



Research on Service Quality Evaluation of Networked Collaborative Manufacturing Platform Based on SERVQUAL Model—Take the J Company as an Example

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Abstract. With the development of information technology, Internet technology and Internet of Things technology, networked collaborative manufacturing has become the future development direction of manufacturing industry. However, there are still a series of problems in the development of the new model of networked collaborative manufacturing. Taking Company J, a service-oriented manufacturing enterprise, as an example, this paper applies the SERVQUAL model to evaluate the service quality of Company J. The service quality evaluation system is established in six dimensions: tangibility, reliability, responsiveness, assurance, empathy and synergy. The main factors affecting the service quality of networked collaborative manufacturing platform of Company J were identified, and the countermeasures to improve the service quality of networked collaborative manufacturing platform of Company J were proposed by constructing IPA model, in order to solve the common service quality problems of networked collaborative manufacturing platform and better serve for the same type of enterprises.

Keywords: Service quality · Network collaborative manufacturing platform · SERVQUAL model

1 Introduction

Currently, the manufacturing industry is developing in the direction of networking, collaborative and service driven by big data, Internet of Things and other information technologies, and the traditional manufacturing model is changing to a customer-centered service manufacturing model [1], and the service quality largely determines the future development trend of enterprises. However, the level of informationization of manufacturing enterprises varies, and the development of networked collaborative manufacturing will not happen overnight, and there are still a series of problems in the development of the new model. Therefore, this paper takes Company J, a service-oriented manufacturing enterprise, as a case study, and analyzes the service quality of Company J's networked collaborative manufacturing platform to find out the key points to improve its service quality, so as to propose countermeasures and suggestions to improve the service quality

of Company J's networked collaborative manufacturing, and also provide new ideas for other service-oriented manufacturing enterprises to apply the networked collaborative manufacturing model to improve their services.

2 Literature Review

In 1982, Gronroos first introduced the definition of quality to the service industry, asserting that service quality is the difference between what customers expect and how they actually feel about the service, and Lewis and Booms defined service quality as "a tool to measure the extent to which a firm's service level meets customer expectations". Parasuraman, Zeithaml, and Berry proposed that service quality is determined by three elements: customer pre-purchase expectations, the process of feeling the service, and the perception of the final outcome, and it compares the expectations of customers towards the service with the real occurrence of both [2]. Yun Duan, Xiaowen Zhang, and Huafeng Pan (2021) used the modified SERVQUAL scale as a survey instrument to investigate patients' expectations and actual perceptions of hospital service quality from the patients' perspective [3]. Wan Chao (2020) used SERVQUAL model and IPA method to evaluate the overall quality of KraussMaffei's after-sales service at the dimensional and indicator levels and made corresponding suggestions for improvement [4]. Wang Wei, Sun Bingneng, Liu Bo, and Fan Hongbo (2021) analyzed the demand for networked collaboration in the industry chain of heterogeneous factories with the case of the industry chain of heterogeneous factories of air conditioning compressors, investigated the challenges of networked collaboration and the research progress of collaborative design and manufacturing, and elaborated the modular architecture of networked collaboration in the industry chain based on the interconnection of heterogeneous factories [5]. Huang Xiaoyan and Li Dequn (2007) analyzed the characteristics of mold enterprises, and summarized the advantages of networked collaborative manufacturing through the specific application of networked manufacturing in mold enterprises, and also analyzed the shortcomings of current networked manufacturing, and built a networked collaborative manufacturing platform for mold based on the ASP model [6].

3 Study Design and Questionnaire Collection

In this study, based on the traditional SERVQUAL model and the actual situation of the networked collaborative manufacturing model, we added the dimension of "complete, efficient, satisfactory, and collaborative completion of the services provided" to evaluate the quality of the collaborative aspects. This dimension was named "Collaboration". Six dimensions of tangibility, reliability, responsiveness, assurance, empathy and synergy were identified, with a total of 18 indicators. The indicators of these 6 dimensions can measure the service quality and customer satisfaction of J's networked collaborative manufacturing platform more comprehensively. Thus, the service quality evaluation index system of the networked collaborative manufacturing platform of Company J was determined, as shown in Table 1 [7].

When the questionnaire was distributed, the respondents were required to score the expected and perceived values of each question item, and the evaluation indexes were

Table 1. Service quality evaluation index system of J Company’s networked collaborative manufacturing platform

| <i>Target layer</i> | <i>dimension</i> | <i>index</i> |
|---|----------------------|--|
| A Service Quality Evaluation of J Company’s Networked Collaborative Manufacturing Platform | B1 Tangibility | C1 The system page overall design is comfortable |
| | | C2 The system page reacts fast |
| | | C3 System software functions can meet the needs of sales personnel |
| | B2 Reliability | C4 The company can care for and help with the difficulties encountered by the sales staff through the system |
| | | C5 The company can accurately guide the service of the sales staff at any time through the system |
| | | C6 Sales personnel can accurately grasp the product status information through the system |
| | B3 Responsiveness | C7 The company can timely respond to the needs of sales personnel through the system |
| | | C8 The system can display the exact time of the company |
| | | C9 Sales personnel can timely track the product information and get feedback through the system |
| | B4 Assurance | C10 The correctness and timeliness of the company’s remote guidance service are guaranteed |
| | | C11 Corporate learning systems provide learning that can help with sales |
| | | C12 Other departments of the company can work together in real time through the system |
| | B5 Empathy | C13 The company can provide personalized services for the sales staff through systematic feedback |
| | | C14 The company can proactively understand the needs of the sales personnel through the system |

(continued)

Table 1. (continued)

| <i>Target layer</i> | <i>dimension</i> | <i>index</i> |
|---------------------|------------------|--|
| | | C15 The company has established a good relationship for various departments through the system |
| | B6 Synergy | C16 Sales personnel can share information and work together through the system information |
| | | C17 Sales personnel can manage customers more easily and quickly through the system |
| | | C18 Sales people can track the sold product information through the system |

designed using the Likert5 scale as the measurement scale, in which 1 represents “very dissatisfied”, 2 represents “dissatisfied”, 3 represents “average”, 4 represents “satisfied”, and 5 represents “very satisfied”. The scale of Likert5 is used as the scale, where 1 represents “very dissatisfied”, 2 represents “dissatisfied”, 3 represents “average”, 4 represents “satisfied”, and 5 represents “very satisfied”. The survey was conducted with the sales staff of Company J’s sales department as the target, and the sales staff of Company J were issued with the questionnaire QR code and questionnaire link, and invited to participate in the survey through random anonymous form. A total of 325 questionnaires were issued and collected, and after screening and eliminating invalid questionnaires, 286 valid questionnaires were obtained.

4 Analysis Results and Countermeasures

4.1 Analysis Results

The data collected were statistically analyzed using SPSS26.0 software to obtain the respective mean values of perceptions and expectations for each indicator, as well as the difference between perceptions and expectations, as shown in Table 2.

According to Table 2, calculate the average scores of customer perception and expectation of each dimension and the gap between them, thus obtaining Table 3.

Table 2 and Table 3 show that the service level of networked collaborative manufacturing platform of Company J needs to be improved. The lowest perception value of reliability dimension is only 2.97, which indicates that the sales force has the lowest recognition of the factors included in this dimension; the perception values of tangibility and empathy dimensions are both greater than 3.5, which indicates that the sales force is more satisfied with the overall design, software functions and departmental relationship of the platform system.

Table 2. Differences in perception and expectation of various indicators for service quality evaluation of J Company's networked collaborative manufacturing platform

| <i>dimension</i> | <i>Dimension index</i> | <i>Feel the value</i> | <i>desired value</i> | <i>disparity</i> |
|-------------------|------------------------|-----------------------|----------------------|------------------|
| B1 Tangibility | C1 | 3.70 | 4.06 | -0.36 |
| | C2 | 3.73 | 4.19 | -0.46 |
| | C3 | 3.69 | 4.20 | -0.51 |
| B2 Reliability | C4 | 3.06 | 4.20 | -1.14 |
| | C5 | 2.88 | 4.10 | -1.22 |
| | C6 | 2.96 | 4.05 | -1.09 |
| B3 Responsiveness | C7 | 3.28 | 4.20 | -0.92 |
| | C8 | 3.93 | 4.22 | -0.29 |
| | C9 | 2.95 | 4.00 | -1.05 |
| B4 Assurance | C10 | 2.97 | 4.07 | -1.10 |
| | C11 | 3.83 | 4.22 | -0.39 |
| | C12 | 2.99 | 4.02 | -1.03 |
| B5 Empathy | C13 | 3.60 | 4.14 | -0.54 |
| | C14 | 3.26 | 3.99 | -0.73 |
| | C15 | 3.86 | 4.09 | -0.23 |
| B6 Synergy | C16 | 3.84 | 4.16 | -0.32 |
| | C17 | 2.97 | 4.08 | -1.11 |
| | C18 | 3.00 | 4.08 | -1.08 |
| Ensemble Average | — | 3.37 | 4.12 | -0.75 |

Table 3. Differences in perception and expectation of various dimensions of service quality evaluation of J Company's networked collaborative manufacturing platform

| <i>dimension</i> | <i>Feel the mean</i> | <i>Expect the mean</i> | <i>disparity</i> |
|------------------|----------------------|------------------------|------------------|
| Tangibility | 3.71 | 4.15 | -0.44 |
| Reliability | 2.97 | 4.12 | -1.15 |
| Responsiveness | 3.39 | 4.14 | -0.75 |
| Assurance | 3.26 | 4.10 | -0.84 |
| Empathy | 3.57 | 4.07 | -0.50 |
| Synergy | 3.27 | 4.11 | -0.84 |

Comprehensive analysis of the above table yields specific service quality evaluations for each dimension as follows:

1) Tangibility

“Tangibility” is directly related to the intuitive feeling of the sales staff, which is one of the services that they are more concerned about. The evaluation shows that the gap between the expected value and the perceived value of Company J in this aspect is relatively small, i.e. the tangibility dimension has little influence on the improvement of the service quality of Company J’s networked collaborative manufacturing platform, but it should continue to be improved and maintained to further improve its market competitiveness.

2) Responsiveness

The reliability dimension has the largest gap of 1.15 between the expected and perceived values, which indicates that the service quality of this dimension is obviously inadequate, so for Company J, the service of this dimension should be improved as soon as possible. In particular, the gap of 1.22 for the indicator “The company is able to accurately guide the sales staff’s service through the system at any time” indicates that the sales staff is very dissatisfied with the service provided by the company, and the company should focus on this direction in order to improve the current service quality evaluation.

3) Responsiveness

According to the evaluation scale, the average perception value of “responsiveness” is 3.39, and the average gap value is 0.75, indicating that the sales staff is satisfied with the “responsiveness” of Company J’s service quality, but relatively speaking, the gap value of “sales staff can follow up product information and get feedback through the system” is as high as 1.05. However, the gap value for the indicator “sales staff can follow up product information and get feedback through the system” is as high as 1.05, which indicates that the service provided by Company J is not yet adequate in this regard.

4) Assurance

The difference between the perception and expectation of “assurance” is 0.84, and the satisfaction of “the correctness and timeliness of the company’s remote coaching service is guaranteed” and “the learning provided by the company’s learning system can help sales” is relatively low. The satisfaction level of “the company’s remote coaching service is guaranteed to be correct and timely” and “the learning provided by the company’s learning system can help sales” is relatively low, indicating that the company’s remote coaching service is not yet satisfactory to sales staff, and the company needs to improve its learning system and training.

5) Empathy

From the table, we can see that the gap value of “empathy” is 0.50, which is in the middle of all dimensions. However, specifically, there is a gap between the perceived value of “the company can provide personalized services to sales staff through system feedback” and the expected value of “the company can actively understand the needs of sales staff

through the system”, indicating that the services provided by the company in these two aspects are not enough.

6) Synergy

The average gap value of this dimension is 0.84, which is the second highest on the scale. The gap values of “sales staff can manage customers more easily and quickly through the system” and “sales staff can track the information of sold products through the system” are 1.11 and 1.08 respectively. Indicating that the services provided by Company J in this area are still far from adequate and there is still much room for improvement. Therefore, Company J should improve this dimension of service as soon as possible in order to improve the satisfaction of its sales staff.

4.2 Countermeasures and Suggestions

Through the analysis, it can be seen that reliability, assurance and synergy have a greater impact on the service quality of Company J. Therefore, we focus on these aspects for improvement. In the following, we establish an IPA model with importance as the horizontal axis and service satisfaction as the vertical axis (The satisfaction degree is the weight value obtained by first assigning weights to each index and then calculating), and analyze the indicators under the three dimensions of reliability, assurance and synergy one by one to find out the priority areas for improvement, so as to improve the service quality of the networked collaborative manufacturing platform of Company J in a targeted manner.

The IPA model is shown in Fig. 1.

Based on the above IPA model, we can obtain the following analysis results in 4 areas:

1) Competitive advantage area improvement direction

The first quadrant of “other departments of the company can cooperate with the work in real time through the system” belongs to the advantageous competition area, which

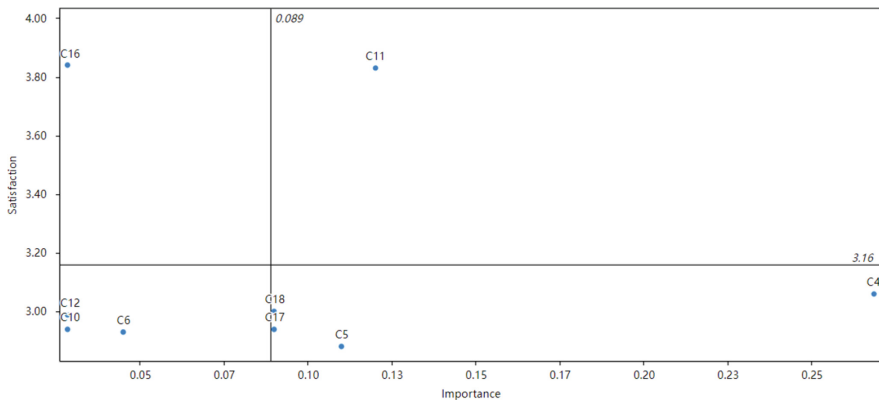


Fig. 1. IPA model matrix diagram of service quality evaluation indicators

indicates that other departments of the company are willing to cooperate with the work of the sales staff, also indicates that the company's internal construction is better, the company has established a good relationship for each department, so each department is willing to cooperate with the work of the sales staff through the system. But this part of the expectations and satisfaction is still a small part of the gap, indicating that there are also still individual departments or staff are not able to cooperate with the work in a timely manner, resulting in a part of the bad experience of sales staff, so the company should maintain a good overall good relationship at the same time, but also targeted training and guidance for departments and staff, etc., to provide personalized services, so as to improve the cooperation of this part of the staff and further strengthen the competitive advantage in this indicator.

2) Continue to maintain district improvement direction

In the second quadrant, "sales staff can share information and work together through the system" belongs to the continual maintenance zone. It shows that the sales force has a high degree of recognition of this indicator, and J's networked collaborative manufacturing platform does provide them with information sharing services, so that the sales force can grasp each customer's information and realize collaborative work. However, there is also a gap between expectations and feelings of this indicator, which also needs attention for improvement, and should continue to maintain the good aspects and improve the deficiencies in order to improve the overall service quality.

3) Improvement direction of secondary improvement area

The indicators in the third quadrant are secondary improvement areas, including "Sales staff can accurately grasp product status information through the system", "The correctness and timeliness of the company's remote guidance service are guaranteed", and "The learning provided by the company's learning system can help sales". The company should train the staff of the management inventory system, set standards, improve the comprehensive quality of the service staff of the collaborative manufacturing platform, so as to efficiently handle and solve problems, and urge them to update the product status information in a timely manner. More learning software and training seminars should be provided to sales personnel to improve their professional quality. In-house training can be used to improve service personnel's operation of related software; standard operation manuals can be designated to establish a standard service manual system, and users can be served through programmed processes and standardized language.

4) Urgent improvement area improvement direction

The indicators in the fourth quadrant are "the company can accurately guide the sales staff's service through the system at any time", "the sales staff can manage customers more easily and quickly through the system", and "the sales staff can track the information of products sold through the system". The sales force pays more attention to these three indicators, but the satisfaction level is low, which is an area in need of improvement. This indicates that the company can not provide guidance services for sales staff at any time, in this regard, the company should assign special service personnel for online platform services, when sales staff encounter any difficulties need help, through the special service window can contact the professional service personnel to answer their

questions, and these personnel are trained to provide services to help solve their problems. The second is that the sales staff is not particularly satisfied with the company's after-sales service, the company should establish a complete after-sales service system, complete after-sales service system is an important part of the platform, the company should make good use of the consumer tracking system, the establishment of a comprehensive customer information database, and the collaboration of various departments to share. The system can grasp and manage customers in all aspects and angles, record customer information in detail in the database, eliminate the trouble of finding traditional notepads, and set up reminder functions to remind sales staff of what they should do today, while ensuring that customer information will not be lost due to employee departures. Determine the type of customers, facilitate the tracking work of important customers and improve work efficiency. After the products are sold, the sales staff can also track the product logistics and other related information in real time through the system, as well as information on whether the customer is satisfied with the product and the service of the sales staff.

5 Conclusion

Based on the SERVQUAL evaluation model, this paper takes J Company's networked collaborative manufacturing platform as the research object, establishes an evaluation index system consisting of 6 dimensions and 18 indicators, and forms a questionnaire for investigation and analysis. The results show that: The networked collaborative manufacturing platform of J Company has major problems in reliability, assurance and synergy, which need to be further improved. Specific countermeasures are as follows: Company J should provide targeted training, guidance and personalized services to departments and employees; Provide more learning software and training lectures, set strict standards, improve the professional quality of all departments; Establish a complete after-sales service system, do a good job of information database integration, to facilitate the company timely targeted tracking.

Networked collaborative manufacturing with the Internet and other new generation information technology as the core has been the choice of more and more enterprises to implement service-oriented manufacturing. This paper only provides a superficial analysis of the factors affecting the service quality of networked collaborative manufacturing platform in Company J. There are still many shortcomings, and we hope that a more complete and rigorous investigation and analysis can be conducted in the future.

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