

The Influence of Elevator Maintenance Program on Customer Satisfaction Based on Multi-Level Grey Relational Analysis

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Abstract: Customers are the bedrock of any business and the driving force behind its growth. As the disparities in manufacturing costs, product quality, and management systems between competing companies narrow, meeting customer expectations, increasing customer satisfaction with the company, and exceeding customer expectations has become a robust measure for businesses seeking to increase their competitiveness. While advanced manufacturing technologies or technological processes are easily replicated or even surpassed, the soft power required to gain customer satisfaction takes ongoing investigation and accumulation. This needs firms to raise their level of customer satisfaction in order to continue constructing an enterprise-specific culture that promotes enterprise development and profitability. The subject of this study is elevator maintenance customers. It employs a method known as multi-level grey relational analysis to integrate the features of customer wants in this business in order to develop an assessment system for elevator maintenance customer satisfaction. Second, collect relevant data via a customer happiness questionnaire survey of the elevator company's maintenance clients, analyze and assess the customer satisfaction data, and lastly, recommend improvement ideas based on the analysis results.

Keywords: customer satisfaction; multi-level grey relational analysis; elevator maintenance

1. Introduction

1.1 Research aim and background

Today, as the general trend toward global economic integration becomes more established and users' awareness of the importance of protecting their rights grows, the rapid development of science and technology, combined with enterprises' increasing excess production capacity, has directly resulted in fundamental changes in customer needs and market preferences. Enterprises are becoming increasingly competitive in terms of product quality, performance, and pricing (Jagdev, 1998). As a result, company profit margins are steadily contracting. However, these businesses must contend with increased market rivalry and a more challenging operating climate.

As consumer demand gradually changes, the buying market gradually shifts from a seller's to a buyer's market. Consumer demand increasingly determines whether firms' products and services can match market demand. To remain viable, businesses must adapt to market changes and deliver more innovative services. Improved goods that address genuine consumer demands are necessary to increase client satisfaction with the company's products and services (Kordupleski, 1993). Satisfying consumers and making their loyalty has become a goal for many businesses, as they recognize that it is only through customer recognition that they can gain market share and increase earnings. As a result, all businesses must pay attention and evolve in order to achieve client happiness. However, businesses must still confront and resolve several significant issues, including how to grow market share through improved customer service, how to better adapt to market competition, and how to seek for a competitive advantage for the firm. Customer happiness has become critical to an enterprise's performance, and the enterprise's purpose has been to increase customer satisfaction and turn them into loyal customers. To really understand customer demands, to address those needs, to earn customers' trust, and to retain customers, businesses must approach challenges from the consumer's perspective.

Customer satisfaction has been extensively examined by business executives, specialists, and academics worldwide. Once upon a time, Peter Drucker, a world-renowned manager, stated: "The

primary objective should not be to maximize profits, but to maximize satisfaction. Customers, since profit is solely a result of client satisfaction (Fornell, 1992)." As can be seen, customers drive an enterprise's growth. The ultimate objective of an enterprise's survival and development is to discover ways to comprehend and address the current and future demands of consumers, while exceeding their expectations. In general, the industry thinks that "companies are dependent on consumers" and that "customers are gods." To increase repeat purchases and customer happiness, businesses must adhere to this philosophy when servicing clients in order to increase market share and foster a healthy and long-term development environment for the organization.

With the market continuing to expand and the number of elevator businesses rising, the competition for businesses will become increasingly tough. In this environment, the ability of elevator firms to win the market requires them to modify their business approach quickly, scientifically, and efficiently, and to turn product competition into a competition to attract consumers. In terms of the present elevator business, high-height structures are increasing in popularity as cities' population densities continue to climb. If there is an issue with any part of elevator manufacture, sales, installation, or maintenance, for example, consumer happiness will be significantly damaged, affecting the company's profit and image and impeding the company's healthy growth. Elevator maintenance is critical for customer satisfaction because it is the longest and last phase of the elevator's life cycle. As a result, major elevator firms have made it a strategic aim to develop after-sales service for elevator maintenance as a new profit center.

1.2 Research purpose and significance

A business's development is a continuous closed-loop innovation system that begins with client wants and concludes with customer pleasure. Nowadays, the market economy is growing more and more flawless. The primary strategy for company development and survival should be to prioritize customer happiness, to innovate, to enhance service quality, and subsequently to increase firms' market competitiveness. Improving and properly evaluating corporate customer happiness is also a prerequisite for improving customer satisfaction and service quality, if not the most critical link.

The study and development of customer satisfaction assessment systems for elevator companies have far-reaching implications, all the more so in light of the complicated backdrop of the elevator industry's growing development issues and rapid changes in market rivalry. With the market economy becoming increasingly competitive, businesses must ensure that their clients are happy with their services while maintaining technical advantages in order to gain market share. Thus, in order to achieve customer happiness, businesses must first identify consumer wants and then continue to address those needs while increasing company competitiveness.

This paper aims to use multi-level grey relational analysis to investigate the relevant factors affecting elevator companies' customer satisfaction, to combine relevant theories in order to identify the critical factors affecting the company's customer satisfaction, and to analyze the research findings appropriately (Julong, 1989). Recommendations for enhancements Simultaneously, identify ways to systematically improve customer satisfaction in order to raise the level of customer service management and provide the best service possible; and conduct research on various key factors affecting customer satisfaction in order for enterprises to fully understand current customer expectations for elevator products and services and to quickly identify the company's current major problems.

Improve existing problems to improve the company's service and quality, increase sales opportunities for the company's products and services, strengthen the company's competitive advantage, add more loyal customers to the company, and improve the company's overall strategic level based on the company's specific situation.

Through study on predecessors, the theoretical system of customer satisfaction has been refined. A new branch of customer satisfaction application has been established in the elevator business, which serves as a link in customer happiness research. This study is significant because it adheres to the value-oriented management philosophy, highlights the importance of customer value in company growth activities, and gives a valuable method for examining customer value. From the consumer's perspective, this study, which is based on customer satisfaction questionnaire analysis and survey methodologies, identifies the most pressing demands of various sorts of customers. This technique can aid clients in making the most precise and scientific purchases possible. Simultaneously, this strategy can assist clients in eliminating certain possible dangers throughout the purchasing process, resulting in a crystal-clear purchase procedure. Allow clients to benefit from a greater variety of high-quality items

and more caring and humane service. This study is critical for the growth of businesses from an enterprise viewpoint.

2. Experiment

The selection of assessment indicators should take into account the comprehensiveness and mutual independence of the indicators, the availability and integrity of data, and the scientific and methodical character of the model when using the multi-level grey relational analysis approach (Rahimnia, 2011). To begin, the evaluation object is divided into components, and the component with the greatest impact on the research content is chosen as the first-level evaluation index; the first-level index is then divided into components, and the component with the greatest impact on the research content is chosen as the second-level evaluation index, and so on until an ideal index evaluation system is constructed.

Using an elevator company's customer as the research object, the elevator company's service department contacted the customer via random sampling, conducted a questionnaire survey on 100 companies, and requested that each company send an experienced customer representative familiar with the elevator service situation to complete the form. One questionnaire to verify the professionalism and accuracy of responses to questions in order to more accurately assess the degree of customer satisfaction at elevator businesses. To gain a better understanding of T company's actual performance in the eyes of customers and to determine the effectiveness of the customer satisfaction evaluation model mentioned previously, the marketing department was tasked with randomly making 100 maintenance customers to send electronic questionnaires via a user satisfaction questionnaire. Actual recoupment. There are 98 questionnaires, 90 of which are legitimate, and a 90 percent effective rate. Calculate the scores after this survey to obtain the customer satisfaction rating for elevator maintenance, as indicated in Table 1.

Table 1: Scores of various indicators of elevator company maintenance customer satisfaction system

standard	index	Score
reliability	The elevator runs smoothly and comfortably with low failure rate	81
	Good quality elevator accessories	80
	Reliable maintenance quality and compliance with acceptance standards	80.55
	Ability to inform customers of the correct process required to complete the service	79.87
responsiveness	After receiving the customer's fault call, arrive at the scene within 1 hour	80.65
	Respond quickly to faults and troubleshoot problems quickly	79.65
	Respond to customer inquiries and inquiries in a relatively short time	80
guaranteed	Maintenance personnel are well-groomed and neatly dressed	79.65
	Maintenance personnel have sufficient professional knowledge and skills	79.45
	Detailed and comprehensive answers to customer consultations by service personnel	80.76
	After the maintenance is completed, the site environment is clean and tidy	80.54
deliver	Parts and materials can arrive at the site on time	79.86
	Ability to complete maintenance as planned and get customer confirmation	79.87
	Timely delivery of documents	80.57
safety	Maintenance personnel meet company requirements during maintenance	80.68
	Maintenance personnel can publicize and guide elevator safety knowledge	79.65
	Owners can use it safely after maintenance	81.35
common exchange	Owner or property can contact maintenance personnel at any time	79.67
	Good relationship with the property and able to communicate well	81.56
	Maintenance personnel are able to deliver on service promises	79.98

3. Relevant theoretical analysis

3.1 Customer Satisfaction and Customer Satisfaction

Customer Satisfaction (CS), also known as customer satisfaction, is a psychological state that describes the state formed by comparing the psychological feelings of consumers with their psychological expectations when purchasing a product or service (Barsky, 1992). The most common

Mental states include happiness and disappointment. The psychological state formed is quantified and reflected as customer satisfaction with products and services, that is, customer satisfaction. It is a kind of psychological experience that allows consumers to evaluate the product and service level from a quantitative point of view, and the evaluation includes customer satisfaction or dissatisfaction. The telegraph and telephone companies in the United States hoped to find a more favorable competitive advantage by improving their product performance and service quality in an all-around way. Got a good profit. From the original customer is God to today's customer satisfaction, it is neither a special management tool nor a new management concept. Although its theoretical development is only a few decades, it is still in the development of enterprises. Played a significant role. A product that makes one customer very satisfied may not necessarily make other customers equally satisfied. What customers are satisfied with under certain conditions may not be satisfactory under other conditions. It can be seen that it is a constantly changing and constantly adjusting target. Therefore, achieving full customer satisfaction requires a very good understanding of the factors that affect customer satisfaction.

Therefore, chasing its origin customers reflect on customer satisfaction by comparing their feelings and expectations. So it can be considered that satisfaction is a relative concept, not an absolute concept. Therefore, if an enterprise wants to gain more recognition, it should not indulge in the subjective understanding of its products and services but should improve itself and take the initiative to understand the degree of conformity between customer needs and enterprise products.

3.2 Customer Satisfaction and Customer Satisfaction Index

Customer Satisfaction Index (CSI), an index model formed by enterprises using data analysis and model calculation, combined with customers' comprehensive evaluation of enterprise service and product quality (Fornell, 1996). Customer Satisfaction and Customer Satisfaction Index are two concepts that are both distinct and interrelated. The main differences between the two are as follows:

(1) Different correlation indicators

Customer satisfaction assessment can only measure one satisfaction result, and it often analyzes customer satisfaction from different angles and directions. Its indicators are more flexible and simple. The customer satisfaction index focuses on the degree of mutual influence and causal connection between various latent variables. Therefore, the customer satisfaction index is more abstract and complex.

(2) The calculation method is different

The calculation of customer satisfaction is mostly calculated by the weighted average method, which is relatively simple. First, the ultimate goal of the research is divided into various factors according to their attributes. Then the judged weight values are assigned to each decomposition result, and finally, each result is analyzed—recursive calculation.

The calculation of the customer satisfaction index is relatively complicated, and its calculation needs to be applied to the relevant methods in economics. First, import the data into the mathematical model, establish and solve the structural equation system, and finally calculate the index result.

(3) The scope of application is different.

Customer satisfaction is suitable for work improvement and is mainly used to evaluate customers' satisfaction with various indicators of the company's products and services. The customer satisfaction index is more suitable for governments and enterprises to understand various industries' overall satisfaction levels and conduct cross-country, cross-industry, and cross-regional horizontal comparisons.

Customer satisfaction is usually divided into seven different levels according to customer satisfaction. Customers form their judgments about their feelings based on their feelings about the company's products and services, that is, their satisfaction and dissatisfaction with the products. Ultimately, it will affect the customer satisfaction evaluation level of the enterprise, which will have an impact on the enterprise.

However, the qualitative description generated in the customer satisfaction evaluation will not simply become the enterprise's customer needs to understand. The enterprise cannot directly analyze it. In the management of enterprises, it is often necessary to reflect the actual situation of the operation of the enterprise through data, and the customer satisfaction index is generated under this situation. It can make it easier for enterprises to understand customers' needs, and it is more convenient to understand

what is happening in the current period of the enterprise.

3.3 Basic Characteristics of Customer Satisfaction

According to the above understanding of the concept of customer satisfaction, the basic characteristics of customer satisfaction can be summarized into four aspects:

- (1) Subjectivity. Due to the customer's conditions, including knowledge, experience, and living habits, the resulting feelings are subjective and vary from person to person.
- (2) Hierarchical. Different customer needs have different evaluation standards for products and services.
- (3) Relativity. When customers buy products, they will compare with similar products or their own experience and habits, resulting in current satisfaction or dissatisfaction.
- (4) Staged. Like products, services are time-sensitive, and customer satisfaction with products and services is gradually formed in repeated purchases, and it is phased.

4. Analysis of elevator products and customer demand characteristics

4.1 Features of elevator products

Elevator equipment, as a mechatronics industrial product, is distinguished from other types of equipment by the following characteristics:

- (1) Unlike traditional large-scale electromechanical equipment, elevator goods are frequently invisible to customers. Elevator items are frequently sent as spare parts, and the majority of associated work is performed on-site (Liu, 2018). Elevator product technical specs Matching work must be completed between the customer's requirements and the building's design characteristics. If elevator manufacturers wish to begin manufacturing, the presumption is that they must get into a sales contract with clients and make a purchase prior to the building's completion. As a result, it is vital to tightly manage the elevator's construction duration.
- (2) Elevator goods must have a lengthy service life because they are the primary mode of mobility within the structure. Because the elevator product becomes integrated into the electromechanical equipment utilized in the building on a regular basis and becomes a part of the building, it must have a longer service life than other electromechanical equipment (Park, 2010). Due to the high investment cost of elevator products, if the service life is extended, the client will invariably perform a thorough study and analysis of the product prior to making a purchase.
- (3) Because elevators are a required piece of mechanical and electrical construction equipment, the characteristics of the building directly influence the selection of various elevator specifications and parameters, and the majority of elevator sales orders come from real estate projects, the construction industry is inextricably linked to the elevator industry.
- (4) Because the elevator is a piece of specialized equipment, its routine maintenance and installation must be performed by specialists. After the elevator leaves the manufacturing, it is not yet a finished product that can be delivered straight to the consumer. The subcontractor or manufacturer must install and debug the elevator. It cannot be given on to the client for usage until the acceptance is qualified.

4.2 Customer demand for elevator maintenance in the elevator business

Due to the unique nature of elevator goods and the division of purchasers and users, elevator maintenance clients have unique requirements when purchasing elevator maintenance services, which necessitates that we first understand their unique requirements. We do customer satisfaction surveys and analysis. We can only grasp consumer wants and then assess the aspects that impact customer satisfaction if we understand and study customer characteristics and influencing factors. The following is a description of the customer requirements for elevator maintenance (Lai, 2017).

- (1) Customers place a premium on elevator safety.

According to data on elevator accidents over the last two years, the impact is significant once the elevator is in operation. Because the experience causes everyone to be fearful of elevators and elevators,

consumers are extremely worried about the safety of elevator use, design, and maintenance. Even in certain projects' bidding documents, severe regulations regarding the origin of elevator safety components are included.

(2) Customers place a premium on elevator maintenance personnel's technical skills.

Elevator maintenance work accounts for the majority of the elevator's life. Due to the fact that the elevator is in operation, the motor regularly begins in forward and reverse rotation, and each component travels continually. The components generate friction and vibration, which ultimately results in mechanical wear, electrical age, and a rise in the elevator's failure rate.

Customers place a premium on the supply of elevator accessories. The replacement of elevator accessories is the most critical aspect of elevator maintenance work. Poor-quality accessories have a short life span, but high-quality accessories have a lengthy life span. Poor-quality components are built badly, and their assembly during maintenance is challenging, reducing maintenance efficiency (Nnamdi, 2018); high-quality parts are well-made, simple to install, and increase efficiency. Second, timely delivery of elevator accessories is critical to ensuring the proper performance of elevator repair operations. For instance, imagine there is a delay in the supply of elevator accessories. Once the elevator is out of service, it can have a direct impact on many people's daily lives and work, as well as on the normal functioning of shopping malls. As a result, customers are extremely concerned about the availability of elevator accessories.

5. Conclusion

Today, as global economic growth slows, elevator manufacturing companies must rethink their business models and explore new opportunities. The service industry, with its competitive benefits, has received increasing attention from elevator firms, as have service differentiation, service diversification, and service quality. While conducting a customer satisfaction survey may appear to be routine for many businesses, it is not easy to perform correctly. It must have a number of components, including the quality of the company's goods, the quality of its employees, and the company's laws. The degree of its complete quality immediately affects the ability of the firm to maintain client loyalty, which is necessary for effective operation.

The construction of a customer happiness assessment system is the study topic, the elevator company maintenance customers are the research object, and prior customer satisfaction research findings are utilized as a reference. Combining methods with the characteristics of customer demand in this industry resulted in the establishment of a customer satisfaction indicator system for elevator maintenance and maintenance, as well as a practical, scientific, and comprehensive evaluation of customer satisfaction in elevator maintenance and maintenance enterprises.

References

- [1] Julong, D. (1989). *Introduction to grey system theory*. *The Journal of grey system*, 1(1), 1-24.
- [2] Rahimnia, F., Moghadasian, M., & Mashregi, E. (2011). *Application of grey theory approach to evaluation of organizational vision*. *Grey Systems: Theory and Application*.
- [3] Jagdev, H. S., & Browne, J. (1998). *The extended enterprise-a context for manufacturing*. *Production Planning & Control*, 9(3), 216-229.
- [4] Kordupleski, R. E., Rust, R. T., & Zahorik, A. J. (1993). *Why improving quality doesn't improve quality (or whatever happened to marketing?)*. *California Management Review*, 35(3), 82-95.
- [5] Fornell, C. (1992). *A national customer satisfaction barometer: The Swedish experience*. *Journal of marketing*, 56(1), 6-21.
- [6] Barsky, J. D., & Labagh, R. (1992). *A strategy for customer satisfaction*. *Cornell Hotel and Restaurant Administration Quarterly*, 33(5), 32-40.
- [7] Fornell, C., Johnson, M. D., Anderson, E. W., Cha, J., & Bryant, B. E. (1996). *The American customer satisfaction index: nature, purpose, and findings*. *Journal of marketing*, 60(4), 7-18.
- [8] Liu, H., & Wu, J. (2018). *Research on preventive maintenance strategy of elevator equipment*. *Open Journal of Social Sciences*, 6(01), 165.
- [9] Park, S. T., & Yang, B. S. (2010). *An implementation of risk-based inspection for elevator maintenance*. *Journal of mechanical science and technology*, 24(12), 2367-2376.

[10] Lai, C. T., Jackson, P. R., & Jiang, W. (2017). *Shifting paradigm to service-dominant logic via Internet-of-Things with applications in the elevators industry*. *Journal of Management Analytics*, 4(1), 35-54.

[11] Nnamdi, O. (2018). *Strategies for managing excess and dead inventories: A case study of spare parts inventories in the elevator equipment industry*. *Operations and Supply Chain Management: An International Journal*, 11(3), 128-138.