Digital Ordering Improves Labor Productivity in Multiproduct Restaurants

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Abstract. This study assessed a digital ordering system (DOS) for use in a multiproduct Japanese cuisine restaurant to enhance labor productivity. Labor productivity of restaurants is lowest among Japanese service industries. After DOS is introduced, restaurant operation processes were changed: order receiving duties are allocated to the DOS, not staff members; also, the number of dishes for preparation is decided based on the DOS promotion contents. Thereafter, restaurant managers can change the work schedule to reduce the total labor hours necessary for operations. Work hours and sales per labor hour measured before / after DOS introduction are recorded as a KIP showing productivity improvement. Results show that DOS introduction reduces labor hours, but increases sales per labor hour. However, the system should be improved to provide greater utility for customers. Moreover, DOS has no character size expansion function. Therefore, elderly customers have difficulties caused by poor vision. Also, DOS does not show all menus together. Therefore, customer selection of dishes to order can take some time and effort.

Keywords: Labor Productivity, Restaurant, Service Engineering

1 Introduction

In recent years, service industries have come to account for 75% of Japanese GDP. The trend is not only prevalent in Japan. Economies of industrialized nations are shifting to service industries. Nevertheless, labor productivity of service industries is lower than that of manufacturing industries. Especially, labor-intensive industries such as transportation, retail, and hotel industries have lower labor productivity than other service industries such as information services and web services. The restaurant industry can be regarded as a typical labor-intensive service.

The restaurant industry has strived to improve labor productivity since the mid-20th century. In the 1950s, some innovative American restaurant companies introduced chain store management systems. In the 1970s, the Japanese restaurant industry adopted such systems [1], introducing a central kitchen to reduce the number of chefs in restaurant kitchens. The system also introduces multi-store operations to realize economies of scale. The strategy rapidly expanded Japanese restaurant markets.

In the 1980s, the industry introduced information systems to improve store operations and supply chains. For instance, point of sales (POS) systems were developed and introduced in restaurants [2]. Before POS introduction, when a service staff member received order information, the staff member wrote it on a sheet of paper and brought it from the floor to the kitchen. By contrast, POS systems communicate order information electronically from a service staff member to a kitchen. The POS printer issues an order sheet. Restaurants reduce order information distribution operations, which reduces workloads of the service staff members.

In the 1990s, cooking machines and production systems were enhanced for more efficient kitchen operations. For instance, sushi production systems were developed for Japanese sushi restaurants [3]. Such systems include sushi preparation machines. The machines require no special sushi preparation skills. Restaurants need not hire sushi chefs. Restaurants can therefore reduce staff wages. Similarly, bulk cooking machines were developed to improve production capacity. For instance, convection ovens were used for simmered and baked dishes. The ovens require no special preparation skills. Restaurants were thus able to reduce the total number of chefs [4].

In the 2000s, the industry improved information systems for better store operations. For instance, process management systems (PMS) were developed. A POS manages order information by paper, but a PMS manages order information by display; PMS updates it regularly (kinds of dishes, total numbers, and lead times). Chefs can raise cooking speeds by referring to the information. In addition, the industry developed simulation systems for facility design and shift scheduling [5]. For instance, kitchen operation simulators were developed for facility layout design and cooking capacity control. Simulators calculate the lead times of dishes and cooking machine workloads. Kitchen designers can refer to simulation results for new kitchen design and cooking machine volume [6]. Furthermore, digital signage was introduced to enhance sales revenue and customer satisfaction. Digital signage shows information for dishes and ingredients: they promote customer orders [7]. Customers can gain knowledge related to ingredients and dishes, and can feel that the waiting time is short. Waiting time is an important factor affecting customer satisfaction [8].

Although many machines, systems and methods have been developed, restaurant labor productivity is lowest among service industries. Conventional studies mainly address kitchen (production) processes because they can be easily augmented by production management methods developed for manufacturing industries. Improving floor (service) process productivity is difficult because the process is a typical service product. Low productivity for service products arises from service characteristics. Services are intangible (intangibility). Therefore, products must be produced at the moment a customer orders them (simultaneity). In restaurant service, a POS system obviates order information transmission processes, but service staff members must wait at the restaurant floor to receive customer orders (thus service staff members are called waiters). To reduce the total number of service staff (labor hour input), the order receiving process must be eliminated, not only the order transmission process. Also, the total order (production output) should be increased to improve labor productivity because productivity is calculated by division (output / input).

To resolve difficulties, a digital ordering system (DOS) was developed and applied for an actual restaurant. In addition, service operations and working shifts are changed to reduce work hours. Kitchen operations are changed to adopt the system. Work hours and the total of orders before/after the system introduction are measured to confirm the system efficacy for productivity improvement. In addition, interviews are conducted to confirm the qualitative efficacy of the system.

2 Digital Ordering System Introduction

2.1 Usage and structure of digital ordering system

Conventionally, order information is recorded in the staff member's memory or order sheet. When a customer orders, the customer calls a service staff member and conveys an order. The service staff member memorizes it or writes it on paper before delivering it to the restaurant kitchen. If a restaurant is busy, then many customers call staff members to convey orders in succession. Therefore, the restaurant manager should assign service staff members to avoid customer complaints.

A POS system automatically transmits order information from the service staff members to the restaurant kitchen using the order input device and transmission system, but the customer order information is received by service staff members. Input devices are operated by service staff member.

By contrast, the DOS can omit staff members' order receiving and delivery processes. Moreover, DOS has sales promotion functions to increase sales revenue. Figure 1 portrays the system structure: it consists of a control server, order input devices, kitchen printers, communication devices, and cashiers. The ordering program, dish information database (food category, name, price and picture), and promotion movie data are stored in a control server. When a customer inputs the order information, the communication device transmits it from the device to a kitchen printer and to a cashier via the control server. The printer issues an order sheet. The cashier calculates the account. If the customer uses no device, then the controller displays recommended information for sales promotion.

The DOS reduces the total number of service staff members because customers input order information by themselves. If a customer decides on an item to order, the customer inputs the information using the order tablet placed on a table. Menu categories are indicated on the main screen. When the customer taps a menu category, the category dishes and drinks are shown on the display. When the customer taps a dish or drink that the customer wants to eat or drink, the order quantity input command pops up; then the customer inputs the order quantity and taps the call button. Therefore, service staff members need not receive and deliver order information except if the customer is unable to do so. They need only to serve the ordered dishes, clear dishes, and clean and prepare the table. Restaurant managers can reduce the total number of service staff members because several operations of staff are allocated to the system.

In addition, the tablet can show product and promotion information. A restaurant manager determines a recommended dish, creates a recommendation movie or still image, and uploads it to the system. The system displays the information when a customer

is not operating the device. The information provokes customer buying interest [7]. Therefore, kitchen staff can forecast the increase in the volume of recommended dishes and make arrangements to prepare it quickly. Reduction of lead times is important for productivity enhancement [9].

Decreasing the total number of staff and lead times is important for labor input reduction, and for increasing total of order is factor for output growth. They enhance labor productivity because it is defined by deduction (output volume / labor input).

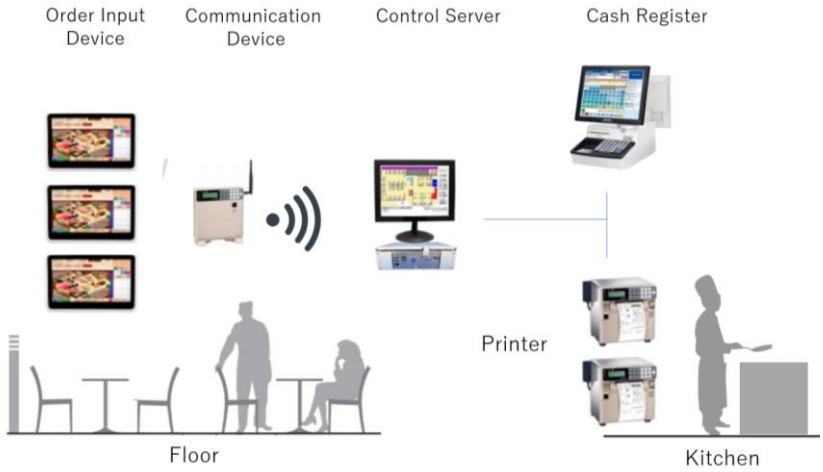

Fig. 1. Digital Ordering System Structure.

2.2 System introduction

The system was introduced to a multiproduct Japanese cuisine restaurants located in Kyoto (2 floors, 1 kitchen, 123 sheets, and 1,234 m^2). Before system introduction, operation training was conducted for restaurant A staff members. The menu category, menu database, and promotion movie are created by a menu planning division staff. The system line, equipment configuration (1 control server, 2 cashiers, 30 order input device, 15 kitchen printer, and 1 communication device), and transmission setting (which kitchen printer receive and issue for dish a, b, c) are prepared by an information system division staff member.

At the time of system introduction, the restaurant manager changes restaurant staff operations. As explained above, customers input order information directly to an order input device. Therefore service staff members can stop visiting customer tables for order receipt, except in cases where customers ask for device operation support. Kitchen staff members can change preparation operations. They increase preparation volumes of system recommended dishes. Based on operation change, the restaurant manager changes the work schedule (service staff member number is reduced).

To confirm the system efficacy for labor productivity enhancement, work hours of the restaurant were measured for 9 weeks as a KPI for labor input reduction. Work hour reduction is a KPI for labor productivity, because Labor productivity is calculated by

division; divide total of production by work hour. Work hours of the respective staff members are recorded by an attendant management system. They are calculated daily. Work hours of the same calendar day of the system introduced year and in the previous year are compared because restaurant operations fluctuate seasonally.

Sales per labor hour are measured for the same term as a KIP for output volume. As explained above, numerator of labor productivity formula is total of production, and sales is a index for production number. Therefore hourly sales per labor hour indicates productivity output volume.

Hourly sales are recorded by the DOS cashier. Hourly staff numbers are recorded by attendant management systems. Sales per labor hour are calculated from hourly sales divided by the hourly working number. Sales per labor hour of the same calendar day of the system introduction year and the prior year are compared because of the same reason.

After the experiment, questionnaires were administered to the restaurant staff members. Questionnaires included four items (DOS is effective for operation efficacy, sales promotion, customer support, and work hour reduction). Staff members evaluated them using an ascending risk scale of 1 to 5.

3 Results

Average work hour per day before the system introduction is 356.4 hr (SD=32.2)., That of after introduction is 339.4 hr (SD=38.1, P=0.0942). Assuming unequal variance with one-sample *t* tests, we found a significant difference in the means ($t(63)=2.686$, $p<0.05$) Average sales per labor hour is 4,003 yen (Sd=575)., That of after system introduction is 4,454 yen (SD=730, P=0.0167). Assuming equal variance with one-sample *t* tests, we found a significant difference in the means ($t(63)=3.847$, $p<0.05$). Figure 2 (left) presents work hours and sales point diagrams for the prior year. Figure 2 (right) shows those of the present year (next page).

Results of questionnaires include the following: The average score of question 1 (DOS is effective for operation efficacy) was 4.1. That of question 2 (DOS is effective for sales promotion) was 4.0). That of question 3 (DOS is effective for customer support) was 3.4. That of question 4 (DOS is effective for work hour reduction) was 4.4. Table 1 presents the questionnaires results next page).

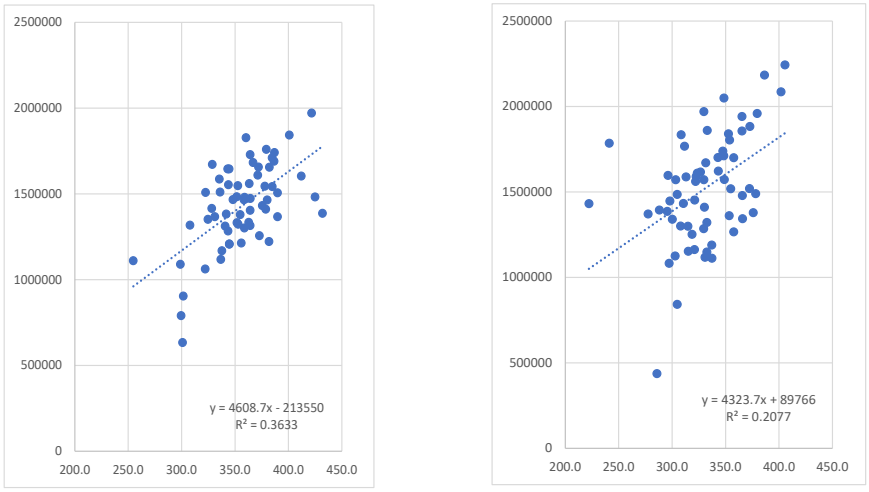

Fig. 2 Digital Ordering System Structure (y axis, sales in yen; x axis, work hour).

Table 1. Responses to questionnaires

Questionnaire item	1	2	3	4	5	Avg.
DOS is effective for operation efficacy	0	0	1	7	2	4.1
DOS is effective for sales promotion	0	0	2	6	2	4.0
DOS is effective for customer support	0	0	7	2	1	3.4
DOS is effective for work hour reduction	0	0	1	4	5	4.4

4 Discussion

First, DOS introduction effects on work hour reduction are discussed. As results show, average work hours were reduced from 356.4 hr to 339.4 hr. The purpose of DOS was to obviate order receiving operations by service staff. Because the restaurant manager reduced the total of service staff after adoption by the system, work hours of the restaurant decreased. In addition, as Table 1 shows, staff members evaluated the most effective DOS function is to reduce work hours (average score is 4.4). The restaurant manager remarked that DOS is effective especially during idle times. On two floors, there are two large rooms in each floor in the restaurant. If DOS is not introduced, then at least four service staff members must be assigned because staff members must wait at each room to receive customer orders. If DOS is introduced, then staff members need only to wait at each floor, and need only serve dishes when they are finished cooking.

Secondly, DOS introduction effects for output volume are discussed. Average sales per labor hour increased from 4,003 yen to 4,454 yen (+11.3%). Work hours decreased by 4.8%. Therefore, the sales increase effect for sales per labor hour was 6.5%. As explained, promotion and product information elicit customer orders [7]. In addition, the ordering system itself increases the total number of orders. If DOS were not introduced, then customers would call a service staff member for ordering. If a restaurant is busy, staff members can not receive all customer orders conveniently. Therefore some customers hesitate or stop orders because they become too busy. By contrast, DOS resolves the difficulty; customers can order dishes timely using an ordering device, even if the restaurant is busy. Employees evaluated DOS as useful for sales promotion.

Thirdly, the DOS qualitative evaluation is discussed. As Table 1 shows, the highest score of the questionnaire is “work hour reduction”. The second score is “operation efficacy”. The purpose of DOS is to enhance labor productivity. Naturally, restaurants reduce work hours by changing service operations and work scheduling. In addition, increased output volume is important for enhancing labor productivity Employees evaluate that the system supports increased sales. However, employees evaluated the “customer support” function as low, although service quality is a primal factor for the restaurant industry. Several reasons can explain this finding. First, older customers are not accustomed to IT device operations. In addition, senior customers have bad eyesight, but the display system does not have a character size transformation function. Order input function should be improved for easier ordering. Secondly, looking at all menus is not easy compared to a paper menu. If a customer decides to order an item, then they need only to tap the “menu category” “menu item” and “number”. However, if a customer does not decide to order something, the customer should search all kinds of menu categories to ascertain which menu items are available.

5 Conclusions

For this study, a digital ordering system was developed and introduced in a multi-product Japanese cuisine restaurant to enhance labor productivity. Before the system introduction, operation training was conducted for staff members. Then the menu of the restaurant was set up. Thereafter, the system was actually introduced. Store managers changed staff operations; order receiving processes were allocated to the system. Numbers of dish preparation were decided based on the system promotion contents. Subsequently, the manager changed the work scheduling to reduce total work hours. Results show that reducing work hours of restaurant staff members can be achieved by introducing the system. A restaurant can improve sales per labor hour using the system. Results demonstrate that the system enhances labor productivity of restaurants by reducing input (work hour) and by increasing output volume (sales per labor hour). However, the system should be improved: it is less useful for elderly customers because the system can not show large characters. Also, the system does not show the entire menu at once. Therefore a customer can not view all items easily.

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