

# A Multidimensional Analysis of Robotic Deployment in Thai Hotels

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#### Abstract

Several hotel businesses are interested in robotic deployment to improve customer service, enhance hotel productivity, and gain a competitive advantage. In this study, I deployed a robot in a real working environment to explore stakeholders' perceptions and investigate factors involved in robotic deployment in Thai hotels. A qualitative research method, interpretative phenomenological analysis, was utilized. As there was no robotic deployment in Thai hotels, Peanut, a navigation service robot, was temporarily assigned to work in the hotels to allow key informants—hotel executives, human resource managers, reception managers, hotel staff, and hotel guests—to understand the phenomenon and experience robotic deployment. The findings revealed that stakeholders in Thai hotels accepted the robot; however, this acceptance was contingent on various robot, human, and organizational dimensions. Greater user acceptance can promote more widespread robotic deployment. This study has important implications for human–robot interactions in the hotel industry, especially in Thailand where this technology has not yet been applied.

Keywords Service robot · Robotic deployment · Acceptance of robot · Human-robot interaction

# 1 Introduction

With technological advancements, social robots have demonstrated highly developed abilities [1, 2] and have increasingly performed service tasks in the hospitality sector [3–7]. Service robots can facilitate decision-making processes and perform a variety of tasks [8]. For example, Henn-na Hotel, the world's first robot hotel in Japan, employs 80 robots, including an arm robot, porter robots, receptionist robots, desktop robots, and cleaner robots [9]. Hotel Jen Orchard Gateway in Singapore uses two service robots to cater to the needs of guests, such as delivering amenities [10]. The Ghent Marriott Hotel in Belgium also deploys robots in various guest services areas [11]. Hoteliers deploy service robots to improve customer service, enhance hotel productivity [7, 12, 13], and gain competitive advantages [14–17].

While the use of service robots is expected to help managers cope with human resource (HR) issues [15, 18, 19], such as seasonal employment and labor utilization [20, 21], they cannot simply replace human workers [7]. In the hospitality industry, the need for human interaction is expected to continue [22], especially because human mindsets and emotions are difficult for machines to read and duplicate [7]. Therefore, while some work may be appropriate for robots, other work must be performed by humans. On the one hand, humans have innate flexibility, intelligence, and problem-solving abilities; on the other, robots provide precision, power, and repeatability [23]. Therefore, human-robot interaction (HRI) is paramount as robots and humans increasingly work hand-in-hand [24–26].

In hospitality settings, HRI is still relatively novel, and hoteliers should be conscious of their guests' discomfort with robots [27]. The acceptance of service robots depends on how well they can deliver on functional, social-emotional, and relational needs to achieve role congruency [28]. However, even if guests have favorable attitudes toward robots, they prefer human employees for sincere and genuine interactions [11]. Moreover, guests attribute service performance responsibilities to humans rather than robots, especially when a service failure occurs [29]. Therefore, the relationship between guests, employees, and service robots must be considered [7].

While research on service robotics in hospitality has addressed the customers' perspective [7], few studies have been conducted from the perspective of organizational management [30]. Studies on this topic from the HR perspective

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are rare [7]. The present multidimensional analysis of robotic deployment in hotels attempts to bridge this research gap and may benefit future decision-making on robotic deployment.

In this study, I explore service robotic deployment in Thai hotels from multiple stakeholder perspectives: Hotel executives, HR managers, reception managers, staff, and guests. I also examine factors involved in robotic deployment in Thai hotels.

The results provide key insights into robotic deployment in the hotel business and can benefit hoteliers considering robotic deployment in their operations in the near future, especially in the Thai hotel industry where it has hitherto not been observed. Employees' feedback facilitates human resource management (HRM), while the responses from hotel guests can be utilized as empirical data for hotel development planning. In addition, this understanding can be used to make recommendations regarding the requirements of robots in the hotel industry.

# **2 Literature Review**

The literature review covers two aspects of multidimensional analysis. The first part explores the relationship between robots and user acceptance. The second aspect concerns organizational management, when robots are deployed.

### 2.1 Robots and User Acceptance

User acceptance is the key to the successful adoption of service robots [31] and depends on several factors. Users from different backgrounds play an important role in robot acceptance [32], and personal attributes such as age, needs, gender, experiences, cognitive ability, education, culture, roles, anxiety, and attitudes toward robot influence acceptance levels [33]. In this regard, hotel staff and hotel guests with differing backgrounds may perceive the robot differently.

Novelty effects in the use of technology [34], including robots, have long been recognized. These effects are the first responses to a technology [35], such as exciting [36] or interesting [37]. In this study, the robot was introduced in a hotel context, which had never occurred before, therefore the novel effect could be in effect. However, novelty effects that promote initial engagement typically wear off after a short duration [35]. Given that robotic deployment requires repeated interactions based on a fixed collection of behaviors, the difficulties of sustaining long-term engagement and interaction quality should be considered [37, 38].

In hotel service, guest satisfaction is crucial, and robots should not be the cause of any guest irritation. Users' comfort also depends on human–robot proxemics [39] as well as physical and psychological distancing from others [40]. People may perceive robots that do not show appropriate distancing behavior as threatening and disruptive to their social environments and work practices [41]. Hence, a service robot should be capable of maintaining proper proxemics to improve the comfort of users [39].

Users' acceptance also depends on the major characteristics of robots, such as capabilities, social interaction, and appearance and safety.

#### 2.1.1 Robots' Capabilities

Robots do not get fatigued or bored [20] and can provide 24-h service without a break [20, 42]. Mobile robots are capable of self-docking to a battery charging station, wherein the standard solution for battery management is to set up a threshold battery level for which the robot redirects itself to the docking station [43]. Thus, delegating routine tasks to robots allows businesses to increase their operational efficiency through more consistent, standardized service offerings [31] and enhance perceived service quality [20, 42].

Although robots can perform certain tasks with a high success rate, they are still vulnerable to error. The robot's systemic recovery behaviors can also have a social effect and affect user experience [44]. Robots must then recover from failure, which prompts a loss of the user's trust [45]. In the hospitality industry, guests expect more than just robots offering goods—they prefer failure-free services to feel comfortable with the service robots [33]. In general, there are two main criteria that robots must satisfy: First, they must offer quality service at an affordable price; and second, they must perform tasks with minimal failure [17].

In the hospitality setting, robots can be categorized by their main tasks; for example, communication robots, chef robots, delivery robots, entertainment robots, housekeeping robots, guide robots, or security robots [46]. Researchers have demonstrated that the robot design can impact user perceptions [47]. In this study, a guide robot was employed as a navigator in the hotel. The perception toward robots would be measured only for this robot type.

According to the technology acceptance model (TAM), the intention to use new technology, such as service robots, depends on a cognitive evaluation of perceived usefulness and ease of use [48]. In this respect, scholars have identified robotic deployment as a useful tool to improve and streamline HR processes, making recruitment, personnel assignment, management, and retention easier [49]. It has also been proved that robot deployment can reduce human workers' emotional labor [9]. Moreover, robots can be time-saving for employees, enabling them to use their skills for more creative, revenue-generating endeavors [3]. For hotel guests, service robotic deployment creates a unique customer experience [50–52]. Therefore, based on TAM suggestions, perceived usefulness and ease of use will be investigated in this study.

#### 2.1.2 Social Interaction

People may have difficulties in realizing whether a robot is ready for interaction, especially when it is stationary [53]. A robot can actively interact with objects and humans using social cues [54]. For example, when robots gaze at humans, an interactive opening, such as a verbal greeting, may be initiated [55, 56]. Some robots may use physical cues to adapt their head orientations depending on the user's distance [57]. Scholars claim that users who experience a responsive robotic system during the opening tend to stay until the end of an interaction, whereas users who experience a non-responsive system tend to disengage [58]. This is an area of concern, since the robot employed in this study did not initiate any interactive opening by using social cues.

One of the objectives of this study is to investigate the key success factors of robot deployment. As scholars claimed, successful social interactions between humans and robots require an understanding of human social behavior and also that robots use appropriate, adaptive, and contingent behaviors to form and maintain these social interactions [59]. Thus, scholars have suggested integrating human characteristics in social robots for more natural interactions with users, targeting better task performance and greater user acceptance [60]. The interactions with robots should be introduced as human-human interactions rather than human-technology interactions [61, 62]. For this, robots must develop "robotiquette" [63], which includes being warm, open, creative, calm, spontaneous, efficient, systematic, cooperative, polite, happy [64], and empathetic [65]. At this point, I will analyze what kind of social interactions are linked to the success of robot deployment, and how they are linked.

The interactional value is an essential element of customer experience [66], and interactive behaviors can be precisely controlled to enforce hotel brand standards or elicit certain emotional responses [67]. It is found that users who interact with service robots feel a sense of fun and enjoyment [20, 68–70]. Additionally, robot acceptance depends on the context in which the robot is used. Guests' acceptance of robots may vary depending on whether they are staying at a full- or limited-service hotel [45].

#### 2.1.3 Appearance and Safety

The appearance of robots must be considered for user acceptance, matching the tasks they are designed to perform [71, 72]. The robot used in this study was designed to look welcoming since it was assigned to work in hotels. It is believed that people are most accustomed to interacting with humans; therefore, "humanoids" or robots with human resemblance, particularly social robots, are increasingly being designed [73]. However, the uncanny valley theory argues that people find robots more acceptable as robots become more realistic and human-like, only to a certain extent; when robots excessively resemble humans, people become uncomfortable with them [74]. Humanoids were not available to employ in this study, and I would only find out later what kind of robot appearance was expected, based on interviews with the stake-holders.

The size of the robot is also important; it should not be extremely small or large. Acceptance is likely to be enhanced if the size of the robot is customized to fit the context in which they are deployed and reflects their function [75]. Large robots can induce feelings of intimidation, anxiety, and being unsafe [76]. In addition, people hold a variety of opinions about the materials from which robots should be made as well as their color [77].

Safety is one of the foremost concerns when robots are being used in direct physical contact with humans. In 2016, the ISO/TS 15,066 safety standards for collaborative robots were introduced to ensure the users' physical safety [78]. However, in the context of this study, where robots are being used at an initial stage, safety of guests and staff must be taken into account. Hotels are a place for relaxation, hence ensuring safety when using robots is a must.

### 2.2 Challenges in Managing Robotic Deployment

While robots promise significant benefits to organizations, their introduction poses various challenges [41], for example, in managing organizational change, ethical dilemmas, and economic efficiency in robotics investment. Thus, I designed this study to explore the management aspects that relate to robotic deployment.

#### 2.2.1 Managing Organizational Change

Organizational change theory [79] provides a useful framework for addressing robotic deployment. According to the theory, leaders need to define challenges, prepare skills, and build a change-embracing culture to modify organizational functioning [80]. Thus, deploying robots require structural and procedural changes in the workplace [41, 81]. As is the nature of change, robotic deployment inherently meets resistance from employees [42]. Scholars warn that this resistance to change is a powerful social factor that should not be overlooked [82, 83].

A new organizational and management structure is required for robotic deployment. First, organizations should adjust the workflow to accommodate the robot. Second, the physical environment of organizations must be adapted to accommodate robots. Third, considering employee–robot goal alignment, employees' interests and robotic deployment should not be in conflict. Fourth, both social and emotional factors in organizations must be considered. Finally, knowledge dissemination among relevant stakeholders and initial user training should be addressed [30]. Additionally, demand for talent in the fields of software and hardware, mechanical and precision instruments, user-friendly interface design, system integration, and marketing and sales are required [20].

To discover whether any resistance occurred or any management change was required, this phenomenological research project employed the robot to work in hotels, to allow hotels to gain direct experience of HRI.

#### 2.2.2 Ethical Dilemma

An ethical dilemma arises wherein leaders must carefully decide between aiming for higher profits by substituting employees with robots, and using technology to support existing employees to improve working conditions, and ultimately, service offerings [31]. I acknowledge that this as an important issue to be considered if the hotels decide to deploy service robots in their business.

The concern is that service robots could replace service workers, causing unemployment [3, 28, 66, 87, 88]. Some researchers have proposed that jobs requiring task repetition should be executed by a robot, eliminating such positions filled by humans [3, 28]. However, an empirical study at the Henn-na Hotel found that not all human jobs can be performed by robots; only simple and routine tasks are assigned to robots, while complex and deterministic tasks are performed by part-time workers. Furthermore, the tasks of full-time workers have become more complex and unpredictable [9]. To clarify this aspect, particularly in the hotel context, there was a focus on investigation via interviews of hotel stakeholders, in this study.

#### 2.2.3 Economic Efficiency

To facilitate robot deployment, the issue of economic efficiency must be addressed to determine the best performance-cost-effectiveness tradeoff [84]. In terms of estimating the cost of initiating projects, a cost/benefit analysis is an effective tool. It can be used to investigate whether robots expand service capacity and revenues, or if the introduction of robots obviates the need to hire more expensive human staff [85]. Alternatively, the total cost of ownership (TCO) method can be employed to estimate costeffectiveness by calculating the costs of a robotic system, the implemented robot system per year, and the number of years during which the system should be operated [86]. If the cost of using the robot outweighs the benefits provided by its adoption, executives are likely to be less willing to use the robot [41]. However, in a previous study, robotic deployment resulted in cost-effectiveness due to the robot's mechanical efficiency [31]. Thus, this might be explored as a decisionmaking criteria of hotel executives in how they evaluate the benefits of robotic deployment.

#### **3 Research Method**

To explore stakeholder perceptions toward robotic deployment, I employed the interpretative phenomenological analysis (IPA) approach, wherein the participant's perspective is central to the analysis [87]. In IPA, key informants can express themselves and their stories about lived experiences without any distortion or prosecution [88]. Hence, IPA is not just storytelling from the actors' perspective [89], but also provides in-depth descriptions and interpretations of the key informants' lived experiences and the way a certain phenomenon impacts their lives [87].

Phenomenologists accept that researcher subjectivity is inevitable. As such, the researchers should acknowledge, describe, and "bracket" their values [90, 91]. Bracketing is an initial step wherein subjective bias is acknowledged as part of the project to establish the rigor and validity of the results [90]. I, therefore, declared that as a university lecturer in the management discipline, without any work experience in the hotel or robotic business, I excluded my preconceptions from the process to enable the key informants to express their concerns and make claims on their own terms, as suggested by scholars [88]. To separate my ideas as a researcher, they have been written in the first person (I, my). Responses from key informants manifest the diverse opinions of the participants through a selection of representative quotations [91].

The key informants in this study were hotel executives, HR managers, reception managers, staff, and hotel guests in Thailand's Eastern Economic Corridor. The different target groups offer broad insight and are useful for developing fundamental inferences from the research findings [92]. After considering the limitations of the physical layout and willingness to participate in the study, three hotels in three provinces were selected as the study sites.

However, as mentioned earlier, there is no existing robotic deployment in Thai hotels. The choice of service robot deployment was limited, and hotel porter robots, cleaner robots, or catering robots were not available at the time of the study. The only possible choice was a navigation service robot. With this type of robot, stakeholders in different groups can easily experience robot deployment in the hotel. It is also convenient to configure the navigation for each hotel. This enabled the analysis of the different stakeholder groups' experiences in different hotels. A service robot named Peanut was rented from a robot company and worked at each hotel for a week to allow the key informants to gain robotic deployment experience.

The robot stands one-meter tall and weighs approximately 50 kg. It is violet and white in color, has a smiling face, and holds a double-sided screen over its head to display the hotel facilities, as illustrated in Fig. 1. Each day, the robot was automatically programed to start work at 7 a.m. The starting point was the hotel entrance near the reception counter, and I



Fig. 1 Service robot- Peanut

was present to introduce the robot and explain how to use it. Without any automatic opening interaction, the robot began navigation only when users selected a destination (e.g., a lift, restroom, or meeting room) from the touchscreen above its head. After a user made a choice, the robot recited the hotel's welcome greeting and asked the user to follow it to the chosen destination. It was programmed to provide information about the hotel while it moved. Upon arriving at the destination, the robot informed the guest that they had reached the destination and said "thank you", before returning to its starting point.

An interview guide was designed as the research instrument by focusing on in-depth questions using Patton's guide [93, 94]. Five experts in the hotel and robotic research fields examined the validity of the interview guide content and recommended that some interview questions be rewritten for easier understanding. Details of the interview guide are illustrated in the appendix.

The interviews were conducted based on prevailing research ethics and standards. The research objectives and key informants' rights were explained before asking them to sign the consent forms. For those who worked in the hotels, the permission of the hotel managers was requested before the interview. Similarly, the hotel guests were asked to confirm their willingness to participate before an appointment was made. After the interview sessions, transcripts were produced using a software package.

Next, content analysis was employed to gain an understanding of the studied phenomenon [95]. This qualitative analysis goes beyond merely counting words to examining language rigorously for the purpose of classifying large amounts of text into highly organized key results [96-98]. There are three approaches to content analysis: 1) Conventional content analysis, in which coding categories are derived directly from the text data collected primarily through interviews, 2) Directed approach, wherein analysis starts with a guiding theory for initial codes before data analysis, and 3) Summative content analysis, which involves counting and comparisons of keywords derived mostly from a review of literature, followed by the interpretation of the underlying context [98]. Of these three approaches, I employed conventional content analysis because it matches the research design wherein the data is obtained from in-depth interviews and the codes are not defined before the analysis.

I analyzed the data by following the three-stage analysis of Gibbs, which comprises coding, categorizing, and thematizing [99]. Data analysis was initiated by repeated reading of all data for immersion to obtain a sense of the whole [100]. To derive codes, data was read word by word by first highlighting the exact words from the text that appeared to capture key thoughts or concepts [100–102]. Based on my first impressions, thoughts, and initial analysis, texts were condensed while still preserving the core meaning [98]. Subsequently, a code was developed using names that closely described the condensed meaning unit [96]. For example, a key informant said, "This is my first time to see the real robot. Amazing, when seeing it speaks and moves." This was coded as "novel feeling." This code was used every time other key informants made similar statements.

Categories are classificatory groupings of codes based on a descriptive denominator [99]. Codes are sorted into categories based on how they are related and linked. These emergent categories are used to organize and group codes into meaningful clusters [93, 103]. In this study, a total of 59 initial codes were extracted. By grouping the codes related to each other through content, the codes were then organized into categories. For example, the codes for "novel feeling," "interested in the robot," "joyful," and "trust" were categorized as "positive perception" toward robots.

Subsequently, categories can be grouped or connected into themes, which consist of analytical statements to identify underlying patterns and commonalities to answer research questions [99]. Thus, categories of "positive perception" and "negative perception" were grouped and labeled as the "human dimension." In this study, I found three dimensions concerning robotic deployment: humans, robots, and organizations. Finally, I decide to identify the relationship between thematic categories, or subcategories, based on their concurrence, antecedents, or consequences [102]. To enhance the interpretative validity, information on the various interviewee perspectives was compared and crosschecked for consistency. Member checking was conducted by taking the results back to some key informants to test the accuracy of their answers. The research ethics of this study were approved by the Research Ethical Committee of Burapha University.

# 4 Results

During the three weeks of data collection from the three hotels, a total of 89 interviews were conducted. By staying at the hotels with the robot, I was able to observe key informants' reactions to the robot and conduct interviews when convenient. The key informants were categorized as hotel employees and hotel guests. The key informants from the hotels included executives, HR managers, reception managers, and staff such as receptionists, bellhops, and waiters. Hotel guests were categorized by generation: Generation Z (under 23 years), Generation Y (23–40 years), Generation X (41–55 years), and Baby Boomers (over 56 years). As data were collected during the COVID-19 pandemic, touring was not possible; most of the guests were visiting the hotels for a seminar or short training program. Therefore, most of the guests were Generation Y.

# 4.1 Stakeholder Perceptions of Service Robotic Deployment in Thai Hotels

From content analysis, I selected only those findings that all 89 key respondents had revealed, based on data saturation to be presented in Table 1. However, two interesting findings were included, despite not being saturated by all 89 key respondents. Firstly, "fear of robot" was included, since I found that the generation of the respondents mattered in this context. Secondly, I noticed that hotel staff and hotel guests held a different opinion regarding whether they were "unafraid of robots replacing humans". Notably, if observed from the interview guide, the question concerning HRM was not intended to be asked to guests, however the finding emerged without any direct questions. Thus, I also included these issues in the findings.

Table 1 presents key respondents' lived experiences of robotic deployment in Thai hotels. Four main themes were uncovered: Multidimensional perception, HRI, robot acceptance, and the intention to use robots in the Thai hotel context.

#### 4.1.1 Multidimensional Perception

From the content analysis, I clustered stakeholders' perceptions into three sub-dimensions, human, robot, and organization. Human Dimension The findings revealed both positive and negative perceptions toward robot deployment in the hotels. Key informants reported that it was their first time interacting with a robot. Thus, novel experiences with feelings of joy, surprise, and interest in the robot were observed. The answers of key informants included "excited in how robots work," "Surprise," "Oh, a robot moving and speaking!" and "Let's take a photo with the robot."

However, in its present form, without an interactive opening, the robot simply stood still, leading to possible negative perceptions, such as questionings and feelings of fear. Guests walking past the robot were likely to wonder what it was. This occurred only when no one (researcher/hotel staff) introduced the robot. In this respect, key informants quoted, "I don't know what it is. No idea that it is a real robot," "No, I dare not touch it. I don't know how to make it work," "I doubt it is a hotel mascot- I do not expect that it is a robot that can move and speak". This indicates that it was essential to introduce the robot as it was novel in this context.

I also found that the personal background of users affected their perception. Five key respondents from generation X and four from the Baby Boomer generation were afraid to touch the robot and refused to use it as a navigator. Generation Z informants revealed that the robot influenced their decision on which hotel to stay in, while other informants chose the hotel based on other factors (e.g., location, budget, and service quality). The experience of the users also affected the use of the robots. Key informants who were comfortable using technology or who had already seen a robot tried to use it more than those who did not have much technological experience.

**Robot Dimension** I found both advantageous and disadvantageous perceptions regarding robotic deployment. Key informants agreed that the dominant advantage of robotic deployment was the robot's capability to work at any time, 24 h a day, 7 days a week, or "24/7." Key informants also agreed that the robot was safe as it had a sensor to avoid crashing while on the move. Moreover, they thought that its current appearance was attractive, describing it as "cute," "lovely," and "wow." The key informants also revealed that they liked how Peanut resembled a robot instead of a human, which would have been extremely scary for them. In addition, key informants suggested that the appearance of the robot should be aligned with the hotel's theme, that is, designing the robot in hotel colors or dressing it in costume for special occasions, such as Santa Claus at Christmas.

However, a lack of human sense, interaction, and decisionmaking were perceived as the robot's disadvantages. These were implied from responses such as, "Peanut doesn't know what I am feeling," "It cannot answer my specific question," "Just there move forward and backward; without any other interactions," or "Only repeat saying the same thing."

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# Table 1 Content analysis of key informants' lived experiences of robotic deployment in Thai hotels

Themes	Categories	Codes	Hotel s	staff		Hote	el guest	ts	
			Exec	Manager	Staff	Z	Y	Х	BB
1. Dimension	Positive perception	Novel feeling	3	5	22	15	27	11	6
1.1 Human		Interested in robots	3	5	22	15	27	11	6
		Joyful	3	5	22	15	27	11	6
		Surprise	3	5	22	15	27	11	6
		Trust	3	5	22	15	27	11	6
	Negative perception	Questioning,	_	-	_	9	7	6	3
		Fear	-	-	-	-	-	5	4
1.2 Robot	Advantages	Working 24/7	3	5	22	15	27	11	6
		Usefulness	3	5	22	15	27	11	6
		Attractive appearance	3	5	22	15	27	11	6
		Safety	3	5	22	15	27	11	6
	Disadvantages	Lack of human sense	3	5	22	15	27	11	6
		Lack of interaction	3	5	22	15	27	11	6
		Lack of decision-making,	3	5	22	15	27	11	6
		Limited movement	3	5	22	15	27	11	6
		Robot error	3	5	22	15	27	11	6
1.3 Organization	Support	Hotel image	3	5	22	15	27	11	6
		No impact on HR	3	5	22	-	-	-	_
	Barrier	Physical layout	3	5	22	15	27	11	6
2. HRI	Inter-related roles	Collaboration	3	5	22	15	27	11	6
		Human control robot	3	5	22	15	27	11	6
		Human maintenance robots	3	5	22	15	27	11	6
	Human work	Complex tasks	3	5	22	15	27	11	6
		Task concerning human sense	3	5	22	15	27	11	6
		Problem-solving	3	5	22	15	27	11	6
	Robot work	Routine task	3	5	22	15	27	11	6
		Navigation,	3	5	22	15	27	11	6
		Providing basic information	3	5	22	15	27	11	6
		Heavy tasks	3	5	22	15	27	11	6
3.Robot acceptance	Accepted the robot	No resistance	3	5	22	15	27	11	6
		Robots as colleagues	3	5	22	15	27	11	6
		Accept the limitations of robot	3	5	22	15	27	11	6
		Unafraid of robots replacing humans	3	5	22	3	7	2	2
4. Intention to use	Return on investment	Costs and Benefits	3	5	22	-	-	-	-
	Guests' preference	Preference for soft or hard skills	3	5	22	15	27	11	6
		Preference for low-cost or high-end services	3	5	22	15	27	11	6
		Short-term or long-term satisfaction	3	5	22	15	27	11	6

Additional service activities were expected—key informants suggested "putting sensor at Peanut when people walk pass, then say welcome automatically," "providing information of nearby attractive area," "speaking in various languages such as English, Chinese, Japanese," and "providing information on how to use robots for navigation."

The robot's limited movement around one floor along the programed route was also perceived as a disadvantage. Errors also occurred. Because the fully-charged battery level was only 84%, the robot often had to recharge itself while working. This affected the quality of service. The hotel staff reported that, "It goes to the charging station while the battery is almost full," "I wonder why Peanut sometimes speaks along the navigation, but sometimes not". These were classified as robot errors creating negative perception regarding the robot.

**Organizational Dimension** I discovered two organizational dimensions, one supporting, and the other a barrier to robotic deployment. The responses demonstrated that the robot could increase the hotel's positive image. Key informants described the robot as "good for upgrading the hotel" and said that it demonstrated a "modern hotel" and a "high- tech hotel." Upgrading the hotel image favored robotic deployment. Notably, I found that the deployment would not affect the hotel HRM.

HR managers revealed that "Peanut supports the staff; there is nothing to do with the HR work," "only training of how to control the robot is required, but it is not very complicated; only half an hour is enough," and "robots don't need a salary, welfare, or bonus. Just only the maintenance costs are required." Therefore, the findings indicate that robotic deployment in the current study context would not affect HR processes. However, key informants revealed that if the robot was developed to perform more activities in the long-run, it could affect HR planning.

The physical hotel layout was the only barrier discovered in an organizational context. Hotel staff stated, "The space area with non-step is limited in our hotel. Peanut could navigate only a short distance route," "With air condition equipped, hotel doors must be closed. The robot therefore could not walk through the door," "Our hotel has many buildings. Crossing the street, even in the hotel, is not possible for the robot."

### 4.1.2 Human–Robot Interaction

This study found mutually collaborative interactions between robots and humans, particularly in hotel staff who directly worked with the robot. Hotel staff agreed that the robot supported their work in various ways. For example, without robots, guests have to ask the front office staff for information. Bellhops cannot service guests simultaneously, leaving some unattended. Having to wait in line for hotel staff to attend to them may cause guests to complain. Hotel staff claimed that these unwelcome incidents were reduced when the robot was deployed. Quoting from the interviews, some key informants responses were "with a simple question such as where the restroom is, Peanut can take the guest there. Thus, [there is] no waiting queue at the reception counter," "when the bellhop was not there, guests still enjoy playing with the robot," and "guests may forget to complain while they are waiting since they enjoy taking photos with Peanut." Key informants also reported that while the robot supports human work, human must perform more sophisticated jobs, such as programing, controlling, and maintaining the robot.

The work allocation for human staff and robots should be clearly assigned. Robots can only perform duties such as navigating along a programed route, welcoming hotel guests, and providing basic information. Respondents described it as "Robots work better in repetitive work since they never feel bored in their work," "Like Peanut, robot should be used as a navigator in the hotel," "Use robots to inform or advertise the hotel campaign." However, the hotel staff reported that some jobs could only be performed by humans, such as dealing with the guests' complaints, solving urgent problems, and making decisions at work. They stated that "Robot cannot catch the human feeling, but human can. When guests upset with the hotel services, only human staff can due this issue," "When something goes wrong, human analysis skills to solve the problem are needed."

#### 4.1.3 Acceptance of Robots

In general, stakeholders—both hotel staff and hotel guests—accepted the robot. I found that there was no resistance toward robot deployment in the hotels. The hotels' executives and managers accepted the navigation robot's usefulness, while hotel staff accepted the robot as their colleague. A hotel executive revealed that "In this digital era, advanced technology, such as robots, is inevitable. In the near future, robots will definitely be employed in the hotel." Acceptance from the staff was evident from statements such as, "Peanut is my friend, and I like it very much. It supports me a lot," "It is not a machine, it is my younger brother," "No reason to resist the robot. Look! It always works with smiles," and "I like to see guests enjoy playing with Peanut. When guests are happy, I am happy. Thank you, my lovely Peanut."

The hotel guests also enjoyed playing with the robot, making statements such as, "Oh! Robot, I accept it," "I definitely agree if the hotels employ robots in their services," "My children love to play with Peanut rather than their favorite swimming in the pool." Interestingly, even with the limited utilization of the robot, stakeholders in different groups still accepted the robot, as revealed from their responses, "It is robots that humans create; of course, it has less ability than humans," and "It depends on what we programed in the robot. The current form of robots can do only navigation; that is too limited. But, I believe, we can make robots do more." This demonstrates that the higher the ability of robots, the higher the level of user acceptance.

An interesting finding from this study is that hotel staff did not agree that robots can replace human staff, while some guests believed they could. The differences in the opinion between hotel staff and guests may have arisen because the hotel staff directly interacted with the robot for a longer period of time than guests. Hotel staff who interacted directly with the robot, such as front office staff and bellhops, reported that robots cannot and would not replace them. Their reason for this was that robots could only support them based on their limitations. These responses aligned with those from the hotel executives, who all agreed that robots like Peanut could not replace human staff as its proficiency was still limited. Thus, there was no fear of robots replacing humans in this context.

### 4.1.4 Intention to Use Robots

With a positive attitude toward robots, people tend to accept and use them. However, even if the robot has acceptability, the decision-making criteria for robotic deployment in Thai hotels include the returns on investment and guest expectations.

The hotel executives revealed that a comparison of costs and benefits from robotic deployment is necessary for decision-making. The costs of employing humans and robots must also be compared. One executive stated, "If the robot is more expensive than human staff, while the robot can work less, then robotic deployment is not a choice."

The hotel executives were also concerned about the guests' expectations that humans must perform work that requires soft skills. An executive stated that "Robots are good for the hotel image, but our hotels care about guests' feelings. A human service, with the soft skills to handle guest satisfaction, is crucial. It is what robots cannot do." This finding aligns with the responses of many hotel guests who preferred human services to robots. This can be inferred from the responses, "I prefer to talk with human staff. Two-way communication with facial expressions is better," "Love to experience the feeling of hospitality from human staff," and "With limited robot conversation, human staff can provide more information."

The passive reaction from robots like Peanut was not favorable from the perspective of the hotel executives; a more active manner was expected. Interestingly, some responses from young guests included, "I may try using the robot but only at first to meet it for fun. Once I knew the direction, [there is] no need to use the robot," "Without young children, I don't think it is necessary to use the robot navigation." This implied that this robot was good for entertainment, not for navigation. Short-term satisfaction from guests may not increase hotel investment in robotic deployment. Additionally, key informants' responses indicated that robotic deployment was suitable for low-cost hotels where cheaper expenditure is prioritized over service.

The expectations of guests were very crucial; those with different backgrounds had different expectations. Therefore, hotels must consider their target consumers and their expectations: active or passive interaction, preference for soft or hard skills, short- or long-term satisfaction, and preference for low-cost or high-end services.

Overall, the executives of the three hotels were interested in robotic deployment but would only decide on it after gaining enough information based on all the criteria mentioned above, the knowledge of which may also benefit robot manufacturers.

# 4.2 Factors Involved in the Robotic Deployment in Thai Hotels

Robotic deployment in Thai hotels is possible as every group of stakeholders revealed that they accepted and intended to use the robot, if available. However, decision-makers in hotels consider a variety of factors. As hotel executives said, "Robot deployment is a good choice of our business, but I want to have more time to gain more information about that," "No reason to refuse the robot. However, in doing business, many factors involved, for e.g., budget, benefit, employees, and customer."

From the analysis and the findings in 4.1, it emerges that the interrelations among robot, human, and organizational dimensions are linked to the acceptance of the robot and HRI. Consequently, those factors affect the intention to use the robot and are crucial for deciding whether to deploy the robot in Thai hotels. Figure 2 presents the summary of such relationships.

# **5** Discussion

Several findings of previous studies were validated in this study. Users of different generations perceived robotic deployment differently. Experience with technology also affected the user acceptance. Younger generations that have grown up with technological advancements, like Generations Y and Z, tend to be more receptive to the robot than the older generations.

As robot deployment is in its early stages in Thailand, the novel effect undoubtedly existed. People were excited, interested, and enjoyed using the robot because it was not a common sight in their daily lives. However, without an active interactional opening, users questioned and felt intimidated



by the robot. As a result, they ignored and refused to interact with the robot and perceived this as a drawback of the robot.

The findings support the theory of technology acceptance. Perceived usefulness and ease of use are important determinants. In my view, the usefulness of the robot in this study is limited, that is, navigation. Users expected the robot to do more activities, such as speaking a variety of languages, providing more information, and so on. However, they still accepted the robot even though it performed below their expectations. Based on my observations, key informants realized that the robot deployment was part of a research project and believed that it is possible to develop higher robotic capabilities in actual robot deployment.

Due to the appearance and safety of the robot, users were satisfied and accepted it. Since this study was conducted at the hotel premises, the welcome appearance and safety of the Peanut robot were appropriated. However, errors in terms of battery management, lack of active interactions, and limitations on movement undermined user acceptance. However, hoteliers may benefit by experiencing both the advantages and disadvantages of robot deployment in order to make an informed decision.

It was evident that the deployment of robots would benefit hotels, especially their image. However, in some respects, I found that the present findings did not support previous studies which indicated that organizations require structural and procedural changes. Robotic deployment in this study did not affect the management and HR processes. Interestingly, unlike previous studies, hotel staff did not fear unemployment but accepted the robot as a colleague. This may have arisen from the experience of the robot performing a single task of navigating a short distance in the area near the hotel lobby. This minimal robotic task may not have affected the structure and work procedure of the hotels. Another reason may be that because of the novelty effect, the key informants were still excited by the new technology. However, when the interactions become repetitive over time, the situation may cause different outcomes after the novelty effect wears off.

The findings indicate that HRI was present, and the work allocations between humans and robots were defined. Robots can only perform duties such as navigating along a programed route, welcoming hotel guests, and providing basic information, while dealing with the guests' complaints, solving immediate guests' problems, and making decisions at work are to be done by human staff. This confirmed that the need for a human touch cannot be neglected in hospitality services.

As advanced technology, robots are expensive. One of the criteria that affect the intention to deploy robots is economic efficiency. Like previous studies, comparing the costs of employing humans and robots is validated in this study. Financial indices such as a cost/benefit analysis and TCO can be analyzed to determine the best tradeoff in performance and cost-effectiveness. In addition, customer expectations affect the intention to deploy the robot. The variety of hotel guests interviewed in this study, across genders, generations, educational backgrounds, lifestyles, and so on, have varied preferences. Thus, the hotel must carefully decide what their main target group is, and what this group desires from the robot.

A novel element of this study is its cultural aspect. As the family is considered the foundation of social life for most Thai people, a relationship is often established with strangers by calling them brother, sister, uncle, grandfather etc., based on age. Interestingly, everything that is cute or lovely is termed "Nong," which also means younger brother or sister. The robot Peanut was never called "it" or treated as a machine. During the study, the respondents called it "Nong" and treated it as a young boy. The hotel staff revealed that they talked to it every day and cared for it like a family member— blanketing it at night, cleaning it in the morning, and providing an umbrella to protect it from rain. These practices reflect that culture plays a key role in the acceptance of robots.

## 6 Conclusion and Suggestions

Robotic deployment was generally accepted by stakeholders in Thai hotels. Deploying robots in hotels, as many international hotels have done, can encourage a multidisciplinary approach to robotic deployment in future. By considering management issues, this study fills a gap in robotic deployment research. Robotic science and engineering researchers can apply these findings in robotics design. Finance researchers can also play a more crucial role in analyzing the returns to investment in robotic deployment, while marketing scholars can analyze the introduction of robots as a marketing strategy.

For hoteliers, particularly in Thailand, and other areas that are yet to launch robotic deployment, the findings can provide a framework for decision-making in terms of robot acceptability and managing challenges. There is scope for future robotic deployment in hotels, and implementation using empirical data can minimize the risks of trial and error. Retaining the strengths and reducing the drawbacks identified by stakeholders' perceptions can lead to higher user acceptance of robotic deployment.

Robots must be developed to perform more diverse service tasks and activities, such as using social cues for an interactive opening, speaking in various languages—English, Chinese, and Japanese–and providing information about nearby attractions. It has also been suggested that the appearance of the robot and its design should align with the hotel's theme and color scheme for greater user acceptance.

The physical layout of hotels must be improved if hotels decide to deploy robots. Additionally, effectively communicating the execution of robotic deployment to hotel staff is crucial. People within the hotels as well as the guests should understand how and which robots can be used in the hotel.

### 7 Limitations and Further Research Scope

A limitation of this study is that service robots are novel in the Thai hotel industry. As such, practical applications readily available for research are limited. This study employed a navigator robot, and so the findings are only applicable for this type of robot. The findings may be extended using other types of robots. I analyzed the qualitative data on my own, without any assistants, to ensure consistency. However, the analysis could have been affected by potential bias of using just one coder. Therefore, member checking was employed by sending back the research result to some key informants to check whether the findings were consistent with their intent and answers.

The COVID-19 pandemic also limited this study. The hotel context changed substantially post lockdown. Hotel visits for leisure were infrequent, and hotels were only used for corporate short-course training. Moreover, the hotel operations were limited, and some staff were working from home. Therefore, the number of key informants was limited. Additionally, with social distancing measures in place, some key informants declined an interview. To mitigate this issue, hygiene practices such as providing face masks for both parties were implemented before the interviews. However, as the researcher personally conducted every interview to standardize the interview protocol, the robot was occasionally left unsupervised. To minimize this limitation, some hotel staff were trained to introduce the robot to guests.

As qualitative research is inductive by nature, generalized topics are less explicit. Unlike survey research, there is a broad consensus in quantitative studies that generalization is achieved using random sampling and statistical methods [104]. Thus, further work using quantitative research approaches is necessary to understand the extent to which the results in Fig. 2 are generalizable for other situations, organizations, robot designs, and tasks.

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# Declarations

Conflicts of interest The author declares no conflict of interest.

# Appendix

See Table 2

					70
	Stakeholde	rs			
	Executive	HR	Staff	Guest	
asic understanding of the robot	>	>	>	>	
xperience of using the robot	>	>	>	>	
in robotic deployment in the hotel?	>	>	>	>	

Research Objectives	Interview Questions	Stakeholder	S	
		Executive	HR	Staff
To explore stakeholder perceptions toward service robotic deployment in Thai	(1) Please describe your basic understanding of the robot	>	>	>
hotels	(2) Please describe your experience of using the robot	>	$\mathbf{i}$	>
	(3) What is your opinion on robotic deployment in the hotel?	>	>	>
	(4) What are advantages and disadvantages of robotic deployment in the hotel?	>	>	>
	(5) How does robotic deployment in the hotel concern your decision to stay in that hotel?	ı	ı	ı
To study the opinion on HRM and HRI when deploy the robot in the hotel	(6) If the hotels decide to deploy the robot, what HRM functions should be modified? How?	>	>	>
	(7) What kind of hotel work is suitable for the robot?	>	>	>
	(8) What problems did you find when humans and robots worked together?	>	>	>
To investigate factors involved in the robotic deployment in Thai hotels	(9) In your opinion, what factors are involved in the success of robotic deployment in the hotels?	>	>	>
	(10) General suggestions on robot deployment in the hotel context	>	>	>

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