A Systematic Review of Empirical Studies on Service Robots

Hizmet Robotları Hakkında Ampirik Çalışmaların Sistematik Bir İncelemesi

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ABSTRACT

The aim of this study is to conduct bibliometric analysis of studies on service robots in terms of the years they were published, the countries where they were conducted, the methodology of the studies, the models/theories used in the studies and the variables in the studies, and to examine the relationships between them. 38 articles were selected for the study and analysis was carried out with the VOSviewer package program. According to the findings, it was understood that most study was done in 2023. Accordingly, it is thought that much more studies will be done on this subject in the future. According to another result, the most studies were conducted in South Korea with 12 studies, the second most studies were conducted in the United States, and the third most studies were conducted in China. However, when looking at the link strength, it was seen that South Korea had zero link strength. It is not surprising that the most work was done in these three technologically advanced states. When looking at the methodology, it was understood that surveys and structural equation modeling were used most. The most used theory/model was the technology acceptance model. It has been observed that the most commonly used variables are attitude and intention to use, and these variables also have a very high link strength.

KEYWORDS

Service Robots, Empirical Studies, VOSviewer, Bibliometric Analysis

ÖZ

Bu çalışmanın amacı hizmet robotlarıyla ilgili yapılan çalışmaların yayımlandıkları yıllar, yapıldığı ülkeler, çalışmaların metodolojisi, çalışmalarda kullanılan modeller/teoriler ve çalışmalardaki değişkenler açısından bibliyometrik analizinin gerçekleştirilerek aralarındaki ilişkilerin incelenmesidir. Çalışma için 38 makale seçilmiş VOSviewer paket programı ile analiz gerçekleştirilmiştir. Elde edilen bulgularda en fazla çalışmanın 2023 yılında yapıldığı anlaşılmıştır. Buna göre bu konuyla ilgili gelecekte çok daha fazla çalışmanın yapılacağı düşünülmektedir. Elde edilen başka bir sonuca göre 12 çalışma ile en fazla çalışma Güney Kore'de yapılmış, en fazla çalışmanın yapıldığı ikinci ülke Amerika Birleşik Devletleri, en fazla çalışmanın yapıldığı üçüncü ülke ise Çin olmuştur. Ancak bağlantı gücüne bakıldığında Güney Kore'nin sıfır bağlantısı olduğu görülmüştür. Teknolojik olarak oldukça ilerde olan bu üç devlette en fazla çalışmanın yapılması şaşırtıcı olmamıştır. Çalışmaların metodolojisine bakıldığında en fazla anket ve yapısal eşitlik modellemesinin kullanıldığı anlaşılmıştır. En çok kullanılan teori/model ise teknoloji kabul modeli olmuştur. En çok kullanılan değişkenlerin tutum ve kullanım niyeti olduğu bu değişkenlerin ayrıca bağlantı gücünün çok yüksek olduğu görülmüştür.

ANAHTAR KELİMELER

Hizmet Robotları, Ampirik Çalışmalar, VOSviewer, Bibliyometrik Analiz

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INTRODUCTION

The advancements in technology gradually fill the gaps that previously existed and create new opportunities for businesses to enter the market, according to García-Haro et al. (2021:18). A Brookings Institution survey found that 52% of adult Internet users in 2021 believe that automation will eventually replace most human tasks, and 94% of those who have adopted it claim that it has boosted productivity in their business. The rapid acceptance of robotics in the business world is likely to lead to further growth and more widespread use of robots in different industries in the future. This trend is expected to provide exciting opportunities for businesses looking to improve business efficiency and gain a competitive advantage through automation. Therefore, the proliferation of robots can play an important role in the transformation of the business world. In general, the hospitality industry has been greatly influenced by technology, and its continued development will likely bring even more advancements and opportunities in the future. The hospitality industry has been a leader in incorporating advanced technology into its service delivery process (Kuo et al., 2017:1306-1307). The robot revolution is predicted to bring about a significant increase in the service robotics industry, with projections showing a surge from $37.0 billion in 2020 to a staggering $102.5 billion by 2025 (Lee, 2021:1-2). It has been suggested that in the future, robots may take over many cooking and hospitality roles currently held by humans, using service robots to fill various roles in the hospitality industry as substitutes (Law et al., 2020:525).

Restaurants in the tourism and hospitality industry are important establishments providing food and beverage services to both tourists and locals (Hjalager and Coriglianoi, 2000:282). At the same time, these businesses contribute to the discovery of cultural richness by offering tourists the opportunity to experience local cuisine (Hjalager, 2002:22). However, in recent years the restaurant industry has witnessed significant changes. The technological revolution has enabled some businesses to use robotics in tasks such as automated food preparation and customer service (Ivanov et al., 2017:1502). Especially restaurants and businesses in the service sector can gain an advantage in providing faster and more precise service to customers by adopting these technologies.

The increasing use of service robots in the restaurant industry, as in many other sectors, is important in terms of showing the level of influence of the business world from technology (Cha, 2020:2948). Many advantages of greater adoption of technology in the business world have begun to be felt (Chuah et al., 2022a:51). Among the most important advantages of these, especially efficiency and productivity, are the ability of customers to receive personalized experience services (Murphy et al., 2019:786). As with every development, technological development has advantages and disadvantages. For example, with the spread of automation, the first concern for labor markets is the increasing number of layoffs (Chuah et al., 2022b:3556). Another concern is about security (Chuah and Yu, 2021:6) and privacy (Hwang et al., 2021a:276). In particular, the issue of how personal information is collected and used through robots causes concern. Finally, the issue of hygiene also comes to the fore with the use of this technology (El-Said and Al Hajri, 2022:10). It is extremely important for businesses to consider the potential impacts of these technological changes and take the necessary steps to address negative consequences.

Empirical studies on service robots and robotic restaurants examine various aspects of the use and effectiveness of these technologies. In particular, Aydın (2021) evaluated how such technologies affect communication between people, focusing on the desire for word-of-mouth communication. Çelik and Aydın's (2022) study investigated how the use of service robots affects customers' intentions by addressing behavioural intentions. In addition, a study by Zhu and Chang (2020) examined how food quality and customer perception perceived the food served in robotic restaurants. Factors such as customer satisfaction (Seo and Lee, 2021), brand satisfaction (Hwang et al., 2021b) and perceived risk (Hwang et al., 2021a) have also been addressed in these studies. Overall, these empirical studies show that service robots and robotic restaurants are potentially beneficial.

The primary aim of this study is to fill the gap by examining the literature in the field of service robots and robotic restaurants. For this purpose, the main sources in the literature were determined by the bibliometric analysis method and the development in the relevant field was tried to be identified and understood. In addition, the empirical tools used on the subject were examined and an attempt was made to provide guidance for future studies.

1. LITERATURE REVIEW

1.1. Service Robots in Restaurants

The definition and functions of service robots are becoming an increasingly important issue with today's technological developments. The definition presented by the International Federation of Robotics (IFR) is an important reference used to identify service robots and to distinguish these machines from other types of robots (García-Haro et al., 2021:1). According to the IFR's definition, service robots are machines that operate partially or completely independently to provide assistance to people and equipment, but not for production purposes (IFR, 2021). Beyond this definition, a definition by Wirtz et al. (2018) defines service robots as autonomous and adaptive systems that interact, communicate and provide services to companies' customers. These two definitions emphasise that service robots are versatile and important tools that can be used in different sectors.

Nowadays, the demand for service robots is increasing rapidly. Especially in the restaurant industry, as Cheong (2016) states, the use of service robots such as robot waiters is becoming increasingly common. These robots can interact and communicate with customers in restaurants and provide waiter service in an efficient and error-free manner. They have the potential to improve service quality by minimising human errors (Aydın, 2021:94). Hence, the use of service robots in the service industry can have positive outcomes for both business owners and customers. Therefore, the market for service robots is likely to continue to grow further in the future.

The service robots market is growing and that there is consumer demand for service robots. There is a growing trend in the service industry of using robots as waiters in restaurants, according to Cheong (2016). "Robot waiters are robots that interact with customers in restaurants, communicate, provide waiter service effectively and efficiently, and do not make human-induced service failures." (Aydın, 2021). García-Haro et al. (2021) found that robot waiters are becoming more common and that they offer advantages such as social interaction and complex task performance. According to writers robots are being created by robotics companies to assist with tasks including serving, interacting, collaborating, and providing help. This is intended to improve the quality of life by having these service robots coexist with humans. Additionally, a new category called catering robotics has been proposed which includes waiter robots- robotic platforms capable of social interaction with customers and physical skills for complex tasks like restaurant work. Chuah et al. (2022b) found that the price premium is significantly affected by demographic, psychographic, and situational factors. This suggests that there is consumer demand for robot waiters.

1.1.1. People's Feelings About Being Served by Robots

There are studies in the literature that examine the emotions experienced by individuals when they are served by robots. People tend to trust robots more when they display humanlike qualities, autonomy, and competence. This includes the ability to recover from failure and work in teams, as shown in research by Byrne and Marín (2018). Therefore, designing robots with these features can increase trust in their services. According to this paper autonomy refers to the ability of a robot or machine system being able to act independently, while team work capability is its capacity for collaboration between multiple machines or agents towards achieving an objective. Robots that have high trust and output quality are perceived as more useful, according to studies by Lee et al. (2018) and Chiang and Trimi (2020). These studies also showed that robots in restaurants can help with human resource shortages and training, and that a positive attitude towards the robot affects acceptance. Additionally, interactivity positively impacts the perceived ease of use. Chiang and Trimi (2020) show that modern robots have become more diversified and humanized due to the development of artificial intelligence. This has enabled them to perform a wider range of tasks than traditional robots, which were limited in their capabilities. Additionally, service industries such as healthcare and hospitality have seen an increase in robot usage over recent years for various applications including customer assistance, medical diagnosis/treatment support, etc. It appears that individuals are more inclined to trust robots that exhibit competence and reliability. Consequently, robots that are designed to seem more humanlike, autonomous, and competent are more likely to be trusted by people.

1.1.2. The Cost of Robots compare to the Cost of Human Labor

There are studies in the literature comparing the cost of human labour and robots. These studies have mixed findings on the cost of robots compared to the cost of human labour. Annual labour productivity growth is promoted by an increase in the use of robots, according to a study conducted by Graetz and Michaels in 2018. According to writers industrial robots have had a positive economic impact, increasing labor productivity and

value added. The heightened deployment of robots has been associated with elevated average growth rates in the countries that implement them. The use of robots led to higher wages and overall efficiency, but may have resulted in fewer working hours for low and middle-skilled employees. Humlum (2019) finds that industrial robots increase average real wages by 0.8 percent. Acemoglu and Restrepo's 2020 study found that each additional robot per thousand workers resulted in a 0.2% drop in employment-to-population ratio and a 0.42% decline in wages. Additionally, it was shown that these effects were distinct from offshoring jobs meaning they could be attributed solely to robotics technology being used instead of human labour in certain industries/tasks. These findings show that robots can increase productivity but may also have a negative impact on employment and wages.

1.1.3. Robots Compare to Human Waiters in Terms of Efficiency

There are studies in the literature comparing the efficiency of human waiters and robots. These studies have mixed findings on robots' efficiency compared to human waiters. Robots are increasingly being used as waiters in restaurants, indicating their increasing efficiency (Cheong et al., 2016). Some restaurant owners have started to consider using robots as waiters because of a shortage of human employees, according to researchers. The researchers developed a prototype robot with mecanum wheels, which is autonomous and has higher payload than existing waiter robots. Byrd et al. (2021) found that individuals had lower expectations for food safety and quality when delivered by robots or humans, but there were no significant differences between the three delivery methods in a field study. This suggests that there is no difference in food-related performance between robots and human waiters, which means that robots are not necessarily more efficient. According to writers off-premise restaurant service, including food delivery robots, have received little attention in terms of research despite their increasing popularity. Afsheen et al. (2018) discovered that "Waiter Robo" technology can be utilized to replace manual labor in various hospitality settings, including cafes, restaurants, hotels, and lodges. This automated system uses an electronic menu bar with LCD display, a Keypad and Bluetooth module for ordering food or beverages. The orders placed through the menu bar will then be sent via wireless network to kitchen staff who prepare it before handing over the order to customers. Additionally, these robots also help clean tables which further reduces human effort required at peak hours of operation. Although robots can move quickly and smoothly, they struggle with efficiently delivering beverages and soup due to jerky motion control, according to Wan et al. (2020). To solve this issue, a state machine design that adjusts the robot's movement based on velocity and position changes while maintaining stability can be implemented. This will allow the robot to effectively serve customer orders without any disruptions or spills.

2. METHODOLOGY

This paper conducts a bibliometric analysis of service robots research by first retrieving relevant publications from a database and describing their characteristics. The analysis then examines influential countries, authors, and identifies research frontiers and hot spots. Finally, the paper discusses current issues, trends, and challenges in the field. Bibliometrics, a term first proposed by Pritchard in 1969, refers to the statistical analysis of research publications (Broadus, 1987:373). It has been used to evaluate various aspects of publications, such as an institution's research productivity and a scholar's research impact through citation counts (Lei and Liu, 2019:542). Bibliometrics, a measure of a journal's reputation and article quality, is used to create major citation indexes. These indexes reflect the publication impact of academic journals in specific fields (Sun and Lan, 2023:2).

A bibliometric analysis of academic literature on service robots and robotic restaurants was conducted using Google Scholar. This search tool was chosen due to its comprehensive matching algorithm (Behl et al., 2022:4). The analyses included 100 articles retrieved from the Google Scholar database; after excluding articles that were not experimental, not related to service robots or robot restaurants, and not in English or Turkish, 38 articles related to the subject of this study were evaluated. These analyses made it possible to identify influential studies, to summarise the nature of the research in this area and to identify gaps in the literature.

After content analysis of 38 articles, bibliometric data for each article was entered into the EndNote file for that article. Analyzes were made by running the EndNote files of the articles in the VOSviewer software program. Social network maps were created by utilizing VOSviewer software program. Thanks to this program, the details of the articles and their years, the countries where the articles were conducted, the methodology of the articles, the theories/models used in the articles and the variables evaluated in the articles were investigated. Cluster analysis was performed using the VOSViewer program to produce the social network maps and analyze co-occurrence. Through the use of a co-word network analysis, the research

landscape of vulnerability assessment methodologies can be depicted and trends can be identified (Amlan et al., 2023: 4).

3. RESULTS

3.1. Selected Studies

The number of studies evaluated for this study is 38. Among the total studies, 1 study in 2018, 9 studies in 2020, 9 studies in 2021, 8 studies in 2022 and 11 studies in 2023 were evaluated for this study. However, as a result of the literature review, no studies were found published in 2019 within the scope of the subject and purpose of this study, and thus, no studies were taken into consideration for this year.

Table 1: Selected Studies

Year	Studies	Documents	Percent	Link Strength
2018	(Lee et al., 2018)	1	2.6	1
2020	(Cha, 2020)	9	23.6	1
	(Ho et al., 2020)			1
	(Hwang et al., 2020a)			1
	(Hwang et al., 2020b)			1
	(Jang and Lee, 2020)			1
	(Lin et al., 2020)			1
	(Sung and Jeon, 2020)			1
	(Zhong et al., 2020)			1
	(Zhu and Chang, 2020)			1
2021	(Aydın, 2021)	9	23.6	1
	(Huang et al., 2021)			1
	(Hwang et al., 2021a)			1
	(Hwang et al., 2021b)			1
	(Kim et al., 2021a)			1
	(Kwak et al., 2021)			1
	(Lu et al., 2021)			1
	(Seo and Lee, 2021)			1
	(Song et al., 2021)			1
2022	(Alotaibi et al., 2022)	8	21.1	1
	(Chuah et al., 2022a)			1
	(Chuah et al., 2022b)			1
	(Çelik and Aydın, 2022)			1
	(El-Said and Al Hajri, 2022)			1
	(Guan et al., 2022)			1
	(Ma et al., 2022)			1
	(Xie et al., 2022)			1
2023	(Chen and Girish, 2023)	11	29.1	1
	(Ivanov & Webster, 2023)			1
	(Kao and Huang, 2023)			1
	(Kim et al., 2023)			1
	(Molinillo et al., 2023)			1
	(Ozturk et al., 2023)			1
	(Pande and Gupta, 2023)			1
	(Said et al.,2023)			1
	(Shah et al., 2023)			1
	(Tu et al., 2023)			1
	(Wang and Papastathopoulos, 2023)			1

According to Table 1, since each study was produced in a certain year, it has a link only to that year and the link strength is 1. It is possible to see the visual presentation of link strength in Figure 1. Figure 1 shows the co-occurrences for the studies selected for this study. It is seen that the most studies are clustered in 2023.

Figure 1: Co-Occurrences for Studies
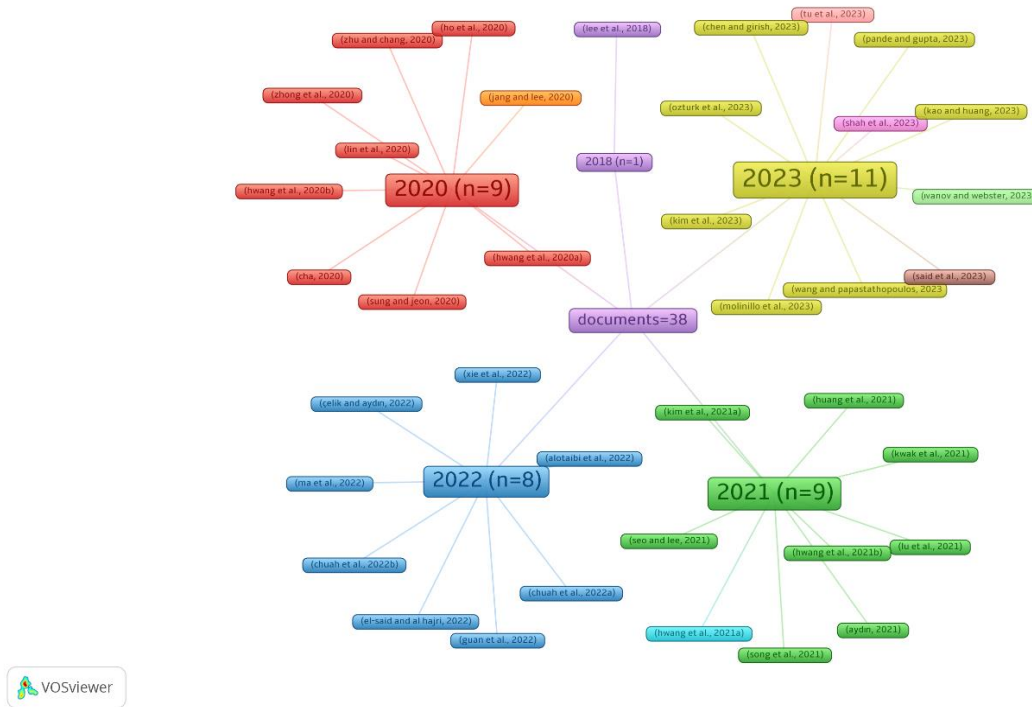
3.2. Countries of Studies

The countries where studies were carried out are shown in Table 2. The highest number of studies were conducted in South Korea with 12 studies, the United States of America with 8 studies, and China with 6 studies. Four studies were conducted in India, Taiwan and Turkey, with the same number in each country. While 3 studies were conducted in Spain, an equal number of studies were conducted in Brazil, Japan and the United Kingdom, that is, 2 studies in each country. However, it is not known in which country the 3 studies were conducted.

Table 2: Countries of Studies

Countries	Documents	Link Strength	Countries	Documents	Link Strength
South Korea	12	0	Germany	1	17
United States of America	8	28	Greece	1	10
China	6	17	Ireland	1	17
India	4	27	Israel	1	10
Taiwan	4	17	Italy	1	17
Türkiye	4	27	Malaysia	1	17
Spain	3	27	Oman	1	0
Unknown	3	0	Portugal	1	17
Brazil	2	27	Romania	1	10
Japan	2	11	Russian Federation	1	17
United Kingdom	2	27	Thailand	1	0
Bulgaria	1	17	United Arab Emirates	1	17
Canada	1	10	Other (83 Countries)	1	17
France	1	17			

Looking at the link strength of the countries where studies were conducted in Table 2, it can be seen that although the most studies were conducted in South Korea, the link strength with other countries is zero (0). This situation shows that no studies are being carried out simultaneously in another country along with South Korea. However, for example, in the Russian Federation, where only one study was conducted, the link strength is 17. It is possible to see the detailed situation for each country in Figure 2. Figure 2 visually presents

the link strength of each country with other countries, depending on whether any study is conducted simultaneously in more than one country. As seen in Figure 2, co-occurrences are formed for countries as a result of the existing link strengths of the countries.

Figure 2: Co-Occurrences for the Countries of Studies
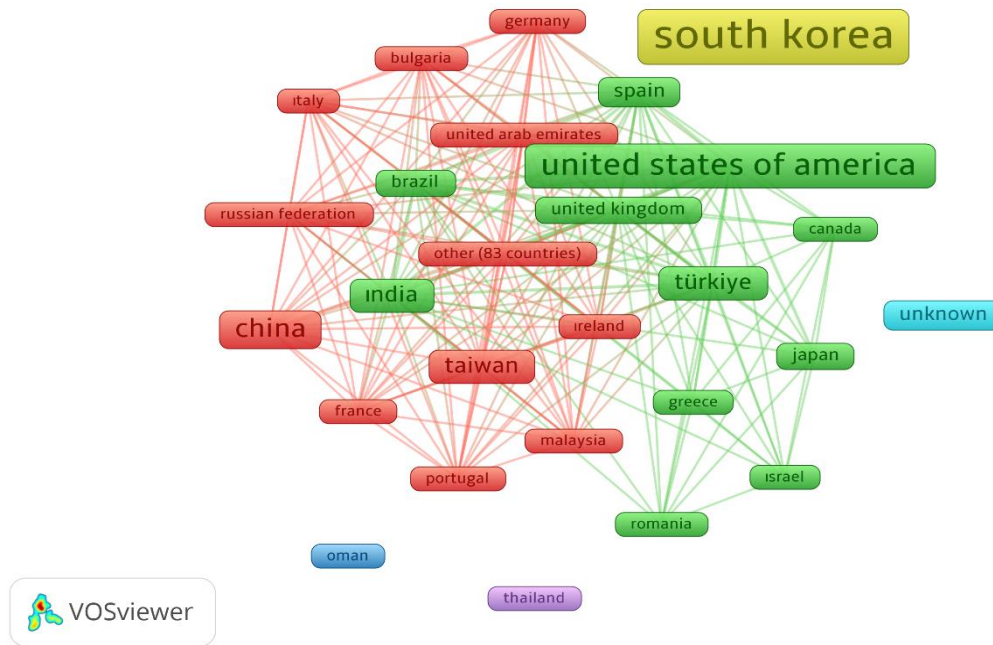
3.3. Methodology of Studies

According to Table 3, different or similar data collection methods, sample sizes and data analysis techniques were used in the 38 selected studies. Survey was used in 35 studies among 38 studies. There are more studies with a sample size greater than 384. Additionally, in most of the studies, Structural Equation Modeling (SEM) was performed.

Table 3: Methodology of Studies

Methodology	Documents	Link Strength
Survey	35	89
Structural Equation Modeling (SEM)	31	77
Sample size > 384	23	59
Sample size < 384	15	36
Video-based scenario	14	44
Regression analysis	4	12
Covariance analysis (ANCOVA)	3	8
Analysis of variance	2	7
Process Macro	2	5
Image-based scenario	1	3
Image, audio and text-based scenario	1	2
Text and image-based scenario	1	2
Online experiment	1	2

Looking at Table 3, it can be seen that the link strengths of "survey", "Structural Equation Modeling (SEM)", "Sample size > 384" and "Video-based scenario" are high. Figure 3 provides a visual of the links between data collection method, sample size, and analysis technique in the context of the methodology used in 38 studies. According to Figure 3, there are links between "Survey" and "Structural Equation Modeling (SEM)" as well as their other data collection methods and analysis techniques. Considering the link strengths, it is possible to say that more than one data collection method and more than one data analysis technique were

used simultaneously in similar studies. It should also be known that different data collection tools for different sample sizes and different analysis techniques for the data obtained are used separately or simultaneously.

Figure 3: Co-Occurrences for the Methodology of Studies
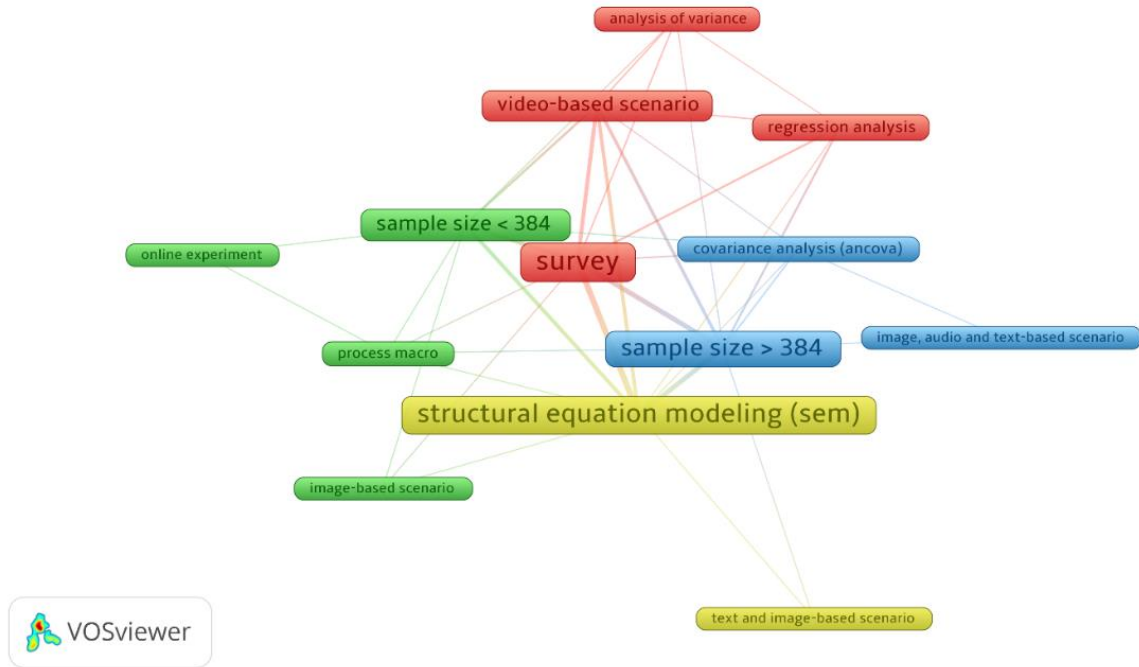
3.4. Theories/Models Included in the Studies

Table 4 shows that 13 of the 38 studies selected for this study used the Technology Acceptance Model in their theoretical background. On the other hand, "Theory of Planned Behavior" was used to write the theoretical background of 5 studies, while "Innovation Diffusion Theory" and "Uncanny Valley Theory" were used to write the theoretical background of 4 studies.

Table 4: Theories/Models Included in the Studies

Theories/Models	Documents	Link Strength
Technology Acceptance Model	13	8
Theory of Planned Behavior	5	6
Innovation Diffusion Theory	4	7
Uncanny Valley Theory	4	6
Cognitive Appraisal Theory	2	4
Motivational Theory	2	4
Risk Theory	2	3
Theory of Reasoned Action	2	4
AIDA Model	1	2
AIDUA Theory	1	3
Appraisal Theory	1	1
Behavioural Reasoning Theory	1	0
Circular Theory	1	2
Computers As Social Actors Theory	1	0
Expectancy Theory	1	0
Job Complementarity Theory	1	2
Job Demands Theory	1	2
Person–Context İnteraction Theory	1	2
Product Level Theory	1	0

Protection Motivation Theory	1	2
Role Congruity Theory	1	0
Role Theory	1	0
Self-Determination Theory	1	2
Stimulus-Organism-Response Theory	1	0
Theory of Consumption Values	1	0
Theory of Word of Mouth	1	0
Trait Theory	1	2
Transmission Model	1	0
Unified Theory	1	1
UTAUT	1	1
Value-Based Adoption Model	1	0

According to Table 4, while 11 theories/models used in the studies do not have link strength, the Technology Acceptance Model has the highest link strength among 31 theories/models. Figure 4 presents co-occurrences (clusters) for theories/models. In Figure 4, it can be seen that many theories/models have a link with the Technology Acceptance Model. While "the Theory of Planned Behavior" has a link to "the Technology Acceptance Model", many theories/models have a link to "the Theory of Planned Behavior". This indicates that many theories/models are used simultaneously to write the theoretical infrastructure of similar studies.

Figure 4: Co-Occurrences for Theories/Models Included in the Studies
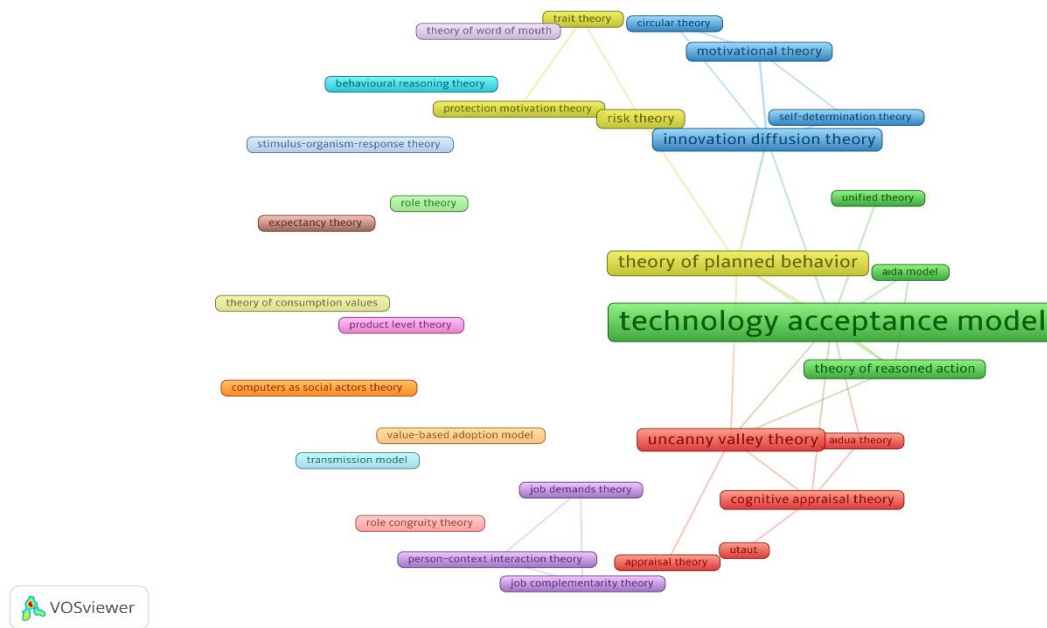
3.5. Variables Evaluated in Studies

Table 5 presents the results for 120 variables evaluated by the studies as a result of the content review of 38 studies. The first 4 variables evaluated in the most studies, respectively, are as follows: Attitude (documents = 18), intention to use (documents = 13), innovativeness (documents = 10), and anthropomorphism (documents = 6). However, among 120 variables, only 43 variables were evaluated in more than one study, while 77 variables were evaluated in only a single study.

Table 5: Variables Evaluated in Studies

Variables	Documents	Link Strength	Variables	Documents	Link Strength
Attitude	18	106	Core product	1	13
Intention to use	13	67	Credibility	1	10

Innovativeness	10	58	Culture	1	14
Anthropomorphism	9	66	Customer value	1	5
Ease of use	8	63	Emotional demands	1	13
Usefulness	8	64	Emotions	1	4
Gender	7	68	Engagement	1	3
Risk	7	52	Entertainment	1	13
Willingness to pay more	6	41	Experience novelty	1	9
Willingness to use	6	35	Extension	1	9
WOM	6	29	Facilitating product	1	13
Age	5	45	Familiarity	1	5
Hedonism	5	30	Food quality	1	5
Trust	5	31	Frequency of dining	1	13
Value	5	32	Functionality	1	5
Desire	4	17	Health risk	1	12
Enjoyment	4	38	Humanlike language	1	10
Income	4	39	Humanlike physical appearance	1	10
Satisfaction	4	27	Humanlike voice	1	10
Quality	4	28	Inspiration	1	3
Competence	3	15	Intention to recommend	1	7
Education	3	38	Interactivity	1	6
Effort expectancy	3	18	Interest	1	6
Intelligence	3	36	Mysophobia	1	5
Safety	3	30	Need for interaction	1	6
Acceptance	2	9	Need for physical distancing	1	5
Animacy	2	23	Newness	1	5
Coolness	2	9	Novelty	1	3
Generation	2	15	Novelty seeking	1	9
Image	2	7	Number of contacts	1	13
Interaction quality	2	12	Openess to change	1	6
Job	2	26	Performance efficacy	1	5
Likeability	2	23	Personality	1	13
Marital status	2	25	Personality traits	1	12
Objection to use	2	14	Product involvement	1	5
Performance expectancy	2	13	Product knwoledge	1	3
Positive emotion	2	17	Purchase behaviour	1	2
Revisit intention	2	19	Purchase intention	1	2
Robot advantage	2	17	Reliability	1	5
Robot disadvantage	2	17	Re-patronage intention	1	14
Service evaluation	2	13	Robot-human rapport	1	5
Technology readiness	2	26	Robot waiters	1	9
Utilitarian	2	11	Role congruity	1	3
Acceptance intention	1	6	Self-protective behavior	1	12
Anxiety	1	14	Speed of service	1	9
Approach behaviour	1	4	Service failure	1	3
Appropriateness	1	5	Service recovery	1	3
Attention	1	6	Servicescape	1	6
Attractiveness	1	9	Social curiosity	1	13
Augmented product	1	13	Social image	1	14
Benefit	1	9	Social influence	1	7
Brand atachment	1	4	Subjective norms	1	14
Brand attitude	1	4	Support	1	6
Brand experience	1	4	Task interdependence	1	3
Brand love	1	5	Threat	1	3
Brand loyalty	1	4	Types of employee	1	5
Brand modernity	1	5	Warmth	1	5
Brand satisfaction	1	4	Willingness to work	1	13
Co-creation intention	1	3	Working duration	1	13
Compatibility	1	5	Voluntariness	1	14

According to Table 5, it is the attitude variable that has the highest link strength with other variables. The link strength of the intention to use variable with other variables is greater than the link strength of the anthropomorphism variable with other variables. However, although the anthropomorphism variable has been evaluated in fewer studies than the innovativeness variable, its link strength with other variables is greater. In other words, the anthropomorphism variable was evaluated simultaneously with more variables. Figure 5 shows the co-occurrence (clustering) visual of variables according to link strength.

Figure 5: Co-Occurrences for Variables Evaluated in Studies

CONCLUSION AND DISCUSSION

It is possible to say that a life dominated by vending machines is becoming more and more common. From cars to small household appliances, products that work without human intervention or can work with very little intervention have been produced. Products that make human life easier, such as driverless cars, smart homes, and robot vacuum cleaners, have effects on consumers in many different ways. One of these products is service robots. Service robots are increasingly used. In parallel with the use of these robots in different service sectors, there has been interest and curiosity about how these robots affect consumers, especially in the marketing literature, and many articles have been written on this subject. In this study, some studies written in the literature were discussed and a bibliometric analysis was carried out in terms of the years in which these studies were published, the countries in which they were conducted, the methodology of the studies, the models/theories and the variables used in the studies.

According to the findings obtained as a result of the analysis, studies on service robots were carried out between 2018 and 2023. While the least amount of work was done in 2018, the most work was done in 2023. When this article was written, 2023 was not yet over. Therefore, it is highly likely that more articles will be written in 2023. Accordingly, the tendency to increasingly use service robots in service sectors is also observed in the literature. Therefore, it can be said that the importance given to this issue in the literature has increased. From this perspective, it is estimated that many more studies will be conducted on this subject in the future and the results obtained in this study will provide predictions for future studies.

Looking at the countries where studies were conducted, the most studies were conducted in South Korea with 12 studies. The country where the second most studies were conducted was the United States, with 8 studies, and the third most studies were China, with 6 studies. Considering that South Korea, the United States and China are quite strong in technological terms (Santarelli et al., 2023), it is natural that most studies on new technologies such as service robots are in these countries. It is not surprising that most of the studies came from South Korea. Because in South Korea, drone delivery (Hwang et al., 2023; Hwang et al., 2019; Kim et al., 2021b; Kim and Hwang, 2020) and metaverse (Hwang and Koo, 2023; Sun et al., 2023; Park and Kim,

2023) there are many studies on new technologies such as. Although most study is done in South Korea, this country's link strength is zero. Although there is only one study in Russia, the link strength of this country is 17. While studies conducted in South Korea collected data only from South Koreans. In the study conducted in Russia, data was collected from many different countries. It is thought that this result arises due to cultural factors.

Looking at the methodologies of the studies, surveys were used as data collection tools in 35 studies (or documents). Because surveys are very powerful instruments in understanding consumer attitudes. Structural Equation Modeling was used as analysis method in 31 studies. Structural Equation Modeling is one of the most powerful and favorite methods used by researchers if the variables are appropriate. In most of the studies, a survey was conducted after video, image and text-based scenarios were shown to the participants. Considering that not everyone has encountered service robots yet, it is thought that conducting a survey after showing the scenarios to people is a very appropriate method. Based on the prediction that service robots will be seen more by people in the future, studies can be conducted in the future without the need for this method, by only filling out surveys.

Looking at the models/theories used in the studies, the most used model is the Technology Acceptance Model with 13 studies. In these studies, where attitudes or behaviors towards a new technology are investigated, it is quite logical to understand whether people accept or reject this technology. When looking at the link strength, it was understood that the Technology Acceptance Model was linked to 8 models. It is understood that some of the researchers use only the technology acceptance model, while others use different models/theories such as "the Theory of Planned Behavior", "Innovation Diffusion Theory", "Theory of Reasoned Action" together with the technology acceptance model. The use of the theory of planned behavior, which tries to explain people's attitudes and subjective norms towards service robots that they will encounter in the future, together with the technology acceptance model, is thought to have contributed to the literature and the business world in terms of both whether the technology will be accepted or not and in terms of predicting behaviors towards this technology.

Looking at the variables used, it is seen that attitude is the highest with 18, intention to use is the second highest with 13, and innovativeness is the third highest with 10. How other variables affect attitude and/or intention to use has been extensively researched. Because when looking at the link strength, it is understood that the attitude is 106 and the intention to use is 67. Understanding attitudes and intentions towards a new technology are important variables in predicting how behaviors towards this technology will be in the future. Therefore, it has been appropriate to use these variables the most in studies on service robots. In addition, the fact that the most used models or theories in the studies include these variables makes it understandable why these variables are used the most in studies.

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