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# Analysis of product quality and customer satisfaction: A case study of the automobile parts industry

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**Abstract**
**Purpose:** Product attributes are primarily designed to meet customer needs. To outperform competitors, companies can establish additional value in their products to actively please customers and enhance loyalty. This study investigates the differences in demographic variables on product quality and customer satisfaction and analyzes the degree of correlation between the two variables.
**Methods**: This study adopted a questionnaire survey method as a tool for data collection. The questionnaire was designed based on the research objectives, focusing on customer satisfaction, exploring the satisfaction levels of the company's relevant dimensions among existing customers, comparing them with customer expectations, and providing recommendations.
**Results**: The results indicated significant differences in gender, marital age, education level, and seniority concerning product quality and customer satisfaction, but no significant differences were found in the organizational size of the company. Subsequent Pearson correlation analysis revealed a Pearson correlation coefficient of 0.85, indicating a high correlation between product quality and customer satisfaction.
**Limitations:** This study focuses on the automotive parts industry to conduct a differential analysis of product quality and customer satisfaction. The research results are only applicable to the automotive parts industry.
**Contribution:** This study found a positive correlation between product quality and customer satisfaction. Therefore, companies actively pursue the capability to enhance product quality, make products attractive, and create differentiated brand value as a development goal. The results of this study are consistent with those of previous studies.
**Keywords:** *Automobile Parts Industry, Product Quality, Customer Satisfaction*
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## 1. Introduction

### *1.1 Research Motivation*

With the increase in societal change and global warming, the automotive industry is inevitably undergoing transformation. The production of energy vehicles or pure electric vehicles-relies on the upgrading and transformation of automobile parts. Taiwan possesses a complete information electronics industry chain, and the introduction of smart manufacturing can maintain the advantage of being a

hidden champion in automobile components, leading to a next-generation automotive electronics market trend. With the increasing proportion of electronic components in automobiles, significant growth in the electric vehicle market, and the trend towards modularization, the demand for automobile components continues to rise. Despite the impact of the COVID-19 pandemic in 2021, the global automobile component market remained robust, reaching $1.612 trillion, an increase of 11.5% from 2020. Considering the automotive industry's characteristics of mass production and customization, connecting equipment, processes, systems, and personnel to construct a complete value chain network from product manufacturing to product design, and forming a smart business model will be a challenge and opportunity for Taiwan's automotive component industry in the future (Tu, 2022).

The automotive industry is technologically and capital-intensive with a vast supply chain that influences various related industries. A typical car consists of over 30,000 parts, covering various industries such as steel, plastic, rubber, glass, machinery, electronics, and services. The professionals involved include skills in research and development, manufacturing, procurement, marketing, management, and warranty services, thus converging into a complete automotive industry, hence the nickname "Locomotive Industry." The upstream of the automotive industry mainly consists of related component manufacturers; the middle stream includes major vehicle assembly plants, assembly, repair, and technical services; and the downstream involves brand manufacturers and sales service outlets. In the first half of 2023, the delivery time of imported vehicles of various brands was affected by a shortage of chips, thus benefiting the sales of domestically produced vehicles. Additionally, with the stabilization of export performance and the introduction of new domestically produced vehicle models, despite the overall unfavorable economic environment and the cessation of production of some domestically produced vehicle models, an impressive performance was still achieved

The automotive parts industry is one of Taiwan’s most important industries for exports by small and medium-sized enterprises. In recent years, owing to the rising costs of labor, foreign manufacturers have shifted their orders to lower-cost Asian regions. However, Taiwan's manufacturing industry has accumulated extensive experience and technology in subcontracting for foreign manufacturers, and the products manufactured in Taiwan are known for their high-quality and customized services as well as the advantages of small-scale, diversified, and flexible production. Therefore, Taiwan remains its preferred trading partner among many foreign manufacturers. Taiwanese automobile parts manufacturers are mostly small- and medium-sized enterprises with a complete industry supply chain and advantages in small-scale, diversified, and flexible manufacturing, enabling them to compete internationally and potentially enter the supply chains of international car manufacturers. After experiencing the impact of the COVID-19 pandemic and global supply chain restructuring, Taiwanese manufacturers actively invested in smart manufacturing equipment to expand into emerging markets. Factors such as the shortage of chips affecting new car sales in major exporting countries such as Europe, America, and Japan; the increase in the number of used cars; the growth of automobile ownership; port congestion; and increased awareness of component inventory crises have led manufacturers to increase their exports. The global automotive parts industry is moving towards modularization, intelligence, electrification, and lighting to meet the diverse, customized, and high-value demands of automotive components. Taiwanese automotive parts manufacturers should develop modularization and system functionality, establish smart manufacturing technology, enhance product added value, establish an international division of labor, maintain industry competitive advantages, and ensure sustainable business operations.

Product quality planning is a structured approach that is used to determine the product quality required to achieve the desired level of customer satisfaction. For manufacturers of well-known brands, product quality is a fundamental element in maintaining brand reputation. A brand with a damaged reputation can lose value instantaneously, resulting in significant losses to the brand owner. Customer evaluations of product quality, satisfaction, and trust were correlated. However, research has suggested a consistent correlation between customer evaluations of product quality and trust. Product attribute design primarily aims to meet customer needs. Companies can establish additional value in their products to actively please customers to outperform their competitors. Understanding a person's degree of

satisfaction is determined by how they feel after comparing their performance or perceived outcomes with their expectations (Tanha et al., 2023).

The market for assembled vehicles focuses on how to cooperate with assembly plants' just-in-time delivery systems to ensure timely, precise, and sufficient delivery of products and ensure that product quality meets the requirements to avoid production stoppage owing to defective products or insufficient materials. Pricing is fixed upon contract signing and is no longer the most important aspect. Stable delivery and product quality determine whether new product orders will be obtained in the future. Different market characteristics and perceptions of the products, services, delivery times, and flexibility of manufacturing providers affect customer satisfaction and subsequent purchase decisions. Through this research, we aim to identify key factors, verify whether the efforts directed towards product quality and customer satisfaction in this case study exceed those of competitors, and provide management indicators for companies as motivation for this study.

### *1.2 Research Objectives*

The scale of enterprises in Taiwan's automotive parts industry varies significantly, ranging from family owned processing plants to publicly traded ones. The types, quality, and delivery times of the products they manufacture vary significantly. Furthermore, their products are sold globally; some focus on single markets, while others are solely for production and handled by trading companies. Each regional market has different characteristics. For example, European and American countries prioritize quality and delivery accuracy, whereas countries in the Middle East and Southeast Asia prioritize prices. How should the manufacturing strategies be formulated? How does market orientation and manufacturing strategies affect customer satisfaction? Product quality and customer satisfaction are crucial variables in the automotive components industry. This study verifies the correlation between product quality and customer satisfaction in Taiwan's automotive parts industry, and confirms the differences in product quality and customer satisfaction due to different demographic variables. Identifying these differences helps to identify areas for improvement, thereby enhancing product design and quality, ensuring product reliability, strengthening customer satisfaction, and increasing corporate performance and competitive advantages.

## 2. Literature review

### *2.1 Automotive Parts Industry*

Automotive parts can be divided into "original equipment parts" and "aftermarket parts." Within the original equipment parts, there are "original design manufacturing (ODM)" and "original equipment manufacturing (OEM)"; aftermarket parts can be further divided into "original equipment suppliers (OES) " and "non-original parts (After Market, AM), " as shown in Figure 1. The Taiwanese automotive parts industry focuses on AM and excels in the field of "parts that need to be replaced after a car collision." AM is commonly known as a secondary brand, and has developed many proprietary brands. However, certification is required to gain trust in the quality of non-original parts and to sell them in some markets. Therefore, obtaining certification in target market countries is crucial (TTR, n.d.).

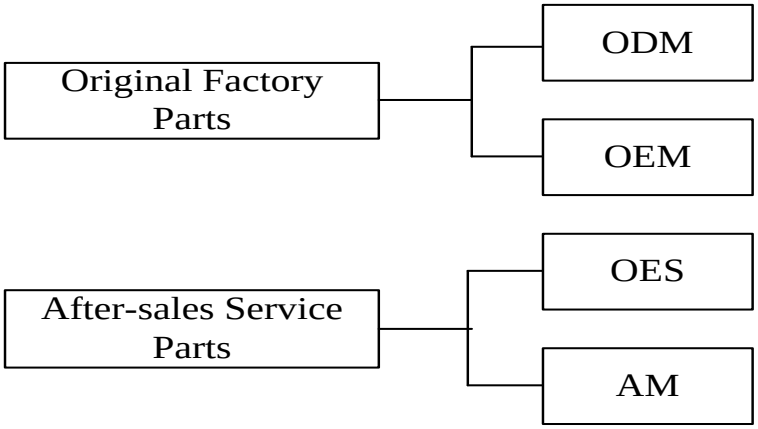


Figure 1 Classification of automotive parts Manufacturers

Sources: TTR (n.d.)

The Taiwanese automotive component industry undergoes major transformations approximately every ten years. Starting in 1982, with the progress of standardization, automation, and electronification, the industry entered an era of intelligence in 2011. Building on this foundation, industries have actively applied technologies such as the Internet of Things (IoT), smart robotics, big data, and lean management techniques to develop interconnected systems for smart manufacturing and services. Further analysis by Tu indicated that traditional automotive component processes, including plastic injection molding, casting, forging, stamping, welding, heat treatment, and machining, have corresponding manufacturing programs that can be aligned with smart manufacturing application technologies. The introduction of smart manufacturing technology into the automotive components industry, whether in robotics, industrial IoT, 3D printing, virtual and augmented reality integration, system simulation, 5G to 6G, electronic control, advanced materials, etc., creates benefits far beyond imagination. The adoption of smart manufacturing in the automotive components industry helps reduce defect rates, increase production volume through automated equipment, lower production and material costs, and enhance added value and professional skills, not only addressing labor shortages and shortening design and development cycles, but also reaping the benefits of rapid market entry. This strengthens the advantage of small-scale diversified production and promotes cross-industry alliances, creating a new wave of employment opportunities (Tu 2022).

Although the automotive parts manufacturing industry was affected during the initial stages of the pandemic in 2020, sectors such as automotive lighting assemblies and suspension systems were severely affected, resulting in a significant decline in exports to NT$192.7 billion, with a growth rate decline of 10.3%. However, subsequent events, such as the global automotive chip shortage in 2021 and the further expansion of supply chain constraints due to the Ukraine-Russia conflict in 2022, led to delays in new vehicle deliveries due to limited production capacity, and the pandemic prompted a reduction in public transportation usage, shifting towards personal vehicles. With new vehicles stuck in supply chain bottlenecks, consumer demand has shifted towards purchasing used cars or extending the use of existing vehicles. Economic downturns during the pandemic and skyrocketing global prices have also prompted consumers to tighten spending, prolonging the use of existing vehicles and thereby increasing the demand for automotive parts. Consequently, Taiwan's automotive parts manufacturing industry benefited, with exports significantly increasing to NT$220.8 billion, **representing** a growth rate of 14.6%, surpassing pre-pandemic levels, further growing to NT$229.3 billion in 2022, as shown in Figure 2 (TTR, n.d.).

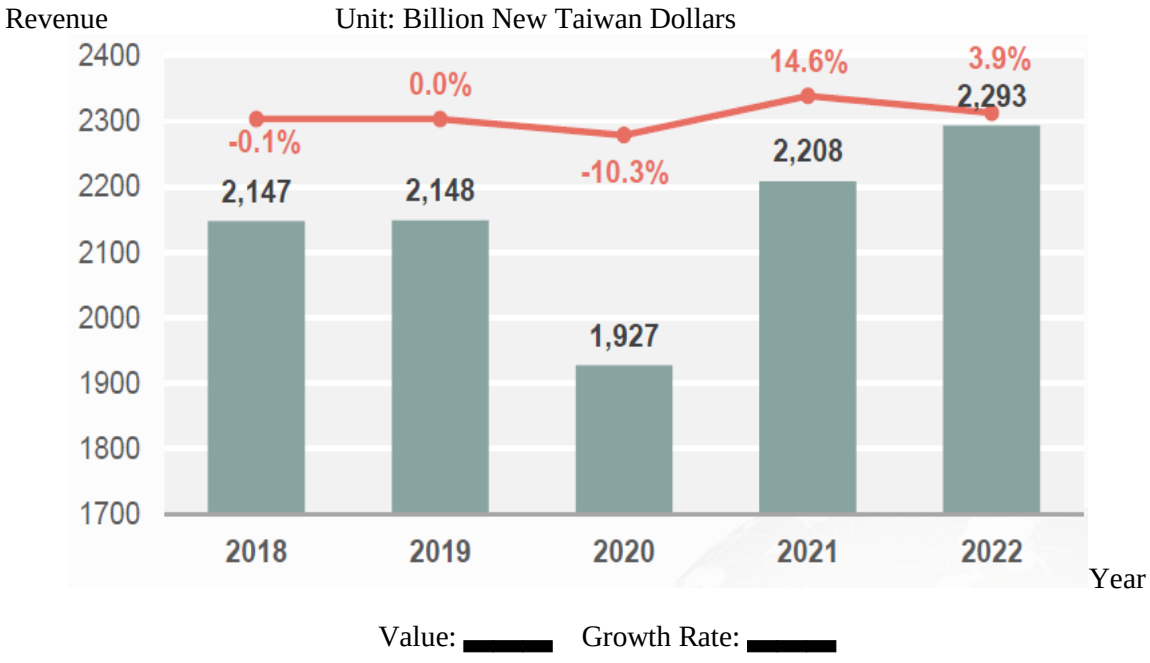

Figure 2 2018-2022 Taiwan automotive parts export value
Sources: TTR (n.d.)

The automotive and automotive parts manufacturing industries are distinguished in terms of revenue (see Figure 3). In the automotive manufacturing industry, owing to competition from imported cars in recent years, revenue has gradually declined due to a decrease in market share. The impact of the COVID-19 pandemic in 2020 and 2021 has further exacerbated this decline. Imported cars are affected by factors such as chip shortages, port congestion, and government subsidies, which stimulate consumers to purchase domestic cars. Additionally, the logistics industry's increased demand for vehicles due to the pandemic further boosted the overall domestic car sales. However, factors such as disruptions in raw materials, slowing economic performance, and the implementation of Phase 6 environmental regulations for diesel heavy vehicles will slightly dampen sales conditions by 2022. However, in the automotive parts manufacturing industry, although there was a severe impact during the initial outbreak of the COVID-19 pandemic in 2020, the situation improved in 2021 as foreign countries gradually reopened. With disruptions in the supply chain of international car manufacturers and insufficient supply of new cars, consumers have delayed replacing their vehicles, stimulating the sale of used cars, and increasing demand for repair parts. This has led to significant growth in the export market for automotive parts (Affairs 2024).

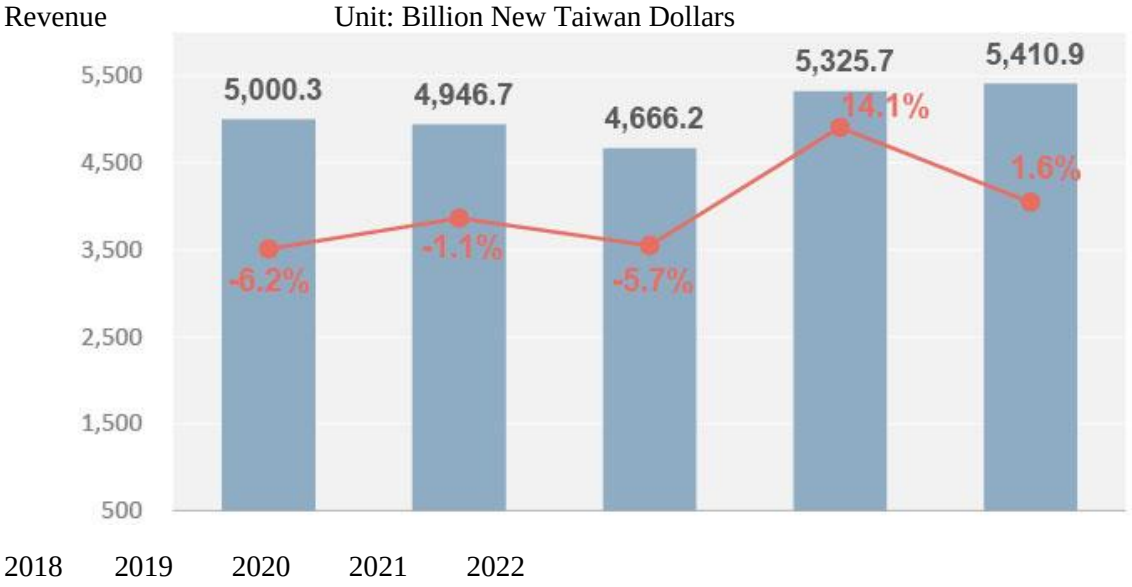


Figure 3 Revenue of the automotive and its parts manufacturing industry from 2018 to 2022
Sources: Ministry of Economic Affairs, Taiwan (2024)

Although some automotive component manufacturers in Taiwan collaborate with international automotive giants and are responsible for Original Equipment Manufacturing (OEM) in the global supply chain of car manufacturers, owing to the strict quality requirements and control of original automotive parts, as well as transportation issues, the profit margin is often less than 10%. Therefore, in terms of the overall market share, the aftermarket (AM) occupies a larger portion than the OEM. However, OEMs cooperate closely with automotive manufacturers; therefore, many businesses gradually enhance their capabilities in product development and manufacturing processes. Some companies accumulated design standards commissioned by original manufacturers and transitioned to Original Design Manufacturing (ODM), enabling them to possess a supply chain system for both design and manufacturing.

Taiwanese automotive parts manufacturers mainly focus on the AM market, where parts are produced in smaller quantities and can be customized for customers, resulting in higher profits, sometimes exceeding 30% (Huang & Chia-Chang, 1997). However, the domestic market is limited, so the focus is

on exports, supplying approximately 85%-90% of the global AM market, with the United States and Europe as the primary export destinations. In the Aftermarket (AM), automotive collision repair parts can be categorized by materials, including car lights, sheet metal, plastics, and bumpers. The Taiwanese manufacturers of automotive collision repair parts are the largest suppliers in the global AM market. Because the prices of AM collision parts are 20% to 50% cheaper than typical OEM products, the demand has increased. Currently, Taiwan's production of collision components accounts for over 80% of the global market, with items such as bumpers and headlight assemblies holding sixto seven percent market share in the United States and Europe, respectively.

### *2.2 Product Quality*

In fiercely competitive markets, many businesses strive to gain a competitive advantage and meet the diverse needs of customers by focusing on "improving quality and reducing costs." Many scholars also advocate using "quality as a means" of achieving cost-reduction goals (Deming, 2000; Garvin, 1984; Gudda, Keitany, & Ombok, 2023). "Quality is built into the manufacturing process, not inspected into it," a classic saying well-known to those involved in process quality control. The design quality can be maintained only through excellent "process control, and a stable product quality is ensured. For companies with well-known brands, product quality is a fundamental element for maintaining brand reputation. A brand with a damaged reputation risk instantly loses value, leading to significant losses for the brand owner. Consumer purchases can be categorized as tangible or intangible. However, customers increasingly demand higher quality products to achieve greater satisfaction. Quality, often considered from a quality control perspective, is defined as manufacturing the most useful products using the most economical means (Deming, 2000; Diarti & Hesniati, 2024). Designing product attributes primarily aims to meet customer needs. To outperform competitors, companies can establish added value through product features to actively delight customers ( Kotler 2000). Olsen (2002) indicates that quality can be seen as a precursor to customer satisfaction. Conversely, greater satisfaction with a brand's product quality tends to generate more trust. Research has confirmed that, when customers have a higher perception of product quality, their satisfaction with the product is higher.

Keller (1993) suggests that product quality has symbolic significance and serves as a means of self-expression. Product quality may not be a single dimension, but can span multiple dimensions. If product quality is clearly described by consumers or can express consumer self-concept, consumers may hold a more positive attitude towards the brand and may even initiate purchase behavior. Individual behavior is often influenced by perceived external environmental characteristics and self-concepts that are similar. Product quality and brands carry specific meanings in customers' minds. Therefore, when the symbolic meanings associated with product quality or brand image align with consumers' self-concepts, purchasing behavior enhances self-esteem and self-maintenance (Rogers, 1965). Zeithaml (1988) believes that intrinsic attributes of products can be generalized according to product types and categories, whereas extrinsic attributes such as price and brand can serve as general quality indicators.

Philip Kotler (2003) divides products into five levels, namely, core benefits, basic products, expected products, augmented products, and potential products. Products are composed of a group of attributes and characteristics. Automobile products have multiple attributes, and customers look for a combination of product attributes that can meet their needs to determine their purchase intention. Thus, customer perceptions of product quality influence post-purchase behavior (satisfaction, repurchase, or recommendation). Product quality planning is a structured method used to determine the product quality to achieve the desired level of customer satisfaction. The goal of product quality planning is to facilitate communication with everyone involved and ensure that the required steps are completed on time. Effective product quality planning relies on the efforts of top management to meet customer needs and fulfill the promises made to customers..

### *2.3 Customer satisfaction*

Measuring customer satisfaction is crucial for company management because it can facilitate marketing analysis, customer behavior analysis, and product or service improvements (Mitra & Jenamani, 2020). In fiercely competitive consumer markets, businesses must confront the direct or indirect impact of

customer satisfaction such as product quality, service quality, and customer loyalty (Chen & Shun, 2023; Jemal, 2022; Ou, Shih, & Chen, 2014). Cardozo (1965) posited that customer satisfaction is influenced by the gap between customer expectations and reality, which significantly influences customer loyalty and repeat purchase intention. When businesses can identify factors that influence consumer satisfaction with products or services, they may be able to alter their experiences with these products or services, thereby maximizing consumer satisfaction. Customer satisfaction leads to loyal consumers, as repeat purchases and positive word-of-mouth attract new customers, which can have a decisive impact on company profit. In summary, customer satisfaction is an asset for organizations and, like other assets, should be measured, maintained, and managed. Therefore, organizations aspiring to success, whether in product or service quality, should recognize the importance of customer satisfaction (Chen, Chen, & Leung, 2023; Sureshchandar, Rajendran, & Anantharaman, 2002). If companies cannot effectively meet customer needs like their competitors do, they risk losing their market share, customers, and investors (PJ et al. 2023).

Gerson's (1994) research indicates that customer satisfaction is a critical indicator of business revenue, guiding new product development and motivating service innovation improvements. Philip Kotler (2000) views customer satisfaction as the result of comparing perceived product or service performance with expectations. If perceived performance falls below expectations, customers are dissatisfied; if it exceeds expectations, customers are satisfied. Customer satisfaction is a composite emotion that is influenced by service quality, price, and personal experience. Therefore, it is considered a crucial and decisive indicator for repurchasing products or acquiring services (especially intangible products) ( Hosseini & Behboudi, 2017; Yang, Chen, & Yang, 2020). Customer satisfaction is a post-purchase evaluation in which the chosen alternative provides the same results as expected, or surpasses consumer expectations. Conversely, dissatisfaction arises if the outcome obtained does not meet or fall below consumer expectations. Customers' post-consumption attitudes can indicate their satisfaction with a product or a service. Enhancing customer satisfaction is an important strategy for changing consumer behavior and building consumer loyalty, and has become a focus of industry attention (Shyu, Yen, & Lin, 2023). The automotive parts industry involves an extremely detailed division of labor and product quality, and the accuracy and timeliness of supply components are crucial. These operational processes affect customer satisfaction; therefore, assessing and improving customer satisfaction in the automotive parts industry must be a significant consideration in business operations.

### *2.4 The Relationship between Product Quality and Customer Satisfaction*

Generally, consumers infer the future performance of a product through external cues, such as price, advertising volume, and brand image (Zeithaml, Berry, & Parasuraman, 1996). When product performance is difficult to judge objectively beforehand, or consumers have insufficient product knowledge, they utilize external attribute signals of the product, such as price, advertising, brand image, and observable marketing mix variables, as signals of product quality (Zeithaml, 1988). In many customer satisfaction analysis models, it is generally believed that consumers' expectations of product quality performance before purchase affect their satisfaction levels (Chen et al., 2023). Product quality has symbolic significance and self-expression for consumers. Therefore, when choosing consumer goods, consumers more or less reflect on the characteristics of their self-concept (Zeithaml, 1988). Research indicates a consistent correlation between customer evaluations of product quality, satisfaction, and trust (Zeithaml, 1988; Garvin, 1984). Product attributes are primarily designed to meet customer needs. Companies can surpass competitors by establishing additional value through product attributes to please customers actively. (P. Kotler, 2002).

The emphasis on quality serves not only to reduce costs and satisfy customers but also helps businesses establish an image, attract investors, and make quality a corporate culture and attitude. In recent years, Taiwanese companies have actively improved their R&D and production processes to enhance competitiveness among competitors. Some key elements in the production process significantly affect quality. Therefore, by controlling these key factors, the yield rates can be improved, and the quality can be greatly enhanced. Customers favor good product quality, which naturally enhances customer satisfaction and willingness to repurchase ( Kotler, 1997; Tian-Cole, Crompton, & Willson, 2002).

Parasuraman, Zeithaml, and Berry (1988) pointed out that satisfaction is not necessarily perceived as high quality by consumers, implying that satisfaction determined solely by quality is insufficient and may lack other key variables that can affect satisfaction. Therefore, before pursuing high customer satisfaction, businesses must thoroughly understand the factors and processes influencing customer satisfaction to formulate effective marketing strategies. Customer satisfaction with the overall purchase or use of a product comes from satisfaction with the product quality (Tanha et al., 2023). Satisfaction with the quality of the brand's product generates a corresponding level of trust in the brand's product. Furthermore, because satisfaction with product quality is derived from comparison, it may also lead to loyalty to the brand's product attitudes and behaviors. Self-concept influences consumer behavior, and consumers may hope to satisfy their expected self-image by consuming a particular product or service. Therefore, marketers still have an obligation to understand consumers' self-concepts and provide and shape brands to satisfy consumers' self-images as much as possible because different self-concepts imply different market segments. An in-depth understanding of consumers' self-concepts facilitates access to target consumer groups in the market.

## 3. Research Methodology

### *3.1 Research Hypotheses*

Based on research motivation and the relevant literature, this study investigates the differences in product quality and customer satisfaction within the industry. The research hypotheses were formulated as follows:

H1: There are significant differences in product quality among the demographic variables.
H2: There are significant differences in customer satisfaction among the demographic variables.
H3: Product quality and customer satisfaction are correlated.

### *3.2 Questionnaire Design*

This study used a questionnaire as a tool for data collection. The questionnaire was designed based on the research objectives, focusing on customer satisfaction, exploring existing customer satisfaction levels across various dimensions of the company, comparing them with customer expectations, and providing recommendations accordingly. According to Kotler (2003), product design primarily aims to meet customer needs, and customers evaluate the benefits of product attributes. After a purchase, consumers experience a certain degree of satisfaction or dissatisfaction. When a product meets or exceeds customer expectations, it can lead to a repurchase intention. Scholars have not yet reached a consensus on the relationship between customer satisfaction and loyalty. This study adopts the perspectives of Bitner (1990) and Janes and Sasser (1995), inferring that product quality has a positive impact on customer satisfaction. The questionnaire was designed after collating relevant literature and discussions with industry practitioners. Changes were made to adapt the wording and expressions of items to suit the industry to which the company belongs. The questionnaire utilizes a five-point Likert scale, with options ranging from "Strongly Agree," "Agree," "Neutral," "Disagree," to "Strongly Disagree," scored as 5, 4, 3, 2, and 1, respectively. Higher scores indicate greater agreement.

## 4. Results and Discussions

### *4.1 Questionnaire Distribution and Collection*

The subjects of this study are companies in the automotive parts industry with a capital of over ten million. The questionnaire was distributed from April to May 2022, with a total of 170 questionnaires distributed and 157 collected, resulting in a response rate of 92.35%. After deducting 13 invalid questionnaires, 144 were obtained, yielding a validation rate of 91.72%.

### *4.2 Descriptive Statistics of Demographic Data*

Among the respondents, 115 (79.3%) were male, 109 (75.7%) were married, 48 (33.3%) were aged 36-45, 109 (75.7%) had an educational background of college or above, 56 (38.9%) had a service tenure of 8-12 years, and 64 (45.1%) worked in companies with an organizational size: 51-100 employees. Detailed demographic information is presented in Table 1.

Table 1. Respondents' demographic characteristics

| Items | Categories | Frequencies | Percentages |
|---|---|---|---|
| Gender | Male | 115 | 79.3% |
| | Female | 29 | 20.0% |
| Marital status | Single | 35 | 24.3% |
| | Married | 109 | 75.7% |
| Age | Below 25 years | 0 | 0.0% |
| | 26-35 years | 34 | 23.6% |
| | 36-45 years | 48 | 33.3% |
| | 46-55 years | 36 | 25.0% |
| | Above 56 years | 26 | 18.1% |
| Education level | Below high school | 0 | 0.0% |
| | High school | 24 | 16.7% |
| | College/University | 109 | 75.7% |
| | Above Graduate school | 9 | 6.3% |
| Years of service | Below 3 years | 0 | 0.0% |
| | 3-5 years | 32 | 22.2% |
| | 5-8 years | 39 | 27.1% |
| | 8-12 years | 56 | 38.9% |
| | Above 12 years | 17 | 11.8% |
| The organizational size of the company | Below 10 | 2 | 1.3% |
| | 11-30 | 35 | 24.3% |
| | 31-50 | 41 | 28.5% |
| | 51-100 | 65 | 45.1% |
| | Above 100 | 1 | 0.7% |

### *4.3 Statistical Test Analysis*

#### *4.3.1 Reliability analysis*

The reliability of the questionnaire in this study was assessed using Cronbach's α for reliability analysis. An α value above 0.7 indicates high reliability, a value between 0.35 and 0.7 suggests acceptable reliability, and a value below 0.35 indicates low reliability (Cronbach, 1951). The results revealed that both the importance and satisfaction of the service elements in this study, as assessed by Cronbach's α in the reliability analysis, exceeded 0.7. Therefore, this instrument was deemed suitable for further analysis. The details of the data are provided in Table 2.

Table 2. Reliability analysis of product quality and customer satisfaction

| Variables | Items | Cronbach's Alpha |
|---|---|---|
| Product quality | 9 | 0.864 |
| Customer satisfaction | 18 | 0.922 |

*4.3.2 Product quality and customer satisfaction hypotheses verification*

1. Gender test

According to Hypotheses 1 and 2, we examined whether there is a difference in product quality and customer satisfaction among customers of different genders. **An independent sample t-test was used for hypothesis verification.** The analysis results are presented in

Table 3. T-test table for gender differences in product quality and customer satisfaction

| Variables | Gender | NO | ME | SD | t | p |
|---|---|---|---|---|---|---|
| Product quality | Male | 115 | 4.01 | 0.50 | -2.61 | 0.01** |
| | Female | 29 | 4.28 | 0.45 | | |
| Customer satisfaction | Male | 115 | 3.95 | 0.47 | -2.59 | 0.01** |
| | Female | 29 | 4.21 | 0.45 | | |

*p<0.05, **p<0.01, ***p<0.001

2**.** Marriage status test

According to Hypotheses 1 and 2 of this study, we examined whether there is a difference in product quality and customer satisfaction among customers of different marital statuses. An independent sample t-test was used for hypothesis verification. The results of the analysis are presented in Table 4 and indicate a significant difference. In summary, the hypotheses of this study are supported.

Table 4. T-test table for marriage status differences in product quality and customer satisfaction

| Variables | Marriage status | NO | ME | SD | t | p |
|---|---|---|---|---|---|---|
| Product quality | Single | 35 | 4.25 | 0.43 | 2.59 | 0.01** |
| | Married | 109 | 4.01 | 0.51 | | |
| Customer satisfaction | Single | 35 | 4.21 | 0.47 | 2.01 | 0.004** |
| | Married | 109 | 3.93 | 0.46 | | |

*p<0.05, **p<0.01, ***p<0.001

3. Age test

Based on Hypotheses 1 and 2, we examined whether there are differences in product quality and customer satisfaction among customers of different ages. One-way analysis of variance (ANOVA) was employed for hypothesis testing. The results show a significant difference (Table 5). There were significant differences in both the product quality survey ($F=8.45$, $p<0.001$) and customer satisfaction ($F=9.65$, $p<0.001$) based on age. Additionally, post hoc LSD comparisons revealed that satisfaction among customers aged 26–35 years, 36-45 years, and 46-55 years was higher than among those aged 56 and above in both product quality and customer satisfaction variables. In summary, the hypotheses of this study are supported**.**

Table 5. ANOVA test F table for age differences in product quality and customer satisfaction

| Variables | Age | ME | SD | F | p | Lsd |
|---|---|---|---|---|---|---|
| Product quality | (1)26-35<br>(2)36-45<br>(3)46-55<br>(4) Above 56 | 4.22<br>4.08<br>4.20<br>3.67 | 0.46<br>044<br>0.54<br>0.41 | 8.45 | 0.00*** | 1>4<br>2>4<br>3>4 |
| Customer satisfaction | (1)26-35<br>(2)36-45<br>(3)46-55<br>(4) Above 56 | 4.18<br>3.96<br>4.16<br>3.64 | 0.46<br>0.45<br>0.49<br>0.29 | 9.65 | 0.00*** | 1>4<br>2>4<br>3>4 |

*p<0.05, **p<0.01, ***p<0.001

*4. Education level test*

Based on Hypotheses 1 and 2, we examined whether there are differences in product quality and customer satisfaction among customers with different educational levels. One-way analysis of variance (ANOVA) was employed for hypothesis testing, and the analysis data are shown in Table 6. The study found significant differences in both product quality (F=2.67, p<0.05) and customer satisfaction (F=5.37, p<0.05) based on the educational level. Furthermore, post hoc LSD comparisons indicated that satisfaction among high school graduates was higher than among those with a university degree or above in both product quality and customer satisfaction variables ((1) high school > (2) college or university > (3) Above Graduate school). In conclusion, the hypotheses of this study were supported.

Table 6. ANOVA test F table for education level differences in product quality and customer satisfaction

| Variables | Education level | ME | SD | F | p | Lsd |
|---|---|---|---|---|---|---|
| Product quality | (1) High school<br>(2) College/University<br>(3) Above Graduate school | 4.29<br>4.04<br>3.86 | 0.39<br>0.52<br>0.42 | 2.67 | 0.05* | 1>2 |
| Customer satisfaction | (1) High school<br>(2) College/University<br>(3) Above Graduate school | 4.31<br>3.97<br>3.78 | 0.43<br>0.47<br>0.29 | 5.37 | 0.02* | 1>2 |

*p<0.05, **p<0.01, ***p<0.001

*5. Years of service test*

Based on Hypotheses 1 and 2, we examined whether there were differences in product quality and customer satisfaction among customers with different tenures. One-way analysis of variance (ANOVA) was used for hypothesis testing, and the analysis data are presented in Table 7. There were significant differences in product quality (F=2.66, p<0.05) and customer satisfaction (F=2.84, p<0.05) according to tenure. Additionally, post hoc LSD comparisons revealed that in the product quality variable, satisfaction among those with 3-5 years of tenure was higher than those with 5-8 years, 8-12 years, and over 12 years of tenure ((1)3-5 years > (2)5-8 years > (3)8-12 years > (4) Above 12

years). Regarding customer satisfaction, satisfaction among those with 3-5 years of tenure was higher than those with 5-8 years and 8-12 years of tenure ((1)3-5 years > (2)5-8 years > (3)8-12 years). In conclusion, the hypotheses of this study were supported.

Table 7. ANOVA test F table for years of service differences in product quality and customer satisfaction

| Variables | Years of service | ME | SD | F | p | Lsd |
|---|---|---|---|---|---|---|
| Product quality | (1)3-5 years | 4.28 | 0.42 | 2.66 | 0.05* | 1>2>3>4 |
| | (2)5-8 years | 4.03 | 0.52 | | | |
| | (3)8-12 years | 3.99 | 0.49 | | | |
| | (4) Above 12 years | 3.97 | 0.56 | | | |
| Customer satisfaction | (1)3-5 years | 4.21 | 0.44 | 2.84 | 0.04* | 1>2>3 |
| | (2)5-8 years | 3.93 | 0.51 | | | |
| | (3)8-12 years | 3.93 | 0.46 | | | |
| | (4) Above 12 year | 4.02 | 0.44 | | | |

*p<0.05, **p<0.01, ***p<0.001

*6. Organizational size of the company test*

Based on Hypotheses 1 and 2, we examined whether there were differences in product quality and customer satisfaction among customers of different organizational sizes. One-way analysis of variance (ANOVA) was used for hypothesis testing. For both product quality ($F=1.74$, $p<0.05$) and customer satisfaction ($F=1.60$, $p<0.05$), the results do not show significant differences, as shown in Table 8. In summary, the hypotheses of this study are not supported, indicating that there are no differences in product quality and customer satisfaction based on organizational size. The study suggests that regardless of organizational size, focusing on product quality and designing products that meet consumer needs can enhance customer satisfaction.

Table 8. ANOVA test F table for organizational size differences in product quality and customer satisfaction

| Variables | Organizational size | F | p |
|---|---|---|---|
| Product quality | (1) Below 10 | 1.74 | 0.15 |
| | (2)11-30 | | |
| | (3)31-50 | | |
| | (4)51-100 | | |
| | (5) Above 100 | | |
| Customer satisfaction | (1) Below 10 | 1.60 | 0.17 |
| | (2)11-30 | | |
| | (3)31-50 | | |
| | (4)51-100 | | |
| | (5) Above 100 | | |

*p<0.05, **p<0.01, ***p<0.001

*4.3.3 Analysis of the relationship between product quality and customer satisfaction*

To investigate the correlation between product quality and customer satisfaction, Pearson correlation analysis was conducted. Pearson's correlation coefficient was 0.85, as shown in Table 9. There is a strong correlation between product quality and customer satisfaction, indicating that higher product quality influences customer satisfaction. Therefore, companies must focus on improving product quality, implementing comprehensive quality management techniques, and increasing their competitive advantage. The analysis also reveals that when product quality reaches a certain level, customers tend to have higher expectations of service quality. Enhancing customer satisfaction can effectively increase customer loyalty and repeat purchase intention. Product quality and customer satisfaction are crucial operational business indicators. Even with excellent marketing strategies, meeting consumer needs becomes difficult if there are flaws in the product quality, leading to a decrease in purchasing intention.

Tsiotsou (2005) finds a positive correlation between product quality and customer satisfaction. Therefore, companies actively pursue the capability to enhance product quality, make products attractive, and create differentiated brand value as a development goal. The results of this study are consistent with those of previous studies. With more streamlined product quality and detailed production history information, consumers' willingness to purchase increases. As consumer purchasing intention increases, brand loyalty also increases, leading to increased profitability and surpassing that of competitors.

Table 9. Analysis of the relationship between product quality and customer satisfaction

| Variables | Customer satisfaction |
|---|---|
| Product quality | 0.85 |

## 5. Conclusion

Taiwan's economic development has entered the stage of technology-intensive industries to upgrade Taiwan's industrial technology and internationalize enterprises. In the past, Taiwan's small- and medium-sized enterprises (SMEs) focused mainly on manufacturing and trade, but it was easy to form an OEM production operation mode, which could limit economic development. Cooperative models of SMEs in Taiwan can be divided into three periods. They entered the third period, aiming to establish independent marketing and own-brand stages to promote the upgrading and enhance international competitiveness. Taiwan's manufacturing industry is mainly oriented towards exports, and most manufacturers in the manufacturing industry are SMEs; therefore, the resources and funds available are limited. To further evolve SMEs and make them more competitive, the government actively promotes the transformation of SMEs and the promotion of brands, and has implemented a series of activities, hoping that companies can maintain competitiveness internationally with existing resources and accumulated technology and gain recognition at major international exhibitions.

### *5.1 Managerial Implications*

With the development of localization in the Taiwanese automotive manufacturing industry and the gradual expansion of local procurement, the self-sufficiency rate of automotive parts in Taiwan has gradually increased, driving the development of the automotive parts manufacturing industry. Over the years of business development and the gradual improvement of production technology, the quality of Taiwanese automotive parts has been internationally recognized, opening up a vast aftermarket service market and becoming a cornerstone of the overall development of the automotive and parts manufacturing industry. This scale is expected to continue to grow and expand. The overall industry is expected to expand and develop with the removal of trade barriers. Looking ahead to the future development of the automotive industry, facing changes in the trade environment and intensified global competition, operators should make relevant response layouts in advance, fully utilize the advantages of Taiwan's automotive parts manufacturing industry to seise opportunities, develop strategies to mitigate possible impacts, and respond to changes in the trade environment as soon as possible.

In addition to the trend towards electrification in the automotive industry, significant progress has been made in autonomous driving technologies in recent years. While most vehicles equipped with autonomous driving are currently only used for driver assistance, in response to the introduction of many models of autonomous driving starting in 2021, which allow hands-off of the steering wheel under certain conditions, countries such as Japan, Germany, and France have successively implemented Level 3 autonomous driving regulations. With the overall maturity of technology and regulations, Taiwanese manufacturers of radars and cameras have penetrated the international automotive supply chain. As autonomous driving gradually matures, investment and layout in related technologies are crucial for enhancing the competitiveness of the automotive industry.

Facing the gradual introduction of intelligent manufacturing in the automotive components industry, in the process of digital transformation, considerations are not only about technology, but also about switching core values to new thinking to successfully transform and navigate towards value innovation in the automotive components market. The competitors that Taiwan's automotive industry faces on an international stage are global competitors and their activities are in the world stage. The environment is more complex in the increasingly competitive international automotive industry. In the face of such an evolution, how the automotive component industry will find niches and establish competitive advantages in the future is a question that urgently needs to be addressed.

### *5.2 Research Limitations and Future Research Suggestions*

The automotive industry is characterized by intensive technology and capital requirements. It is complex, vast, and encompasses a wide range of peripheral industries. As the core of the automotive manufacturing industry, vehicle manufacturers mainly procure directly from first-tier suppliers, who are responsible for system integration, and purchase components from second-tier suppliers (component suppliers). The relationships in the supply chain are stable with shared information systems. Therefore, the automotive industry is often relatively closed, making it difficult to easily penetrate the supply chain. This study focuses on the automotive parts industry to conduct a differential analysis of product quality and customer satisfaction. The research results are only applicable to the automotive parts industry. Future research should incorporate concepts such as brand image and brand equity to extend the analysis and to provide greater assistance to academic research.

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