innovation in the company, but it is not broad. On the whole, the table shows that enterprises implement leadership appropriately (M = 3.10; SD =.43), which means that most respondents show a high level of consistency and balance in their level of innovation.

3.3. TQM Practice as Predictors of Innovation

Analyze the influence of TQM practice on different variables of enterprise innovation (technology innovation, product innovation, service innovation and process innovation).

Table 13. Multiple Regression Table: TQM Practice as predictors of the Level of Technological Innovation

Variable (Predictor)	Unstandardized Coefficient		Standardized Coefficient	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.725	.206	-	8.382	.000**
Leadership	.076	.043	.098	1.766	.078
Personnel Management	.066	.045	.083	1.469	.143
Customer Focus	.103	.046	.125	2.262	.024*
Strategic Plan	-.007	.047	-.008	-.143	.887
Process Management	.160	.044	.206	3.675	.000**
Information Analysis	.057	.052	.062	1.094	.275

Table 14. Multiple Regression Model Summary Table: TQM Practice as predictors of the Level of Technological Innovation

Model	R	R Square	F value	Sig
1	.371[a]	.138	8.923	.000**

Table 13 is a multiple regression table showing the predictive effect of TQM practice on the level of technological innovation.

The constant term (B = 1.725) indicates that the expected level of technological innovation in the absence of any TQM practice is 1.725 units. The t value was 8.382 and the p value was 0.000, indicating that the constant was statistically significant.

Process management has the highest standardization coefficient (Beta = 0.206), indicating that its relative impact on technological innovation is the strongest predictor. The standardization coefficients of customer focus (Beta = 0.125) and leadership (Beta = 0.098) are also positive, indicating that they have a positive impact on technological innovation. The positive effects of personnel management (Beta = 0.083) and information analysis (Beta = 0.062) were relatively weak. The standardization coefficient of strategic plan is negative (Beta = -0.008), which has a very weak negative correlation with technological innovation.

At the significance level of 0.05, customer focus (t = 2.262, p = 0.024) and process management (t = 3.675, p = 0.000) were significant predictors of technological innovation. Leadership (t = 1.766, p = 0.078) had marginal significance. Personnel management (t = 1.469, p = 0.143), strategic plan (t = -0.143, p = 0.887), and information analysis (t = 1.094, p = 0.275) were not significant predictors.

The above shows that process management and customer focus are key TQM practices that have a significant positive impact on technological innovation.

Table 14 is a summary of multiple regression models, showing the predictive effect of TQM practice on technological innovation level. R = 0.371 indicates a positive correlation. R squared = 0.138, which means that approximately 13.8% of the change in technological innovation can be explained by TQM practices included in the model.

The F value is 8.923 and the significance level is 0.000, which is highly significant. This suggests that, as a whole, the TQM practice set is significantly correlated with technological innovation.

The results show that although there is a relationship between TQM practice and technological innovation, the relationship is not strong. Only a small fraction (13.8%) of changes in technological innovation can be explained by the TQM practices considered in the model. The overall significant F-value indicates that the model is useful for predicting technological innovation as a whole, but the relatively low R-square value indicates that there may be other important factors not included in the model that also affect technological innovation.

According to the results of the regression model provided, TQM practice has a significant predictive effect on the level of technological innovation (Sig < 0.05), which means that all factors of TQM practice jointly affect the level of technological innovation.

Table 15. Multiple Regression Table: TQM Practice as predictors of the Level of Product Innovation

Variable (Predictor)	Unstandardized Coefficient		Standardized Coefficient	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.951	.175	-	11.139	.000**
Leadership	.068	.037	.102	1.863	.063
Personnel Management	.044	.038	.064	1.138	.256
Customer Focus	.015	.039	.021	.385	.700
Strategic Plan	.092	.040	.131	2.283	.023*
Process Management	.085	.037	.127	2.291	.023*
Information Analysis	.135	.044	.169	3.042	.003*

Table 16. Multiple Regression Model Summary Table: TQM Practice as predictors of the Level of Product Innovation

Model	R	R Square	F value	Sig
1	.395[a]	0.156	10.317	0.000**

Table 15 is a multiple regression table showing the predictive effect of TQM practice on product innovation level.

The constant term (B = 1.951) indicates that the expected level of product innovation in the absence of any TQM practice is 1.951 units. The T-value was 11.139 and the P-value was 0.000, indicating that the constant was statistically significant.

The standardization coefficient of information analysis was the highest (Beta = 0.169), indicating that information analysis had the strongest relative influence on product innovation among the predictors. strategic plan (Beta = 0.131) and process management (Beta = 0.127) also had a strong impact. Leadership (Beta = 0.102) and personnel management (Beta = 0.064) had weak positive effects. The positive standardization coefficient of customer attention is very weak (Beta = 0.021).

At the significance level of 0.05, strategic plan (t = 2.283, p = 0.023), process management (t = 2.291, p = 0.023) and information analysis (t = 3.042, p = 0.003) were significant predictors of product innovation. Leadership (t = 1.863, p = 0.063) had marginal significance. personnel management (t = 1.138, p = 0.256) and customer focus (t = 0.385, p = 0.700) were not significant predictors.

The above shows that information analysis, strategic plan, and process management are key TQM practices that have a significant positive impact on product innovation.

Leadership has some effect on product innovation, but not as strong as important predictors. In this model, personnel management and customer focus do not seem to have a significant impact on product innovation.

Table 16 is a summary of multiple regression models showing the predictive effect of TQM practices on product innovation levels.

R = 0.395 indicates a positive correlation. R squared = 0.156, which means that about 15.6% of the variation in product innovation can be explained by TQM practices included in the model.

The F-value is 10.317 and the significance level is 0.000, which is highly significant. This suggests that the collection of TQM practices as a whole is significantly correlated with product innovation.

Table 17. Multiple Regression Table: TQM Practice as predictors of the Level of Service Innovation

Variable (Predictor)	Unstandardized Coefficient		Standardized Coefficient	t	Sig.
	B	Std. Error	Beta		
(Constant)	2.034	.189	-	10.775	.000**
Leadership	.085	.040	.122	2.154	.032*
Personnel Management	.127	.041	.177	3.065	.002*
Customer Focus	.046	.042	.062	1.092	.276
Strategic Plan	-.046	.043	-.063	-1.055	.292
Process Management	.024	.040	.034	.600	.549
Information Analysis	.095	.048	.115	1.998	.047*

Table 18. Multiple Regression Model Summary Table: TQM Practice as predictors of the Level of Service Innovation

Model	R	R Square	F value	Sig
1	.313[a]	.098	6.068	.000**

Table 17 is a multiple regression table showing the predictive effect of TQM practice on service innovation level.

The constant term (B = 2.034) indicates that the expected level of service innovation in the absence of any TQM practice is 2.034 units. The T-value was 10.775 and the P-value was 0.000, indicating that the constant was statistically significant.

Personnel management has the highest standardization coefficient (Beta = 0.177), indicating that it has the greatest relative impact on service innovation. Leadership (Beta = 0.122) and information analytics (Beta = 0.115) also had a positive impact. Customer focus and process management has a weak positive normalization coefficient (Beta = 0.062, 0.034). The standardization coefficients for strategic plan are negative (Beta = -0.063), but their effects are relatively weak.

At the significance level of 0.05, leadership (t = 2.154, p = 0.032), personnel management (t = 3.065, p = 0.002) and information analysis (t = 1.998, p = 0.047) were significant predictors of service innovation.

Personnel management is the most important TQM practice for predicting service innovation. Leaders play an important leading role in service innovation. Information analysis can help enterprises understand customer needs, market trends and the dynamics of competitors, and provide an important basis for service innovation. Customer focus and process management has a weak influence on service innovation. Strategic plan and process management do not seem to have a significant positive impact on service

innovation.

Table 18 is a summary of multiple regression models showing the predictive effect of TQM practices on service innovation levels. R = 0.313 indicates a positive correlation. R squared = 0.098, which means that about 9.8% of the variation in service innovation can be explained by TQM practices included in the model.

The F value is 6.068 and the significance level is 0.000, which is highly significant. This shows that, taken as a whole, the collection of TQM practices is significantly correlated with service innovation.

The results show that there is a moderate relationship between TQM practice and service innovation. However, only a small percentage (9.8%) of changes in service innovation can be explained by TQM practices in this model. F-value significantly indicates that the model has a certain predictive effect on service innovation. But the low R-squared value suggests that there may be other important factors not included in the model that also affect service innovation.

Table 19. Multiple Regression Table: TQM Practice as predictors of the Level of Process Innovation

Variable (Predictor)	Unstandardized Coefficient		Standardized Coefficient	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.440	.202		7.117	.000**
Leadership	.051	.042	.064	1.197	.232
Personnel Management	.133	.044	.165	3.000	.003*
Customer Focus	.161	.045	.193	3.591	.000**
Strategic Plan	.132	.046	.161	2.846	.005*
Process Management	.044	.043	.055	1.014	.312
Information Analysis	.015	.051	.017	.302	.763

Table 20. Multiple Regression Model Summary Table: TQM Practice as predictors of the Level of Process Innovation

Model	R	R Square	F value	Sig
1	.431[a]	.186	12.735	.000**

Table 19 is a multiple regression table showing the predictive effect of TQM practice on the level of process innovation.

The constant term (B = 1.440) indicates that the expected level of process innovation in the absence of any TQM practice is 1.440 units. The T-value was 7.117 and the P-value was 0.000, indicating that the constant was statistically significant.

The standardization coefficient of customer attention was the highest (Beta = 0.193), indicating that it had the greatest relative impact on process innovation among the predictors. strategic plan (Beta = 0.161) and personnel management (Beta = 0.165) also had a strong impact. Leadership has a weak positive normalization coefficient (Beta = 0.064). The standardization coefficients for process management and information analysis are very weak (Beta = 0.055, 0.017).

At the significance level of 0.05, personnel management (t = 3.000, p = 0.003), customer focus (t = 3.591, p = 0.000) and strategic plan (t = 2.846, p = 0.005) were significant predictors of process innovation. Leadership (t = 1.197, p = 0.232), process management (t = 1.014, p = 0.312), and information analysis (t = 0.302, p = 0.763) were not significant predictors.

Customer focus, strategic plan and personnel management are key TQM practices that have a significant positive impact on process innovation. In this model, leadership, process management, and information analysis do not seem to have a significant impact on process innovation.

Table 20 is a summary of multiple regression models showing the predictive effect of TQM practices on the level of process innovation.

R = 0.431 indicates a positive correlation between the two. R squared = 0.186, which means that about 18.6% of the variation in process innovation can be explained by TQM practices included in the model.

The F-value is 12.735 and the significance level is 0.000, which is highly significant. This suggests that the set of TQM practices as a whole has a significant relationship with process innovation.

The results show that there is a moderate relationship between TQM practice and process innovation. While only a small percentage (18.6%) of process innovation changes in this model can be explained by TQM practices, this is a relatively high percentage compared to models for service innovation and product innovation. The significant F-value indicates that the model is useful in predicting process innovation. However, the relatively low R-squared value suggests that there may be other important factors not included in this model that also affect process innovation.

3.4. Strategic Roadmap

With the acceleration of globalization, international auto parts manufacturers have entered the Chinese market, and Chinese enterprises are also facing the pressure of competition in the international market.

The strategic roadmap aims to address these key factors - TQM and innovation - by providing a phased plan for continuous improvement. To guide Guangdong manufacturing enterprises to adopt advanced quality management system and cultivate innovation culture. By embracing this dual focus, the roadmap enables the company to improve operational performance, enhance product quality, and build a sustainable competitive advantage in the global automotive supply chain.

3.4.1. Vision

To be a global leader in the automotive parts manufacturing industry, consistently delivering innovative and high-quality products that meet changing customer needs through continuous improvement and sustainable practices, and achieving excellence in total quality management.

3.4.2. Mission

Improve operational efficiency, foster a culture of innovation, integrate total quality management (TQM) with innovation, and enhance the competitiveness of enterprises in the global automotive supply chain.

Stage 1: Assessment and Baseline Setting (Year 1)

Main Objectives:

- Comprehensive TQM Assessment
- Innovation Level Analysis
- Identify strengths and weaknesses

Main Activity:

- Comprehensive TQM assessment
- Innovation Level Analysis
- Establish Key Performance Indicators (KPIs)

Expected Result:

- A Clear Grasp of the Status Quo
- Baseline Data Obtained

Phase II: Targeted Improvements and Pilot Projects (Year 2)

Main Objective:

- Based on the evaluation results of the first phase, improvement work will be carried out to address the deficiencies in various aspects, and pilot projects will be introduced to verify the effectiveness of the improvement measures.

Main activity:

Leaders need to deeply learn the core concepts and methods of TQM and communicate them to employees so that employees can understand and accept TQM principles.

According to the different needs and backgrounds of employees, designing personalized training courses can improve the pertinence and effectiveness of training.

Continuous tracking of customer feedback and timely response is an important guarantee to meet customer needs.

According to the actual situation and needs of the enterprise, the existing process is optimized and designed to remove unnecessary links, simplify the process and improve the process efficiency.

Through the pilot data collection and analysis measures in a small range, the effect and feasibility can be observed, and the experience and reference can be provided for the comprehensive promotion.

Measures shall be taken in response to different situations of technological innovation, product innovation, service innovation and process innovation.

Expected Result:

- The Improvement Measures Have Shown Initial Results
- The Pilot Project has Proved Effective

Stage 3: Comprehensive promotion and deepening of innovation (Years 3-4)

Main Objective:

- Comprehensively promote the effective improvement measures verified in the second stage within the enterprise, deepen the innovation practice, and further improve the TQM implementation level and innovation ability of the enterprise.

Main activity:

- Comprehensively Implement TQM Improvement Measures
- Expand the Scale of Innovation Projects

Expected Result:

- TQM Implementation Level and Innovation Capacity Improved
- Our Market Competitive Edge has been Expanded

Phase IV: Consolidation and Sustainable Development (Year 5)

Main Objective:

- Consolidate the results achieved in the first three stages, and embed the culture of continuous improvement and innovation into all levels of the enterprise to ensure the long-term competitiveness of the enterprise.

Main Activity:

- Continue to Invest in Staff Training
- We Will Further Improve the Incentive Mechanism for Innovation
- Establish an Innovation Monitoring and Evaluation System
- Explore New Markets
- We Will Strengthen Supply Chain Management

Expected Result:

- The Company has Formed a Stable Culture
- Enterprises Gain Greater Advantages
- Sound Progress has been Made in the Sustainable Development of the Enterprise

3.4.3. Monitoring and evaluation framework

(1) KPI (Key Performance Indicator):

- TQM implementation has been Improved
- Technological Innovation has Increased
- Improved Product Innovation Effect
- Service Innovation and Quality Improvement
- Process Innovation Efficiency is Improved
- Employee Engagement in Continuous Improvement and Innovation
- Sustainable Development Indicators

(2) Quarterly review meetings:

- Purpose of the Meeting

The main purpose of the quarterly review meeting is to monitor the progress of the various stages in a timely manner and ensure that the implementation of the strategic roadmap of the company is on schedule.

- Conference Content

Progress reporting: Heads of departments are required to report on their work progress in the implementation of the strategic roadmap, including the implementation of TQM improvement measures and the implementation of innovative projects.

KPI data analysis: Conduct in-depth analysis of the data of each KPI indicator to understand the trend of change and the actual achievement of the indicator.

Problem discussion and solution: Discuss the problems found in the analysis process, and determine the cause and scope of the problems.

Strategic roadmap adjustment (if necessary): According to the results of the meeting, if the current strategic roadmap is found to be unreasonable or unable to adapt to market changes, it is necessary to adjust the strategic roadmap.

(3) Annual report:

- Purpose of the Report

The purpose of the annual report is to provide shareholders and stakeholders with a comprehensive report on the company's achievements, challenges and next steps in TQM implementation and innovation.

- Report Content

Performance summary: Detailed description of the company's TQM implementation and achievements in the past year.

Challenge analysis: Objective analysis of the challenges encountered in the process of TQM implementation and innovation.

Next plan: Clearly put forward the company's plans and goals for the next year.

4. Discussions

4.1. Conclusions

Based on the study of the automobile parts manufacturing industry in Guangdong Province, this paper evaluates the degree of TQM implementation from six aspects: leadership, personnel management, customer focus, strategic planning, process management, information and analysis, analyzes the degree of innovation from four aspects: technology innovation, product innovation, service innovation, and process innovation, and discusses the impact of total quality management practice on enterprise innovation. These findings are closely related to the objectives of the study, which aims to comprehensively understand the current situation and relationship of TQM implementation and innovation in the industry, and provide references for enterprises to improve their quality management and innovation capabilities.

This paper analyzes the degree of TQM implementation from six aspects: leadership, people management, customer focus, strategic planning, process management and information analysis. Enterprises have implemented TQM appropriately in all aspects, but there is still room for improvement.

In terms of leadership, leaders actively participate in quality management, but there are shortcomings in encouraging employees to participate in and organizing quality management activities.

In terms of personnel management, the organization has conducted training and planning, and can communicate effectively, but it needs improvement in personalized training, information transmission and organizational performance.

In terms of being customer focus, we have made some efforts in understanding customer needs and inviting customers to participate in design, but there are problems such as communication and understanding limitations, and unstable relationship maintenance.

In terms of strategic planning, companies have objectives and planning processes, but there is a lack of formulation and implementation of quality strategic objectives and quality strategic plans.

In terms of process management, there is consensus on process design, guide understanding and supplier relationship management, but there are problems such as incomplete implementation of quality control and insufficient optimization of process design.

In terms of information analysis, companies performed well in providing performance data and implementing benchmarking programs, but there were shortcomings in performance measurement systems and competitive benchmarking.

The level of enterprise innovation is analyzed from four aspects: technology innovation, product innovation, service innovation and process innovation.

The level of technological innovation is moderate, with some effort in updating products/services, processes and technological frontier, but not high.

High level of product innovation, good performance in competitive benchmarking, use of new technologies, speed of product development, new products to market and launch innovative products to reach new markets.

The level of service innovation is medium, and there is some innovation in service concept, technical service and service experience, but the level is not high, and there are problems such as limited service concept renewal and insufficient innovation of technical service.

The level of process innovation is medium, and there is some innovation in technological competitiveness, technological innovation, process change, etc., but the level is not high, and there are problems such as limited technological competitiveness, get up to speed on the latest technology.

The analysis of the impact of TQM practices on innovation can be found that process management and customer focus practices are the key TQM practices that have a significant positive impact on technological innovation, leadership has a certain impact, but people management, strategic planning and information analysis have no significant impact. Information analysis, strategic planning, and process management are the key TQM practices that have a significant positive impact on product innovation, leadership has some impact, but people management and customer centrism have no significant impact. People management, leadership, and information analysis were the key TQM practices that had a significant positive impact on service innovation, while strategic planning and process management had a less significant impact and customer centrism had a weaker impact. People management, customer focus, and strategic planning were the key TQM practices that had a significant positive impact on process innovation, while leadership, process management, and information analysis had no significant impact.

This study finds that process management has little impact on service innovation, which is different from the emphasis on process management in TQM in most literature. The traditional view is that optimized process management can improve the efficiency and effectiveness of service innovation, but in practical applications, because service innovation depends more on flexibility and employee initiative, strict norms of process management may limit innovation.

Customer orientation is often considered a key factor in promoting innovation, especially when developing new products, but this study shows that customer orientation has a limited impact on product innovation. This may be because over-reliance on customer feedback can lead to a lack of foresight and a failure to make breakthrough innovations.

This study comprehensively evaluates the extent to which enterprises implement TQM, provides a basis for studying the impact of TQM on innovation, and helps to understand the status quo and problems of enterprises in quality management, so as to propose targeted improvement measures. It clarifies the level of enterprises in different aspects of innovation, provides specific innovation variables for analyzing the impact of TQM practice on innovation, helps to find out the advantages and disadvantages of enterprises' innovation, and provides directions for improving the level of innovation. The specific relationship between TQM practice and different innovation variables is revealed, which provides a basis for enterprises to improve their innovation level by optimizing TQM practice, and helps enterprises to strengthen relevant TQM practice in a targeted way to promote different types of innovation.

4.2. Recommendations

Based on the findings of this paper, the following practical recommendations are provided for key stakeholders:

(1) Suggestions for auto parts manufacturing enterprises:

Leadership development: Enhance understanding of TQM principles, Promote TQM principles in the organization,

create a culture of learning and continuous improvement, actively encourage employees to participate in quality management activities, Strengthen the organization to promote quality management activities.

(2) Personnel management optimization: Provide personalized training, Ensure the timeliness and accuracy of information transmission, Strengthen the flexibility of work arrangement.

(3) Customer focus improvement: Continuously track customer feedback, Rapid response, strengthen communication and understanding, Stable customer relationship, Improve the effect of customer participation in design.

(4) Strategic plan adjustment

Conduct comprehensive market research and competitor analysis, Understand the quality standards and customer needs in the industry, Determine the quality strategic objectives, develop a detailed quality strategic plan, establish effective quality management system, Ensure the effective implementation of the measures of the quality strategic plan.

(5) Process management is strengthened

Thorough implementation of quality management, Optimization process design, Strengthen the optimization of the entire supply chain, Focus on continuous improvement of internal processes.

(6) Information analysis improvement

Establish a more perfect performance management system, Benchmark regularly.

(7) Technological innovation and improvement

Increase investment in digital innovation and technology platforms, further enhance technological competitiveness and innovation depth, Strengthen strategic adjustment and resource investment.

(8) Product innovation continues to advance

Applying design thinking and integrating different technologies into the product development process, strengthen risk management and market response speed: In the process of product innovation, it is necessary to fully recognize the existence of risks and establish a risk assessment and management mechanism.

(9) Service innovation and reform

Carry out customer demand research, Update the service concept, increase investment in technical services, Optimize the service process from the customer's point of views.

(10) Process innovation optimization

Increase investment in technology research and development, Improve the independent innovation ability of enterprises, establish an incentive mechanism for technological innovation, comprehensively comb and analyze the existing process.

Suggestions for relevant policy makers:

Encourage enterprises to strengthen TQM practice; 2. Guide enterprises to attach importance to innovation; 3. Establish a sound innovation incentive mechanism.

Suggestions for industry associations:

Organize exchange activities within the industry; 2. Conduct relevant research; 3. Issue industry standards and guidelines.

4.3. Implications of the Study

This study focuses on the implementation degree of TQM in Guangdong auto parts manufacturing industry and its impact on enterprise innovation. The research covers six key aspects of TQM implementation (leadership, people management, customer centricity, strategic planning, process management, information and analysis) and four innovation dimensions of technology innovation, product innovation, service innovation and process innovation. The following is a detailed analysis of the impact of this study from three aspects: theory, practice and policy.

4.3.1. Theoretical impact

Academic contribution: Through the combination of quantitative analysis and qualitative research, this study reveals the complex relationship between TQM implementation and the innovation of auto parts manufacturing enterprises, providing a new perspective and empirical basis for the application of total quality management theory in manufacturing industry.

Model and framework: Based on research findings, existing theoretical models can be developed or improved, such as constructing a causal chain model between TQM implementation and innovation performance, or proposing a TQM-innovation integration framework applicable to the automotive parts manufacturing industry.

Filling the research gap: At present, there are relatively few studies on the specific application of TQM in the automotive parts manufacturing industry and its impact on enterprise innovation.

4.3.2. Practical influence

Enterprise performance improvement: Auto parts manufacturing enterprises can learn from the results of this study, optimize TQM implementation strategy, and improve the overall performance of enterprises by strengthening leadership, personnel management, customer orientation and other aspects of efforts.

Quality management system optimization: This study reveals the key elements in the implementation process of TQM and the impact path on enterprise innovation, and provides an empirical basis for enterprises to optimize quality management system.

Benchmarking in the industry: By comparing and analyzing the performance of different enterprises in TQM implementation and innovation, this study sets a benchmark for the industry.

4.3.3. Policy impact

Development of industry norms: The results of this study can provide a reference for the government and industry organizations when formulating relevant norms and standards.

Policy support and guidance: The government can introduce corresponding policy measures for the weak links and key areas found in the research, such as increasing financial support for enterprise innovation, tax incentives and talent introduction, so as to stimulate the innovation vitality of enterprises and promote industrial upgrading and transformation.

Improvement of quality standards: This study reveals the important role of TQM implementation in improving the product quality and service level of enterprises, and provides strong support for the government to promote the improvement of quality standards.

To sum up, this study has a wide and far-reaching impact in theory, practice and policy, and provides a strong support and guarantee for the high-quality development of Guangdong auto parts manufacturing industry.

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