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Factors Influencing Service Robot Adoption: A Comparative Analysis of Hotel-Specific Service Robot Acceptance Models

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FACTORS INFLUENCING SERVICE ROBOT ADOPTION: A COMPARATIVE ANALYSIS OF HOTEL-SPECIFIC SERVICE ROBOT ACCEPTANCE MODELS

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Abstract

The market for service robots is expected to expand significantly owing to the increasing relevance of service automation under the outbreak of the COVID-19 pandemic. Despite the growing managerial interest in robotic applications in the hotel industry, current robotic research has been mostly conceptual with limited robot data on hand. In light of this issue, this paper will conduct a comparative analysis of hotel-specific service robot acceptance models between the Service Robot Acceptance Model (sRAM) and the Service Robot Integration Willingness (SRIW) framework. By identifying key elements of each service robot acceptance model, this paper puts an emphasis on investigating the impact of anthropomorphism on the guest acceptance of service robots. The findings of this paper contribute to the existing service robot research and provide valuable insights for hoteliers who are seeking to stay competitive to keep up with technological transitions.

Keywords: service robots, robotics, human robot interaction, guest acceptance, hotel industry, service robot acceptance model, anthropomorphism, COVOD-19

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Chapter One

Introduction

From forging metals to produce weapons in the iron age to inventing computers to automate mathematical calculations in the 20th century, the creation and use of tools set humans apart the most from other species. In the current era, artificial intelligence (AI), also known as AI, is being accepted and utilized across various industries. Examples of AI applications are plentiful, to name a few, Tesla's AI-enabled vehicles advanced Autopilot system, Apple's AI-based voice assistant, and Amazon's AI-enhanced online shopping experience. In the hotel industry, the AI-driven service robot is one of the most conspicuous tools that has been found to add convenience and increase customer satisfaction (Yam et al., 2020).

Service robots in the hotel industry have rapidly become smarter, cheaper, and more trustworthy as technology advances (Luo et al., 2021). Luo et al. (2021) found this advanced AI technology is not limited to performing only repetitive and tedious tasks, but that they can be programmed with greater precision and versatility. Part of the reason why service robots have provoked a stir in the development of hotel technology is that service robots are capable of offering customized solutions based on the data they gathered from previous transactions (Lukanova & Ilieva, 2019). In the context of a global pandemic, the implementation of service robots enables a quick, flexible, and contactless experience, which meets guests' expectations and needs for health and safety and enhances hotel guests' evaluations of service quality (Atadil & Lu, 2021). From a hotelier's perspective, working alongside hotel employees, the use of service robots is a feasible way to streamline hotel operations, reduce labor expenses, and improve overall satisfaction, which ultimately has a positive impact on costs and profitability.

The hotel practitioners were full of hope when Frey and Osborne (2017) suggested that service robots could have the potential to take over nearly half of the American workforce by 2030. Despite the debate on service robots leading to mass unemployment, hoteliers are thrilled to adopt robotic technologies, expecting service robots to reliably substitute for humans in ways that maximize both productivity and consistency (Atkinson, 2019). However, a study done by Choi et al. (2021) found that the failure of the first entirely robot-staffed hotel in Japan's Henn-na Hotel, that placed in 2019, raised a red flag on the acceptance of service robots by hotel guests. Additionally, by analyzing online reviews, Bhimasta and Kuo (2019) found that hotel guests were frustrated when the reception robots failed to recognize emotional cues or voice commands at check-in, when the porter robots appeared to be counterintuitive for use, and when the humanoid robots could not depict emotions in human-robot interaction. It is tempting to speculate about whether service robots will ultimately gain hotel guests' acceptance.

Purpose of the Study

Although previous studies have extensively examined human-robot interaction using the Technology Acceptance Model (TAM) and its extensions, a comparative analysis of hotel-specific service robot acceptance models is missing. Therefore, this paper aims to fill this gap by conducting a comparative analysis between the Service Robot Acceptance Model (sRAM), proposed by Wirtz et al. (2018), and the Service Robot Integration Willingness (SRIW) framework, developed by Lu et al. (2019). In addition, existing literature has not emphasized much on the impact of anthropomorphism on the guest acceptance of service robots. Many aspects of guest acceptance associated with anthropomorphic features remain unknown. Therefore, further analysis of guest perceptions involving robot appearance is needed. The findings of this paper provide hotel practitioners with a literature-based comparative analysis of

service robots' acceptance to assess the acceptability and feasibility of implementing service robots in the hotel industry.

Conceptual Framework

Based on a thorough literature review, this paper will evaluate key variables of guest acceptance from two hotel-specific service robot acceptance models, which are the Service Robot Acceptance Model (sRAM) and the Service Robot Integration Willingness (SRIW) framework. Enablers and barriers of service robot acceptance in each model will be identified to help hoteliers overcome the challenges of technological and service innovation. Furthermore, the role of human-oriented robots in guest acceptance will be examined and compared with product-oriented robots.

Statement of Problem

There will be a significant increase in robotic support over the coming years. While previous studies have systematically examined human-robot interaction, they only investigate robotic adoption based on a single technology acceptance model. This paper seeks to explore how anthropomorphism and other elements affect guest acceptance, by comparing two service robot acceptance models. This will support previous research on guest acceptance of service robots in the hotel industry with respect to their potential to continually permeate and automate the service sectors.

Delimitations

Given the timeframe and the amount of data needed, this paper will only focus on two hotel-specific service robot acceptance models. The findings of this paper could generally be transferable to all sizes and all types of hotels that are seeking technological transitions.

Adjustments may be required for different countries, in which hotel operations and state laws vary.

Summary

As the evolution of robotic technologies has not yet approached sufficient maturity to overtake hotel employees, many people view the future of service robots as a big uncertainty, rather than a bigger opportunity. When leisure travel fully resumes, the need to study the guest acceptance of hotel-specific service robots will be more significant than ever because the urgency of a contactless hotel experience has increased due to the pandemic. This paper will review the literature related to hotel-specific service robots and compare the Service Robot Acceptance Model (sRAM) and the Service Robot Integration Willingness (SRIW) framework. The findings of this paper will be helpful to understand what has been found in the literature regarding service robot acceptance, as well as implications of robotic anthropomorphism.

Definition of Terms

Anthropomorphism: an attribution of a non-human object that bears the internal psychological states and external humanoid appearance (Lu et al., 2019).

Emotion: a complex psychological state involving experiential, behavioral and physiological elements (Lu et al., 2019).

Facilitating conditions: the resources and assistance provided to hotel guests (Lu et al., 2019).

Hotel-specific service robot: a professional service robot that performs hotel operational tasks.

Human-oriented robot: a service robot that is designed to resemble humans, also known as humanoid robots or anthropomorphic robots (Choi & Kwak, 2015).

Intrinsic motivation: the pleasure received while interacting with a service robot (Lu et al., 2019).

Perceived ease of use: an individual's belief that using a particular technology is unchallenging (Park & Del Pobil, 2013).

Perceived humanness: indicates the level of anthropomorphism in both physical appearance and behaviors (Fuentes-Moraleda et al., 2020).

Perceived usefulness: an individual's evaluation that using a certain technology is expected to improve his or her job performance (Park & Del Pobil, 2013).

Performance efficacy: a service robot' performance in terms of accurate, consistent, and dependable service delivery (Lu et al., 2019).

Personal service robot: a service robot is used for a non-commercial task (Murphy et al., 2017).

Product-oriented robot: a service robot that does not imitate humans in shape, also known as non-humanoid robots (Choi & Kwak, 2015).

Professional service robots: a service robot is used for a commercial-related task (Murphy et al., 2017).

Rapport: a guest's perception of enjoyable interaction with a service robot (Fernandes & Oliveira, 2021).

Service robot: a device that is programmed to perform customer service-oriented tasks automatically (Choi et al., 2021).

Service Robot Acceptance Model (sRAM): a hotel-specific service robot model that examines consumer perceptions, beliefs and behaviors as related to robot-delivered service (Wirtz et al., 2018).

Service Robot Integration Willingness (SRIW): a service robot adoption framework that evaluates the key variables characterizing consumers' long-term willingness to integrate service

robots across four service industries, including hotels, airlines, restaurants, and retail stores (Özkan et al., 2020).

Social influence: the degree to which an individual's attitudes or behavioral intentions are affected by society (Ivkov et al., 2020).

Social interactivity: a service robot's ability to recognize and display appropriate emotions and actions (Fernandes & Oliveira, 2021).

Social presence: the degree of salience of a service robot that takes place in human-robot interaction (Fernandes & Oliveira, 2021).

Subjective social norms: a set of social values and rules applied to service robots (Carlucci et al., 2015).

Technology Acceptance Model (TAM): a technology theory that explores the psychological perspectives related to consumers' attitudes and acceptance towards new technology (Davis, 1989).

Trust: a feeling of reliability and credibility when engaging with a service robot (Pillai & Sivathanu, 2020).

Chapter Two

Introduction

The emergence of service robots is increasingly tailored to hotel guests' needs and expectations, enabling more seamless, flexible, and personalized service delivery (Luo et al., 2021). As service robots become more capable teammates, hotel guests develop affective commitment towards service robots as they receive predictable service from service robots. This is because under precise programming, service robots can provide reliable and consistent levels of service, which eliminates human cognitive biases and outperforms humans in repetitive tasks (Zemtsov, 2020). However, the implementation of service robots could be a double-edged sword in managing hotel experience where guest satisfaction may depend on either positive or negative service encounter outcomes (Li et al., 2021). Advocacy in service robots among a new breed of tech-savvy hotel guests mainly results from enhanced self-efficacy and service convenience (Fan et al., 2020). While others oppose using service robots for reasons that include missing human touch, ethical concerns of the unemployment rate, and potential risk of personal data privacy (Jia et al., 2021). Although the significance of human-robot interaction has drawn scholars' attention, few academic research has explored hotel-specific service robot acceptance models. In addition, the contradictory findings related to decisive variables of service robot acceptance need to be probed and interpreted.

Hence, in this paper, the main objective is to examine the guest acceptance of service robots by comparing the Service Robot Acceptance Model (sRAM) and the Service Robot Integration Willingness (SRIW) framework. The findings of the comparative analysis will help reveal the influence of each variable on service robot acceptance and predict the future trends of service robots in the hotel industry. To accomplish this goal, this chapter is divided into three

sections. Started by presenting a foundational knowledge of service robots, introducing service robot adoption in the global settings and applications in the hotel industry. Then, this chapter will review the relevant literature of robotic anthropomorphism, followed by a section that introduces technology acceptance models and two hotel-specific service robot acceptance models.

Definition of Service Robots

In spite of the growing managerial interest in hotel-specific service robots, current robotics research has been mostly conceptual with limited robotic data (Murphy et al., 2019). Although there is excitement and promise for developing hotel-specific service robots, a clear understanding of service robots is necessary. So far, there is no precise definition of a service robot. In simple terms, service robots can be described as devices that are programmed to perform customer service-oriented tasks automatically (Choi et al., 2021). Depending on their characteristics such as autonomy, mobility, and social interaction, Murphy et al. (2017) roughly divided service robots into two categories: professional service robots and personal service robots, where a professional service robot is used for a commercial-related task and a personal service robot is used for a non-commercial task. In this paper, a hotel-specific service robot is defined as a professional service robot that performs hotel operational tasks.

Types of Service Robots

Service robots can be classified by diverse criteria. In addition to the categories offered by Murphy et al. (2017), Choi and Kwak (2015) sorted service robots based on the first impression of robot appearance. In this view, service robots are grouped into human-oriented robots that are designed to resemble humans and product-oriented robots that do not imitate humans in shape (Choi & Kwak, 2015). Human-oriented robots, also known as humanoid robots or anthropomorphic robots, are driven to perform human-like behaviors and mimic human

cognitive functions (Choi & Kwak, 2015). Hilton hotels, for example, implemented a humanoid robot, named Connie, which is advanced in machine learning algorithms, using its moving arms and legs to express emotions (Fedde, 2016). At the Mandarin Oriental Las Vegas hotel, a 4-feet tall, wheeled Pepper robot, equipped with an interactive interface and a range of sensors, moves around to answer questions from hotel guests in a dialog-based interaction (Scholastic News, 2018; Pandey & Gelin, 2018). Typically, these human-oriented robots require more intense programming to be independent of human operator control (Onyeulo & Gandhi, 2020).

On the other side, product-oriented robots, also known as non-humanoid robots, tend to execute very specific hotel duties. FlyZoo hotel in Hangzhou, China, built by Chinese electronic commerce giant, Alibaba Group, employed assorted forms of Alibaba-made non-humanoid robots with an eye to the future of workplace automation (Liu et al., 2020; Zhong et al., 2020). The taller capsule-shaped robot butler can be found everywhere at FlyZoo hotel to deliver room service as needed (Cadell, 2019). A flat round shape in-room smart device, Tmall Genie, is used at FlyZoo's guestroom to adjust room temperature, lights, curtains, and TVs with a simple voice command (Biron, 2019). At FlyZoo's bar, a large robotic arm can make over 20 different kinds of cocktails (Cadell, 2019). Although these mechanical-like product-oriented robots seem to be emotionless and less user-friendly (Fan et al., 2020), they are conceived of having a higher level of competence since they prioritize functions over forms (Stroessner & Benitez, 2019).

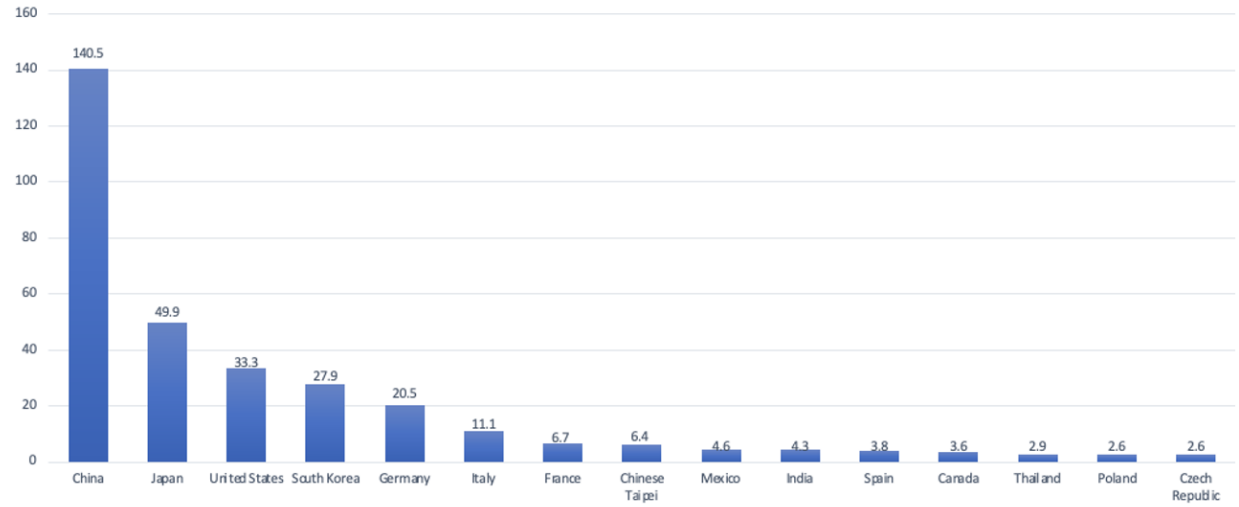
Robot Adoption in the Global Settings

In the era of automation, robots have been adopted extensively in the service sectors, for instance in healthcare, education, retails, restaurants, tourism, and lodging (Bartneck et al., 2010; Tung & Au, 2018; Lee, S. & Lee, D., 2019). Some robots will completely replace humans, while others have been projected to act as a complement to humans, offering tremendous opportunities

for economic development. For example, a report from the World Economic Forum estimated that robotic automation will globally add 97 million jobs by 2025, as jobs transformed by automation will always require skilled workers to introduce the human elements into the workplace (Deffenbaugh, 2020).

Figure 1

Top 15 Countries of Service Robot Annual Installations in 2019



Source: International Federation of Robotics (2020).

Based on the latest statistics in Figure 1, the global average for robot adoption grew about 85% from 2014 to 2019. Asian countries dominated the robot market in 2019, occupying three of the top five positions in the ranking of global robot installations (International Federation of Robotics, 2020). In contrast, Europe and North America overall were lagging. China, which led by 140,500 units of robot installations in the first place, quadrupled the robot adoption rate of the United States (International Federation of Robotics, 2020). China' invincible lead in the global robot market alerts that the United States has fallen behind and highlights the importance of recognizing and addressing the deficiency in robot adoption in the United States.

Service Robots in the Hotel Industry

Gaining insights into the global robot market, the applications of service robots have continued to grow in order to meet the ballooning demand for self-service in the labor-intensive hotel industry (Murphy et al., 2019). Although many perceive that service robots cannot fulfill certain guest requests (Tung & Au, 2018), technology-infused service has been found to be beneficial in improving service efficiency, reducing labor costs, and enhancing guest satisfaction (Marinova et al., 2017). Moreover, the spread of coronavirus disease accelerated robotic automation to reduce the amount of direct contact between hotel guests and hotel employees (Chiang & Trimi, 2020; Zeng et al., 2020; Seo & Lee, 2021). Hotel-specific service robots have been pivotal in the fight against the COVID-19 pandemic. Consequently, understanding the role of service robots during the pandemic and subsequent technology acceptance of hotel guests has become prevalent and critical, guiding hoteliers who want to bring service robots to a practical possibility in the near future, in a novel way to attract the market of tech enthusiasts and serve as a solution for the labor shortage (Ivanov & Webster, 2019, pp. 157-158).

Generally, the adoption of service robots in the hotel industry aims to enhance and expedite the overall guest experience (Pinillos et al., 2016). In recent years, they are gaining social acceptance because of service personalization made possible by AI-enabled machine learning technology, which studies customers' previous needs and preferences, and thus innovating hospitality service production and delivery (Go et al., 2020; Savela et al., 2018). Service robots are expected to carry out essential hotel-related tasks, for instance, checking in and out, handling luggage, receiving and delivering room services, providing general hotel information, and interacting with hotel guests. Amid the outbreak of the COVID-19 pandemic, many countries, such as Singapore and the Netherlands, have implemented service robots to

check body temperature, detect facial masks, and disinfect guestrooms with UV lights (Choi et al., 2021; Senhaji et al., 2021). While improving human capabilities, service robots free up hotel employees' time for more challenging work.

Reis et al. (2020) advised that service robots are likely to outperform human beings when performing routine tasks in a high-level customer contact environment. Compared to hotel employees who require continuous training and education, service robots could adapt their behaviors to the dynamic environment due to their ability to learn from both guests and employees, which yields consistent and high-quality frontline services and contributes to reducing customer frustration and disappointment (Reis et al., 2020). This result is corresponding to the studies from Choi and his colleagues (2021), as well as Seo and Lee (2021), that from the service quality perspective service robots guarantee service consistency, reduce wait times, and enhance labor productivity. Besides the service attributes, the miscellaneous appearance of service robots affects guest acceptance on a varying level (Urquiza-Haas & Kotrschal, 2015). Please see Appendix A on page 25 for more explanations regarding the guests' perceptions about anthropomorphic robots. These studies raise the question of what factors most influence the guest acceptance and satisfaction of service robots.

Technology Acceptance Model and Extended Technology Acceptance Models

Since service robots become progressively influential on hotel guest experience, hoteliers need to gain a competitive advantage in this new field and investigate the impact of each factor influencing human-robot interaction. The well-known Technology Acceptance Model (TAM), proposed by Davis (1989), explores the psychological perspectives related to consumers' attitudes and acceptance towards new technology. It is a seminal model predicting consumers' usage behavior through their perceived usefulness and perceived ease of use (Davis, 1989).

Perceived usefulness, which has a direct effect on technology acceptance, is defined as an individual's evaluation that using a certain technology is expected to improve his or her job performance (Park & Del Pobil, 2013). Perceived ease of use, in contrast, which has an indirect effect on technology acceptance, is described as an individual's belief that using a particular technology is unchallenging (Park & Del Pobil, 2013).

Over the years, researchers have extensively added more variables to the original TAM for the purpose of increasing the predictive power of technology acceptance (Jamšek & Culiberg, 2020). The later research suggested that perceived enjoyment, as the intrinsic motivation to use service robots, shapes affective experience with a service robot (Park & Del Pobil, 2013; Kumar Kakar, 2017; Zhou & Feng, 2017). Ghazali et al. (2020) advised that positive social influence reduces psychological resistance to new technologies, which determines people's behavioral intention to use service robots. Furthermore, Seo and Lee (2021) demonstrated that trust has a positive impact on both perceived usefulness and perceived ease of use of a service robot, suggesting increased trust in human-robot interaction lowers perceived risk, which accordingly promotes service robot acceptance.

Service Robot Acceptance Model

The Service Robot Acceptance Model (sRAM), developed by Wirtz et al. (2018), is built upon the original TAM. It acknowledges three dimensions of service robot acceptance. They are functional, social-emotional, and relational dimensions. In agreement with the original TAM (Davis, 1989) and other existing studies (Park & Del Pobil, 2013; Kumar Kakar, 2017; Zhou & Feng, 2017; Seo & Lee, 2021), the sRAM reaffirms that perceived usefulness and perceived ease of use, under in the functional dimensions, are the antecedent variables of technology acceptance (Wirtz et al., 2018). That said, if perceived usefulness and perceived ease of use of a service

robot fail to fulfill hotel guests' needs and expectations at the same level of sophistication as a hotel employee, it could yield negative guest experiences. Hotel guests, thereby, are more likely to take a skeptical stance on the service quality of service robots (Choi et al., 2021). Wirtz et al. (2018) also pointed out that service robot acceptance is affected by subjective social norms under the function dimensions, which represent a set of social values and rules applied to service robots (Carlucci et al., 2015). Subjective social norms trigger hotel guest perceptions of robot competence, which in result increases cognitive evaluation of a service robot and forms affective attitudes (Saunderson & Nejat, 2019). It can be assumed that if a service robot engages in socially desirable behaviors as expected by a hotel guest, service robots are deemed to be more competent and socially interactive (Saunderson & Nejat, 2019).

Compared to the original TAM, the sRAM asserts that an individual's behavioral intention towards using a service robot is not merely decided by the functional dimensions. The social-emotional dimensions and relational dimensions jointly shape service robot acceptance. According to Wirtz et al. (2018), all three factors under the social-emotional dimensions are positively associated with human-robot interaction. Respectively, perceived humanness, which indicates the level of anthropomorphism in both physical appearance and behaviors, is crucial in inspiring trust and promoting guests' willingness to use service robots (Fuentes-Moraleda et al., 2020). Social interactivity corresponds to a service robot's ability to recognize and display appropriate emotions and actions (Fernandes & Oliveira, 2021). While social presence can be understood as the degree of salience of a service robot that takes place in human-robot interaction (Fernandes & Oliveira, 2021). Wirtz et al. (2018) commented that people have a tendency to apply social norms to service robots when socially engaged with them.

Finally, the relational dimensions in the sRAM underline trust and rapport as two essential components of service robot acceptance (Wirtz t al., 2018). Trust reflects a feeling of reliability and credibility when engaging with a service robot (Pillai & Sivathanu, 2020). Perceived trust plays an essential role in human-robot interaction, because technological readiness enhances the perceived competence of a service robot after several repetitions of successful interactions (Fuentes-Moraleda et al., 2020). This consequently develops a perception of high affiliation with a service robot (Saunderson & Nejat, 2019). More preeminently, Seo and Lee (2021) reported that perceived trust reduces the uncertainty that may arise from a service robot in a dynamic hotel setting with minimal or no human augment. As for rapport, Fernandes and Oliveira (2021) defined it as guests' perceptions of enjoyable interaction with a service robot. Rapport has been found to directly impact guests' behavioral intention to use service robots (Kumar Kakar, 2017), providing emotional and social value to the service-oriented industry (Wirtz et al., 2018).

Service Robot Integration Willingness Framework

Based on previous knowledge of technology acceptance models, the SRIW measures six key constructs that either contribute to or obstruct consumers' long-term willingness to integrate service robots across four service industries, including hotels, airlines, restaurants, and retail stores (Özkan et al., 2020). These constructs are performance efficacy, social influence, intrinsic motivation, emotions, facilitating conditions, and anthropomorphism (Lu et al., 2019). From high to low, Lu et al. (2019) found that emotions (accounted for 27%) constitute the core of human-robot interaction. Emotions can be described as negative such as bored, hostile, annoyed, passionless, and uncanny, or positive, such as surprising, friendly, pleased, relaxed, and excited. Similar to the social-emotional dimensions in the sRAM, positive emotions positively affect the

guest's willingness to use service robots (Lu et al., 2019). Apparently, when engaging with service robots, the emotions of guests in different contexts differ. The emotions in human-robot interaction influence whether a service robot could establish a significant relationship with a hotel guest.

After emotions, intrinsic motivation (accounted for 21%) is tied for second place in the SRIW (Lu et al., 2019). Intrinsic motivation, described as the pleasure received while interacting with a service robot (Lu et al., 2019), is substitutable for the term perceived enjoyment or rapport under the relational dimensions of the sRAM. In accordance with the sRAM, when a service robot displays human traits during human-robot, a higher level of intrinsic motivation positively influences guest willingness to use service robots (Lu et al., 2019).

While the concept of anthropomorphism (accounted for 18%), which bears the internal psychological states and external humanoid appearance of a service robot (Lu et al., 2019), is greatly alike to perceived humanness under the social-emotional dimensions of the sRAM. The level of anthropomorphism determines if a service robot is perceived as favorable or unfavorable (Belanche et al., 2021). As opposed to the rRAM, anthropomorphism in the SRIW, is found to thwart guests' willingness to integrate service robots (Lu et al., 2019). The divergent view on anthropomorphism is derived from the uncanny valley effect, which suggests that human-like characteristics induce positive perceptions of service robots, but beyond some point, highly anthropomorphic appearance may easily arouse aversion to service robots (Belanche et al., 2020). Akin to the studies from Fan et al. (2020) and Shin and Jeong (2020), even although a greater degree of anthropomorphism leads to higher likeability and more forgiving in service failures, once a service robot's human-like attributes reach a certain point, it causes an

uncomfortable sensation, and subsequently guest acceptance declines sharply (Goudey & Bonnin, 2016; Chiang & Trimi, 2020; Chuah & Yu, 2021).

Performance efficacy (accounted for 16%) in the SRIW indicates service robots' performance in terms of accurate, consistent, and dependable service delivery (Lu et al., 2019). With different terminologies being used, it can be understood in the same way as perceived usefulness and perceived ease of use under the functional dimensions of the sRAM. As a critical predictor of guest acceptance of service robots, performance efficacy is well studied in many technology acceptance models. Lu et al. (2019) noted that performance efficacy stresses certain service outcomes where service robots are more competent than human substitutes, such as accelerating service speed and avoiding inefficient social interaction.

Facilitating conditions (accounted for 14%) are related to the resources and assistance provided to hotel guests, which are exclusive to the SRIW. Lu et al. (2019) posit that facilitating conditions suggest the existing organizational and technological infrastructure designed in a way to assure the efficient and effective engagement with a service robot. This construct provides valuable insights to robotics developers and hoteliers to formulate service robots design or renovate hotel environments to support the use of robotic technologies (Lu et al., 2019).

Ranked lowest in the SRIW, social influence (accounted for 4%), an equivalent term of subjective social norms under the functional dimension of the sRAM, is defined as the degree to which an individual's attitudes or behavioral intentions are affected by society, especially when responding to friends and family influence (Ivkov et al., 2020). In the SRIW, social influence is shown to have no significant effect on guests' willingness to integrate service robots (Lu et al., 2019).

Since each industry is weighted differently in the SRIW, Lu et al. (2019) supplementarily concluded the following: 1) emotions played a leading and positive part in airlines and hotels; 2) social influences positively affected guest intention to use service robots in hotels and retail stores; 3) anthropomorphism was negatively associated with guests' willingness to use service robots in restaurants and retail stores; 4) facilitating conditions remarkably influenced service robots adoption in restaurants; 5) intrinsic motivation contributed to a higher level of service robots usage intention in hotels.

Conclusion

With the gradual improvement of robotic technologies, hotel-specific service robots will play an important role in increasing cost-effectiveness, improving operational efficiency, and offering a meaningful interaction (Choi et al., 2021; Lin & Mattila, 2021). A few studies (Bartneck et al., 2010; Lu et al., 2019; Tussyadiah & Park, 2017) reported that anthropomorphism positively influenced consumers' willingness to use service robots. They found that product-oriented robots are regarded as less friendly and less favorable than human-oriented robots due to a lack of social interaction (Prakash & Rogers, 2015; Tung & Law, 2017). Chiang and Trimi (2020) further suggested that people are more satisfied with the service provided by human-oriented robots in a psychological stance. However, the opposite result was revealed by Choi and Kwak (2015), as well as Stroessner and Benitez (2019), demonstrating that the service evaluation of a product-oriented robot is higher than a human-oriented robot.

Although many hotels have already started integrating service robots into daily operations, little attempts have been made to identify the driving factors of hotel guests' behavioral intentions to use service robots. In addition, the existing literature mainly concentrates on the service attributes of service robots by comprehensively reviewing the concepts,

applications, and development of robot adoption based on a single technology acceptance model, minimal information is available for researchers to study the impact of anthropomorphism in human-robot interaction. Thus, a comparative perspective in both guest perceptions of anthropomorphic robots and collective service robot acceptance models is in great need. To address these gaps in existing literature, a comparative analysis of two popular service robot acceptance models, the Service Robot Acceptance Model (sRAM) and the Service Robot Integration Willingness (SRIW) framework, will be conducted in the next chapter. With a goal of generating new knowledge from service robot acceptance theories, this paper will give prominence to reveal the impact of service robot anthropomorphism. Implications of service robot adoption will be discussed at the end of next chapter to provide valuable insights for hoteliers who are seeking to stay competitive to keep up with technological transitions.

Chapter Three

Introduction

Given the growing need of service robot adoption in the hotel industry, studying the impact of service robot anthropomorphism and service robot acceptance models will benefit from keeping pace with pandemic-driven demand. Nevertheless, investing in such technology may potentially put hoteliers at risk as service robots in different forms and functions have shown different levels of guest acceptance (Belanche et al., 2021). As anthropomorphic features transform into a trendy marketing game plan, it is worth pondering whether service robot anthropomorphism will change hotel guests' attitudes favorably (Huang et al., 2020). A great deal of existing studies has attempted to conceptually examine the guests' perception of service robot usage (Choi et al., 2021; Murphy et al., 2019) and how psychological processes are influenced by various variables, such as self-efficacy (Fan et al., 2020), perceived enjoyment (Kumar Kakar, 2017; Park & Del Pobil, 2013; Zhou & Feng, 2017), and perceived trust (Seo & Lee, 2021; Ghazali, 2020). However, understanding the reason why hotel guests accept or reject service robots has proved to be more challenging and subtle than expected. The findings from existing research were only acquired from a single technology acceptance model due to inadequate robotic data. In this chapter, a literature-based comparative analysis of service robot acceptance models will be conducted to help hoteliers to identify barriers that hinder service robot acceptance. Research related to how service robot anthropomorphism affects guest acceptance will also be highlighted and analyzed.

Comparative Analysis of the Service Robot Acceptance Model and the Service Robot Integration Willingness Framework

Among three dimensions proposed in the sRAM, scholars empirically validated that an individual is primarily motivated by functional dimensions, followed by social-emotional dimensions, and the relational dimensions receiving the lowest ranking (Fuentes-Moraleda et al., 2020; Fernandes & Oliveira, 2021). Under the functional dimensions of the sRAM, a higher sense of perceived usefulness and perceived ease of use tend to be easier to enhance guest acceptance and satisfaction of service robots (Fuentes-Moraleda et al., 2020). Even though Wirtz et al. (2018) identified subjective social norms as having a positive contribution on human-robot interaction, the norms of society for service robots are conditional and need to be studied over longer time spans. Likewise, the social-emotional dimensions in the sRAM influencing guests' affective commitment towards a service robot are much complex, depending on each individual and different context (Fuentes-Moraleda et al., 2020). Wirtz et al. (2018) asserted that it is more important for hotel guests to develop trust in service robots' social skills and service attributes, rather than human-like features (Wirtz et al., 2018). This implies that service robots do not need to possess anthropomorphic characteristics when socially presenting and interacting with hotel guests (Wirtz et al., 2018). Referring to the relational dimensions of the sRAM, Wirtz et al. (2018) advised that anthropomorphism can help hotel guests to build both trust and rapport with a service robot. It is evident that people cultivate more emotional connections when interacting with a human-oriented robot than a product-oriented robot (Onyeulo & Gandhi, 2020). Humanoid robots have been evaluated to be more "sympathetic, lively, active, and engaged" when using gestures (Saunderson & Nejat, 2019). When a humanoid robot makes appropriate facial expressions, such as giving a wink, lowering its eyebrows, and making a smiley face, it

encourages human-robot engagement and increases the quality and pleasure of human-robot interaction (Prakash & Rogers, 2015).

Unlike the sRAM claiming all three dimensions positively influence service robot acceptance in the hotel industry, the SRIW highlighted that only performance efficacy, intrinsic motivation, facilitating conditions, social influence, and emotions are positive antecedents of service robot acceptance. Emotions in the SRIW are of vital importance to robots' service outcomes. Whereas social influence in the SRIW has limited influence on consumers' willingness to integrate service robots. This finding contradicts the sRAM, which suggested that social influence has the potential to influence guest perceptions toward the use of service robots. In addition, in the SRIW, Lu el al. (2019) did not disclose how social interactivity and social presence impact guests' emotions when using service robots. Facilitating conditions, as an exclusive construct in the SRIW, should be considered a solution to reduce barriers for service robot acceptance. It is important to note that the SRIW discloses that anthropomorphism does not necessarily increase guest acceptance of service robots. In the sRAM, Wirtz et al. (2018) identified that service robots with certain levels of humanoid attributes are more likely to stimulate emotional trust. On the contrary, Lu et al. (2019) found that a higher level of anthropomorphism is inclined to elicit negative feelings of strangeness, danger, and threat and presents an enormous technical challenge.

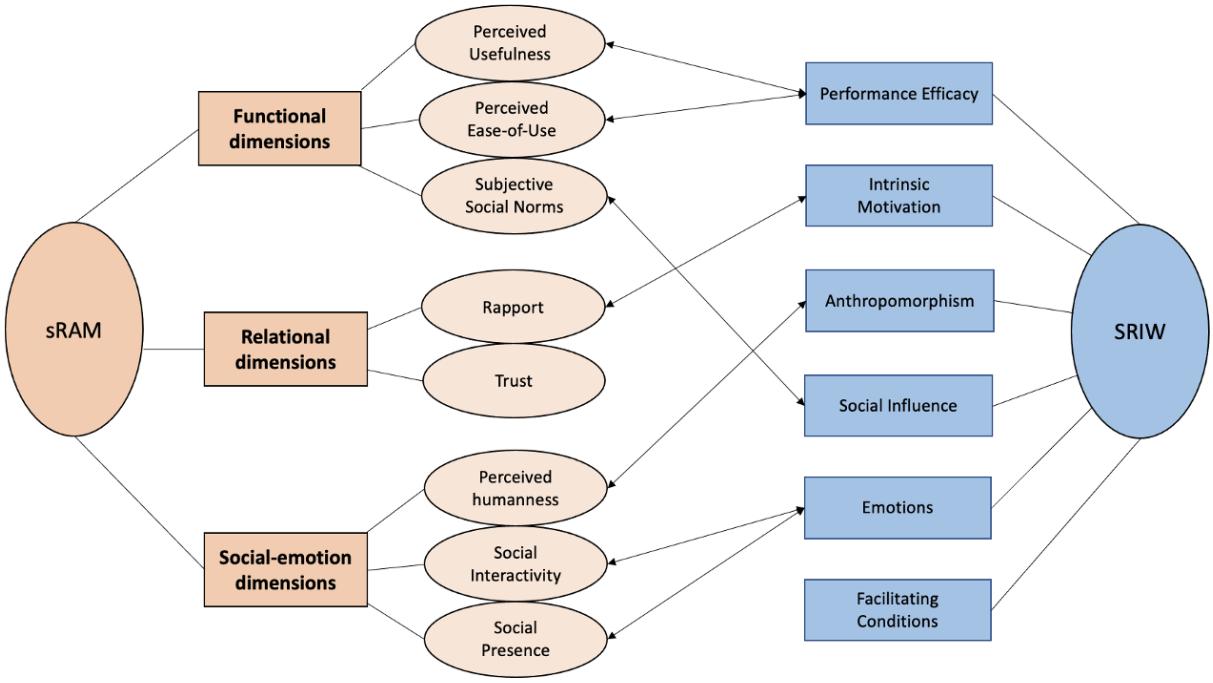
Conclusion

A majority of key determinants in both service robot acceptance models are overlapped. As indicated in Figure 2 below, the sRAM values the functional dimensions of service robots over social-emotional dimensions. Conversely, the SRIW considers emotional connections as the

most important antecedent in predicting guests' intentions toward service robot usage among any other constructs.

Figure 2

Comparing the Service Robot Acceptance Model (sRAM) and the Service Robot Integration Willingness (SRIW)



Both models consider performance efficacy (or perceived usefulness and perceived ease of use under the functional dimensions in the sRAM), intrinsic motivation (or rapport under the relational dimensions in the sRAM), social influence (or subjective social norms under the functional dimensions in the sRAM), and emotions (or social interactivity and social presence under the social-emotional dimensions in the sRAM) as positive antecedents of service robot acceptance. But the SRIW suggests that social influence has a negligible influence on service robot acceptance. Although both service robot acceptance models attach importance to anthropomorphism (or perceived humanness of the social-emotional dimensions in the sRAM),

their findings are conflicting. The sRAM advocates anthropomorphism positively facilitates human-robot interaction, while the SRIW finds anthropomorphism to be an impeding determinant of consumers' continuing willingness to use service robots.

Distinctively, the sRAM regards trust as a critical antecedent determining guest behavioral intentions, bringing ethical concerns regarding privacy and security. While the SRIW underlines that facilitating conditions have a positive influence on human-robot interaction, which enlightens robotics developers to design robots in a way that helps hotel guests communicate effectively and naturally with service robots.

Implications

There is little doubt that the adoption of service robots will continue to have a powerful and profound influence on the global labor market. Before the COVID-19 pandemic, robotics developers and hotel practitioners paid a lot of attention to service robot anthropomorphism in human-robot interaction. The idealized staffing strategy in the hotel industry was to consider using service robots as an extra set of hands of human staff (Chiang & Trimi, 2020). However, many people argued that being service-driven is the nature of the hotel industry. Especially for luxury hotels, which thrive on nurturing loyal customer relationships, it requires maintaining a high ratio of staff to guests to ensure high touch in service encounters (Li et al., 2021).

The Covid-19 pandemic has flipped the hotel industry upside down. It is now table stakes for hoteliers to accelerate the adoption of robotic technologies for safe travel (Parker, 2020). Hotel guests are beginning to accept service robots as lifesavers, regardless of their anthropomorphism (Chiang & Trimi, 2020). Although human-like characteristics such as appearance, emotions, and behavioral traits entertain hotel guests, it is only up to a certain level. In some cases, humanoid appearance may be a backfire for robotic design due to the perceived

risk of human identity, which leads to decreased guest satisfaction (Seo & Lee, 2021). The balance of the robot aesthetics is anticipated to be further investigated. It is also worth mentioning that anthropomorphism might be more concerning in certain service sectors, such as restaurants and retail stores. But anthropomorphism does little to affect guests' willingness to use service robots in hotels (Lu et al., 2019). Thus, the adoption of service robots will likely accelerate post-COVID-19, despite the controversial views of robotic anthropomorphism. From the perspective of robots' service outcomes, even though service robots are empowered to detect human emotions, they are not competent to display genuine emotions as human employees (Go et al., 2020). Hotel employees are still needed to support service robots on emotional tasks, resulting in hotel guests easily and quickly losing benevolence-based trust on service robots (Wirtz et al., 2018). Humans are considered more emotionally intelligent and creative than service robots in the service attributes (Jia et al., 2021; Kim et al., 2021). In conclusion, service robots can be an impressive tool for good, but only if humans and robots can augment each other to provide quality service to hotel guests.

Limitations and Future Research

Although the findings of this paper are expected to make contributions to the existing literature, this paper has some limitations. First, even though service robots have become widely recognized in many industries, the limited information available on statistical analyses in regard to the guest experience and evaluation still remains scarce in robotics research. This form of AI technology is being held back by issues of privacy-sensitive data collection. Although it would be helpful to collect and analyze literature about the variables of guest satisfaction regarding service robots and to identify opportunities for product and service improvement, this paper does not provide such an in-depth analysis.

Second, at the time of the study, the popularity of service robots in the hotel industry is still at the initial stage. Under the current stage of technology development, service robots are not fully self-sufficient without human intervention. The outcome of human-robot interaction, in the long run, is mysterious. As guests become better acquainted with service robot technology, their perceptions of service robots are subject to change. Hence, future research needs to examine the ever-changing guest perception of the value provided by service robots over time.

And last, this paper only considers hotel guests' and hoteliers' perspectives. Employees are considered the most valuable assets in an organizational structure because their soft skills and personality traits cannot be replicated. As more and more service robots share the workplace with human labor, taking a hotel employee's perspective to explore technological acceptance and ethical concerns raised by using service robots would be another important future research area.

Appendix A

Table 1. Literature Review About Robotic Anthropomorphism

Author(s)	Year	Title	Field of Study	Key Findings
Bartneck, Bleeker, Bun, Fens, and Riet	2010	The influence of robot anthropomorph-ism on the feelings of embarrassment when interacting with robots	Healthcare	• Patients are less embarrassed when interacting with a technical-looking robot than a highly anthropomorphic robot. • If patients are less embarrassed when interacting with a robot, they are less likely to postpone medical examinations performed by a medical robot.
Chiang and Trimi	2020	Impacts of service robots on service quality	Hotel	• The top two priorities of robot service are assurance and reliability, while tangible and empathy are not as significant. • The degree of anthropomorphism influences hotel guests' perceived rust and robot acceptance, depending on the type of service and familiarity with robots.
Choi and Kwak	2015	The effect of robot appearance types and task types on service evaluation of a robot	Robotics	• People evaluate a human-oriented robot more effectively than a product-oriented robot in a social context because they require more emotions and socially oriented communication in a social context. • People consider a product-oriented robot more effective than a human-oriented robot in a task-oriented context since people put more importance on the efficiency of a task in a task-oriented context.
Choi, Y., Oh, Choi, M., and Kim	2021	Service robots in hotels: understanding the service quality perceptions of human-robot interaction	Hotel	• Customers tend to have higher expectations of humanoid robots because they exhibit better communication skills and high perceptions of security, compared with functional robots. • Human staff relatively outperform service robots when providing personalized service and displaying sincerity.

Author(s)	Year	Title	Field of Study	Key Findings
Fan, Wu, Miao, and Mattila	2020	When does technology anthropomorphism help alleviate customer dissatisfaction after a service failure? - The moderating role of consumer technology self-efficacy and interdependent self-construal	Self-Service Technology	• Consumers are more inclined to show favorable attitudes, evaluations, and behavioral intentions toward anthropomorphic robots. • For consumers with high technology self-efficacy, neither anthropomorphism nor social rules have no significant impact on their attitudes toward self-service failure. • Consumers with low technology self-efficacy are more likely to forgive a humanoid agent, and thus show less dissatisfaction with the service failure.
Goudey and Bonnin	2016	Must smart objects look human? Study of the impact of anthropomorphism on the acceptance of companion robots	Healthcare	• The human-like features of a companion robot do not increase consumer acceptance. • A partially anthropomorphic robot is more accepted than the other robots by individuals who have practical experience with similar technology.
Jia, Chung, and Hwang	2021	Assessing the hotel service robot interaction on tourists' behaviour: the role of anthropomorph-ism	Hotel	• People working with human-like robots have a higher sense of responsibility and a lower sense of presence than people working with machine-like robots. • People are most likely to accept medium-human likeness robots and least likely to accept high-anthropomorphic robots because a high degree of anthropomorphism easily causes aversion.

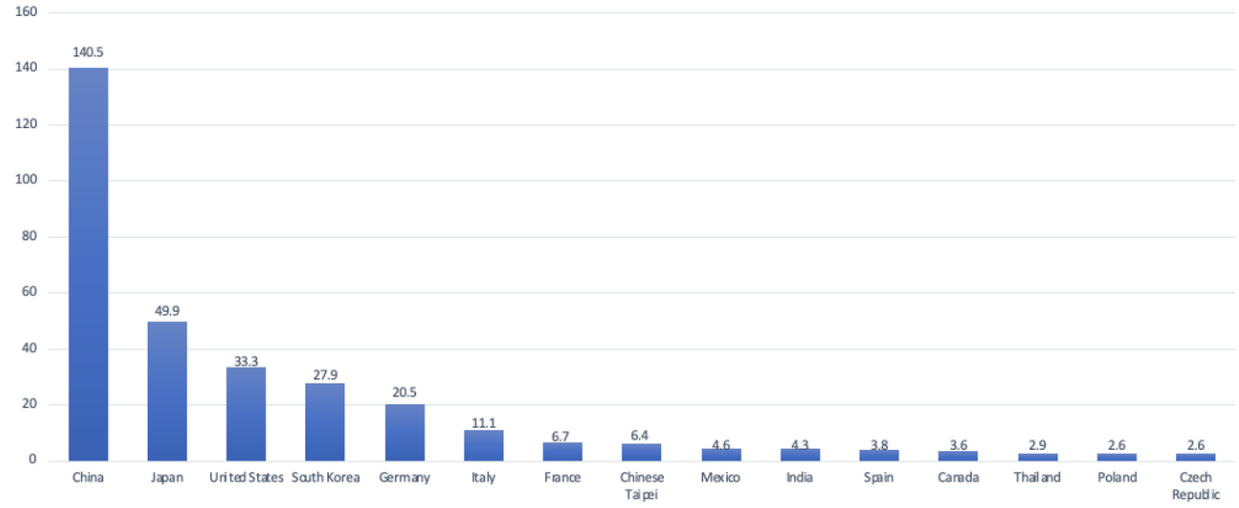
Author(s)	Year	Title	Field of Study	Key Findings
Murphy, Gretzel, and Pesonen	2019	Marketing robot services in hospitality and tourism: the role of anthropomorph-ism	Hospitality and Tourism	• When the robot is sufficiently human-like, customers could develop affective reactions and attach loyalty to robots. • Once anthropomorphism reaches a certain level, customers decrease the favorability and may completely stop accepting robots.
Onyeulo and Gandhi	2020	What makes a social robot good at interacting with human	Robotics	• Humans can interact well and form emotional attachments with robots, even if the robot does not look like a human.
Prakash and Rogers	2015	Why some humanoid faces are perceived more positively than others: effects of human-likeness and task	Robotics	• Different age groups have differences in needs and preferences on robot appearance. • Both younger and older adults prefer a human appearance for social tasks due to perceived intelligence and friendliness. • Majority of younger adults prefer mixed human-robot features, while older adults are more likely to reject the mixed appearance.
Stroessner and Benitez	2019	The social perception of humanoid and non-humanoid robots: effects of gendered and machinelike features	Robotics	• People also use gender stereotypes to judge robots based on their features, which influences human-robot interaction. • Feminine and human-like robots are considered more competent and warmer than masculine and machine-like robots.
Tang and Au	2018	Exploring customer experiences with robotics in hospitality experience research in human-robot interactions	Hotel	• Children are particularly sensitive to robot interaction and are easily able to develop an interest regardless of the robot appearance. • Parents are willing to accept a certain amount of service failure in exchange for allowing their children to interact with robots.

Author(s)	Year	Title	Field of Study	Key Findings
Tussyadiah and Park	2017	Consumer evaluation of hotel service robots	Hotel	• Anthropomorphism increases a sense of efficacy with non-humanlike objects, as well as intensifies emotional attachment with them. • A mix of human and robot appearance will contribute to inducing a positive attitude towards service robots.

Appendix B

Figure 1

Top 15 Countries of Service Robot Annual Installations in 2019

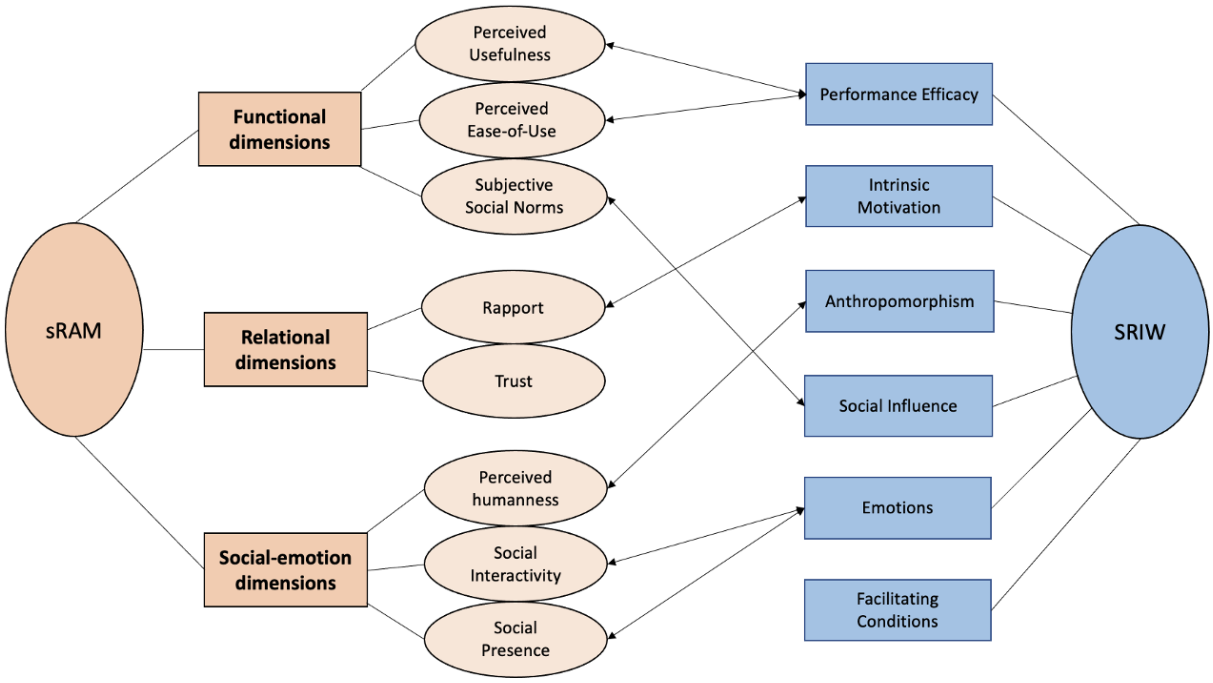


Source: International Federation of Robotics (2020).

Appendix C

Figure 2

Comparing the Service Robot Acceptance Model (sRAM) and the Service Robot Integration Willingness (SRIW)



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