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Understanding Barriers to Service Robot Usage: A Qualitative Study in Hotels

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Short Research Paper

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Abstract: Robot applications are gaining momentum in many fields, especially in service-oriented industries. However, the robot usage rate in service industry is relatively low. Thus, we conducted 23 semi-structured interviews in upscale and luxury hotels. Accordingly, we identified barriers to service robot usage from three stages, including the pre-usage stage, the encounter stage, and the post-usage stage. Moreover, based on Expectation-disconfirmation Theory (EDT), we investigated the influential mechanisms of identified barriers. In the pre-usage stage, negative organizational valence and hoteliers' unreadiness would trigger hoteliers' low initial expectations to service robot usage. In the sencounter and post-usage stage, robot unfriendly design, robot low working efficiency, and hoteliers' technostress would jointly influence the expectation-performance disconfirmation. The disconfirmation would cause the hoteliers' dissatisfaction to service robot usage. Consequently, hoteliers are reluctant to use service robots. The findings extend the literature of service robot studies and Expectation-disconfirmation Theory in the context of hospitality management as well as help guide the development of service robots.

Keywords: Service Robot, Barriers, Robot Usage Stages, Expectation-disconfirmation Theory

1. INTRODUCTION

Service robots are defined as "actuated mechanisms programmable with a degree of autonomy and humanness, moving within its environment, to finish specific works" [1]. Nowadays, service robot usage is developing rapidly, diffusion into a broad of service-oriented industries including public service, healthcare, tourism, etc. For example, in airports, service robots could provide travelling information to travelers. In many restaurants, service robots are used for food preparation. The robot working progress would be visible to customers as they could see how service robots providing the foods in the kitchen [1]. In the post-COVID-19 era, service robots could provide contactless service to meet the need for epidemic prevention and control [2]. Noticing the robot development momentum, the International Federation of Robotics (IFR) avowed that the market for professional service robots grew rapidly in 2020 by 32% from USD 8.5 billion to USD 11.2 billion. Meanwhile, the global service robotics market is expected to reach USD 63.8 billion by 2025 [3].

However, it's noteworthy that there are still tremendous service companies not using service robots [4]. Besides, although some companies have successfully adopted robots, the robot workforces were still reduced. Therefore, it is imperative to investigate why individuals are reluctant to use service robots. Previous studies have preliminarily revealed the challenges faced by service robot manufacture, for example, the scarcity of government regulations would impede service robot manufacture [1][5]. Meanwhile, some studies also explored customers' perceptions and indicated that customers' distrust of service robots was a major impediment to service robot usage [6][7]. However, considering employees are major users and decision-makers [8], it still lacks a holistic consideration for barriers to service robot usage from the employee perspective in an organization [1]. What salient barriers eventually influence service robot usage and in what way this influential mechanism in an organization is largely unknown.

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Noticing the above research gaps, firstly, this study identified barriers to service robot usage holistically based on three robot usage stages, including pre-usage stage, encounter stage, and post-usage stage. These stages are covering the whole processes of service robot usage in an organization and could provide a set of useful theoretical explanations for understanding the barriers in different service robot usage levels. Secondly, we investigated the influential mechanisms of the barriers by integrating the Expectation-disconfirmation Theory (EDT), which is used for explaining individuals' technology using intentions [9]. Thus, EDT is resonating with our study purpose. Moreover, this study proposed a theoretical framework of barriers to service robot usage. Accordingly, we conducted semi-structured interviews of 23 hoteliers in upscale and luxury hotels in China. Upscale and luxury hotels are typical service enterprises applying service robots and more agile to new technology compared with other organizations [10]. The research questions are as follows:

RQ1: What are salient barriers to service robot usage from different stages in the hotel context?

RQ2: How could these barriers jointly impede service robot usage in the hotel context?

The following sectors of this paper are structured as follows. Firstly, we present a literature review of the related studies. Secondly, we post the methodology and data collection process. Thirdly, we show the preliminary findings and the theoretical framework. Finally, we draw a conclusion of this paper, including theoretical contributions, practical implications, and future work directions.

2. LITERATURE REVIEW

2.1 ICTs and robot in the service industry

Information and Communication Technologies (ICTs) have been conceptualized as all devices, networking components, applications, and systems that allow humans to interact with the world [11]. ICTs have been dramatically influencing the hospitality industry. Nowadays, ICTs have become pervasive as a routine part of daily operations of collecting customers' information, conducting business, and making managerial decisions.

As a form of ICTs, service robots are different from other traditional ICTs. The novelties of service robots include the following perspectives. Firstly, the capability of sensing, learning, and adapting without human intervention is the critical point that distinct service robots from traditional automation technologies [12]. Only those automations that perform a certain level of intelligence could be regarded as robotics, which are enabled by advanced mechanical engineering and AI technologies, e.g., image recognition, automatic speech recognition, and natural language processing. Thus, tremendous ICTs are considered as automation but not robotics. Secondly, robots have anthropomorphic characters and afford a higher level of human-technology interactivity [13]. Many service robots have human-like appearances and can mimic human motion like tilting their head and making gestures.

Drawing on previous studies related to service robot usage, studies paid attention to the following perspectives: Firstly, studies illustrated the drivers to service robot usage. Service robots could work continuously without needing a rest or any salary. Meanwhile, service robots could handle simple tasks fast and accurately [14], thus, service robots would release employees from repetitive or dangerous works. Thus, service robot usage is beneficial to increase operational efficiency. Furthermore, individuals' curiosity also drives them to use service robots. Individuals would think service robots are more advanced, stylish, as individuals have yet to interact with robots [15].

Secondly, current scholars preliminarily explored the individuals' robot usage experience after interacting with service robots. Drawing on individuals' acceptance of service robots, studies revealed that perceived ease of use (PEOU) and perceived usefulness (PU) are two major indicators of individuals' acceptance [16][17]. Besides, studies indicated that individuals would evaluate robot embodiments, human emotions, human-oriented perceptions, the feeling of security, and co-experience during what human-robot interaction process [18].

2.2 Robot usage stages

Previous studies revealed the robot usage process in the service industry context [19][20]. Generally, the service robot usage could be divided into three stages, including pre-usage stage, encounter stage, and post-usage stage as follows [19][20].

The pre-usage stage is the starting condition. In this stage, individuals would realize the existence of service robots and find the relevant information of those advanced facilities.

The encounter stage involves the interaction between individuals and service robots. In this stage, individuals and service robots co-create the service delivery process, and individuals would preliminarily evaluate the service robot design (e.g., technology interface, functions).

The post-usage stage is the process that individuals would appraise the technology performance and effectiveness (e.g., service quality, working efficiency) based on using experiences in the robot-encounter stage. Then, users would compare the evaluation results with the initial expectations toward service robots.

2.3 Expectation-disconfirmation theory (EDT)

Expectation-disconfirmation theory (EDT) was developed by Bhattacherjee [21] to systematically explain individuals' expectations and purchasing intention in marketing across many products and services. In technology usage contexts, EDT explains why individuals are reluctant to use the new technology [22], such as outsourcing platforms [23], mobile applications [24], and augmented reality (AR) [25]. From previous studies, EDT has four key elements, including expectation, expectation-performance disconfirmation, satisfaction, and users' behavioral intentions [21]. Expectations are individuals' beliefs and images before using the technology. Expectation-performance disconfirmation is a subjective post-usage comparison that thinking the technical performance was worse than individuals' expectations, while individuals' performance in the workplace could not be improved by technology usage. Especially, satisfaction is an essential dependent variable that represents a hotelier's emotional state following the usage experience. The behavioral intention is an individuals' determination to behave in a certain way [22].

3. METHODOLOGY AND DATA COLLECTION

3.1 Methodology

In this research, we chose a qualitative methodology as this research is an early attempt to investigate the impediments of service robot usage in hotels. Corbin and Strauss [26] revealed that qualitative methods are preferable to study the topics in the nascent stage of theoretical development. Accordingly, this study adopted the grounded theory and "grounding" the theory by analyzing research data. we conducted semi-structured interviews to gather first-hand data and developed systematic analysis procedures based on grounded theory. From Corbin and Strauss [26], the systematic procedures focus on the individuals' perceptions and experience adhere to a strict and rigorous protocol. we strictly followed the coding processes including open coding, axial coding, and selective coding to better understand the impediments to service robot usage from hoteliers' perspectives. Furthermore, we applied the constant comparative during the coding processes to achieve maximum rigor. It is an iterative process and requires the researchers to go back and forth when analyzing each interview to the next and back again to continually compare the data and identify the similarity and differences from each statement.

3.2 Data collection

Data were collected from February 2020 to April 2020. The sample consists of 23 hoteliers who were working in upscale and luxury hotels. Meanwhile, studies verified that hoteliers could provide indicative insights about hotel technology usage [8]. We selected hoteliers with a balanced ratio of men and women. Considering the different robot usage stages, we chose hoteliers who yet to work with service robots or stop using service robots. Their job position including general managers, operation directors, middle managers, and grass-root staffs.

At the beginning of each semi-structured interview, we invited interviewees to give a short self-introduction. Meanwhile, we introduced the service robot development and application. In the interview process, we left enough time for the interviewees to think deeply about each question. Each interview lasted over 30 minutes. With interviewees' permissions, the interviews were well recorded and transformed. As interviewees explained their perceptions, they were asked the current robot usage situation and why hotels yet to use robots or stop employing the robots, followed by more probing questions about their experience related to service robot usage. Every respondent was labeled after the interview.

4. PRELIMINARY FINDINGS

4.1 Barriers to service robot usage in hotels

The following part is our preliminary findings regarding barriers to service robot usage in hotels. The barriers were identified from interview transcripts based on the grounded theory approach. The salient barriers in the pre-usage stage include negative organizational valence and hoteliers' unreadiness. Unfriendly design is the most salient barrier in the encounter stage. In the post-usage stage, low working efficiency of robots and hoteliers' technostress are the salient barriers.

- **The pre-usage stage**

Barrier 1: Negative organizational valence. Negative organizational valence means that hoteliers believe the organization (hotel) will not be benefited from the service robot usage [27]. Hoteliers would search relevant information about service robots before adoption, and then preliminarily evaluate the service robot according to the collected information. In this study, respondents mentioned that hearing from current news and hotel experts, some adopted hotels would face the potential legal risks introduced by service robot usage, as the data in the robot system would be leaked. Besides, hoteliers emphasized that the hotel would face financial distress. According to previous cost estimates, hoteliers would evaluate the potential financial cost to service robot usage. If the service robot is too expensive for the hotels, the hotel would suffer from a cash-flow shortage based on cost estimates, then the hotel would not obtain benefits from service robot usage. Consequently, hoteliers would refrain from adopting service robots.

Barrier 2: Hoteliers' unreadiness. Hoteliers' unreadiness is the condition or state in which a hotelier is unprepared for working and collaborating with the service robot before interacting with service robots. Respondents proposed that service robot usage requires hoteliers to achieve skills to qualify for robot-related tasks. However, respondents believed that they are incapable to operate and maintain the service robot. Thus, hoteliers' unreadiness is another resistant factor for service robot usage.

- **The encounter stage**

Barrier 3: Unfriendly design. The design of service robots could be generally divided into visible components and invisible components. The visible components are robot morphological features, such as color, shape. Although previous studies revealed that service robots have anthropological design cues, i.e., human-like appearance [12], respondents reported that service robots still lack human-like characters. They even used words like "scary", "terrible" to describe the robots' appearance. The invisible components are robotic functions. Respondents indicated that they would evaluate whether service robots could provide suitable functions in different scenarios. However, most service robots are designed for a fixed purpose in a targeted scenario rather than setting multifunctions for different scenarios, like concierge robots are incapable to clean the guests' rooms. Thus, service robots are hard to provide high-quality service during the interaction process due to the limited functions.

- **The post-usage stage**

Barrier 4: Robot low working efficiency. Respondents would evaluate the quantity and quality of tasks

finished by service robots, i.e., robot work efficiency. However, robots' low working efficiency was complained about by many respondents. Service robots are incapable to provide the service accurately and fastly. Respondents would be prone to negative attitudes due to the service robot frequently crash and restart, low technical quality, unreliable at critical times.

Barrier 5: Hoteliers' technostress. Technostress is the stress caused by service robot usage [28]. Respondents stated that they were forced to spend more time and effort on robot-related tasks. Thus, the service robot usage increased the amount of workload and the level of time pressure. Furthermore, in the post-usage stage, hoteliers faced the fast pace of service robot upgrades, which triggered hoteliers' anxiety. Every new upgrade means that hoteliers have to adapt to new situations. Meanwhile, hoteliers had to consume more time and energy to learn the new functions.

4.2 Influential mechanisms

We also roughly proposed the influential mechanisms of barriers to service robot usage as follows:

- **The pre-usage stage**

The low initial expectation to service robots is jointly influenced by negative organizational valence and hoteliers' unreadiness in the pre-usage stage. Respondents believed that the hotel would not benefit from service robot usage. Meanwhile, respondents are still not fully prepared for the service robot usage. Thus, they held low initial expectations of service robot usage in hotels. Consequently, the low initial expectation negatively influences their usage intention, as hoteliers would be reluctant to use service robots in the pre-usage stage.

- **The Encounter/post-usage stage**

Expectation-performance disconfirmation is affected by the robots' poor design, low working efficiency and hoteliers' technostress. The actual design and performance of robots could not meet hoteliers' expectations, while perceived technostress would trigger work-exhaustion in the workplace. Meanwhile, respondents stated that perceived technostress was detrimental to hoteliers' working performance. Thus, the disconfirmation between expectation and (robot/hotelier) performance would trigger hoteliers' dissatisfaction with service robots, consequently, hoteliers would be reluctant to use service robots.

4.3 Theoretical framework

Figure 1 displays the theoretical framework of this study. Firstly, we identified the contingent barrier-related perspectives based on the interview data, including organizational valence, hoteliers' readiness, unfriendly design, robot performance, and technostress. Secondly, we adopted the EDT to present the influential mechanisms of the robot-related barriers on hoteliers' initial expectation and expectation-performance disconfirmation. Thirdly, we preliminarily propose the robot usage barrier framework by integrating barriers to service robot usage and EDT.

5. EXPECTED CONTRIBUTIONS

This study investigated barriers to service robot usage and the influential mechanisms of the barriers. The expected contributions as follows: Firstly, different from existing studies mainly focused on the positive value of service robots [18], we focused on the dark sides of service robot usage in the service industry. Moreover, current studies explored service robot challenges macroscopically [1][5] and customers' perceptions of service robot usage [18]. Differently, we focused on the employees' perceptions and identified the perspectives of barriers to service robot usage based on three usage stages. Accordingly, this study will further refine barriers to service robot usage. Secondly, few studies have investigated the influential mechanisms of barriers to service robot usage [2][6]. We adopted EDT and discussed the low initial expectation and the gap between users' expectations and actual technical performance. We will further discuss the influential mechanisms with research continues. Thirdly, we extended the EDT to the service robot usage context. Meanwhile, we integrated different perspectives, e.g., organizational valence, hoteliers' readiness, robot design into EDT, as the integrative approach would improve

EDT illustrative capacity [22].

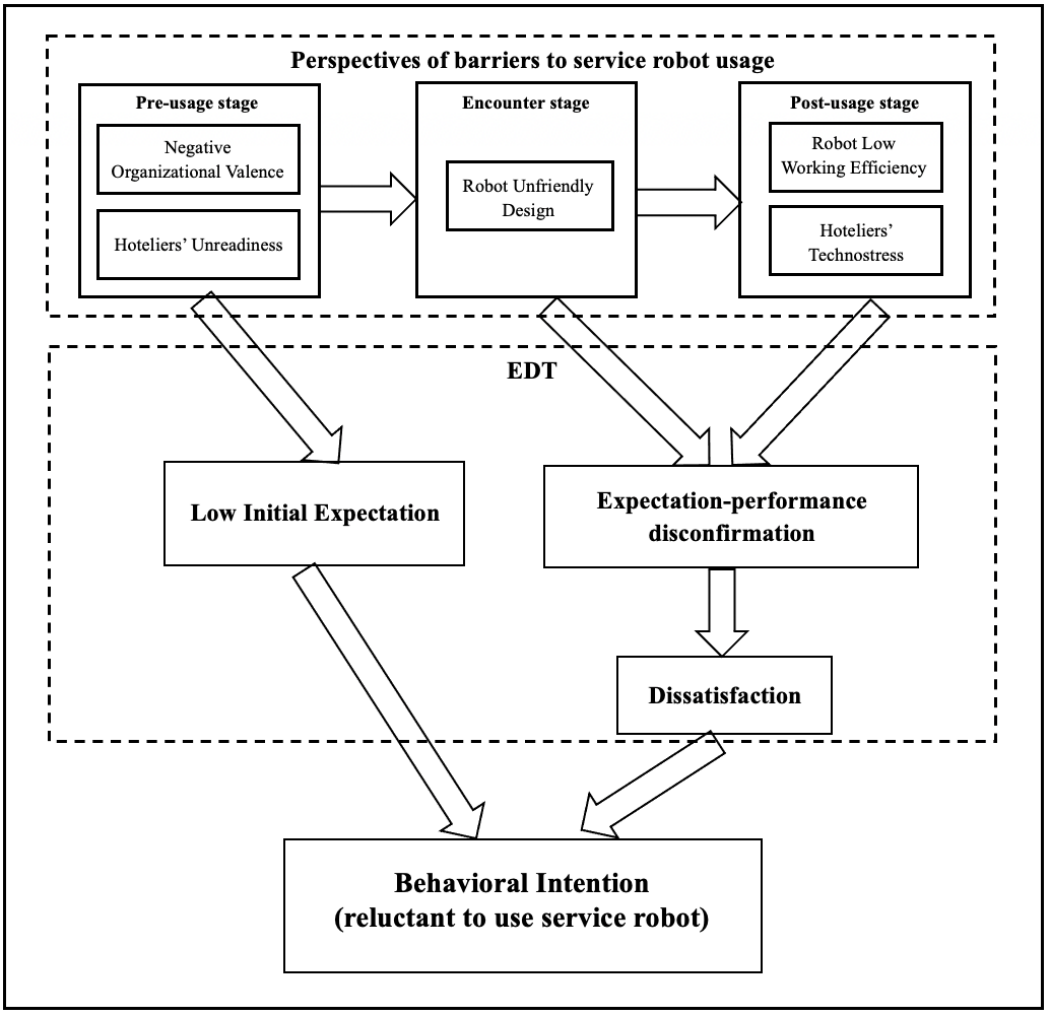

Figure 1. Barriers to service robot usage framework.

Practically, the contributions from this study will help hoteliers and robot manufacturers to find the influential factors of robot usage and better promote this advanced technology strategically. It would be beneficial to maximize the robot value and enlarge the target audiences of service robots.

6. LIMITATIONS AND FUTURE WORK

However, this study only focused on robot usage in upscale and luxury hotels from hotelier perspectives. In the future, we will increase our sample sizes and consider the characters of multi-type hotels and other service industries. Secondly, to increase the illustrative capacity, we will examine the proposed framework in the context of other technologies used in hotels or other service scenarios. Thirdly, we will adopt quantitative research to verify the proposed model.

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