



**HAL**  
open science

# Service System Design Considering Employee Satisfaction Through Introducing Service Robots

Tomomi Nonaka, Takeshi Shimmura, Nobutada Fujii

► **To cite this version:**

Tomomi Nonaka, Takeshi Shimmura, Nobutada Fujii. Service System Design Considering Employee Satisfaction Through Introducing Service Robots. IFIP International Conference on Advances in Production Management Systems (APMS), Aug 2020, Novi Sad, Serbia. pp.686-692, 10.1007/978-3-030-57997-5\_79 . hal-03635637

**HAL Id: hal-03635637**

**<https://inria.hal.science/hal-03635637>**

Submitted on 20 Jun 2023

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

# Service system design considering employee satisfaction through introducing service robots

Tomomi Nonaka<sup>1</sup>, Takeshi Shimmura<sup>1</sup>, and Nobutada Fujii<sup>2</sup>

<sup>1</sup>College of Gastronomy Management, Ritsumeikan University,  
1-1-1 Noji-higashi, Kusatsu, Shiga 525-8577, Japan

<sup>2</sup>Graduate School of System Informatics, Kobe University  
nonaka@fc.ritsume.ac.jp

**Abstract.** In this paper, we perform a basic analysis on employee satisfaction and production planning by introducing a service robot which delivers dishes in restaurant service. As an example of a service robot introduced in a Japanese restaurant, we focus on the pantry staff, kitchen staff, and customer service staff, as well as production planning that individual employees implicitly plan and update in their heads. The service robots are used to deliver the dishes prepared at the kitchen to the customer service floor, where the worker specifies the destination and transports the dishes while patrolling the restaurant. By analyzing the productivity and employee satisfaction before and after the introduction of the service robots into the categories of serving, cooking area, and customer service, how employees can identify and coordinate work between humans and machines and change process design. From December 2019 to January 2020, an analysis was conducted based on the results of employee questionnaires and interviews conducted at a restaurant.

**Keywords:** service system design, employee satisfaction, productivity, restaurant service

## 1 Introduction

The use of robots in the service industry is progressing in order to improve labor productivity and shortage of labor in the service industry. Part-time employment is very severe in the food service industry, especially in the restaurant industry, and the decrease in the working population is an urgent issue. Many of the food service sites are labor-intensive, and research and development to improve productivity in the service industry is underway by industry, government, and academia. Single-function robots have already been introduced into service areas such as inns, hotels, and restaurants [1], and their productivity has been improved.

Economic activity in the service industry is increasing, creating important jobs not only in developed countries but also in developing countries. The service industry accounts for about 70% of Japan's GDP and two-thirds of the country's employment. In the food service industry, which is classified as a food service industry, production is carried out by an intensive labor force. Staff working on the service floor of a restaurant

provide face-to-face service to customers. In the kitchen, there are still many hand-crafted processes in service operations that create value [2][3]. Therefore, the working conditions of the staff may affect the delivery of the service. The importance of employee satisfaction in providing good service has been pointed out [4][5][6]. A previous study [4] showed that there is a substantial relationship between individual job satisfaction and individual performance. If employee performance improves, the quality of service is expected to improve. In terms of service satisfaction [7], the relationship between service quality and customer satisfaction has been shown to be independent but closely related [8]. The importance of the linkage effect is mentioned in order to improve overall satisfaction, including customer satisfaction, employee satisfaction, and management satisfaction [7][9].

In order to improve both employee satisfaction and service quality, it is necessary to examine employee satisfaction and clarify its structure. In the previous study [10], the authors analyzed employee satisfaction by looking at the results of a questionnaire distributed to restaurant staff. First, we build a structural model of employee satisfaction. The questions were categorized into seven questions: "Work environment," "Work efficiency and quality of service," "Relationship with supervisor," "Rules," "Education system," "Attitude and willingness to work," and "Interest in multi-skill development. The results of the questionnaire examined the relationship between employee satisfaction and the seven categories from multiple perspectives. As a result, differences between employee satisfaction structures and attributes such as job title, employment status, age group, and duration of continuous employment were analyzed from multiple perspectives. The results were analyzed using two approaches: correlation analysis and covariance structure analysis.

This paper presents a basic analysis of employee satisfaction and production planning with the introduction of robot serving in a restaurant service. Using a serving robot introduced in a Japanese restaurant as a case study, we focus on the operations of the serving staff, kitchen staff, and customer service staff, as well as the production planning that each employee implicitly plans and updates in his or her head. This delivery robot carries the food prepared in the kitchen to the customer's floor, where the operator specifies the destination and carries the food while patrolling the restaurant. They are also responsible for carrying the dishes from the lower table to the washing area. We analyze the results of employee questionnaires and interviews conducted from December 2019 to January 2020 at a store where robots were introduced.

## **2 Employee satisfaction and productivity in restaurant services**

### **2.1 Job categories in a restaurant service**

The employees working in a restaurant can be divided into three categories: kitchen staff in charge of cooking, floor staff in charge of serving customers and serving food to customers, and cashiers, and serving and washing staff. In this paper, we define the difference between these tasks as occupations. The role of serving is to arrange the dishes that are prepared individually for each customer between the kitchen and the floor, and to assemble a set menu, etc. Focusing on these three occupations, the authors

propose a model of employee satisfaction that takes into account the customer contact and customer orientation in different occupations and the customer contact and customer orientation in different occupations. A questionnaire survey was conducted in restaurants, and the structure of the relationship between improved customer service and employee satisfaction awareness was modelled through structural analysis of covariance [11]. The restaurant locations where the service delivery robots were installed in this paper are the same restaurant chain with similar menus and service forms, but on a larger scale. In addition to the traditional customer service staff, there are auxiliary staff who assist in serving food and support the overall service of the store in cooperation with the serving staff and the customer service staff. In this paper, we analyze kitchen staff, catering staff, customer service staff, and assisting customer service staff.

## **2.2 Employee satisfaction and productivity**

In the field of service research, in addition to customer satisfaction (CS), the importance of employee satisfaction (ES) has been pointed out, and the cycle of success model [13] and the "service profit chain" [12], which describes the relationship between employees and customers as a satisfaction mirror, influence each other. Especially in interpersonal service situations where employees and customers face each other directly, the state of employees and their feelings have a significant impact on service quality.

Labor productivity is calculated by dividing value added by labor input, and increasing labor productivity is a combination of increasing the value added in the numerator and reducing the labor input in the denominator. In restaurant services, there are difficulties with both numerator and denominator approaches due to the heterogeneity of services and the labor-intensive nature of the work.

## **3 Questionnaire and interview surveys for employees**

### **3.1 Targets**

Employee questionnaires and interviews were conducted between December and January 2019 for employees working in four occupations: hospitality staff, hospitality auxiliary staff, culinary staff, and catering staff. Types of employment include both formal and informal employment. Interviews were conducted with executives, leaders, regular staff, and long and short years of service, respectively. The employee questionnaire received valid responses from 18 employees. Employee interviews were conducted with 12 employees in semi-structured interviews lasting approximately 25 minutes on December 20, 23, and 24.

### **3.2 Questionnaire Design**

The questionnaire consists of questions on employee satisfaction and productivity, in addition to the attribute survey and job satisfaction, by recalling two time points

immediately after the introduction of the service robot and after the passage of time. A six-point Likert scale ranging from "very much agree" to "don't agree at all" was used as a choice questionnaire and an open-ended questionnaire. In detail, the questions (Q1) and (Q2) are questions that assume the awareness/motivation and quality of provision of work, and (Q2) and (Q3) are questions that assume two time points immediately after and after the introduction of the serving robot, respectively. Questions related to work efficiency, service delivery quality, teamwork, and the operability and awareness of using the robot were set up. The questions on perceived quality took into account the characteristics of the target restaurant and the business and restaurant in question, such as the quality of the food served, the speed at which it was served, and the response and satisfaction of the customers.

Employee interviews examine efficiency and operational changes, customer satisfaction and employee satisfaction in the implementation of service robots. The objective is to find out how service robots are used in the work that employees are responsible for and what changes in operation will lead to quality, efficiency, and customer and employee satisfaction.

As a measure of employee satisfaction, Gazzoli et al. categorized the questionnaire questions into three categories: empowerment, job satisfaction and perceived service quality [14]. Empowerment includes questions such as "Is my job important to me" and "I have discretion on how I do proceed my job". In addition, it has been shown that a single indicator of job satisfaction is correlated with the use of the overall job satisfaction scale [15]. As for perceived service quality, conventional studies have been proposed that question items are required to be tailored to the characteristics of the target service, such as restaurant [14] and bank [16].

The questionnaire survey used in this paper is based on a questionnaire survey on employee satisfaction [11] conducted by the authors at the same restaurant chain and was developed by adding questions about service robots. Questions included in empowerment include, "Is work important to me?" and "Do I have freedom in how I proceed with my work? In the questionnaire survey used in this paper, questions related to empowerment, job satisfaction and perceived quality were set, respectively. In the question on perceived quality, the questions were set in consideration of the characteristics of the restaurant. This questionnaire consists of questions on perceived quality to directly ascertain the effects and influences of the introduction of service robots and questions to indirectly ascertain the effects of the introduction of service robots on employees in terms of their feelings and job satisfaction. In addition to the questions on empowerment, job satisfaction, and perceived quality, the questions on perceived quality included questions on the quality of food delivery, speed of food delivery, and customer response and satisfaction, taking into account the characteristics of the restaurant location [11]. In the (Q2) and (Q3), two scenes were set up for the question items, one immediately after the introduction of the service robot and the other at the present time. The same question items are set up to be answered for each of the two periods. Respondents are asked to describe their feelings and conditions both when the service robot was introduced and their current feelings and conditions. Some questions are about work efficiency, provision quality, teamwork, and operation using the robots by

introducing the robots. Regarding questions related to perceived quality, the following questions are set considering the characteristics of restaurants including quality of serving food, food serving speed, and customer response and satisfaction. During employee interviews, we examine changes in efficiency and operations, customer satisfaction, and employee satisfaction when introducing the service robots. The purpose is to examine how the service robots are used in work for which the employee is responsible, and to assess what changes in the operations result in improved quality, efficiency, and customer and employee satisfaction.

#### 4 Discussions

First, the results of the employee questionnaire are presented. We compared the mean values of the current Likert scale immediately after the introduction and after the passage of time with respect to the effect of introducing the service robot in question categories (Q2) and (Q3). 'The skills to operate the service delivery robot have been acquired so that we are able to provide high quality service. The positive results for the introduction of robots were obtained (Q41). In this question, a significant difference (the average of gap is 0.45) was found as a result of the difference test of the mean value of the t-test (one-tailed test, P-value: 0.03). However, although we were able to confirm a certain number of positive changes in the number of subjects for the other question items, we were not able to confirm any significant differences between the current and immediate introduction. Since this questionnaire analysis was conducted on a single store, quantitative verification by increasing the number of stores and the number of survey targets is a future issue.

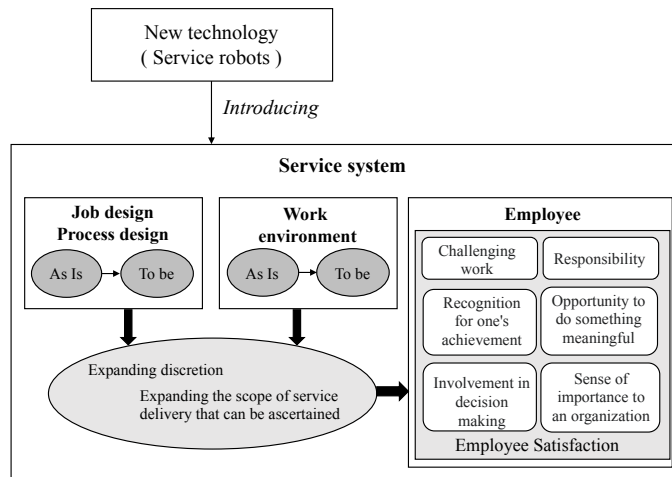


Figure.1 The outline of the impact of technology implementation on service systems and employee satisfaction

According to the results of the employee interviews, it was mentioned that the serving staff was able to stay in the serving area and work because the distance travelled from the serving area to the table in question on the hospitality floor was significantly reduced. This suggests that people are reducing the non-value-added tasks of movement and avoiding more time for other tasks or original tasks that can contribute to value-added and service quality improvement. In addition, the ability to strategically instruct the robot on the timing, location, and movement of food to be placed on the serving robot increased productivity by allowing the robot to perform other tasks, such as serving food, in its free time within its own work time. As a secondary effect of the introduction of the robot, we heard the opinion that the introduction of the tablet to check the position of the service robot in the store and its status made it possible to grasp the entire store. In [11], many of the serving staff had the perception that they work independently between the cooking and customer service staff. On the other hand, the staff in question also felt that the motivating factors increased employee satisfaction, while they felt that their work was more rewarding and that they had acquired new skills (figure1). On the other hand, it was observed that the service assistant staff actively promoted the use of the service delivery robot and helped the service staff to focus on more value-added tasks close to the customers. Although some subjects in the interview survey mentioned certain improvements in quality and efficiency, the questionnaire survey did not reveal any significant differences, except for (Q41). For example, "As a result of the improvement and efficiency of our operations, we are now able to satisfy our customers (Q42), I feel my work efficiency has improved and my physical load has been reduced (Q44), and I feel that I have a high level of value-added work I am now able to devote more time to work that I couldn't do before (Q46), and to work with customers. It is now possible to devote more time to direct customer service (Q50). Further analysis is needed to take into account the differences in occupations and intention to use the robot.

## **5 Conclusions**

This paper discusses the impact of the introduction of service delivery robots on employee satisfaction and productivity. The next challenge is to increase the scope of the survey and propose a more quantitative evaluation and employee satisfaction model.

## **Acknowledgements**

This work was supported in part by JSPS KAKENHI Grant Number 7H01827.

## **References**

1. Qing-xiao, Y., Can, Y., Zhuang, F., and Yan-zheng, Z., Research of the Localization of Restaurant Service Robot, *Int. J. of Advanced Robotics Systems*, Vol.7, No.3, pp.227-238 (2010)

2. Shimmura, T., Takenaka, T., Ohura, S., Improving Labor Productivity and Labor Elasticity at Multiproduct Japanese Cuisine Restaurant Introducing Cell-Production System, Proc. of International Conference Advances in Production Management Systems (APMS2013), State College, USA, 9-12 September, III11-17 (2013)
3. Takenaka, T., Shimmura, T., Ishigaki, T., Motomura, Y., Ohura, S., Process Management in Restaurant Service - A Case Study of a Japanese Restaurant Chain, Proc. of International Symposium of Scheduling 2011 (ISS2011), Osaka, Japan, 2-4 July, pp.191-194 (2011)
4. Judge, T.A., Thoresen, C.J., Bono, J.E., Patton, G.K, The Job Satisfaction-Job Performance Relationship: A Qualitative and Quantitative Review, Psychological Bulletin, Vo. 127, pp.379-407 (2001)
5. Iaffaldano, M.T., Muchinsky, P.M., Job Satisfaction and Job Performance: A Meta-analysis, Psychological Bulletin, 97: 251-273 (1985)
6. Harter, J.K., Schmidt, F.L., Hayes, T.L., Business-Unit-Level Relationship Between Employee Satisfaction, Employee Engagement, and Business Outcomes: A Meta-Analysis, Journal of Applied Psychology, Vol. 87, No. 2, pp.268-279 (2002)
7. Fujii, N., Toshiya, K., Nonaka, T., Oda, J., Shimmura, T., A Study on Staff Shift Scheduling Improving Service Satisfaction in Restaurant Business - Proposal of Planning Method considering Difference in Employee Abilities, 23rd Conference on the Japan Society of Mechanical Engineers, Design and Systems Division (in Japanese) (USB), 2314 (2013)
8. Sureshchandar, G.S., Rajendran, C., Anantharaman, R.N., The Relationship between Service Quality and Customer Satisfaction - A Factor Specific Approach, The Journal of Service Marketing, Vol. 16, No. 4, pp.363-379 (2002)
9. Fujii, N., Toshiya, K., Uemura, M., Nonaka, T., Shimmura, T., 2013, Facility Layout Planning of Central Kitchen in Food Service Industry – Application to the Real-scale Problem, Proc. of International Conference Advances in Production Management Systems (APMS2013), State College, USA, 9-12 September, pp. 33-40 (2013)
10. Nonaka, T., Kaihara, T., Fujii, N., Yu, F., Shimmura, T., Hisano, Y., Asakawa, T., Employee Satisfaction Analysis in Food Service Industry - Resultant of Questionnaire to the Restaurant Staff -, Proc. of the 2nd International Conference on Serviceology (ICServ2014) USB, pp.9-15, Yokohama, September 2014 (2014)
11. Nonaka, T., Fujii, N., Shimmura, T., Takahashi, T., Kaihara, T., An Employee Satisfaction Model Considering Customer Satisfaction -Difference Analysis of Staff Work Positions in Restaurant Services-, Journal of Japan Industrial Management Association, Vol. 67, No. 1, pp.59-69 (2016)
12. Heskett, J.L., Jones, T.O., Loveman, G.W., Sasser Jr., W.E. and Schlesinger, L.A., Putting the Service-Profit Chain to Work, Harv. Bus. Rev., Vol. 72, pp. 164-174 (1994).
13. Schlesinger, L.A., Heskett, J.L., Breaking the Cycle of Failure in Services, Sloan Management Review, Vol. 32, No.3, pp.17-28 (1991)
14. Gazzoli, G., Hancer, M. and Park, Y., The Role and Effect of Job Satisfaction and Empowerment on Customers' Perception of Service Quality a Study in the Restaurant, Ind. J. Hosp. Tourism Res., Vol. 34, No. 1, pp. 56-77 (2010)
15. Wanous, J. P., Richers, A. E., and Hudy, M. J., Overall job satisfaction: How good are single-item measures?, Journal of Applied Psychology, Vol. 82, No. 2, pp. 247-252 (1997)
16. Schneider, B. and Bowen, D. E., Employee and customer perceptions of service in banks: Replication and extension”, Journal of Applied Psychology, Vol. 70, No. 3, pp. 423-433 (1985)