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Examining the Impact of Frontline Service Robots Service Competence on Hotel Frontline Employees from a Collaboration Perspective

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Abstract: With the increasing adoption of frontline service robots (FLSRs) in hospitality workplaces, collaboration between frontline employees (FLEs) and FLSRs has become a necessity. The existing literature focuses on the customer perspective of FLSRs; however, this study explains the mechanisms through which employees' willingness to collaborate with FLSRs are built. By incorporating robot service capability and perceived risk as external variables into a technology acceptance model, this study investigated the mechanisms of FLEs' willingness to collaborate with FLSRs. The results showed that the service capability of FLSRs plays a significant role in increasing FLEs' willingness to collaborate, whereas perceived risk decreases their willingness to collaborate. These results indicate that the level of service capability of FLSRs and the management of perceived risk are important in shaping FLEs' positive attitudes toward collaborating with FLSRs. Therefore, this study extends the literature by investigating how FLEs and FLSRs relate to each other from a collaboration perspective.

Keywords: frontline service robots; service competence; perceived risk; technology acceptance model; willingness to collaborate

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1. Introduction

Frontline service robots (FLSRs), a term which refers to "system-based autonomous and adaptable interfaces that interact, communicate, and deliver service to an organization's customers" [1] (p. 909), are the driving forces behind a paradigm shift in the tourism industry [1]. FLSRs are changing the landscape of service encounters in the tourism industry, affecting employees and customers who are critical actors in the service ecosystem [2]. With the introduction of FLSRs, employees faced a change wherein they had to work in the same workplace as robots, and customers experienced automated services provided by robots rather than human services [3]. Therefore, for successful implementation of FLSRs, theoretical grounds considering the viewpoints of both employees and customers are needed [2–4]. The existing literature has focused on exploring the mechanism of customer robot adoption [5,6] and customer perception of the robots' service quality [7–9] to theoretically explain the success of the FLSR introduction. Unsurprisingly, understanding customer perspectives on robot adoption in the tourism industry is critical for the development of automated service environments [10–12]. The results of previous studies provide us with valuable knowledge about FLSRs from the customer's perspective; however, these prior studies overlook the relationship between employees and the FLSRs [2].

Recently, some researchers have acknowledged the importance of the employee–FLSR relationship in the changed work environment, but they have focused mainly on job insecurity as they assumed that FLSRs are a threat to employees' jobs [13–16]. Recent literature has emphasized the need to view the employee–FLSR relationship as a collaborative relationship rather than a competitive one in an automated workplace [17,18]. As these studies show, the relationship between an employee and FLSRs is complicated. When there is a change in the workplace due to the introduction of innovative technology such as FLSRs,

the perspective of employees and organizations on the change must be considered [3,19,20]. However, previous literature explored employee–FLSR relationships from a fragmentary perspective and limits the scope of comprehensive knowledge about employee behavior in workplaces integrated with FLSRs. To fill this literature gap, this study aims to explain the organizational management mechanism of tourism companies where FLSRs have been introduced by focusing on the results of prior literature that the relationship between employees and FLSRs can be collaborative [17,18,21].

In the tourism work environment, understanding how employees perceive coworkers is crucial for successful organizational management as collaboration between the two is essential [22]. Moreover, since the integration of FLSRs into the work environment causes many changes to organizational management, managers must understand the changes in the workplace and employees' perceptions of them [20,23]. Therefore, identifying the antecedent factors that form employee–FLSR collaboration relationships may provide important theoretical and practical knowledge from the perspective of organizational management in tourism companies where FLSR adoption is increasing. An employee's perceived risk to a coworker's competence level affects the building of their collaboration [24,25], and the employee perceived the unfamiliar collaboration relationship as a risk in the workplace [16]. To explain the employee–FLSR relationship from the perspective of collaboration, this study explores the mechanisms by which the level of service competence of the FLSRs and employees' perceived psychological risk for collaboration lead to acceptance of FLSRs as coworkers.

This study, which focuses on whether an employee may accept FLSRs as coworkers, applied a technology acceptance model (TAM) that is suitable for predicting users' behavioral intentions for unfamiliar technologies [26,27]. This study's results expand the employee–FLSR relationship into a coworker and further enrich knowledge on FLSR adoption in the workplace, thereby resolving the bias of previous literature, which focused on the relationship between customers and FLSRs and filling the gaps in the existing literature that explored the employee–FLSR relationship from a limited perspective. The organization management literature emphasizes that understanding the employee–coworker relationship is an important process for successful organization management [28–30]. To the best of the author's knowledge, no study so far has investigated how FLSR competence may affect employee–FLSR collaboration. This study integrates the FLSRs' service competence as an external variable of TAM and provides theoretical knowledge on the mechanism of employee–FLSR collaboration relationship.

Especially in Asian tourism workplaces such as South Korea, where employees are relationship-oriented [31], recognizing and trusting colleagues is an important organizational value [32]. South Korea is a global leader in workplace automation [33], and FLSRs are quickly being implemented in tourism workplaces [34]. Since working with FLSRs is an unfamiliar change for employees, understanding the psychological mechanisms of employees' perception of FLSRs as coworkers is an important issue for relationship-oriented Korean tourism organizations. By addressing the issues in South Korean tourism workplaces following the introduction of FLSR, this study enriches the employee-perspective FLSR literature which is focused on the psychological response to job insecurity by exploring the employees' psychological reaction to working in collaboration with FLSRs. Finally, to provide theoretical and practical knowledge of the employee–FLSR relationship from a collaborative perspective, this study empirically investigates the mechanism of employees' willingness to collaborate with FLSRs by integrating the robots' service competence and employees' perceived risk of collaboration with the robots as external variables of TAM.

2. Literature Review

2.1. The Importance of Employee–FLSR Collaboration in the Tourism Industry

Robots can be defined as "mechanical objects developed to facilitate daily tasks and help people" [3] (p. 2). Robots can be classified into industrial robots or service robots according to their functions and roles [35]. Industrial robots can increase production efficiency by performing repetitive tasks with high precision and high speed and can reduce production costs and potential risks of dangerous and repetitive tasks [36,37]. Service robots evolved from industrial robots [38] and are "robots that specialize in service tasks useful to humans" [39]. Unlike industrial robots, which are rigid and require human control, service robots interact with employees and customers through verbal and non-verbal communication based on human-centered design [38]. Moreover, the adoption of service robots in the tourism industry is being accelerated as the combination of robotics and artificial intelligence (AI) technology enables service tasks by FLSRs without human instructions [2]. FLSR implementation in the tourism industry is compared to the impact of the 18th-century industrial revolution on the manufacturing industry, changing all sectors in the industry [40].

In the tourism industry, the expansion of FLSR implementation cannot be explained by the development of robotics alone, as the adoption of FLSRs incurs financial costs for purchase, installation, and maintenance [5,41]. The adoption of FLSRs provides tourism companies with financial benefits such as labor cost savings [8,42], operational benefits such as working all year round and improving service efficiency [35], and improvements in marketing competitiveness such as positive word of mouth [6,35]. With these benefits, FLSRs are attracting industry attention as the future labor force that replaces frontline employees (FLEs) in the tourism industry [42]. Despite this, the introduction of FLSRs may bring unanticipated results given that it is a change that has never been experienced before [3,4].

As the role of FLSRs increases in service encounters, the concept of automated social presence (ASP), a customer's perception of believing in the social entity of the robots, has attracted researchers' attention. Consequently, they have explored social-level operations and enhancement mechanisms in the automated service encounter. Previous studies have demonstrated that a high level of social presence perceived by customers during face-to-face interactions leads to positive performance [43–45]. However, even though FLSRs have a higher ASP, customers prefer the FLE service for its emotional connection [46] and compare FLE and FLSR service levels [47]. It is difficult for customers to be satisfied with the unfamiliar service of FLSRs, as they have long experienced the sophisticated and warm service of FLEs [48]. These findings indicate that the traditional paradigm of the service provider and customer relationship works equally in an automated service workplace, regardless of the ASP level of the FSLRs.

McLeay [49] found that customers could reject the introduction of FLSRs from an ethical and social perspective because of unemployment issues that occur when robots completely replace FLE jobs. Accordingly, the authors emphasized that FLEs and FLSRs should collaborate to reduce customer concerns. FLSR implementation in the tourism industry changes the overall service experience for customers [34,50]. Since customers are habituated to FLE services, they perceive the FLSR service process as inconvenient and complex [34]. This creates a psychological barrier to change for customers, which requires FLE–FLSR collaboration in the service workplace to mitigate customer concerns [34]. The findings of the literature presented above show that FLSRs cannot completely replace FLEs, suggesting that FLEs and FLSRs need to collaborate in automated tourism workplaces to deliver the service experience customers expect and to address the various challenges of FLSRs.

2.2. An FLE Perspective on Collaboration with FLSRs

It is important to understand the FLEs' reactions and attitudes when implementing cutting-edge technology that causes psychological challenges for FLEs owing to unpredictable outcomes in the workplace [20,51]. Recently, some researchers realized the necessity of research from the perspective of FLEs, who are the main actors in the service ecosystem, and began to pay attention to the responses of FLEs to FLSRs and the changes in the workplace [3,20,35]. According to the results of these studies, FLEs have an ambivalent attitude toward working with FLSRs. The results of previous literature showed that FLEs have positive or negative reactions from job and technical perspectives to the changes in the workplace brought by the introduction of FLSRs. FLEs are interested in working with FLSRs in anticipation of reducing physical and psychological workload and improving work efficiency [3,17,52]. Furthermore, when FLSRs have high anthropomorphism and work competencies, FLEs respond in a positive manner psychologically to collaborating with the FLSRs [53]. The results of these studies show that FLEs have a positive perception of working with FLSRs if the implementation of the FLSRs can improve their work [17].

However, the literature reports more negative than positive employee attitudes toward FLSRs. FLEs are concerned about the lack of interaction between them and robots, empathy, and communication gaps [3,17,35]. Moreover, if FLSRs' competencies are inadequate for the task, FLEs' psychological resistance to collaborating with FLSRs increases [51], and the FLEs' trust in the FLSRs as coworkers decreases [17]. Previous research emphasized that FLEs' anxiety about FLSRs' functional characteristics and fear of their employment relationships contribute to their negative perceptions of working with FLSRs. In contrast to the manufacturing industry, workplaces in the tourism industry have long had the human being at the center of the work process. Therefore, FLEs may fear that implementing FLSRs will place their positions under FLSR control in the workplace [3]. According to the prior literature, FLEs are reluctant to work with FLSRs because they perceive the automation of the workplace as a threat to their employment [13–16].

Contrary to these FLE fears, the adoption of FLSRs in the tourism industry is the stream of the tourism 4.0 era [54]. Therefore, FLEs need to recognize and accept FLSRs as coworkers with whom they need to work together. The success of workplace changes brought about by technology implementation depends on the receptiveness of employees to new technologies introduced in the workplace [19,51,55]. Accordingly, it is essential to understand the factors that promote or hinder the collaboration between FLEs and FLSRs, which is critical to the success of robot introduction in the workplace [17,51]. This indicates the need to explore FLEs' acceptance mechanisms for collaboration with FLSRs.

2.3. Technology Acceptance Model (TAM)

The TAM proposed by Davis [56] is a theoretical model for empirically explaining the acceptance of new technologies [57]. This model focuses on the mechanism of the user's intention to use technology and antecedent factors based on the assumption that the actual behavior of users who want to use the technology can be explained through their attitude toward the technology [58,59]. Researchers have theoretically and empirically verified TAM, making it the most powerful and effective model for predicting a user's intention to accept technology [60]. The user's perceived usefulness and perceived ease of use for technology are critical factors of TAM to explain the user's intention to accept technology [56]. Davis [56] (p. 320) defined perceived ease of use (PEU) as "the degree to which a person believes that using a particular system would be free of effort." Perceived usefulness (PU) refers to "the degree to which a person believes that using a particular system would enhance his or her job performance" [56] (p. 320). Applying these definitions to the context of the current study, PEU refers to the extent to which FLEs believe that collaborating with FLSRs requires no effort, and PU can be defined as the extent to which FLEs believe that collaborating with FLSRs will improve their work performance.

TAM is a widely adopted theory that explains the acceptance intent of cutting-edge technology users, such as self-service technology [61–63] and tourism 4.0 technologies [55,64–66]. TAM has recently been extended to the context of FLSRs, which is receiving attention from tourism researchers and has been verified as a valid theoretical tool for predicting users' acceptance of robots [67,68]. These studies found that the intention to accept FLSRs is established when customers perceive the positive usability and usefulness of the robots and emphasized that PEU and PU are leading factors for predicting customers' acceptance of robots. Accordingly, these results showed that the theoretical mechanism of TAM can be applied in the FLSR context.

In addition to TAM, the Unified Theory of Acceptance and Use of Technology (UTAUT/UTAUT2) is another theoretical model used to explain user acceptance of technology [69,70]. In contrast to these two models, TAM has the theoretical flexibility to incorporate external factors into the basic model when a more in-depth explanation of the user's acceptance is required [65,71]. Furthermore, TAM is an optimal theoretical framework for empirical user behavior prediction studies because it can be generalized across technologies and users [71]. These results show that TAM is an appropriate model for the explanation of user behavior in the early stages of FLSR adoption. Previous studies used TAM to explain employees' attitudes toward the acceptance of change in organizations implementing technologies, which suggests that TAM is a suitable theoretical model to explain work paradigm changes due to adoption of technology [19,55,72–74]. Thus, based on previous literature, this study adopts TAM to investigate the changing paradigm of the tourism industry workplace through the implementation of FLSRs in the workplace.

Despite the longstanding acceptance of TAM, there is a limit to providing a theoretical basis for improving users' technology acceptance only with PEU and PU, which are the antecedent factors of the model [75–78], because external variables may affect the technology acceptance mechanism and interfere with the acceptance process [61]. Therefore, verifying specific drivers that affect users' acceptance of technology by integrating external variables into the TAM is crucial [57,77,79]. Moon [72] criticized TAM for not explaining the user's acceptance intention from a work perspective because it focuses only on the technology characteristics perceived by employees and addressed that it should explain the technology acceptance introduced to the workplace through the integration of TAM with external factors related to work.

2.4. Hypotheses Development and Conceptual Framework

Tourism industry organizations emphasize teamwork to improve work efficiency and performance [80]. Therefore, collaboration with coworkers at the workplace is essential for employees in the tourism industry [81]. Employees expect to achieve personal benefits, performance, and organizational performance through collaboration [80,82]. Since the belief that employees can achieve their expected performance affects their attitude toward the job, the level of coworkers' competence at a workplace where collaboration is important, such as the tourism industry, affects their attitude toward collaboration [83]. Given the definition of collaboration, "a work process performed by two or more employees to achieve one or more joint goals" [84], the performance of collaboration can be determined by collaborative relationships with coworkers.

According to previous literature, the customer's service experience in the tourism industry is influenced by FLE–customer interactions; thus, FLEs' competence is the critical factor determining service performance [85–87]. These researchers' findings showed that the FLEs' competence to participate in collaboration plays an important role in building collaborative relationships. In a workplace where a collaborative relationship with a coworker is required, the level of competency of the coworker affects the employee's psychology and attitude to work [88,89] and the relationship between the employee and coworker [90]. FLSRs have evolved from innovative technology meant to improve productivity and convenience to being coworkers that are meant to collaborate with FLEs [21]. Therefore, if collaboration with FLSRs is not effective, FLEs regard collaboration with the robots as

a risk factor in the workplace [51]. Guan [91] (p. 3488) defined FLSRs' competence as "the extent to which robots can successfully complete their tasks in providing services to customers", and found that FLSRs' competence was a factor that determined the quality of service in a workplace. Moreover, when FLSRs' job competencies are stable and reliable, employees positively expect collaborative performance with the FLSRs as collaborative coworkers [3,35]. Conversely, FLSRs' lack of competence causes FLEs' psychological resistance [51]. The results of these studies indicate that FLEs' perceived level of FLSR service competence is an antecedent of their psychological attitudes. Based on the rationale from the previous literature, it is anticipated that when FLEs positively recognize the FLSRs' service competence, the collaboration risk with FLSRs will be reduced.

H1. *FLSRs' service competence negatively affects the FLEs' perceived risk of collaboration with FLSRs.*

Perceived risk is "the subjective perception of the negative consequences of individual actions and choices" [92]. Employees' perceived risk in the workplace is an antecedent factor used to predict their subjective assessments and perceptions of the work environment [93,94]. These mechanisms of perceived risks and individual acceptance attitudes could also be explained in the workplace context where the use of FLSRs is implemented [16,18]. In the tourism industry, FLEs experience physical fatigue through emotional labor, shift work, and long-term work [95,96]. FLEs expect to reduce their working hours and physical and psychological workloads through collaboration with FLSRs [3,53]. However, if FLEs' lack of experience or the knowledge required for successful collaboration demands the employee's effort, the employee may have doubts about the benefits of the collaboration with FLSR [17]. FLEs' concerns about FLSRs' lack of workplace mobility and FLEs' fears about new technology's capabilities make working with FLSRs difficult [3,35]. In the tourism industry, FLEs fear service failure [97], and employees strive to increase service efficiency [98,99]. Therefore, FLEs want to improve service performance and efficiency in collaboration with FLSRs [3,20,53]. However, when the FLEs perceive the uncertainty and instability of collaboration with the FLSRs, the employees do not expect a positive outcome to come from the collaboration [3,35]. Collaboration with FLSRs is a challenge that FLEs have not faced previously [23]. Therefore, the utility and value (e.g., PEU and PU) of collaboration will be undermined by FLEs' psychological vulnerability to FLSRs [58]. Applying this logic, if FLEs' workload increases to collaborate with the FLSRs and the FLEs have concerns about collaboration, the PEU may decrease. Additionally, the psychological fear that collaborating with FLSRs will interfere with job performance may reduce the PU of collaboration.

H2a. *The perceived risk of collaboration with FLSRs negatively affects perceived ease of use for collaboration.*

H2b. *The perceived risk of collaboration with FLSRs negatively affects perceived usefulness of collaboration.*

In this study, PEU is the degree to which FLEs believe that no effort is demanded to collaborate with FLSRs. This means that additional work by FLEs is not required for collaboration with FLSRs. Previous literature showed that employees perceive ease of use if no additional effort is required when accepting changes in the workplace [56,73]. Moreover, if performance improvement is expected when adopting changes, employees' perception that the changed workplace is useful increases [55,72,73]. When the workload decreases, an employee can focus their resources and energy on performance improvement, but performance quality is degraded because heavy workloads require the distribution of an employee's limited resources and energy [100]. In the tourism industry workplace, where emotional labor is experienced, high workload pressure depletes FLEs' physical and psychological resources. Thus, if there is a reduction in workload as a result of cooperation with FLSRs, the work performance of FLEs may be improved [101]. With the evolution of technology that implements the operation of FLSRs, technical malfunctions by robots

are reduced, and the collaboration performance can be improved if the collaboration obstacle with FLEs is lowered [23]. Additionally, the interface and control of the FLSRs facilitate collaboration with the FLEs and reduce the FLEs' workload, leading to successful collaboration [53,102]. If these propositions are valid, the FLEs will positively perceive the efficiency and performance of the collaboration when they recognize that no additional effort is required to collaborate with the FLSRs.

H3. *The perceived ease of use of FLSRs positively affects perceived usefulness of FLSRs.*

According to previous literature adopting TAM, PU and PEU are critical antecedent factors in predicting an employee's attitude toward changes in the workplace [19,55,73]. The results of this study show that additional effort is not required to accept changes in the workplace and that an employee's positive attitude toward changes is established when performance improvement is expected owing to the changes [19,73]. When an employee puts in more effort than expected while collaborating with a coworker, they feel less motivated to collaborate and perceive their work negatively [103]. Pailé [28] found that FLEs may stop collaborating with coworkers if the collaboration makes work more difficult or to protect themselves if the collaboration has no benefits or results. These mechanisms can also be found in studies within the FLSR context. The FLEs accept FLSRs as good coworkers when the FLSRs support their job tasks and reduce their workload, but FLEs do not accept FLSRs as coworkers when they do not understand the robots' technology or when the robots' performance is inefficient [17]. Moreover, FLEs actively support collaboration with FLSRs if an employee perceives that the collaboration saves working time and improves service quality [3,35]. To put this result into the context of the current study, when no additional effort is required by FLEs to collaborate with FLSRs and collaboration improves work performance, the potential of having a positive attitude toward the collaboration with the FLSRs will increase.

H4a. *The perceived ease of use of FLSRs positively affects FLEs' willingness to collaborate with FLSRs.*

H4b. *The perceived usefulness of FLSRs positively affects FLEs' willingness to collaborate with FLSRs.*

The hypothesis of this study, developed based on a thorough review and discussion of the previous literature, is presented in Figure 1.

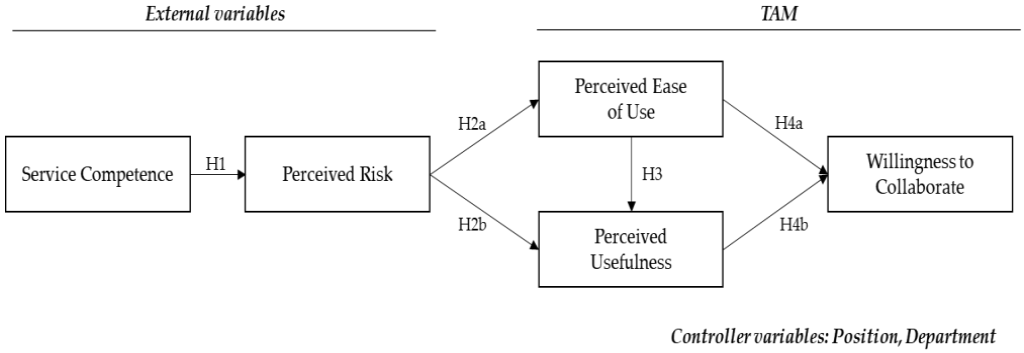

Figure 1. Conceptual framework.

3. Materials and Methods

3.1. Data Collection

The survey of this study was conducted at five-star hotels in Seoul, Busan, and Incheon in South Korea. These cities are the three largest metropolitan cities with the largest number of five-star hotels in South Korea [104]. Five-star hotels are more likely to have the budget to implement FLSRs than lower-rated hotels [105]. Therefore, the author contacted the general managers or directors of 13 hotels where FLSRs were implemented among the five-star hotels in three cities, and 11 hotels agreed to participate in the survey. The survey responses

were limited to FLEs working at the service encounters where FLSRs were introduced. This study distributed 196 paper-based questionnaires to participants. A total of 158 completed questionnaires were received between August 2022 and September 2022.

3.2. Measurement

All validated measures in the prior literature were adapted and then modified to suit the context of this study. This study used a seven-point Likert-type scale (1 = strongly disagree to 7 = strongly agree) for all measurements. Two bilingual experts translated the questionnaire into Korean using a back-translation approach [106]. To detect errors in the questionnaire and check the validity of the instruments, this study conducted a pilot test with 16 tourism industry professionals who had experience working with FLSR in hotels or restaurants. According to the suggestions of some participants of the pilot test, this study added a definition of FLSRs to the questionnaire to help the main test respondents understand it. Based on Guan [91], five items were developed to assess FLSRs' service competence. Perceived risk was measured with five items adapted from Song [18]. PEU and PU were measured by adapting Kim's [55] items, which were based on Davis [56] and modified for workplace change, to the context of this study. Willingness to collaborate with FLSRs was measured using three instruments adapted from Zhang [107].

3.3. Data Analysis

First, this study conducted examined data screening to identify missing values. After data screening, 15 responses were excluded from the data analysis. Second, a Shapiro–Wilk test was conducted to check relevant assumptions. The result of the Shapiro–Wilk test indicated that the measurements were not all normally distributed ($p < 0.001$). Third, multicollinearity was checked by examining bivariate correlations among the constructs and variance inflation factors (VIF). Finally, this study investigated the two-step process of partial least squares structural equation modeling (PLS-SEM) recommended by do Valle [108] for hypothesis testing: measurement (external) and structural (internal) models. PLS-SEM is more widely used in tourism research because it is more flexible than covariance-based SEM in terms of data assumptions, such as data distribution constraints [108].

4. Results

4.1. Characteristics of the Sample

Of the samples used for the analysis, 52.4% of respondents were men (see Table 1). The mean age of respondents was 36.5 years old, and 62.2% of respondents had bachelor's degrees. Further, 60.1% of respondents were married, and 39.9% were outnumbered single (39.9%). In terms of position, 42.0% worked as a supervisor. About 53.8% worked in the food and beverage department, and in terms of tenure, 36.8% of respondents had worked at their current hotel for more than six years and less than 10 years.

4.2. Common Method Variance (CMV)

CMV refers to systematic variance owing to the method bias used to collect data [109]. CMV artificially inflates the relationship between variables and can seriously distort results [110]. CMV can be particularly powerful when, as in this study, data are collected from the same sample using the same contextual questions in the same measurement context [111]. This study used Harman's one-factor test, which is the most widely used statistical remedy by researchers to address CMV [111]. The test result showed that the single factor variation was 43.75 lower than the threshold of 50%; thus, this study did not have CMB issues [112].

Table 1. Characteristics of the sample (n = 143).

Variables	Frequency	Ratio (%)
Gender		
Male	75	52.4
Female	68	47.6
Age		
20–29 years old	31	21.7
30–39 years old	57	39.9
40–49 years old	42	29.4
50 years old and above	13	9.1
Educational Level		
High school diploma	2	1.4
Associate's degree	40	28.0
Bachelor's degree	89	62.2
Graduate degree	12	8.4
Marriage		
Single	57	39.9
Married	86	60.1
Position		
Rank and file level	32	22.4
Supervisor level	60	42.0
Assistant manager level	31	21.7
Manager level	20	14.0
Department		
Rooms	66	46.2
Food and beverage	77	53.8
Tenure at the current hotel		
1–5 years	46	32.2
6–10 years	48	33.6
11–15 years	29	20.3
16 years and above	20	14.0

4.3. Measurement (Outer) Model Analysis

This study examined the indicator loadings to check the indicator reliability, and the composite reliability was tested via the ϱ_n values (Table 2). Next, this study tested Cronbach's α for an indicator of internal consistency reliability and AVE for convergent validity of each construct. Finally, we examined Heterotrait–Monotrait (HTMT) ratios, which we found to be a superior procedure to the commonly considered Fornell–Larcker criterion for testing discriminant validity [113]. All indicator loadings and ϱ_n values were above the threshold of 0.70 [114]. Cronbach's α satisfied the threshold of 0.70 [114]. The AVE values for each construct exceeded the threshold of 0.50; therefore, convergent validity was satisfied [114]. As shown in Table 3, all HTMT values were below the threshold of 1.0 [115]. The measures in this study met the validity and reliability required by PLS-SEM, as shown in the results above.

4.4. Structural (Inner) Model Analysis

As shown in Table 4 and Figure 2, the results of the structural model analysis indicate that all hypotheses were supported. The impact of the introduction of FLSRs on FLEs depends on an employee's position [14], and the workplace characteristics determine the functions and roles of the introduced FLSRs [116]. Therefore, this study set those two variables as control variables to exclude their possible influence on the estimated model. Before structural model analysis, VIF values of each variable were estimated to examine potential multicollinearity. Consequently, the structural model of this study did not have multicollinearity because all VIF values were estimated to be lower than the threshold of 5.0 [114]. PLS-SEM should look at the Q^2 values of blindfolding to measure the predictive fit of the structural model before estimating a structural model [114]. The current structural model had predictive relevance because all Q^2 values were larger than 0 (Table 4) [114]. The

R^2 values given in Table 4 show the explanatory power of FLSRs' service competence on the endogenous latent variable [114,115]. R^2 values of 0.75, 0.50, and 0.25 are considered to have strong, moderate, and small explanatory power, respectively. Service competence showed that the power for each endogenous latent variable was less than medium (0.38) in PR, weak in PEU (0.11) and PU (0.27), and more than medium (0.64) in willingness to collaboration.

Table 2. Results of measurement model analysis.

Measurement Items (Cronbach's α)	Mean (SD)	Loading	ϱ_n (AVE)
Service Competence (SC) (α = 0.86)			0.89 (0.69)
The FLSR in this hotel is competent.	3.66 (1.60)	0.82	
The FLSR in this hotel is intelligent.	3.95 (1.62)	0.87	
The FLSR in this hotel can do its job accurately.	3.84 (1.61)	0.77	
The FLSR in this hotel can do its job efficiently.	3.95 (1.53)	0.83	
The FLSR in this hotel can handle customers' needs.	4.41 (1.67)	0.85	
Perceived Risk (PR) (α = 0.83)			0.85 (0.60)
Collaborating with the FLSR requires dealing with more uncertain work.	4.15 (1.40)	0.71	
Collaborating with the FLSR is not as efficient as I had expected.	3.90 (1.27)	0.82	
Collaborating with the FLSR requires extra time and energy.	4.16 (1.46)	0.80	
The FLSR often make mistakes, which makes my work more passive.	4.24 (1.43)	0.74	
I am frustrated that FLSR's service was not so intelligent.	4.05 (1.32)	0.78	
Perceived Ease of Use (PEU) (α = 0.93)			0.93 (0.83)
Learning to collaborate with the FLSR is easy for me.	4.83 (1.67)	0.91	
It is easy to find information on collaboration with the FLSR.	4.83 (1.51)	0.90	
My role in collaboration with FLSR is clear and understandable.	4.86 (1.55)	0.92	
It is easy to collaborate with the FLSR to do what I want it to do.	4.92 (1.55)	0.91	
Perceived Usefulness (PU) (α = 0.87)			0.87 (0.71)
Collaboration with the FLSR improves the performance of my work.	4.41 (1.50)	0.82	
Collaboration with the FLSR enables me to provide more accurate and trustworthy service to customers.	4.11 (1.62)	0.86	
Collaboration with FLSR enables me to work effectively with coworkers and manager.	4.08 (1.64)	0.84	
Collaboration with the FLSR enables me to accomplish my work more quickly with other employees and manager.	4.20 (1.62)	0.86	
Willingness to Collaboration (WC) (α = 0.88)			0.89 (0.81)
I will feel happy to collaborate with the FLSR.	4.14 (1.87)	0.90	
I am willing to collaborate with the FLSR to improve customer satisfaction.	4.09 (1.85)	0.91	
I am likely to collaborate with the FLSR.	4.20 (1.86)	0.88	

Notes: ϱ_n = composite reliability; AVE = amount of variance extracted.

Table 3. Results of HTMT.

	SC	PR	PEU	PU
PR	0.69			
PEU	0.56	0.27		
PU	0.75	0.43	0.47	
WC	0.74	0.40	0.51	0.89

Notes: SC = Service Competence; PR = Perceived Risk; PEU = Perceived Ease of Use; PU = Perceived Usefulness; WC = Willingness to Collaboration.

Structural model analysis results indicated that service competence (β = −0.61, t = 11.30, and p = 0.000) had a significant and negative effect on perceived risk. The results showed that perceived risk had a significant and negative influence on PEU (β = −0.24, t = 2.62, and p = 0.009) and PU (β = −0.29, t = 3.55, and p = 0.000). The study found that PEU (β = 0.33, t = 4.10, and p = 0.000) had a statistically significant positive

impact on PU. Both PEU (β = 0.14, t = 2.32, and p = 0.021) and PU (β = 0.72, t = 15.14, and p = 0.000) had a significant positive impact on willingness to collaborate. As shown in the structural model analysis above, all hypotheses were supported. The f^2 value represents the effect size, which can be described as small (0.02), medium (0.15), or large (0.35) [117]. The results show that PU had the largest effect size on willingness to collaborate (f^2 = 1.16), and PEU had the smallest effect size on WC (f^2 = 0.04).

Table 4. Results of structure model analysis.

Path	β	t	p	VIF	f^2
Hypotheses test					
H1: SC → PR	−0.61	11.30	0.000 ***	1.04	0.58
H2a: PR → PEU	−0.24	2.62	0.009 **	1.02	0.06
H2b: PR → PU	−0.29	3.55	0.000 ***	1.09	0.10
H3: PEU → PU	0.33	4.10	0.000 ***	1.12	0.13
H4a: PEU → WC	0.14	2.32	0.021 *	1.25	0.04
H4b: PU → WC	0.72	15.14	0.000 ***	1.24	1.16
Control variables					
POS → PR	0.10	0.45	0.654	1.03	0.00
POS → PEU	−0.16	0.67	0.506	1.02	0.01
POS → PU	−0.12	0.54	0.589	1.03	0.00
POS → WC	−0.03	0.18	0.860	1.02	0.00
DEPT → PR	−0.39	1.02	0.308	1.01	0.01
DEPT → PEU	−0.20	2.58	0.010 *	1.00	0.04
DEPT → PU	−0.15	1.39	0.164	1.04	0.00
DEPT → WC	−0.15	1.41	0.158	1.05	0.02

Notes: SC = Service competence; PR = Perceived risk; PEU = Perceived ease of use; PU = Perceived usefulness; WC = Willingness to collaboration; POS = Position; DEPT = Department; Q^2 predict: PR = 0.31, PEU = 0.05, PU = 0.14, WC = 0.10; R^2: PR = 0.38, PEU = 0.11, PU = 0.27, WC = 0.64; *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

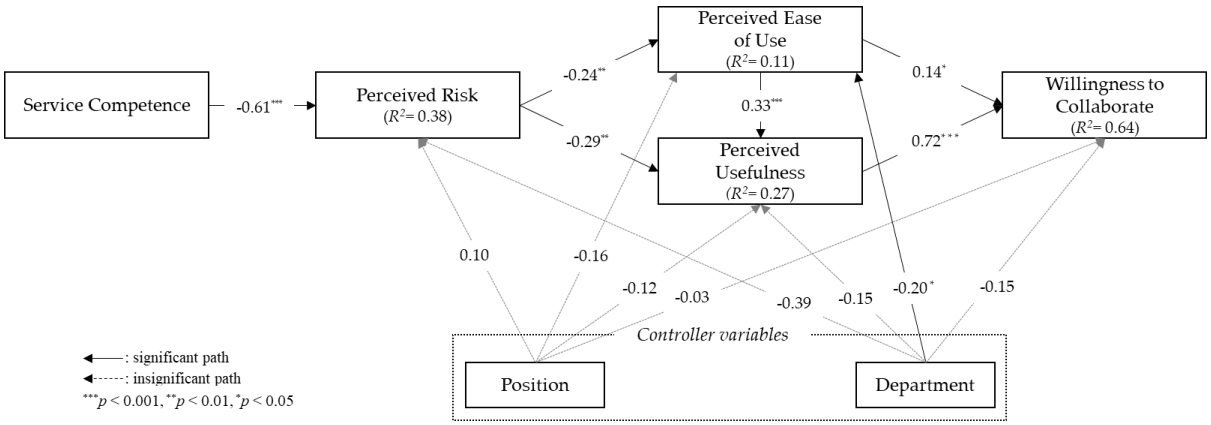

Figure 2. The results of hypotheses.

4.5. Mediation Test

The comprehensive mechanism of external variables and TAM can provide meaningful theoretical insights into the impact of FLSRs' service competence on FLEs' willingness to collaborate. Although this study does not propose any hypotheses regarding the role of mediation, the mediation test was conducted as a post hoc test (Table 5). The mediation test shows that the mediation structure with PEU is statistically significant. However, the mediating effect of PEU on its own, without PU, is not significant. A positive mediation effect was found when service competence was included in the statistically significant mediation structure. However, a negative mediation effect was shown when the mediation structure included perceived risk instead of service competence as an exogenous variable. None of the mediation relationships with control variables were statistically significant.

Table 5. Results of the mediation test.

Specific Indirect Effects	*β*	*t*	*p*
PR → PEU → WC	−0.03	1.63	0.102
SC → PR → PEU → WC	0.02	1.55	0.121
PR → PU → WC	−0.21	3.37	0.001 **
SC → PR → PU → WC	0.13	2.84	0.005 **
PR → PEU → PU → WC	−0.06	2.10	0.036 *
SC → PR → PEU → PU → WC	0.04	2.02	0.044 *
Control variables			
POS → PR → PEU → WC	−0.01	0.36	0.72
POS → PR → PU → WC	−0.02	0.44	0.66
POS → PEU → PU → WC	−0.04	0.63	0.53
POS → PR → PEU → PU → WC	−0.01	0.38	0.71
DEPT → PR → PEU → WC	0.01	0.75	0.45
DEPT → PR → PU → WC	0.03	0.97	0.34
DEPT → PEU → PU → WC	−0.09	1.97	0.05 *
DEPT → PR → PEU → PU → WC	0.01	0.84	0.40

Notes: SC = Service competence; PR = Perceived risk; PEU = Perceived ease of use; PU = Perceived usefulness; WC = Willingness to collaboration; POS = Position; DEPT = Department; ** $p < 0.01$, * $p < 0.05$.

5. Discussion

With the implementation of FLSRs in the tourism workplace, FLEs will need to collaborate with these robots. In this context, this study provides empirical evidence on the mechanisms of FLE–FLSR collaboration acceptance by identifying the critical role of the robots' service competence and the employees' perceived risk of collaboration for FLEs to accept FLSRs as collaborative coworkers. The results show that FLEs' positive perception of FLSRs' service competence reduces FLEs' perceived risk of such a collaboration. This is because the FLEs' positive psychological response to collaborating with FLSRs develops when the FLSRs have the competence to provide quality service to the customer. This finding is consistent with previous literature that an employee's evaluation of a coworker's competence facilitates the building of psychological relationships between coworkers [118] and with Jeong's [119] finding that the job relevance of innovative technology features builds a psychological bridge between employees and technology. The result indicates that FLEs' perceived risk of collaboration with FLSRs reduces PEU and PU. When FLEs perceive the risk of collaborating with FLSRs, the employees perceive the difficulty of collaboration and do not expect to benefit from it [3,18]. This finding is in line with previous research showing that an individual's perception of the risk of change influences their attitude that the change will require additional effort and that acceptance of the change may lead to a reduction in efficiency [58,120]. This study shows that the ease of use of FLSRs is an antecedent of usefulness, which is consistent with prior research finding that PEU of the changed workplace increases PU [72,73]. This is because the usefulness of collaboration increases when FLEs realize that collaborating with FLSRs is straightforward and easy. Further, the results indicate that both PEU and PU increase FLEs' willingness to collaborate with FLSRs. The effect size shows that PU has a stronger influence on willingness to collaborate than PEU does because FLEs are more likely to accept FLSRs as coworkers if the employee perceives the benefits of collaboration, such as reduced difficulty or increased usefulness [17].

The results of the mediation test underscore the importance of the FLSRs' service competencies for FLEs to accept FLSRs as coworkers for collaboration. The results show that FLEs' perceived risk of collaboration with FLSRs reduces the employees' willingness to collaborate via PU, and perceived risk negatively affects willingness to collaborate via PEU and PU. However, when FLEs perceive FLSRs' service competence positively, the FLEs' willingness to collaborate increases through perceived risk and PU, and service competence increases willingness to collaborate through perceived risk, PEU, and PU. These results indicate that FLSRs need to have high levels of service competence to be

successful in an FLE–FLSR collaborative workspace. Specifically, when FLEs positively recognize the service competence level of FLSRs, the employees' negative psychological reaction to collaborating with the robots is reduced, and the employees' willingness to collaborate with FLSRs is increased. This is related to the findings of previous studies that employees positively accept such a collaboration when the function of the FLSRs is suitable for performing tasks [17,23]. Conversely, the mediated model consisting only of PEU without PU was found to be statistically insignificant. This is likely because the latest technology in FLSRs does not require additional effort from FLEs to collaborate with robots, regardless of the increase or decrease in perceived risk. This study emphasizes that FLEs' perceptions of the usefulness of collaboration with FLSRs play an important role in increasing their willingness to collaborate.

6. Implications

6.1. Theoretical Implications

This study adds new theoretical insights to the existing literature in three ways. It responds to the literature that has identified the need to research the FLE perspective [2,4]. Accordingly, the findings of this study extend the scope of FLSR research to include the FLE perspective and fill a gap in the literature that focuses on the customer perspective. Specifically, this study enriches the knowledge about FLSRs by exploring FLE attitudes toward FLE–FLSR collaboration, which has been highlighted in the customer perspective literature.

Rather than viewing FLSRs as a cutting-edge technology that will displace FLEs from their jobs, this study examined FLEs' acceptance of FLSRs from their perspective as collaborative coworkers. Thus, this study empirically validated the mechanism by which FLEs accept FLSRs as coworkers. The results show that while FLEs' perceived risk of collaborating with FLSRs reduces their willingness to collaborate, their willingness to accept these robots as coworkers improves when there is an antecedent to reduce perceived risk. The significance of this finding is in line with the prior literature's emphasis on the management of FLEs' psychological responses to the integration of FLSRs into the workplace [17,51].

This study investigated the service capability of FLSRs by integrating TAM as an external factor from a task perspective. Although TAM is a theoretical model that has been applied in the literature to employee acceptance of workplace change, no theoretical framework has been proposed that integrates TAM with external factors that influence job performance [55,72,73]. The results show that FLSRs' service competence can act as an external factor in TAM, affecting the performance of the workplace implementation of FLSRs. Specifically, FLSRs' service competence reduces negative psychological reactions to collaboration and causes the FLEs to have an accepting attitude toward robots as coworkers. This finding highlights the importance of the FLSRs' service competence in the shaping of the FLE–FLSR relationship, just as a coworker's work competence is an important determinant of a coworker relationship.

6.2. Managerial Implications

This study's results, which explore the relationship between FLEs and FLSRs from a collaborative perspective, highlight the importance of implementing robots with service competence into workplaces to collaborate with the FLEs. As FLSRs continue to grow in the tourism industry, working with FLEs and FLSRs has inevitably become an integral part of the workplace [17,23]. Furthermore, if the FLEs accept the FLSRs as coworkers rather than tools, attitudes toward the FLSRs will improve [23]. Therefore, for the collaboration to be successful, it will be essential for the FLEs to accept the FLSRs as collaborative coworkers. The results of this study suggest that for FLEs to accept FLSRs as coworkers, FLEs must positively perceive FLSRs' service competencies. Therefore, this study suggests that managers should test the level of FLSRs' service competence in the workplace before deciding on its implementation. Furthermore, managers should listen to and understand FLEs' opinions about FLSRs' required service capabilities to collaborate with FLEs since

the former is the collaborating party. The importance of FLSRs' service competencies for FLEs to accept FLSRs as coworkers has important practical implications for roboticists. Roboticists must understand the competencies of FLSRs to collaborate with FLEs in tourism workplaces and consider incorporating these competencies into the FSLR design.

The FLEs are not used to working with the FLSRs; thus, they may be afraid of or may resist the collaboration [3,35,51]. The results indicate that when FLEs perceive collaboration with FLSRs as risky, FLEs' willingness to collaborate with FLSRs decreases. Therefore, this study highlights the importance of managing FLEs' negative disposition toward collaborating to increase their willingness to collaborate with FLSRs. More specifically, managers need to monitor FLEs' attitudes toward working with FLSRs to identify and then address sources of psychological anxiety. Furthermore, to reduce employee anxiety about working with the FLSRs, managers should create a manual for working with FLSRs and train FLEs on how to use the FLSRs and increase their familiarity with the FLSRs.

This study highlights that the usefulness of the FLSRs is more important than their ease of use in shaping FLEs' attitudes toward accepting the FLSRs as collaborative coworkers. With advances in AI and automation, FLEs will not have to expend extra effort to work with FLSRs, and they will not have to anticipate the difficulties and inconveniences of working with robots [3]. Thus, perhaps FLEs are not too concerned about the ease of use of FLSRs. Instead, they expect that collaborating with FLSRs will be more useful and efficient than collaborating with a human coworker [17]. When the FLSRs do not meet the FLEs' expectations, the employees will be reluctant to collaborate with the FLSRs; however, if the expectations are met, the FLEs will accept the FLSRs as collaborative coworkers [17,35]. Therefore, managers need to adopt FLSRs that can meet the FLEs' expectations from a work perspective. To do so, managers must view FLSR implementation not as adopting cutting-edge technology but as the recruitment of coworkers who work collaboratively with FLEs to achieve the desired performance.

7. Limitations and Future Research

In this study, which focused on the impact of FLSRs' service competence on FLEs' willingness to collaborate, the position of FLEs was included as a control variable. However, the differences and changes in perceptions of collaboration between the management-level and the employee-level were not examined. According to construal-level theory, management-level and employee-level perceptions of organizational change differ and change over time [121]. With this in mind, future researchers could investigate the differences between management-level and employee-level perceptions of collaboration with FLSR and how their perceptions change over time. Previous literature found that workplace attachment is a result of employees' feelings of security in their work environment [122]. Applying this result to the context of the FLSR study, if FLEs feel safe in the workplace in the tourism industry where the FLSRs are being implemented, they may be more attached to the changed workplace. However, the conceptual framework of this study did not include workplace attachment. Thus, future researchers can explore the mechanisms of FLEs' perceptions of workplace attachment in the work environment with FLSRs. Additionally, the similarity of values among employees is an important variable in organizational management because individuals' values are the determinants of their attitudes toward their workplace [123,124]. Therefore, FLEs' perception about implementing FLSRs in the workplace may depend on their personal values. Future researchers can examine FLEs' attitudes toward workplace changes brought about by FLSRs based on the generational similarity of their values and their similar values pertaining to technological innovation.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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