T.C.

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İNGİLİZCE İŞLETME ANABİLİM DALI

PAZARLAMA (İNGİLİZCE) BİLİM DALI

BRAND IMAGE AND PERCEIVED VALUE IN TECHNOLOGY ACCEPTANCE: EMPIRICAL RESEARCH ON ROBOTIC VACUUM CLEANERS

Master's Thesis

EBRU GÜNEY

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Sensitivity: Public

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Advisor: Prof.Dr. TAŞKIN DİRSEHAN

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To my dear Mom, today, as I write these words, I am filled with a mixture of joy and sorrow. Joy, because I have completed my thesis study, a milestone in my academic journey that I wish I could share with you. Sorrow, because you are no longer here with us, physically, to witness this momentous achievement. Words cannot express the gratitude and love I have for you, dear mother. You were not just my parent, but also my guide, my inspiration, and my greatest supporter. Your love and guidance will forever be a part of me, guiding me through the ups and downs that lie ahead. I dedicate my thesis study to you as a token of my gratitude and a testament to the values you instilled in me. Thank you, for everything you have done for me. I am forever grateful for your love, your wisdom, and your unwavering support. This thesis study is not just a personal achievement; it is a tribute to you and the profound influence you had on my life. With all my love and gratitude…

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EBRU GÜNEY

Istanbul, 2023

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TEKNOLOJİ KABULÜNDE MARKA IMAJI VE ALGILANAN DEĞER: ROBOT SÜPÜRGELER ÜZERİNE AMPİRİK ARAŞTIRMA

ÖZET

Bu tez çalışması Robot Süpürge kullanım niyetini etkileyen değişkenleri Teknoloji Kabul ve Kullanımı Birleştirilmiş Modeli-2 (UTAUT2) (Venkatesh V. , Morris, Davis, & Davis, 2003) *ve Uyarıcı-Organizma-Tepki Modeli (SOR)* (Houston & Rothschild, 1977) *kapsamında incelemektir. Marka imajı, bir uyarıcı olarak belirlenmiş, algılanan değer ve algılanan fayda ile algılanan risk organizma olarak belirlenmiştir. Kotler (2001), marka imajını "bir kişinin bir nesne hakkında sahip olduğu izlenimler, inançlar ve fikirlerin bir kümesi" olarak tanımlarken (s. 273), Hsieh, Pan ve Setiono (2004), "başarılı bir marka imajının tüketicilere markanın karşıladığı ihtiyaçları tanımalarına ve markayı rakiplerinden ayırmalarına izin verdiğini ve tüketicilerin markayı satın alma olasılığını artırdığını" açıklar (s. 252). SOR modeline göre kullanım niyeti de Yanıt altında değerlendirilmiştir. Çalışmanın sonucunda, marka imajının ve algılanan değerin (algılanan risk ve algılanan fayda) robot süpürge teknolojisini kullanma niyetindeki etkisinin gösterilmesi amaçlanmaktadır.*

ANAHTAR KELİMELER

Robot Süpürge, Marka İmajı, Algılanan Değer, Sürdürülebilirlik, Nesnelerin İnterneti (IoT), Teknoloji Kabul Modeli (TAM), UTAUT (Teknoloji Kabul ve Kullanım Birleşik Teorisi), UTAUT2 (Teknoloji Kabul ve Kullanım Birleşik Teorisi 2), Uyarıcı-Organizma-Tepki (S-O-R) paradigması, Akıllı Ev Cihazları, Marka Sinyali

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BRAND IMAGE AND PERCEIVED VALUE IN TECHNOLOGY ACCEPTANCE:

EMPIRICAL RESEARCH ON ROBOTIC VACUUM CLEANERS

ABSTRACT

In this thesis study, the purpose is to investigate the determinants that affect the intention of using RVC (Robotic Vacuum Cleaner) within the context of UTAUT2 (Unified Theory of Acceptance and Use Technology) Venkatesh et al. (2012) which is an extension of the original model Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh *et al., 2003) and Stimulus Organism Response Model (SOR) developed by Houston and Rothschild (1977). Brand image as a signaling has been determined as stimulus, perceived value which includes perceived benefit and perceived risk have been determined under organism. Kotler (2001) defines the brand image as "the set of impressions, beliefs and ideas that a person holds about an object" (p. 273) while Hsieh, Pan and Setiono (2004) explain as "a successful brand image allows consumers to recognize the needs that the brand satisfies and to distinguish the brand from its competitors and increases the probability that consumers will purchase the brand" (p. 252). Intention to use which is being evaluated under Response in SOR model. As a result of the study, it is aimed to show the effects of brand image and perceived value that includes perceived benefit and perceived risks on the field of financial and performance on the intention to accept RVC (Robotic Vacuum Cleaner) technology.*

KEY WORDS

Robotic Vacuum Cleaner, Brand Image, Perceived Value, Sustainability, Internet of Things (IOT), Technology Acceptance Model (TAM), UTAUT (Unified Theory of Acceptance and Use Technology, UTAUT2 (Unified Theory of Acceptance and Use Technology 2), Stimulus- Organism- Response (S-O-R) paradigm, Smart Home Appliances, Brand Signaling

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CONTENTS

LIST of TABLES iv
LIST of FIGURES v
INTRODUCTION 1
1. LITERATURE REVİEW 3
1.1. Internet of Things (IOT) 3
1.2. The Concept of Smart Home 5
1.3. Smart Home Appliances 6
1.4. The History of Robotic Vacuum Cleaner (RVC) 7
1.5. Robotic Vacuum Cleaner Global Market Size 8
1.6. Robotic Vacuum Cleaner (RVC) Technologies 9
1.7. Advantages and Disadvantages of RVCs 12
2. THEORETICAL FRAMEWORK 14
2.1. Technology Adaptation Models and Theories 14
2.1.1 Theory of Diffusion of Innovations (DIT) 15
2.1.2. The Theory of Task-technology fit (TTF) 17
2.1.3. The Theory of Reasonable Action (TRA) 17
2.1.4. Theory of Planned Behavior (TPB) 18
2.1.5. Decomposed Theory of Planned Behavior 19
2.1.6. The Technology Acceptance Model (TAM) 20
2.1.7. Final version of Technology Acceptance Model (TAM) 21
2.1.8. Technology Acceptance Model 2 (TAM2) 21
2.1.9. Unified Theory of Acceptance and Use Technology (UTAUT) 23
2.4. Stimulus-Organism-Response (S-O-R) Paradigm 28
2.5. Developing the Research Model 30
2.5.2. Brand Image 31
2.5.3. Perceived Value 33
2.5.3.1. Perceived Benefit 34
2.5.3.1.1. Performance Expectancy 35
2.5.3.1.2. Effort Expectancy 36
2.5.3.1.3. Hedonic Motivation 37
2.5.3.1.4. Time Saving 37
2.5.3.1.5. Energy Saving 38
2.5.3.1.6. Sustainability 41

Sensitivity: Public

2.5.4. Perceived Risks 42
2.5.4.1. Performance and Financial Risks 43
2.5.5. Intention to Use 45
3. RESEARCH MODEL DEVELOPMENT 45
3.1. Research Purpose and Objectives 45
3.2. Research Method 46
3.3. Research Model Development 47
3.4. Hypothesis of the Study 49
3.5. Variables of the Study 50
3.6. Sampling Design 52
3.6.1. Target Population 52
3.6.2. Sampling Technique 52
3.6.3. Sampling Size 52
3.7. Data Collection Method 53
3.8. Data Analysis Method 53
4. RESEARCH FINDINGS 53
4.1. Non-Response Bias Test 54
4.2. Descriptive Analysis of Respondents 54
4.2.1. Demographic and Socioeconomic Characteristics 54
4.2.2. Vacuum Cleaner Usage Habits of the Sample Group 55
4.2.3. Awareness about Robotic Vacuum Cleaner of the Sample Group 56
4.2.4. Special Reasons to Desire Using Robotic Vacuum Cleaner 57
4.3. Analysis of the Constructs 57
4.3.1. Normal Distribution Test 57
4.3.2. Multicollinearity Test 59
4.3.3. Construct Reliability and Convergent Validity of the Constructs 60
4.3.4. The Model's Goodness of Fit 64
4.3.5. Analysis of The Structural Model 65
5. DISCUSSION 69
5.1. Evaluation of The Proposed Model and Revised Model 69
5.2. Brand Image and Perceived Value 73
5.3. Sustainability 74
6. CONCLUSION 74
6.1. Academical Indications and Further Research Directions 74
6.2. Managerial Implications 75
6.3. Research Limitations 77

Sensitivity: Public

7. **REFERENCES** **78**

8. **APPENDIXES** **89**

LIST OF TABLE

Table 1. Chronological List of Proposed Theories.....15

Table 2. Examples of TAMs and UTAUTs in Literature by Time.....16

Table 3. Examples of Conducted on the Subject of Robotic Vacuum Cleaners in Literature by Time 27

Table 4. Examples of TAM in SOR Usage in Literature by Time..... 30

Table 5. List of Hypotheses.....49

Table 6. List of Measured Items.....51

Table 7. Sample's Demographic and Socioeconomic Characteristics.....54

Table 8. Frequency of Vacuuming the House of the Sample Group.....55

Table 9. Types of Vacuum Cleaner Currently Used.....55

Table 10. Number of Respondents Considering the Using Robotic Vacuum Cleaner.....56

Table 11. Knowledgeable Level of the Respondents about the Robotic Vacuum Cleaners.....57

Table 12. Findings of the Normal Distribution Test.....58

Table 13. The Values of VIF.....60

Table 14. Evaluation of scales for reliability and convergent validity.....61

Table 15. Evaluation of correlation matrix and discriminant validity (HTMT).....63

Table 16. Evaluation of correlation matrix and discriminant validity.....63

Table 17. Factor Loading of Variables.....64

Table 18. Total Model Fit Results.....65

Table 19. Structural Model Results.....66

Table 20. Total and Indirect Effects.....68

Table 21. R Square Results.....69

Table 22. Summary of Hypothesis Following the Measurement.....69

Table 23. Research Examples from Literature Regarding Brand Image, Perceived Risks and Perceived Benefit.....72

Sensitivity: Public

LIST OF FIGURES

Figure 1:	Roomba Discovery.....	2
Figure 2:	Worldwide RVC Market Revenue Source: Statista,2022.....	9
Figure 3:	The Main Part of RVC.....	9
Figure 4:	Development of RVC Navigation Technologies RVC Navigation Technologies....	11
Figure 5:	RVC Navigation Technologies.....	11
Figure 6:	Multipartite Evaluation System Study to recommend the most suitable Robot.....	14
Figure 7:	Adaption Innovation Curve	16
Figure 8:	Diffusion of Innovation Model.....	16
Figure 9:	Task-technology fit.....	17
Figure 10:	The Theory of Reasonable Action (TRA)	18
Figure 11:	Theory of Planned Behavior (TPB)….....	18
Figure 12:	Decomposed Theory of Planned Behavior (Decomposed TPB)	19
Figure 13:	Original Technology Acceptance Model.....	20
Figure 14:	First modified version of Technology Acceptance Model (TAM).....	21
Figure 15:	Final version of Technology Acceptance Model (TAM).....	21
Figure 16	Technology Acceptance Model (TAM 2)	22
Figure 17:	Unified Theory of Acceptance and Use Technology.....	23
Figure 18:	Unified Theory of Acceptance and Use Technology (UTAUT2)	24
Figure 19:	Technology Acceptance Model (TAM 3) …….....	25
Figure 20:	The Classification of Marketing Research Designs.....	47
Figure 21:	Proposed research Model….....	48
Figure 22:	Consideration of the Using Robotic Vacuum Cleaners.....	56
Figure 23:	Revised research Model.....	70

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INTRODUCTION

Technology, a primary driver of swift societal and marketing transformations, undergoes continuous evolution. The significance and adoption of technological tools continue to expand steadily. The most prominent manifestation of these changes is the widespread presence of robots, evident across various domains, spanning industry, healthcare, households, offices, and personal applications. Recent years have witnessed a notable consumer preference for robotic products across diverse sectors. Robots play an important role in many aspects of our lives in today's rapidly evolving technology. Robots are now being used in the industrial sector, the health sector, the agricultural sector, and even in our homes. Robots replace workers on assembly lines in the industrial sector, providing speed and accuracy in mass production. At the same time, it protects worker health and safety by performing dangerous and difficult tasks. Robots are used in both the construction and industrial sectors. In the construction industry, robots perform tasks such as pouring concrete, transporting building materials, and welding operations, reducing worker fatigue and reducing workplace accidents. In the medical field, robots can be used on operating tables to perform more precise surgical procedures. Surgical procedures become less invasive as a result, and patients' recovery times are shortened. Furthermore, wheelchair-accessible robots make life easier for people with disabilities. Robots are used in agricultural processes such as tillage, planting, and irrigation. It alleviates the exhausting work of agricultural workers while increasing productivity. Furthermore, robots can monitor plant growth and perform necessary maintenance, ensuring that plants grow healthier. Cleaning robots are used in our homes to assist us with housework. It is also used to manage our homes when combined with smart home systems. Robot vacuums, for example, that can be controlled by smart home systems, assist homeowners in keeping their homes clean and increasing the hygiene level of their homes. As a result, robots play an important role in today's technology. The applications of robots are expanding all the time as technology advances. People's lives become easier and more efficient as a result.

The use of service robots in the home has been on the rise in recent years. These robots can be used for entertainment, or for more specific and specialized services. Studies have shown that these smart technologies are replacing traditional products and tools, leading to a greater number of robots in the home. Furthermore, the home environment is now being impacted by these new technologies in a variety of ways. What is more important is that these factors stand out due to their tendency to change quickly as a result of mutual interaction. As a result, these new smart technologies, including service robots, act as catalysts for these variable factors in the home environment. Taking into account the various variables in the decision-making process of buying a robotic vacuum cleaner will be the focus of this study.

With the significant developments in technology, there is a great change in the tools and equipment we use to do our housework. There are some products have been observed in home appliances industry,

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one of these products is vacuum technology such as bagless, rechargeable and cordless handstick vacuum cleaners and additionally Robotic Vacuum Cleaners (RVCs) which are currently one of the most enlarging products. Robot vacuums are small-sized automatic devices designed to vacuum our homes. It is mostly called as RoboVac, it can be used by mobile applications, via app user can start and get information about process. All subcategories in this category provides different kind of benefits to the users. While consumers find it difficult to find time to spare for house cleaning in the fast pace of city life, robot vacuum cleaners that make life easier provide an effective solution to this problem by sweeping the whole house. These devices can reach every corner of the house and, thanks to their programmable features, allow people to save time and take care of other work while RVC is vacuuming the house. For the certain reasons, robot vacuum cleaner technology has attracted great interest in recent years. The biggest reason for this interest is that people want to save time, since people who have a busy business life cannot spare time to do their housework. Robot vacuums provide them with great convenience in their housework, makes people's lives easier in house cleaning and saves time and energy during housework.

While RVC attracts increasing attentions day by day, the market size shows the remarkable growth. According to the report has been published by Statista, while the worldwide vacuum cleaner market will be around 60 billion US dollars in 2023 and annually 4,4% growth is being expected till 2028. On the other hand, total market size in Turkiye will be around 0,65 billion US dollars in 2023 and annually 8,91% growth is being expected till 2028 (Statista, 2023).

With this regard, sales numbers show that RVCs started to become one of the indispensable things for people living in cities. The global market in 2014 was 0,9 billion USD and raised up to 4,48 billion US dollars in 2021 (Statista, 2022). People started to see their robotic vacuum cleaners as the member of their families, it allows them to spend much more time with their loved ones and for their social activities. According to research made by Georgia Institute of Technology, when asked to research participants who totally 30 people and have at least one RVC at their home "What does Roomba[1](shown in figure1) mean to you", they received answers are like following; "a helpful assistant", "a pet-like being" and "a valuable family member". Research shows that people are acting like an advocator and suggest it to everyone, some remarkable comments are like; "I can't imagine not having him any longer. He's my BABY!!...When I write emails about him which I've done that as well, I just like him, I call him Roomba baby…He's a sweetie." They underlined how the robot is time and energy saver and helps them become tidy, they found life-like association to engage with their robot, and always promote it to others (Guo, Grinter, Christensen, & Sung, 2007). The straight and important



Figure 1: Roomba Discovery™

[1] Roomba is the one of iRobot's models. iRobot Corporation is American company that is leading global consumer robot industry.

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relationship between hedonic motivation and behavioral intention have been shown in the different research studies and hedonic motivation has been considered as one of the best determinants of the model (Kasaj & Xhindi, 2016).

The main expected tasks from the robotic vacuum cleaners are cleaning, removing dust, pet hair, bread crumps and other dirt types, cleaning all floor types such as hard floors and carpets, cleaning tricky spots at home such as corners and under the sofas. In addition, it should be able to clean the place the robot needs to be compatible with the environment: strong navigation abilities and effective recognition and overcoming of the obstacles.

LITERATURE REVİEW

1.1. Internet of Things (IOT)

Internet of Thing expression was found by Kevin Ashton in 1999 in Massachusetts Institute of Technology (MIT) (Kramp, Kranenburg, & Lange, 2013). "The term Internet of things (IoT) is used to describe embedded devices (things) with Internet connectivity, allowing them to interact with each other, services and people on a global scale. This level of connectivity can increase reliability, sustainability, and efficiency by improved access to information. Environmental monitoring, home and building automation and smart grids could be interconnected, allowing information to be shared between systems that affect each other (Mukhopadhyay, 2014, p. 1)." It is a combination of internet connectivity, electronics, and other forms of hardware. IoT is about enlarging the network power among electronic products like computers, smartphones and the any devices has internet in the processes and environments. Those devices collect the data and information and share it each other. IOT enables people and business to stay more connected to the world and to be more efficient and high level of businesses. Since we are living in very competitive world, IOT based devices are being used very often. Connection between devices creates more opportunities in the many areas such as smart agriculture, automotive industry, industry, transportation, smart cities, retail, smart homes, smart energy/grid, e-health, healthcare, and marketing (Kramp, Kranenburg, & Lange, 2013). Addition to IOT, Industrial Internet has been firstly used by GE (General Electric). It is very significant to distinguish usage purposes like end user & consumer based or, trading, and industrial manners of the Internet from the wider horizontal theme of IOT, since there are many distinctive target groups, differentiated needs and necessaries, and strategies (Gilchrist,2016, p.1). Apart from industries and businesses, there are some product groups has important visibility in the daily life among people which is called as Consumer IOT such as smart wearable products like smart watches which enable people to track fitness activity or daily movements, personalized devices which connected with smart home or cars (Gilchrist,2016, p.15). Advantages of IOT in business can be listed as improved physical safety, security, cloud services, more efficient and agile process management, increase business opportunities, cost & time saving, enhanced

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asset utilization, sustainable competitive advantage, and increased productivity (Đurđević, Labus, Bogdanović, & Zrakić, 2016).

According to Statista report published in July,2022, the total number of Internet of Things (IoT) connected devices globally is expected to achieve 29.4 billion units by 2030, there is projected remarkable increase from 2021 that was ended up at 11.3 billion units. According to the report, it is anticipated that by 2030, the Greater China area will have the most Internet of Things (IoT) connected devices, with an estimated 8.6 billion. Europe and North America are also expected to have a high number of IoT devices. With the fast improvement and reliable networks, such as with comprehensive development of 5G, expedites the pace with which IoT spread happens. This development enables many devices to become connected and the forecast show that the trend will continue in both consumer and commercial areas (Vailshery, 2021). The Internet of Things (IoT) is a rapidly growing technology that is transforming the way people interact with the physical world. It is a network of physical objects, such as sensors, connected to the Internet, which can collect and exchange data. IoT has the potential to revolutionize the way we live, work, and play, by providing us with unprecedented access to data and insights about our environment.

When looking at the literature, it has been seen that there are many researches conducted about usage IOT and also usage IOT in smart homes. Here are below some examples from those; The Internet of Things: A survey" has been provided by Luigi Atzori, Antonio Iera, and Giacomo Morabito in (2010), it is quite comprehensive study of the IOT usage on many areas such as infrastructure, communication networks, and security that are all important considerations. Luigi Atzori, Antonio Iera. Raskar and Nema also conducted the study “A Review on the Internet of Things (IoT)” in (2019) , it delivers general info about the IOT usage areas, implementations and challenges by adapting on the acts of wireless sensor network and the purpose of this article is on the use of facilitating IoT technologies in the advancement of IOT systems and their integration in the smart city environment.. On the other hand, Yang, Bukkapatnam, Tsung, & Kumara delivered the study in (2019) as “Internet of Things (IoT)-based smart manufacturing: a review” which investigates the implementation of IOT in business involving the smart manufacturing, supply chain management and quality control. The article gives a summary of the Internet of Things (IoT) technologies and systems that serve as the drivers and foundations for data-driven innovations in smart manufacturing; while talking about how the internet evolved from computer networks to human networks to the current period of smart and connected networks of manufacturing things. Moreover, Ahmad and Zhang conducted the study “Using the Internet of Things in Smart Energy Systems and Networks” in (2021), they examined the main impacts of IOT usage in sustainability areas, they investigated the probable opportunities of IOT in the energy systems such as sustainable energy management, integration of renewable energy sources, and energy efficiency enhancement with the very comprehensive research. In the meantime, there are many examples of the articles which analyzed the IOT in smart home. For instance; “A Review of Smart Home Applications based on Internet of Things”

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was conducted by Alaa, Bahaa, Talal, & Zaidan (2017), they mainly completed the comprehensive literarue review from three well-known sources like Web of Science, ScienceDirect and IEE Explore, the focus was on the mainly IOT usage in smart home. Another example is "A smart home energy management system using IoT and big data analytics approach" conducted by Al-Ali, Zualkernan, Rashid, & Gupta (2017), because of the rising cost and electricity consumption, many organizations are seeking creative approaches to measure, regulate, and save energy. A smart Energy Management System (EMS) could really assist in lowering expenses while still satisfying energy requirements. The Internet of Things (IoT) and Big Data emerging technologies may be implemented to properly manage energy consumption in the housing, industrial, and manufacturing sectors. An Energy Management System (EMS) for home automation is discussed in this article. Third example would be "Design and Implementation of an IoT Based Home Automation" conducted by Islam, Mostafa, Arafat, & Farook (2019), This study examined the benefits of teh use of IOT in the home and recommend the usage of IOT in smart home which enables automation system that will help to lower the costs and provide user friendly operations.

1.2. The Concept of Smart Home

The one of the well-known definition of the smart home is "residence equipped with computing and information technology, which anticipates and responds to the needs of the occupants, working to promote their comfort, convenience, security and entertainment through the management of technology within the home and connections to the world beyond" (Aldrich, 2003, p. 17). There are various advantages and benefits have been discussed which smart home provide people in the research studies. The subject of smart homes has been increasingly discussed in the academic literature in recent years. These studies cover topics such as the design, technologies, use, safety, efficiency, and effects of smart homes. The term smart home is a term generally used for homes where various devices and systems of the home communicate with each other using internet and sensor technologies, increasing the management and functionality of the home. The smart home topic is explored in many fields such as architecture, engineering, computer science, psychology, sociology, and other disciplines. Most of these studies focus on making smart homes easier for homeowners, saving energy, and increasing the security of homes. According to a study conducted by the US Department of Energy, smart homes can reduce energy consumption by up to 50% (2021) . Another study has been delivered by the University of North Carolina at Charlotte found that smart homes can improve home security by alerting homeowners to potential threats and allowing them to take immediate action (Zhou, et al., 2016). The study conducted by Shuhaiber & Mashal (2019) would be also good example about the studies on the acceptance of smart homes, they used the TAM model in tehir study. A smart home is a residence that uses internet-connected devices to enable the remote monitoring and management of appliances and systems, such as lighting, heating, security, and entertainment. Smart homes are becoming increasingly popular as they

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offer convenience, energy efficiency, and improved security. This literature review examines the current state of smart home technology, its potential benefits, and the challenges associated with its implementation. For example, Marikyan, Papagiannidis, & Alamanos, (2021) made the study by using TAM examining the users' behavior changes on the adaption to technologies for their private areas, while Zhou, et al., (2016) examined smart home energy management systems. Wilson, Hargreaves, & Baldwin (2014) conducted a systematic analysis of smart homes and their users, identifying key challenges and opportunities.

According to published report by Statista, global market size in value was around 100 billion US dollars in 2021, while the most selling occurred in China and Far East with the 40% share in total. Moreover, there is an expectation for the number of smart homes market to reach 350 million mark by 2023 while it was 258,54 million in 2021. The most well-known market sector, with over 320 million units in use in 2020, is that of smart speakers. By 2024, the installed base's size is anticipated to have doubled. Other significant categories of the smart home industry include video entertainment systems like smart TVs, home security and monitoring systems, and smart appliances. Other goods that can be incorporated into smart home systems include smart thermostats, sensors, and intelligent lighting. These devices are employed to improve indoor comfort and manage energy usage. Big Tech Companies Dominate the Smart Home Market. Big tech companies such as Google, Amazon, and Apple have been instrumental in transforming the concept of smart homes into commonplace reality. This transformation has been largely due to their smart speaker products, which often serve as the main control hub for smart homes. These companies are also rapidly expanding their smart home product portfolio by offering smart doorbells, among other products. In fact, in the fourth quarter of 2020, Chinese vendors Xiaomi, Baidu, and Alibaba combined, accounted for almost one-third of the global smart speaker sales, highlighting the increasing dominance of these companies in the smart home market. Additionally, Amazon's Ring and Google's Nest were the leading smart doorbell brands in mid-2020, further reinforcing the industry dominance of these big tech companies (Statista, 2022).

1.3. Smart Home Appliances

Smart home appliances started to be popular as technology advances which are connected to the internet and can be controlled remotely, allowing users to control their home environment from anywhere. Smart home appliances can be used to automate tasks such as controlling lighting, temperature, and security systems. They can also be used to monitor energy usage and provide feedback to users. Due to their convenience and cost savings, smart home appliances can be used to reduce energy consumptions too. Smart sustainable home appliances are gaining popularity as people become more aware of the environmental impact of their energy consumption. Smart appliances are designed to reduce energy consumption and waste, while providing convenience and comfort. Smart appliances can be connected to the internet, allowing users to monitor and control their energy usage from anywhere.

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Smart appliances can also be programmed to run at optimal times, reducing energy costs and helping to reduce the environmental impact of energy consumption. Smart appliances can also be integrated with other smart home systems.

Major home appliances now need to be sustainable, and this importance has grown in recent years. The need for resources and energy is rising along with the global population, which is driving up the demand for sustainable solutions. Due to this, emphasis has been placed on the creation of energy-efficient appliances and the utilization of renewable energy sources.

Union has set ambitious targets for energy efficiency in major domestic appliances, such as refrigerators, washing machines, and dishwashers. Definitely, the robotic vacuum cleaners alter the standards for cleanliness in houses and the smart home sector pays close attention to practical ways to clean the house as Bill Gates who is the founder of Microsoft also initiated his vision as "a robot in every home" (2007). In parallel with this, according to Statista, IOT delivers smart solutions and services to home and kitchen worldwide. Since homes started to be more and more connected and smart, smart home appliances became the main driver of the growth in the sector. In recent years, the market for connected appliances developed at a compound annual growth rate of more than 40%, and it is anticipated that this trend will continue. Its expansion goes beyond simply conventional appliances and encompasses the rising demand for smart kitchen appliances. For instance, sales of vacuum robots have increased significantly (Statista, 2022).

1.4. The History of Robotic Vacuum Cleaners (RVC)

There are various types of robotic vacuum cleaners have been observed in the literature (Ulrich et al. 1997; Liu et al. 2011; Oh et al. 2002; Liu et al. 2011; Prabakaran et al. 2017; Adithya et al. 2019). Robotic vacuum cleaners have been around since the early 1990s. In the context of autonomous floor cleaning, one of the first applications had been seen in the chain stores early 1996 (Lawitzky, 2000). On the other hand, the world's first household version of robotic vacuum cleaner which was called as "Trilobite" has been developed by Electrolux2 in Sweden in 1996 to response the need of millions of housework haters, during that period even though there was no plans to produce immediately, the company foresee the needs and expect that robotic vacuum cleaner would be an ordinary things in homes all over the world in the near future (Electrolux, 1997). Karcher3 followed Electrolux and developed RoboCleaner in Germany in 1999 (Prassler, Ritter, Schaeffer, & Fiorini, 2000). Since then, robotic vacuum cleaners have become increasingly popular and advanced, with features such as mapping, navigation, and obstacle avoidance. Today, robotic vacuum cleaners are widely available and are used in both residential and commercial settings.

[2] "Electrolux is a leading global appliance company that has shaped living for the better for more than 100 years."
[3] "Kärcher is a family-owned company from Germany and global market leader in cleaning technology."

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Dyson4 has launched DC06 in December ,1999, however it could not be move to mass production due to huge cost (Gow, 1999). Probotics Inc.[5] in US has developed Cye in 1999. All of them has common problem as low durability and performance, that's why those models are no longer existing.

Until the late 1990s, there were models developed with low suction power, low durability and high cost. After that iRobot has launched its robot vacuum cleaner in 2002 and companies in the industry has started to launch similar kind of models. For example, Samsung launched the first model has mapping feature and sweeping the house systematically. Many brands like LG and Neato[6] followed the market trends and succeeded to produce models with reasonable prices like iRobot and Dyson (Hossen, et al., November,2019). In 2015, camera-based mapping models have been launched by Dyson and iRobot.

1.5. Robotic Vacuum Cleaner Global Market Size

According to the published in November 2022 by Statista, while the value of the global vacuum cleaner market is expected 60 billion US dollars in 2023, annual growth expectation is 4,40% (CAGR 2023-2028). In comparison to other countries, China is expected to generate the most revenue in 2023, with a total of 12,830 million US dollars. In term of units, 2022 market was 328.8 million units (2021 was 384,1 mil units) and it is expected to increase to 379.3 million units in 2027.

There is a huge growth expectation for Robotic vacuum cleaners. As observed during the pandemic in 2020-2022, sales of RVCs started to increase remarkably. According to report published by Statista in November 2022, by 2028, the global robotic vacuum cleaner market is projected to be worth 4.98 billion U.S. dollars, up from its value of 3.44 billion U.S. dollars in 2022. iRobot is the clear leader in the industry, controlling around 57 percent of the global market share in 2021 (Statista, 2022).

[4] "Dyson is a British technology company established in the United Kingdom."
[5] "Probotics Inc is a leading-edge robotics company that specializes in developing personal robots for home and office."
[6] "Neato Robotics is a robotics company located in San Jose, California and independent subsidiary of German appliance manufacturer Vorwerk."

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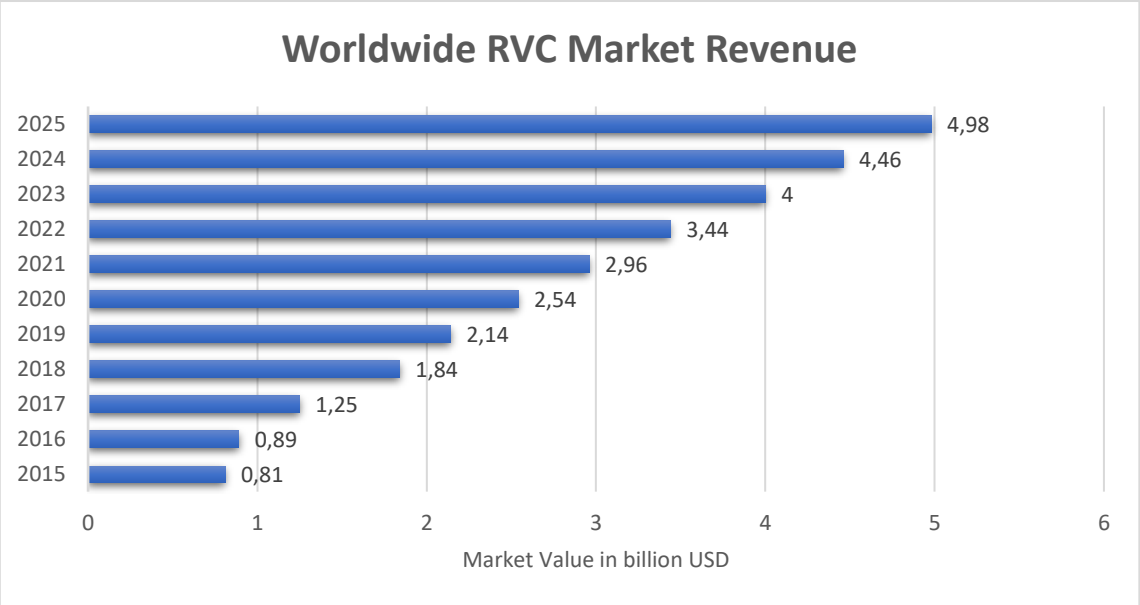


Figure 2: Worldwide RVC Market Revenue Source: Statista,2022

1.6. Robotic Vacuum Cleaner (RVC) Technologies

Robotic vacuum cleaners are a great example of robotic technology that can be used in the home. These devices are designed to clean all dirt and debris from flat surfaces without any human assistance. In recent years, there have been many improvements in robotic vacuum cleaner technology, making them more affordable and giving them more features. Nowadays, they are autonomous, remote-controlled, lightweight, and take up minimal space, among other features.

The main parts of the Robotic Vacuum Cleaners are (Figure3) (Asafa, Afonja, Olaniyan, & Alade, 2018):

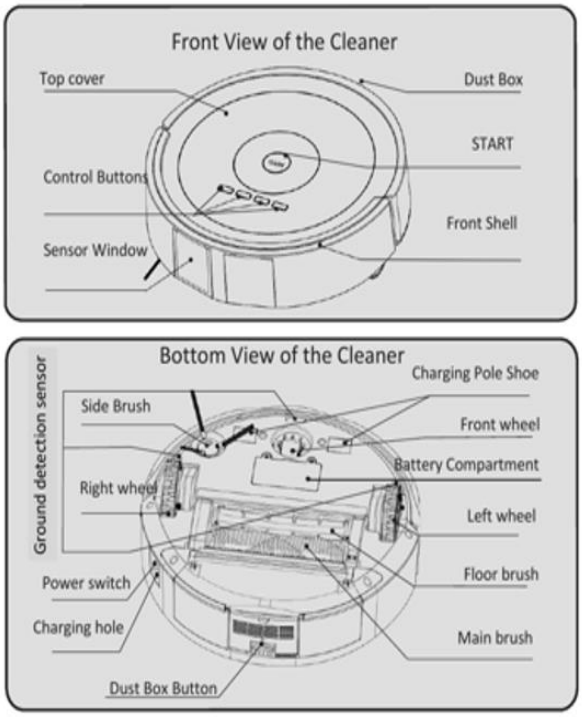


Figure 3: The Main Parts of RVC

- Container stores the dust
- Electrical system and battery
- Wheels drive the system
- Filters hold particles
- Cleaning system including floor brushes
- Control System: Sensors, microcontroller and Camera detect and scan the environment

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The improvements on navigation technology are directing the Robotic Vacuum Cleaner business. In the literature, there are many papers published and studies conducted about this topic such as Oh, Choi, Park, & Zheng provided the study which discusses an innovative methodology for cleaning robot navigation in an unfamiliar working area. To accomplish this, researchers suggest an alternative map simulation model as well as an entire coverage navigation technique (2004). Figure 4 summarizes the historical development of robotic vacuum cleaners' technologies; it mainly differs on the navigation strategies. It was initially doing random navigation and had scheduling and cleaning mode. Secondly, error reports and live mapping features have been added to Gyro-Slam (simultaneous localization and mapping) which depends on the stagnancy navigation technology, it uses the excellent gyroscope sensor and performs with the driving wheels, recoding the routes the robots have went through before, so it collected data, makes localization, navigation and motion control based on the collected data (Amicro, 2021). Ceiling Visual simultaneous localization and mapping (CV-SLAM) technique is using a single ceiling vision sensor. The algorithm is being proposed for the system that requires so high localization certainty such as an intelligent robot vacuum cleaner. A single camera looking upward direction (called ceiling vision system) is attached over the robot, and outstanding image features are detected and tracked through the image sequence, addition to previous version it has map saving and zone cleaning features (Jeong & Mu Lee, 2005). In laser-Slam (LDS - Laser Detect System) version, product has additional features like adding restricted areas, multi floor map, room name, merge and dividing etc. LDS models seems mostly suitable for the people interesting high technologies mostly such as creating mapping rules room by room etc. Last and most developed version is LDS with AI dynamic map algorithm solutions such as object recognition, detection of the floor, obstacle and drop/cliff.

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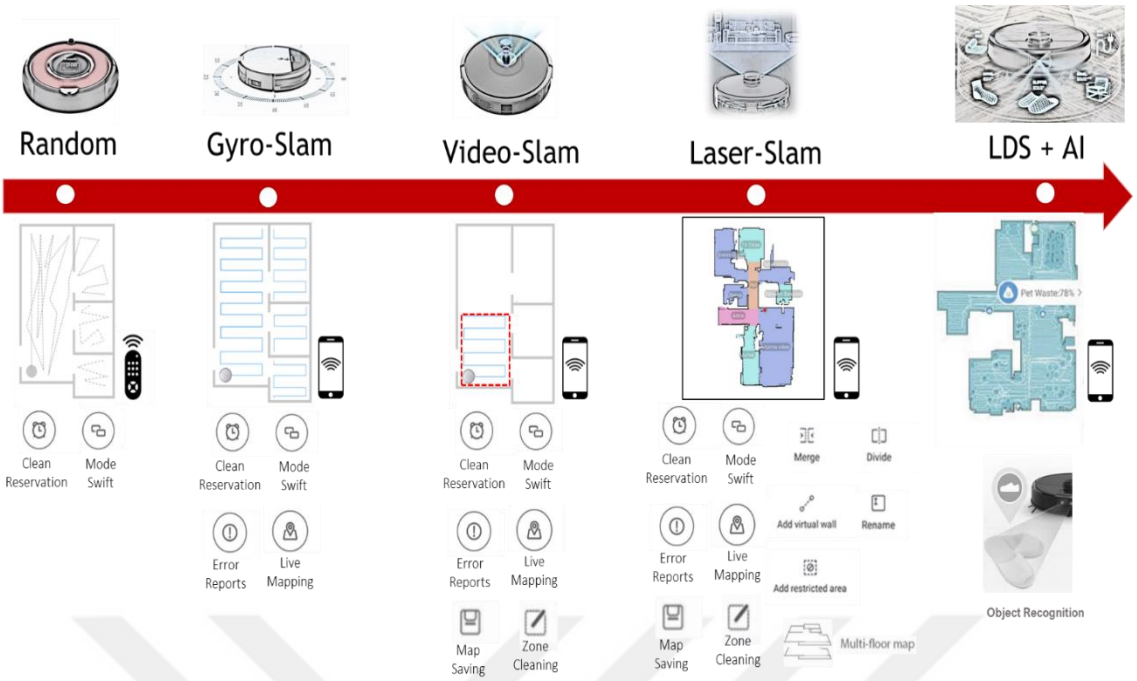


Figure 4: Development of RVC Navigation Technologies (Illustrated by researcher)

App Features	Navigation Method			
	Gyro	Gyro+Vslam	Laser Slam	LDS+ AI Cam
Mapping	✓	✓	✓	✓
Cleaning mode selection	✓	✓	✓	✓
Suction/Mop mode selection	✓	✓	✓	✓
Remote control	✓	✓	✓	✓
Clean reservation for all map	✓	✓	✓	✓
Save map	×	✓	✓	✓
Target zone cleaning	×	✓	✓	✓
Resume Cleaning	×	✓	✓	✓
Room name, divide, merge	×	×	✓	✓
Room Cleaning	×	×	✓	✓
Clean Reservation for selected room	×	×	✓	✓
No go area	×	×	✓	✓
Virtual Wall	×	×	✓	✓
Multi-floor/map	×	×	✓	✓
Object Detection	×	×	×	✓
Showing object on map	×	×	×	✓
Real time video rec.	×	×	×	✓
Real time voice transfer	×	×	×	✓

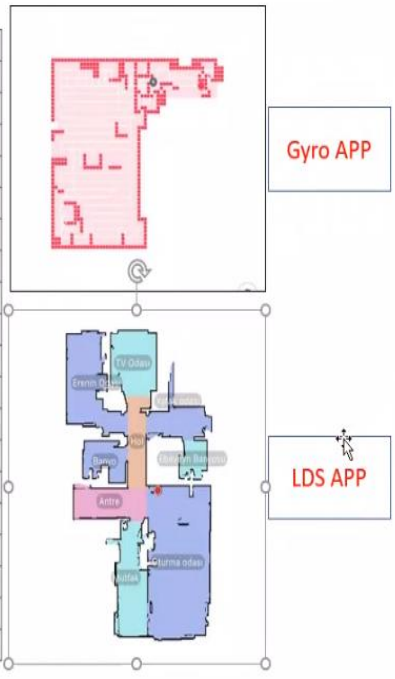


Figure 5: RVC Navigation Technologies (Prepared by researcher)

Figure 5 shows the main differentiation points between navigation methods. Gyro navigation method has following features; mapping, cleaning selection, suction /mop mode selection, remote control and clean reservation for all map while Gyro+Vslam (Visual simultaneous localization and mapping) has additional save map, target zone cleaning and resume cleaning features. Third method is Laser Slam (LDS) which has following features addition to Gyro+Vslam as room name, divide & merge,

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room cleaning, clean reservation for selected room, no go area, virtual wall and multi floor-map. The most innovative method is LDS+AI cam has following extra features to LDS as object detection, showing object on map, real time video record and real time video transfer.

1.7. Advantages and Disadvantages of RVCs

The main advantages of having robotic vacuum cleaners are as following. Sweeping is always seen as time consuming by people and buying robotic vacuum cleaner would be the solution for it. It is absolutely time saver, so people may spend much more time with their families or on their social activities. In other words, robotic vacuum cleaners give the users extra time that in itself beneficial, as the phrase goes "time is money". It provides the much cleaner life space and healthy body, especially for the people have mobility issues or suffering from joint, elders and physically disabled people, families with little kids, very busy people, pet owners, allergy sufferer and technology lovers. For them, robotic vacuum cleaner is perfect solution. With this regard, some people tend to be tidier while trying to eliminate obstacles for robotic vacuums and even give the name to robot and see it as a member of family (Guo, Grinter, Christensen, & Sung, 2007). On the other hand, research findings have reported that during using new technology women much more tend to give an importance on external support factors (Venkatesh, Thong, & Xu, 2012), therefore the relation between facilitating conditions and behavioral intention should be strong in case of women.

As consumers expect the device to do its job without human interaction, it is cleaning the entire floor as independently as possible. So that it always provides the clean environment to people especially mentioned above group. Since it can be controlled via mobile applications, it makes the life easier for the people, they can set the time and start cleaning remotely. It can easily detect the floor and change its work; accordingly, it is much smarter than we expected. It can also detect the obstacles and boundaries and avoid any kind of damage itself and to any other furniture at home. It can go to docking station once it finishes the cleaning, so people do not need to think about its charging. Noise is really disturbing thing and when we compared to traditional vacuum cleaners, robot vacuum cleaners have less noise. It is really keeping the small area and easy to store and carry. Thanks to its dimensions, it can easily clean the hard-to-reach places like corners and underneath furniture which are hard to reach by people. As a last advantage, it can be said that robotic vacuum cleaners are cost efficient and economical (Guo, Grinter, Christensen, & Sung, 2007).

Main pain points for people are unhygienic container emptying- people prefer to minimize interaction with dirt-, difficult brush cleaning - cleaning brushes are perceived as necessary evil, because long hair gets screwed in-, wi-fi signal problems, small container, high noise and low suction power so bad cleaning performance for some models (Xedzone, 2018).

Design, power, waste bin capacity, automatically empties dust bin, smart navigation, mopping, battery life, cleaning performance, price are the main points consumers are looking for during the

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selecting the model. It's definitely the game-changer for the pet owners according to the national survey completed by the American Pet Products Association, they predict that approximately 70 percent of citizens own pet and ds own a pet which are the ones who shed. Having and using the robotic vacuum cleaner in a regular basis will help individuals to avoid clouds of dog or cat hair that would otherwise pile up on furniture and clothes.

According to study conducted by Kadioglu (2020), from the perspective of robotic vacuum cleaner users, the advantages of the product are respectively; it saves labor and can be controlled remotely. Consumers have stated that they are satisfied with the product in terms of vacuuming when no one is at home, learning by mapping the house, and charging itself. They also stated that they are satisfied with the fact that the product saves them time and cleans houses in detail. The disadvantages faced by consumers are that the product's container fills up quickly, it is expensive, and it is frequently attached to objects. Consumers stated that they were not satisfied with the difficulty and slowness of the vacuuming process when the house was messy. As a result of these results, some suggestions have been developed. Another study has been conducted by Yapıcı, Tuglulular, and Basoglu in 2022 to be presented in Technology and Engineering Management Conference and delivers the valuable insights for the customization framework and supportive technology strategy with the study of "Multipartite Evaluation System". They underlined that this technology of robotic vacuum cleaners in the daily life is a quite new concept for lots of people. During the study process, they saw that even the users -who initially were aware of the technology and know what they want and expect from the product- may change their basic needs and expectations after they started using robovac. In the meantime, they are also aware of some minor solutions are available to overcome basic problems instead of buying the new one: in the analysis as a first stage, they created the set called "Prerequisites" which describes the ecosystem that robot vacuum cleaner to be used by user before they suggest the robovac model. Under these prerequisites home type, home size, owning pet, wifi quality, the features of the furniture, home population, carpet pile height, ecosystem and floor plan have been listed as presented in the figure 6. Additionally, they looked at the cases which refers persons who are the users and provide the information about product usage process in the solution space phase. Lastly, the proper Robotic vacuum cleaner would be suggested to the users according to defined needs, preferences, working environment and habits (Yapıcı, Tuglulular, & Basoglu, 2022).

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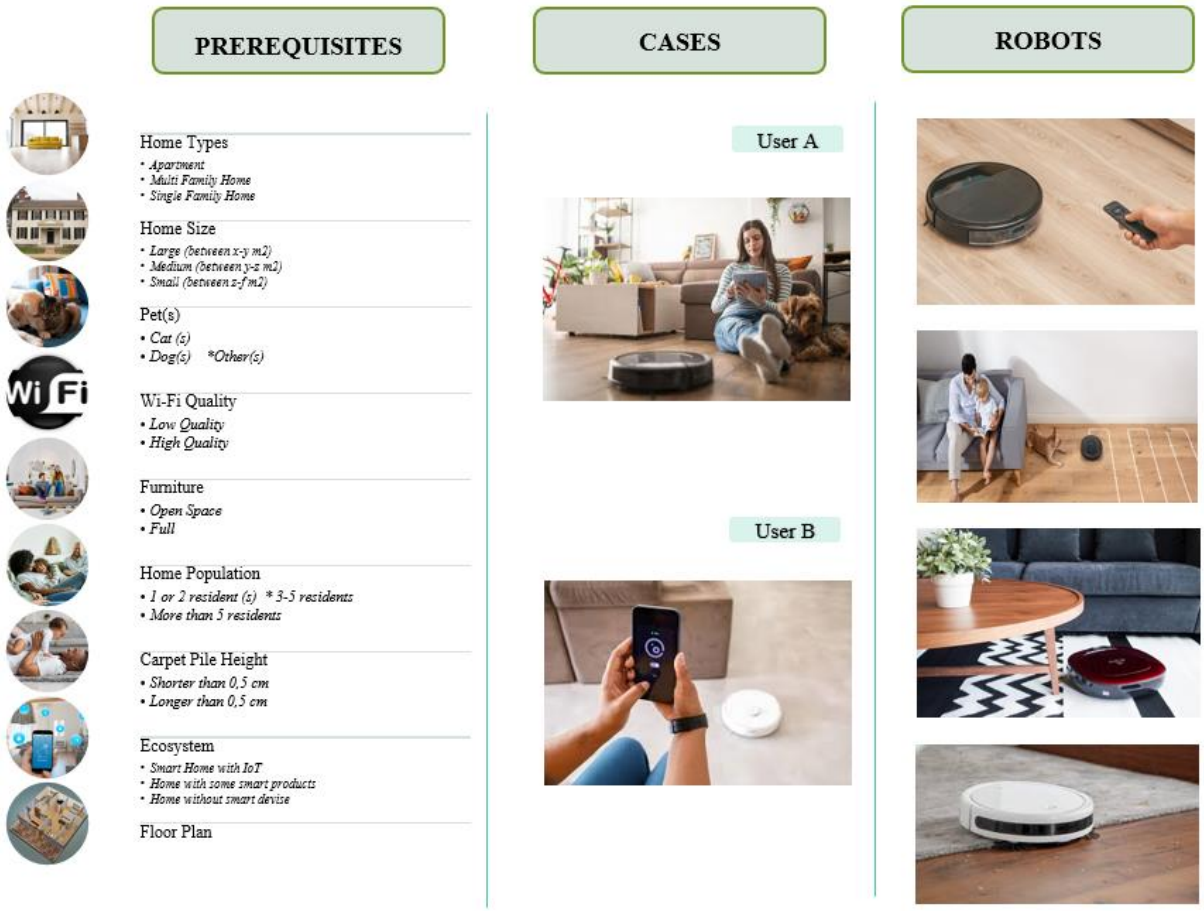


Figure 6: "Multipartite Evaluation System Study to recommend the most suitable Robot" illustrated by researcher. Source: *(Yapıcı, N. B., Tuglulular, T., & Basoglu, N. (2022). Assessment of Human-Robot Interaction between Householders and Robotic Vacuum Cleaners. IEEE Technology and Engineering Management Conference (TEMSCON EUROPE). IEEE.)*

As a Results, advantages of robotic vacuum cleaners may differ user by user since preferences, habits, expectation from the products and working places or environment vary user by user.

THEORETICAL FRAMEWORK

2.1. Technology Adaptation Models and Theories

In the literature, there are some theories proposed to examine and evaluate the individuals' Embracing emerging technologies and their willingness to utilize them that technology (Lai, 2017). Lai listed some of these theories as summarized in the table 1.

Table 1: Chronological List of Proposed Theories

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The Theory	Author	Year
Theory of Diffusion of Innovations (DIT)	Rogger	1995
The Theory of Task-technology fit (TTF)	Goodhue, and Thompson	1995
The Theory of Reasonable Action (TRA)	Fishbein and Ajzen	1975
Original Technology Acceptance Model	Davis	1986
Theory of Planned Behavior (TPB)	Ajzen	1991
Decomposed Theory of Planned Behavior	Taylor and Todd	1995
The Technology Acceptance Model (TAM)	Davis, Bogozzi and Warshaw	1989
Final version of Technology Acceptance Model (TAM)	Venkatesh and Davis	1996
Technology Acceptance Model 2 (TAM2)	Venkatesh and Davis	2000
Unified Theory of Acceptance and Use of Technology (UTAUT)	Venkatesh, Morris and Davis	2003
Technology Acceptance Model 3 (TAM3)	Venkatesh and Bala 2008	2008
Unified Theory of Acceptance and Use of Technology 2(UTAUT 2)	Venkatesh et al.	2012

2.1.1 Theory of Diffusion of Innovations (DIT)

Diffusion innovation theory has been proposed by Rogers (1995), he completed his more than 508 diffusion studies and bring the diffusion theory for the organizations and individuals' adaptation on the technology. With this theory he explains "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 1995, p. 5). S-shaped curve has been illustrated to show the adaption curve of the innovators, early adopters, early majority, late majority, and laggards in the Figure 7 (Rogers, 1995):

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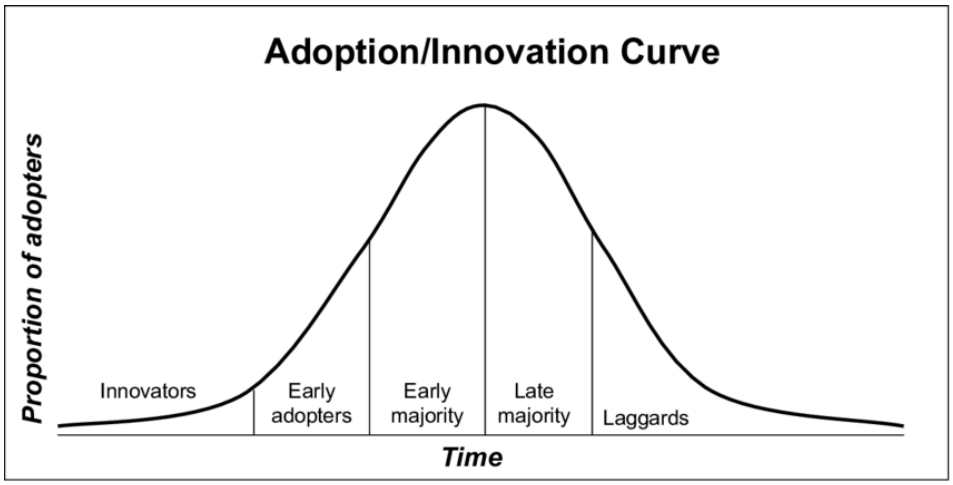


Figure 7: Adaption Innovation Curve (Adapted from Rogers,1995)

According to the DIT theory, innovation adoption occurs in five stages: (1) Knowledge Stage: learning about the innovation and how to implement it. (2) Persuasion Stage: developing attitudes toward the innovation; (3) Decision Stage: deciding whether to adopt or reject the innovation (4) Implementation Stage: Putting the innovation to use, gathering feedback, and adapting it to the needs. (5) Confirmation Stage: to confirm attitudes, reflect on the process and outcomes as shown in figure 8 (Frei-Landau, Muchnik-Rozanov , & Avidov-Ungar , 2022).

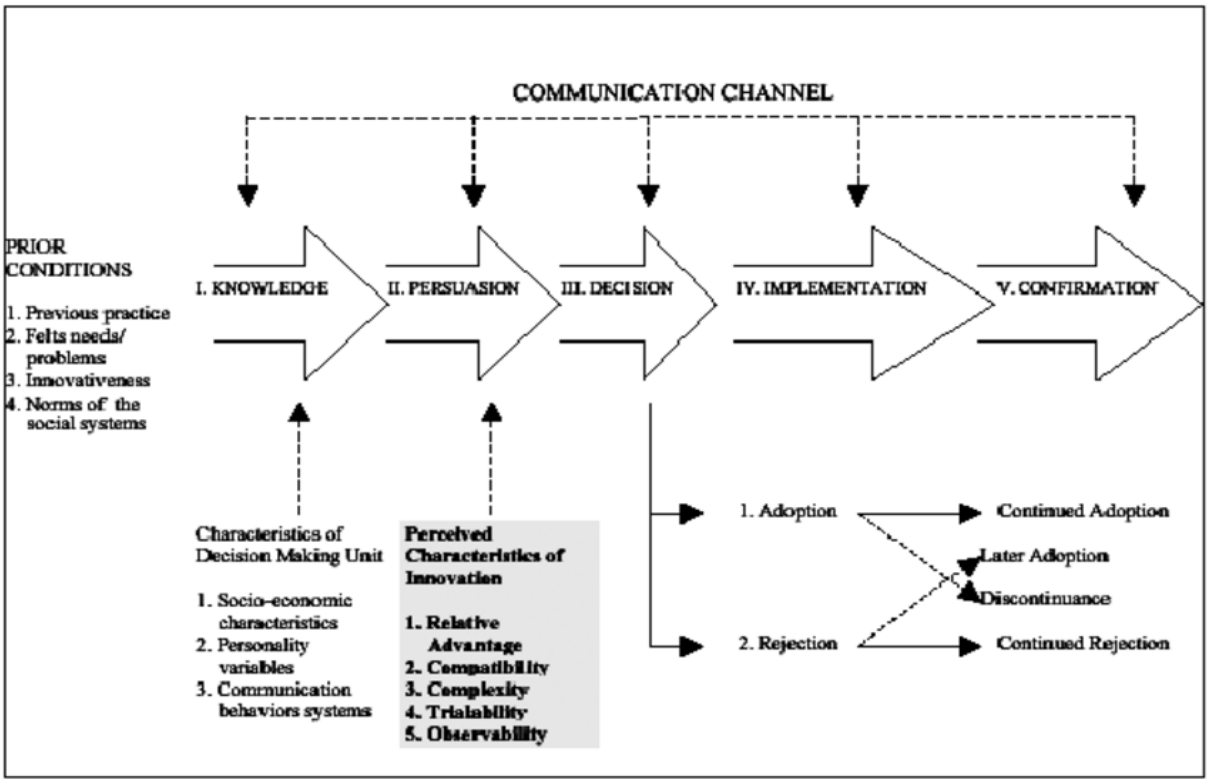


Figure 8: Diffusion of Innovation Model (Rogers, 1995)

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2.1.2. The Theory of Task-technology fit (TTF)

The Task-Technology Fit (TTF) model focuses on how technology can enhance efficiency, effectiveness, and work quality. Goodhue & Thompson (1995) found that a good match between task and technology increases the likelihood of use and better performance. Figure 9 depicts TTF as an appropriate model for testing new technology and measuring the effectiveness of technology already in the marketplace. TTF can help assess technology's support of job duties and improve utilization and performance with a good task-technology match.

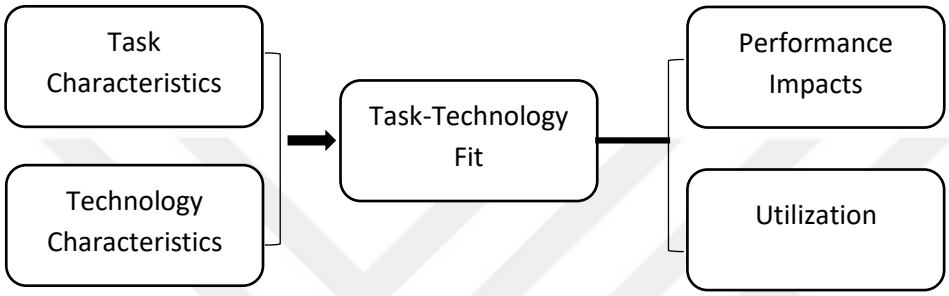


Figure 9: Task-technology fit (Goodhue & Thompson, 1995)

2.1.3. The Theory of Reasonable Action (TRA)

Theory of Reasoned Action (TRA) is introduced by (Fishbein & Ajzen, 1975). The Theory of Reasonable Action (TRA) is the formation in social psychology that investigates to clarify the factors of consciously intended behavior as can be seen in the Figure 10 (Fishbein & Ajzen, 1975). It determines the connections between behavior, norms, attitudes, beliefs, and intentions such as specific behavior to use or refuse the technology, is the consequence of an intention to do the behavior, and this intention is affected collectively by the individuals attitudes so that this stated attitude beliefs and nominative norms against the aimed behavior (Silva & Dias, 2006).

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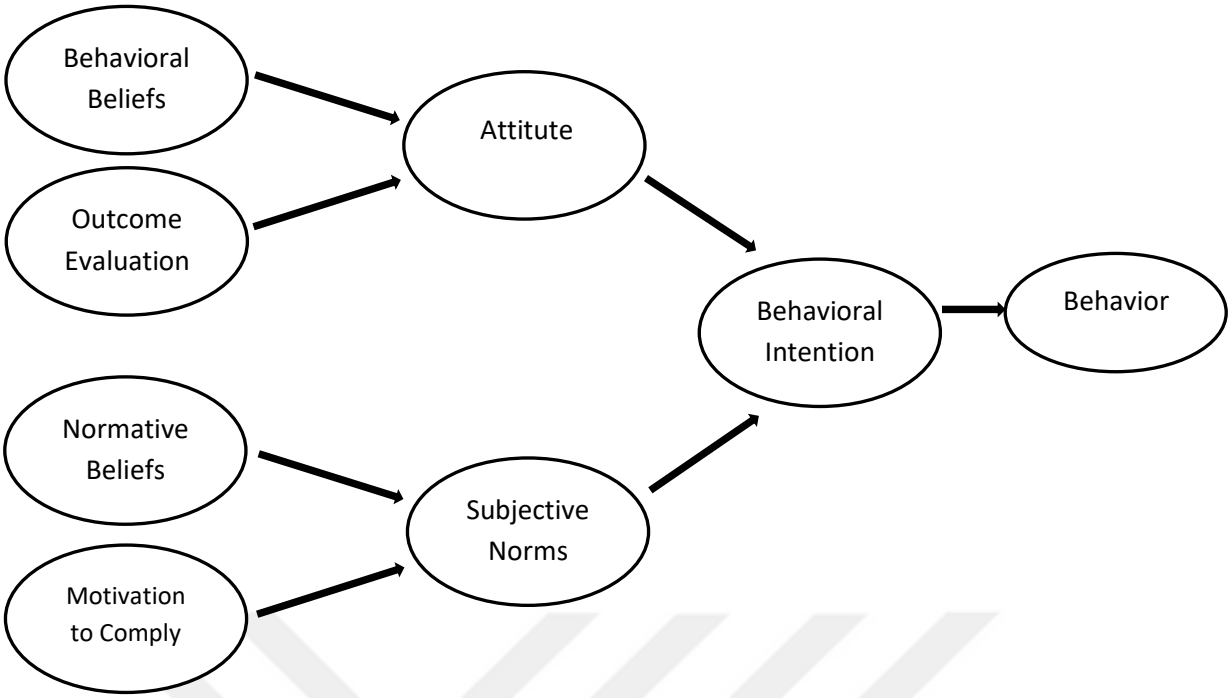


Figure 10: The Theory of Reasonable Action (TRA) (Fishbein & Ajzen, 1975)

2.1.4. Theory of Planned Behavior (TPB)

Ajzen (1991) proposed the Theory of Planned Behavior, which focuses on one variable that influences an individual's intention and attitudes toward that behavior, as shown in Figure 11. The first two elements are the similar like in the Theory of Reasonable Action (Fishbein & Ajzen, 1975). The next factor, called perceived control behavior, is the control that consumers feel as limiting their behavior.

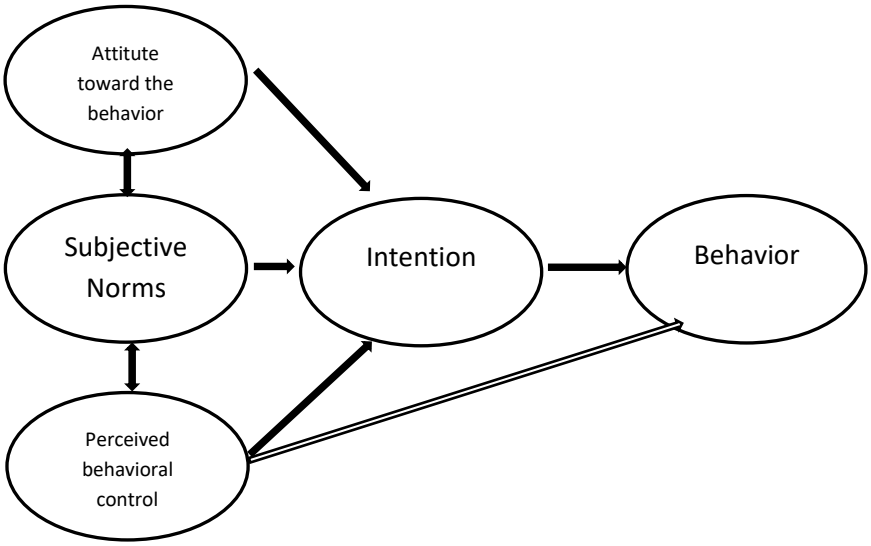


Figure 11: Theory of Planned Behavior(TPB) (Ajzen, 1991)

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2.1.5. Decomposed Theory of Planned Behavior

Taylor and Todd proposed the Decomposed Theory of Planned Behavior as shown in the Figure 12 (Decomposed TPB) (1995). The Decomposed TPB comprises three key elements that impact the intention to behave in a certain way and the subsequent adoption of the behavior: attitude, subjective norms, and perceived control over the behavior. Several research investigations have been carried out to test the DTPB's ability to predict human behavior. For example, Conner and Armitage (Conner & Armitage, 1998) discovered that the DTPB was a superior behavior predictor than the TPB solely. Parallel to this Shih and Fang (2004) investigated internet banking adoption using the TPB and Decomposed TPB. Correspondingly, Sheeran, Conner, and Norman (2001) also discovered that the DTPB was a better predictor of physical activity than the TPB.

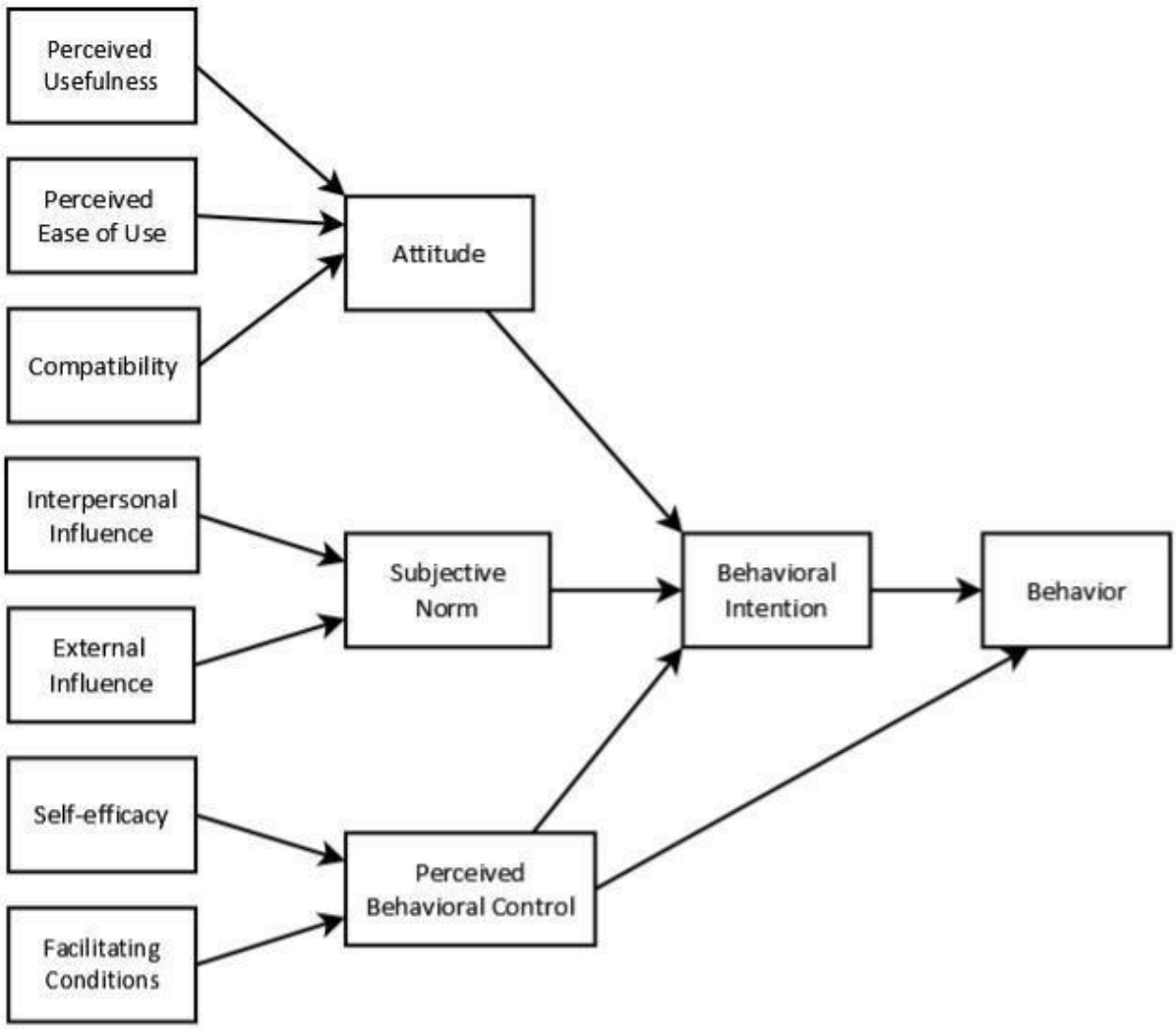


Figure 12: Decomposed Theory of Planned Behavior (Decomposed TPB) (Taylor & Todd, 1995)

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2.1.6. The Technology Acceptance Model (TAM)

Similar to the TRA, TAM is the most used model to examine the acceptance of new technology (Venkatesh & Davis, 1996). Technology acceptance model was initially developed by Davis in 1986 as can be seen in the Figure 13. With the adaptation of Theory of Reasonable Action, TAM is primarily designed for designing consumers' recognition of information systems or technologies.

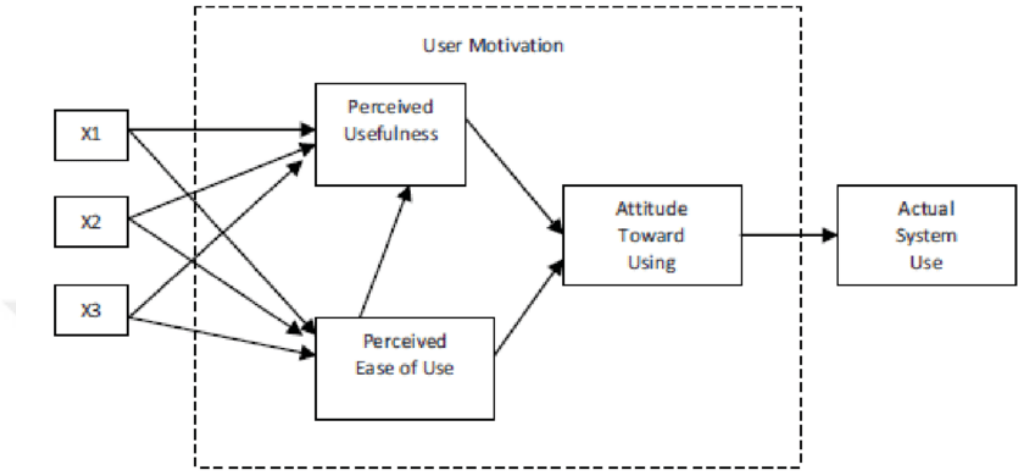


Figure 13: Original Technology Acceptance Model (Davis, 1986)

Then after, the model has been updated by Davis in 1989 as can be seen in the Figure 14. Perceived Usefulness (PU) and Perceived Ease of Use (PEoU) are two main factors of Technology Acceptance Model (TAM) defined by Davis (1989) and those are known as the most powerful variables which affect the adaption of the new technology (Venkatesh & Davis, 1996) (Liker & Sindib, 1997) (Liang, Xue, & Byrd, 2003). PU is the rate to which an individual believes that using specific technology might develop its performance. PEoU reflects an individual's perception of how effortless it will be to use an information system.

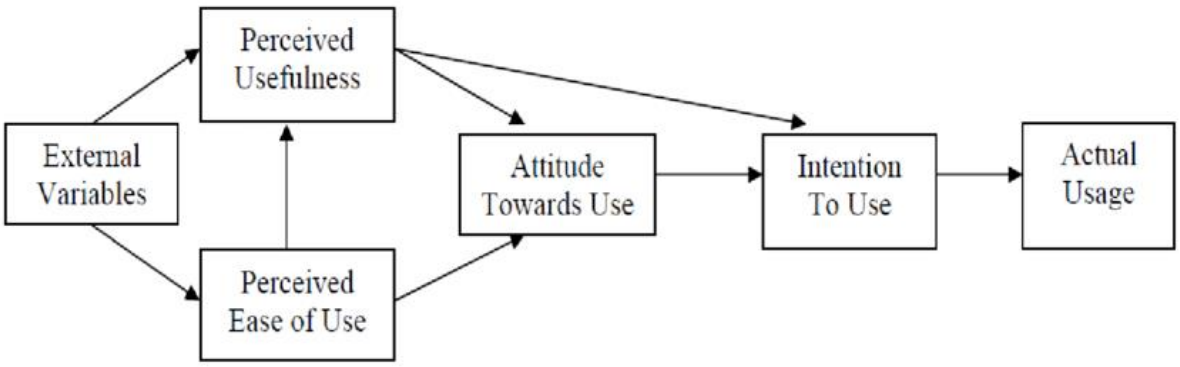


Figure 14: "First modified version of Technology Acceptance Model (TAM) (Davis, Bagozzi, & Warshaw, User acceptance of Computer technology: A comparison of two theoretical models, 1989)"

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2.1.7. Final version of Technology Acceptance Model (TAM)

Venkatesh and Davis (1996) advanced the final version of the Technology Acceptance Model, as shown in Figure 15, after they discovered that both perceived usefulness and perceived ease of use actually have a direct and strong influence on behavior intention, that's why they removed the requirement for the attitude construct.

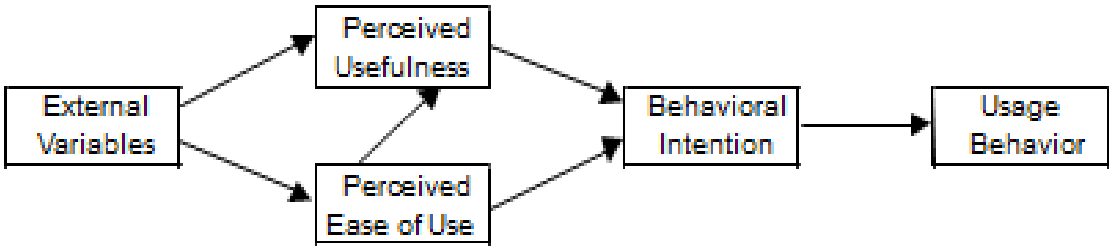


Figure 15: "Final version of Technology Acceptance Model (TAM) (Venkatesh & Davis, 1996)"

TAM is used to estimate the user's intention to accept the technology and the frequency of use of the technology. TAM is a model used specifically for computer systems. Later, it was adapted for other technologies as well. In the first version, the core elements of TAM are the user's attitudes and perceptions towards using technology. However, in the original version of the model, there are main four variables. Those are external variables which is directly affecting the user's beliefs that are Perceived Usefulness and Perceived Ease of Use. Perceived ease of use highly impacts the perceived usefulness. In the meantime, users' beliefs also have direct effect on their attitude on the new technology usage. The after users' attitudes impacts the intention to use the new technology. And lastly the users' behavioral intention defines the behavior of actual usage of the technology.

2.1.8. Technology Acceptance Model 2 (TAM2)

TAM model has been enlarged with new variables which are experience, voluntariness and subjective norm as TAM2 as can be seen in the Figure 16 (Venkatesh & Davis, 2000).

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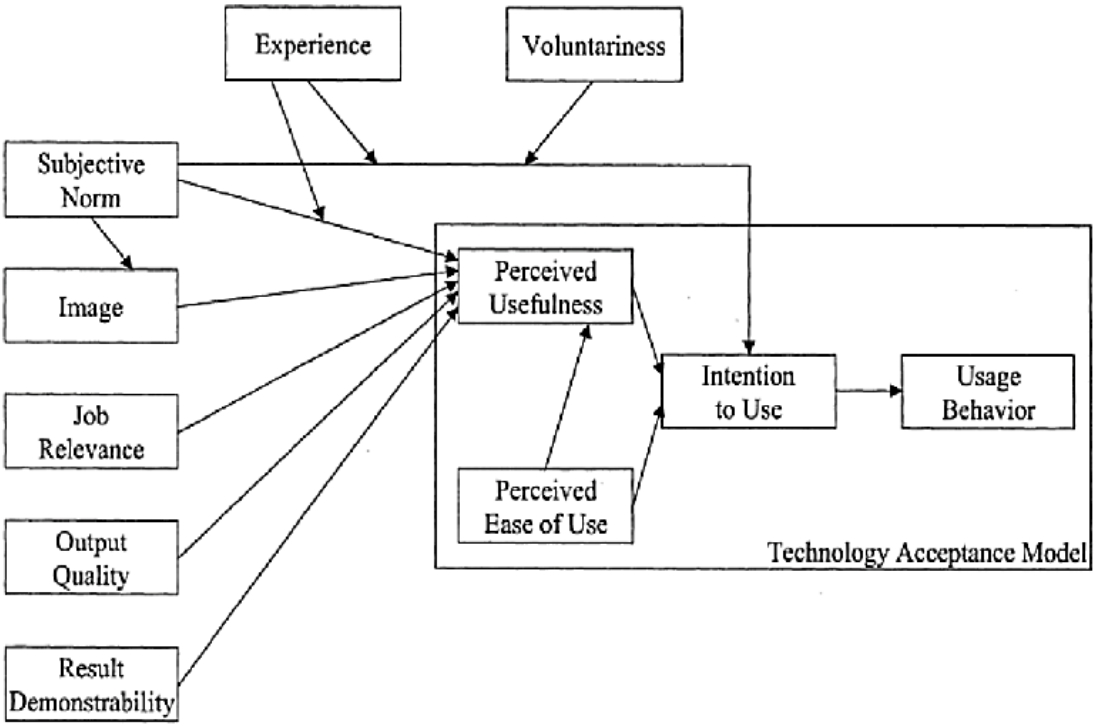


Figure 16: Technology Acceptance Model (TAM 2) (Venkatesh & Davis, 2000)

The Technology Acceptance Model 2 (TAM2) is a model developed by Venkatesh and Davis in 2000 and is an enhanced version of the original Technology Acceptance Model (TAM). TAM2 examines the factors that influence a user's decision to accept a technology and tries to predict a user's intention to use the technology. TAM2 retains the core of TAM, which includes the factors of perceived usefulness and perceived ease of use on the use of technology, while including additional factors, specifically behavioral intention, behavioral control, and subjective norm. These additional factors aim to address more variables that influence a user's decision to adopt a technology. TAM2 is applied especially in technology-oriented areas such as information systems and e-commerce. Various academic studies demonstrate the effectiveness and feasibility of TAM2.

For example, the study by Venkatesh and Bala (2008) showed that TAM2 can be successfully used to predict acceptance intentions of users on an e-commerce platform. As another example, Wu and Chen's (2017) study used TAM2 to examine factors that affect the use of a mobile app. This study showed that perceived usefulness, perceived ease of use, subjective norm, and behavioral control had a significant effect on intention to use. The applicability of TAM2 in different industries and different technologies demonstrates its versatility and effectiveness. TAM2 is a model that can be used in many industries to understand and influence the adoption of a technology.

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2.1.9. Unified Theory of Acceptance and Use Technology (UTAUT)

By using TAM model, the unified theory of acceptance and use of technology (UTAUT) have been proposed as shown in the Figure 17 and UTAUT2 models have been developed by Venkatesh et al. (2012). UTAUT consist of four main constructs as performance expectancy, effort expectancy, social influence and facilitating conditions as factors of behavioral intention and behavior; Social Influence is the grade to which an individual perceives that significant someone esteems they should use the new technology. Facilitating Conditions refer the grade to which an individual believes that organizational and technical infrastructure exists to support the use of a system (Venkatesh V. , Morris, Davis, & Davis, 2003). While UTAUT2 has following three variables as hedonic motivation, price value, and habit as shown in the figure 18. The model additionally recommends that these four constructs can be moderated by gender, age, experience, and voluntariness of use.

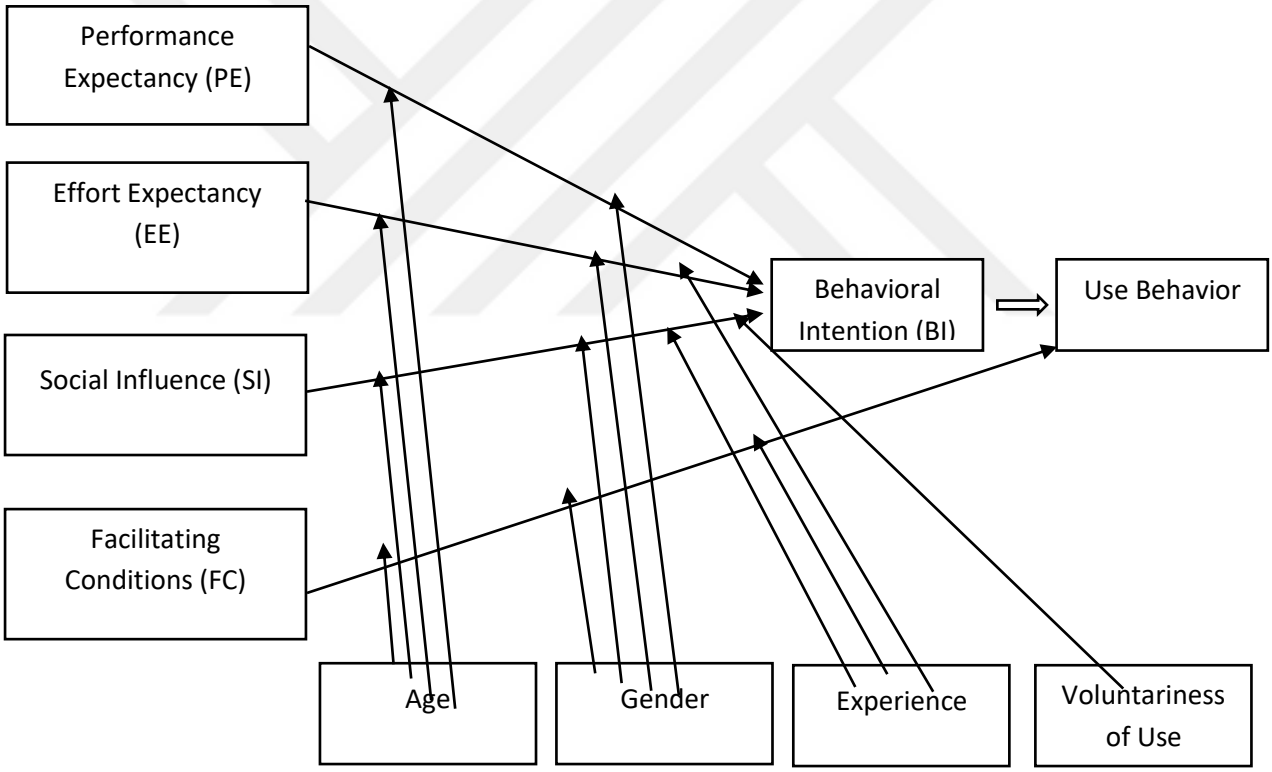


Figure 17: Unified Theory of Acceptance and Use Technology (UTAUT) (Venkatesh V. , Morris, Davis, & Davis, 2003)

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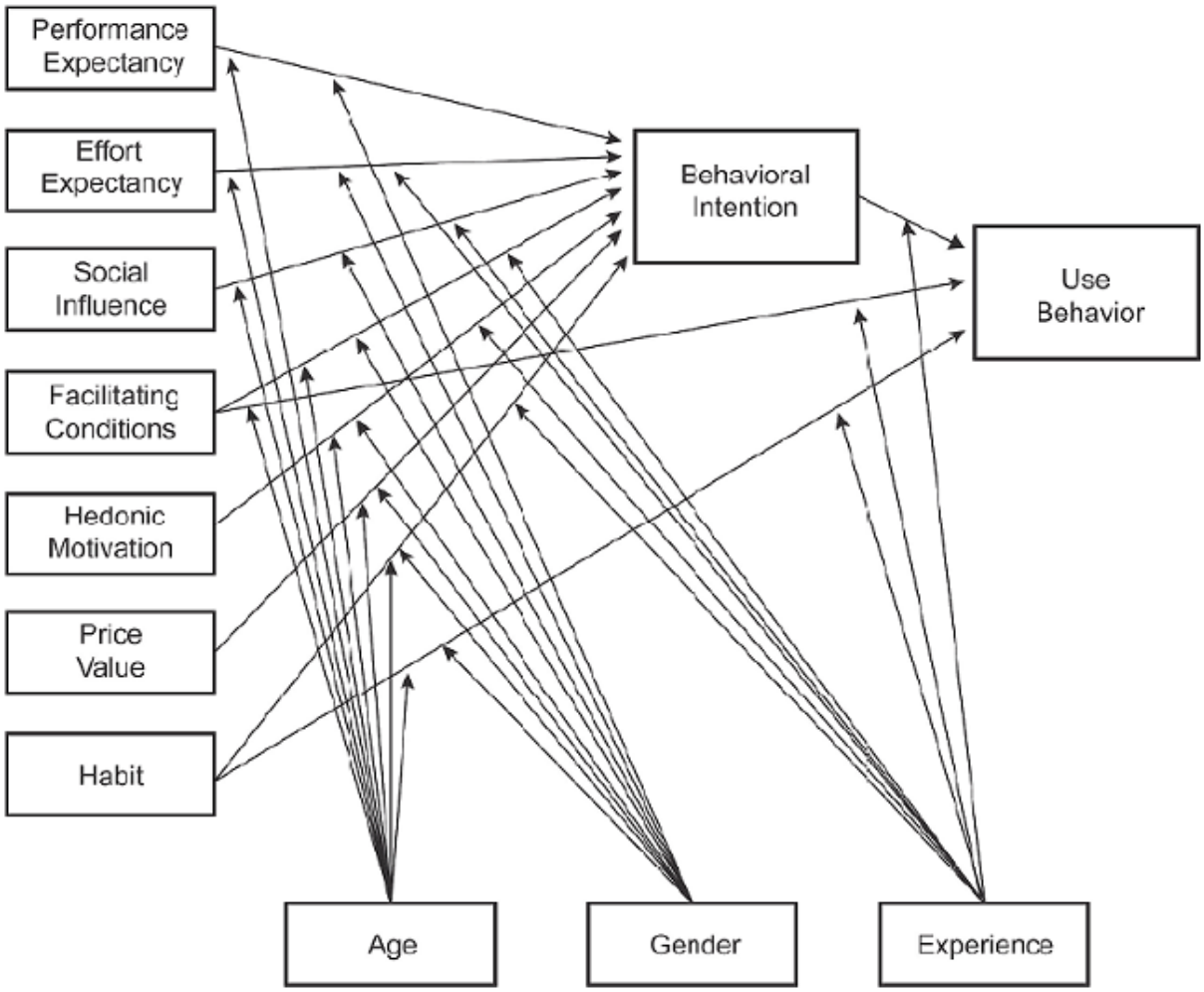


Figure 18: Unified Theory of Acceptance and Use Technology (UTAUT2) (Venkatesh et al. (2012))

2.1.10. Technology Acceptance Model 3 (TAM3)

TAM3 model has been developed by including the anchor and adjustment variables as shown in the figure 18 (Venkatesh & Bala, 2008). The Technology Acceptance Model (TAM) is a theoretical framework developed to explain the factors that affect the acceptance of a technology. The third version of TAM (TAM3) was developed in 2008 by Venkatesh et al. TAM3 includes the user's perception of the technology as well as the variables included in its previous versions. This model is used to understand the user's reasons for accepting the technology and their willingness to use the technology. TAM 3 is an enhanced version of the original TAM model and focuses specifically on the use of mobile technologies. In this model, the user's decision to accept technology depends on factors such as perceived usefulness, perceived ease, perceived risk, perceived value, and social impact. The academic literature on TAM3 is extensive and has been covered by researchers from various disciplines.

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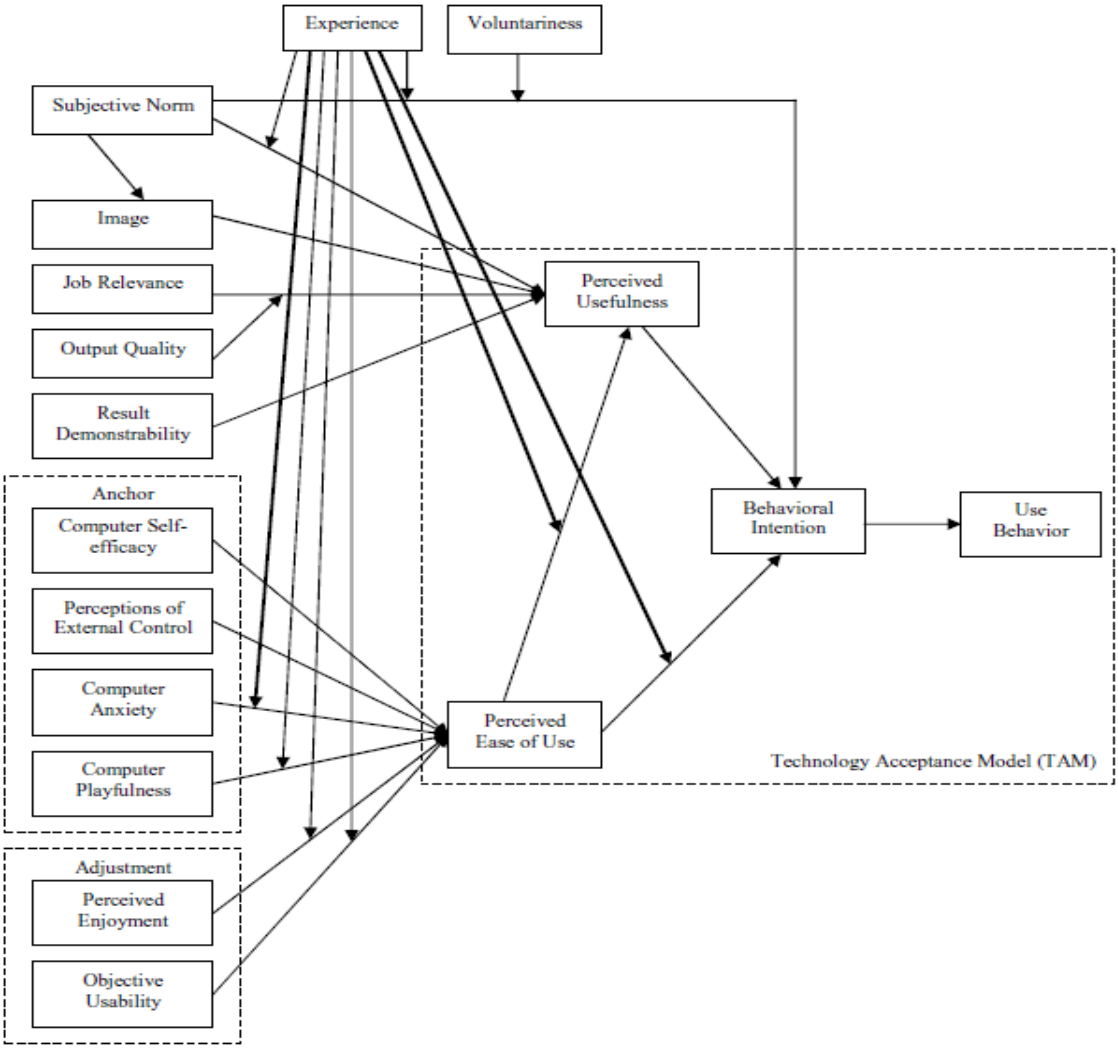


Figure 19: Technology Acceptance Model (TAM 3) (Venkatesh & Bala, 2008)

2.2. Examples of Technology Acceptance Models from Literature Review:

There are many studies have been conducted in the literature that used one of the proposed theories, it can be seen that TAM is one of the most used versions of those proposed theories in the literature. Table 2 shows some sample studies on the types of technology acceptance models with the purposes.

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Table 2: Examples of TAMs and UTAUTs in Literature by Time

Article Name	Author	Year	Model	Purpose
"Testing the technology acceptance model across cultures: A three country study"	Straub, D. W., Keil, M., & Brenner, W.	1997	TAM	The study aims to see whether TAM implementation works in other regions apart from North America.
"The technology acceptance model: Past, present, and future."	Lee, Y., Kozar, K. A., & Larsen, K. R.	2003	TAM	This article discusses the past, present and future of TAM, and underlines that TAM is the one of the most used models while examining the intention to use of new technological products.
"Why do people use information technology? A critical review of the technology acceptance model"	Legris, P., Ingham, J., Collerette, P.	2003	TAM	The study finds the TAM as beneficial model by underlying that it would include variables which are related to both human and social change progress & to innovation adaption.
"User acceptance of information technology: Toward a unified view"	Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D.	2003	TAM	The study examined the TAM models and highlights the contractions in UTAUT which enables to understand the main drivers of acceptance (i.e., Training, marketing etc.). The paper delivers the recommendations for the future research.
"The Actual Usage of ERP Systems: An Extended Technology Acceptance Perspective"	Shih and Huang	2009	Extended TAM	This study revealed that the user's decision to use the ERP system is affected by perceived ease of use, perceived benefits, organizational factors (top management support), and personal factors (computer anxiety, computer self-efficacy).
"Factors Affecting the Adoption of Online Banking: An Extension of the Technology Acceptance Model"	Nour-Mohammad, Y., Bahmani, E.	2010	TAM & TPB	In this study, researchers developed the model by combining the TAM and TRA to examine intention to use of online banking.
"A partial least squares structural equation modeling (PLS-SEM) approach to the technology acceptance model (TAM)."	Teo, T.	2010	TAM	This article investigates users' behavioral intention to use mobile wallet services in Bangladesh by implementing and examining the TAM.
"Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology"	Venkatesh, V., Thong, J. Y., & Xu, X.	2012	UTAUT2	This article describes the theoretical framework used for the development of UTAUT by extending the model with hedonic motivation, price value and habit. Individual differences are also examined including age, gender, and experience to investigate the effects of mentioned constructs on behavioral intention and use of technology.

Sensitivity: Public

2.3. Examples of the Studies Conducted on the Subject of Robotic Vacuum Cleaners in the Literature Review

In the literature, there are very limited studies about robotic vacuum cleaner. Since the product is one of the major smart appliances and there is massively increasing market, we highly recommend making deep analysis on this market. In the meantime, there are some research studies about robotic vacuum cleaners which already predicted how the RVCs will be taking the attention of manufacturers and increase the demand from consumers in a few years.

Table 3 shows the example studies from literature related to Robotic Vacuum Cleaners.

Table 3: Examples of Conducted on the Subject of Robotic Vacuum Cleaners in Literature by Time

Subject of the Article	Author	Year
Autonomous Vacuum Cleaner	Ulrich, I., Mondada, F., & Nicoud, J.	1997
A Navigation System for Cleaning Robots	Lawitzky, G.	2000
A Short History of Cleaning Robots	Prassler, E., Ritter, A., Schaeffer, C., & Fiorini, P.	2000
Development of small robot for home floor cleaning	Oh, Y.-J., & Watanabe, Y.	2002
Complete Coverage Navigation of Cleaning Robots Using Triangular-Cell-Based Map	Oh, J. S., Choi, Y. H., Park, J. B., & Zheng, Y. F.	2004
Development of a measurement and control system for a cleaning robot utilizing a sensor array for detection	Dai, G., & Chen, T.	2007
A floor cleaner robot using Swedish wheels.	Gao, X., Li, K., Wang, Y., Men, G., Zhou, D., & Kikuchi, K.	2007
Localization and Mapping Using a Laser Range Finder: A Goal-Seeking Approach	Diamantas and Crowder	2009
Robot Vacuum Cleaner Personality and Behavior	Hendriks, B., Meerbeek, B., Boess, S. et al.	2011
Living with a Vacuum Cleaning Robot: A 6-month Ethnographic Study	Fink, Bauwens, Kaplan, & Dillenbourg	2013
Lessons learned from robotic vacuum cleaners entering the home ecosystem	F. Vaussard et al.	2013
“hTetro: A tetris inspired shape shifting floor cleaning robot”	Prabakaran, V., Elara, M. R., Pathmakumar, T., & Nansai, S.	2017
Development of a vacuum cleaner robot	Asafa et al.	2018
Improving robotic vacuum cleaners; Minimizing the time needed for complete dust removal	Gylling, A., & Elmarsson, E.	2018

Sensitivity: Public

Design and implementation of vacuum cleaner robot using Arduino and smartphone	Mohd Annuar, Khalil; Dahari, R.M.; Harun, Mohamad Haniff ;Sapiee, Mohd	2018
Robotic vacuum cleaners save energy? Raising cleanliness conventions and energy demand in Australian households with smart home technologies	Nicholls, L., & Strengers, Y.	2019
"Design and Development of Automatic Cleaning and Mopping Robot"	Adithya P S, T. R.	2019
A Research on Consumers' Use of Smart Robot Vacuum Cleaners	Kadıoglu, C. T.	2020
Smart vacuum cleaner	M. Vijayalakshmi	2021
"Design and implementation of a cost effective vacuum cleaner robot"	Anıl Eren, Hatice Doğan	2022
The Development Prospect of Cleaning Robot in Chinese Market in the Next Ten Years	Zhang, S.	2022
Assessment of Human-Robot Interaction between Householders and Robotic Vacuum Cleaners	Yapıcı, N. B., Tuglulular, T., Basoglu, N.	2022

2.4. Stimulus-Organism-Response (S-O-R) Paradigm

In 1974, Mehrabian and Russell proposed the Stimulus-Organism-Response (S-O-R) model from environmental psychology (Mehrabian & Russell, 1974). This model suggests that external stimuli can affect an individual's emotional state, which then leads to cognitive and emotional responses. The response is the individual's behavioral outcome, which can be both physical and intangible (Jacoby, 2002). The S-O-R model suggests that environmental cues can influence an individual's emotional and cognitive state, resulting in certain behavioral. The SOR model is a popular psychological theory in consumer behavior research, as it is useful for distinguishing environmental stimuli from the internal and external behavior of consumers. Therefore, it is often employed in the study of consumer behavior (Chang, Eckman , & Yan, 2011). Stimulus Organism Response (SOR) is a psychological theory that describes how humans react to different stimuli in their environment. This theory has been studied extensively by scholars and researchers, and there is a wide range of academic literature available on the topic. Harry Helson carried out one of the earliest and most significant investigations on SOR in 1947. Helson looked at how people respond to various environmental cues in his study and discovered that reactions were influenced by both the stimulus and the individual. This study paved the path for additional SOR research (Helson, 1947). Richard Lazarus conducted a significant additional study on SOR in 1966. According to Lazarus, people's emotional and behavioral responses are determined by how they interpret and experience the stimuli in their environment. The significance of cognitive processes in SOR was stressed in this study (Lazarus, 1996). The SOR theory has recently been used by

Sensitivity: Public

researchers in many fields, including marketing and consumer behavior. According to a study done by Janiszewski and Uy (2008), characteristics of stimuli such as the degree of arousal and the complexity of the message had an impact on people's responses to advertisements.

The purpose of this study is to examine consumers' consumption behavior of robotic vacuum cleaner from their cognitive and emotional responses through the S-O-R framework, the Stimulus factor is brand image as a signaling during this study. The reason is that consumers are exposed to the situational stimulus in the use of RVC at home. Organism refers to the users' emotional and cognitive state, including their views, experiences and evaluations, and its factor selected in this study is perceived value that divided into two variables as following: (1) perceived benefit which includes performance expectancy, effort expectancy, hedonic motivation, time saving and energy saving which are related to sustainability; (2) perceived risk which includes performance risk and financial risk. Finally, the response factor is the intention of use.

In the meantime, there are some studies in the literature that already combine the TAM and SOR models in the research models. For instance, the study made by Venkatesh and Morris (2000) applied SOR model to TAM. In that study, they saw that perceived usefulness and ease-use of new technologies were quite crucial elements that effects users' acceptance of related technology. These factors are related to the stimuli in the SOR model. Another example can be the one made by Kim and Malhotra (2005), they used the SOR mode to examine the role of emotions in technology acceptance. In the result of the study, it's been shown that users' emotional actions and replies to related new technology like frustration, excitement etc. directly affected their behavioral intentions to use that technology. The study has been made by Chou, Horng, Liu, Yu, & Kuo (2022) also would be an great example to show how TAM and SOR could be combined to explore the related dimensions' attraction among each other, the studay mainly aimed to provide comprehensive analytical model by combining TAM and SOR, TAM has been embedded under Organism in their model as following factors: Perceived Usefullness, Perceived ease of use and Big Data Application. They examined the sustainable marketing mix by application of the big data in the catering industry in the postepidemic period. Additionally, Lee, Xu, & Porterfield (2021) also deliver the study that combined SOR and TAM models. In their study, they mainly targted to examine individuals' intention to adopt augmented products. Perceived Hedonic Valur is also examined under Perceived value as we will keep hedonic motivation in our proposed research model.

Overall, the scholarly literature on SOR is extensive and is always expanding. It offers helpful insights into how people process and respond to environmental stimuli, and it has significant ramifications for the study of psychology, marketing, and consumer behavior.

In our study, extended version of TAM as UTAUT and SOR are being combined and when checked the literature the studies shared in the table 4 can be given as the latest examples:

Sensitivity: Public

Table 4: Examples of TAM in SOR Usage in Literature by Time

Article Name	Sector	Model	Year	Author
"New developments in modeling Internet consumer behavior: Introduction to the special issue"	E-Commerce	TAM in SOR	2010	Laroche, M.
"Teacher supported behaviors affecting MOOC learners' intention based on TAM and SOR Model"	Education	TAM in SOR	2020	Ge, W., Bai, H., Wu,H., He,J.
"Effects of mobile augmented reality apps on impulse buying behavior: An investigation in the tourism field"	Tourism	TAM in SOR	2020	Do., H.N., Shihi, W., Ha, Q.A.
"Antecedents and moderators of consumer adoption toward AR-enhanced virtual try-on technology: A stimulus-organism-response approach"	Online Shopping	TAM in SOR	2021	Lee, H.; Xu, Y.; Porterfield, A.
"Effect of Farmers' Awareness of Climate Change on Their Willingness to Adopt Low-Carbon Production: Based on the TAM-SOR Model"	Agriculture	TAM in SOR	2022	Ling, J., Xue, Y., Yang,C., Yuanyuan,Z.
"Flow Experiences and Virtual Tourism: The Role of Technological Acceptance and Technological Readiness"	Virtual Tourism	TAM in SOR	2022	Yang, C., Yan, S., Wang, J., Xue, Y.
"Identifying the critical factors for sustainable marketing in the catering: The influence of big data applications, marketing innovation, and technology acceptance model factors"	Marketing	TAM in SOR	2022	Chou, S.F., Horng, J.S., Liu C.H., Yu, T.Y., Kuo, Y.T
"Integrated technology acceptance model (TAM) of sports team smartphone application (STSA) in the stimulus organism response (SOR) framework"	Marketing	TAM in SOR	2022	Jeong, S.H.,Chung, J.Y.
"Factors Affecting m-learning Continuance: From the Perspectives of flow Theory and Stimulus-Organism-Response Theory"	M-learning	TAM in SOR	2022	Chang, C.C.
"Enhancing students' English language learning via M-learning: Integrating technology acceptance model and S-O-R model"	E-Learning	TAM in SOR	2023	Peng, M.Y, Xu, Y., Xu, C.

2.5. Developing the Research Model

Technology acceptance models have been intensively used by researchers in many studies to explain the users' intentions to use new technologies. Surendran (2012) has also evaluated different studies made by using Tam and highlighted that it has been mostly used in field of banking, online shopping, e-commerce, and e-learning. That study also analyzed the possible application areas that technology

Sensitivity: Public

acceptance model could be applied, and it predicts that there can be study about extension of technology acceptance model and implement it to see users' technology acceptance in e-recruitment (Surendran, 2012).

If we explain with the example of robotic vacuum cleaner, robotic vacuums have been widely used in homes in recent years. These devices are a technology that facilitates cleaning operations in homes and enables users to use their time more efficiently. The expectation element of TAM also plays an important role in the use of robotic vacuums. Users expect robotic vacuums to do their home cleaning work faster and more efficiently. The perceived usefulness elements are that robot vacuums offer a more effective and less tedious solution for cleaning homes. Ease of use is about how easy the robot vacuums are to use. It is important for users to have an idea of how easy the robot vacuums are to be used before using them. On the other hand, there may be factors such as battery life in the use of robot vacuum cleaners. Considering these elements, the intentions of users to accept robot vacuum technology can be examined with the TAM model. However, in our study, we will examine the perceived value which will be evaluated in two different variables that perceived benefit and risks. Because, in the literature it can be seen that while making decision to use new technology, both variables perceived usefulness and ease of use have already proved strong relationship with behavioral intention to use. In this study, we do use the UTAUT 2 including the main elements of Perceived Benefit, Perceived risks and Hedonic motivation which are examined whether influence the Perceived Value. UTAUT2 model is being embedded in SOR in the research model.

2.5.2. Brand Image

According to completed study named as "The Importance of Brand Image on Consumer Purchase Attitude" by Lin and Chuang (2018), it's been clearly observed that Brand image has definitely strong positive effect on the process of purchase decision. Brand image is accepted as an important variable for the studies about customer's behavior. Reynolds (1965) describes that "an image is the mental construct developed by the consumer on the basis of a few selected impressions among the flood of the total impressions; it comes into being through a creative process in which these selected impressions are elaborated, embellished, and ordered" (Reynolds, 1965). Additionally, it's definition has been made by Keller as "brand image is stated as a set of associations, which are organized in some meaningful way, is linked to the brand that consumers hold in memory" (Keller, 1993), on the other hand another definition comes from Kotler as "the set of impressions, beliefs and ideas that a person holds about an object" (Kotler, A Framework for Marketing Management, 2001, p. 273) . By the way Kotler defines the brand as "A brand can be defined as "a name, term, sign, symbol, or design, or combination of them which is intended to identify the goods and services of one seller or group of sellers and to differentiate them from those of competitors" (Kotler, 1991, p. 442). On the other hand, Hsieh, Pan and Setiono delivers another definition for the brand image as "a successful brand image allows

Sensitivity: Public

consumers to recognize the needs that the brand satisfies and to distinguish the brand from its competitors and increases the probability that consumers will purchase the brand" (Hsieh, Pan, & Setiono, 2004).

The significance of brand names in assessing items across cultures has been looked at in various areas of research. Dawar and Parker (1994) and Richardson et al. (1994) discovered that when consumers are unsure about a product, brand names serve as an essential extrinsic signal.

Hypothesis 1: Brand Image is positively linked to perceived benefit

Hypothesis 2: Brand Image has significant relation with perceived risk

Hypothesis 3: Brand Image has significant relation with perceived value

H3a. Brand Image has significant relation with overall perceived value

H3b. Brand Image has significant relation with sub constructs of perceived value

Additionally, it is commonly acknowledged that a brand's function as a social signal plays a significant effect in consumer decision (Lannon & Cooper, 1983). According to Tian et al. (2001), customers use the symbolic meanings of the things they buy to pursue social image upgrades. In order to satisfy consumers' desire for uniqueness, brands are utilized along with product categories, variations, and styles. Belén del Río, Vázquez, & Iglesias's (2001)evaluation of the symbolic value of brand names also looked at how easily people could identify with them and convey their social position. The researchers discovered that consumers utilize brand names as a significant tool to improve their social standing. They came to the conclusion that brand names can help people associate with a specific brand and convey their social position. According to Park and Chen's (2007) research, a strong belief in social recognition was positively correlated with the intention to acquire international luxury brands. This suggests that luxury products are seen as a way for consumers to raise their social status. Since RVCs are relatively new smart devices with easily accessible brands. Hence, it is crucial for businesses in this industry to take into account not just the brand name of their device.

Brand signaling, also known as brand signals or signaling theory, is a concept commonly discussed in the field of marketing and brand management. It refers to the deliberate actions, messages, or signals that a brand or company sends to convey information about its products or services to consumers and other stakeholders. These signals are meant to shape consumers' perceptions and influence their behavior, such as purchasing decisions and brand loyalty. Brand signaling can take various forms, including advertising, branding, packaging, pricing, product quality, endorsements, and corporate social responsibility initiatives. The goal of brand signaling is to establish a strong brand image, build trust, and differentiate a brand from its competitors. The concept of brand signaling is often associated with the theory of asymmetric information in economics. In situations where consumers lack complete

Sensitivity: Public

information about a product or service, brands use signaling to reduce information asymmetry and build credibility. For instance, a luxury brand may use premium pricing and high-quality materials to signal exclusivity and superior product quality (Keller, 1993).

“Managing brand equity: Capitalizing on the value of a brand name “ has been written by Aaker (1991) is one the a pioneer in brand equity. The book provides a comprehensive framework on how to manage brand image and increase brand equity. In addition, the effect of brand image on purchasing behavior is also discussed. When we looked the articles in the literature, there are many articles present various theoretical and empirical studies on the effect of brand image on purchasing behavior. Topics such as how brand image affects purchasing behavior, how brand value is measured, how consumers' perceptions of brand image can be managed, and the relationship between brand image and customer loyalty are discussed. For instance, Keller (1993) conducted the study “Conceptualizing, measuring, and managing customer-based brand equity”, Collange (2008) has delivered the study “The Impact of Brand Name Substitution on Product Evaluation and Purchase Intention ”which determines the variables affect the purchase intention of the users’ for the different brand names, Park, Jaworski, & MacInnis (1986) conducted the study “Strategic brand concept-image management” which delivers the normative framework, named brand concept managament, in order to select, implement and control the brand image by the time progress. Erdem & Swait (2004) provided the study “Brand credibility, brand consideration, and choice.”and they studied how trustworthy and knowledgeable a brand is, and how it affects what people choose to buy, especially in product categories where it's hard to know what to choose, or where there are risks. They found that if a brand is trustworthy and knowledgeable, it's more likely to be chosen. This is especially true in categories where there's a lot of uncertainty or where people are especially sensitive to uncertainty. However, this effect is present in all categories. They also found that being trustworthy is more important than being.

Sum up, image could even add value by assisting customers in processing information, differentiating the brand, generating reasons to buy, eliciting positive emotions, and providing a foundation for extensions (Aaker, 1991).

2.5.3. Perceived Value

Perceived value is a crucial concept in the field of marketing, as it is a key determinant of consumer behavior. It refers to the overall worth or utility that a product or service provides to a consumer, based on their perception of what they receive in exchange for what they give up. In other words, it is a subjective assessment of the benefits and sacrifices associated with a product or service. To better understand perceived value, various scholars have proposed different definitions and dimensions of the concept. Schechter (1984) emphasized that perceived value is composed of both qualitative and quantitative, objective and subjective factors that jointly form a buyer's experience. Dodds (1991) defined perceived value as the ratio of perceived benefit to perceived sacrifice, which implies that

Sensitivity: Public

consumers compare what they receive to what they give up determining the value of a product. On the other hand, Sheth, Newman, & Gross (1991) conducted the study “Why we buy what we buy: A theory of consumption values” which presents a theory developed to explain why consumers make the choices they make. The theory identifies five consumption values that influence consumer choice behavior and described the perceived value as involving 5 different dimensions as functional, conditional, social, emotional and epistemic.

In the meantime, Boksberger & Melsen (2011) also examined the three different dimensions to describe perceived value as (1) societal that includes service industry, social corporate responsibility, business ethics, individual customer, attitude, desired values, comparison standards, expectations; (2) transaction-specific that includes service excellence, service recovery, pricing, value creation, service quality, customer satisfaction, consumption values, benefits and (3)end-state values that includes customer lifetime value, service profit chain, relationship marketing, quality of life wellbeing. Another definition example would be of Woodruff and Gardial’s (1996) , they described perceived value as a trade-off between desirable attributes and sacrificed attributes, suggesting that consumers evaluate a product based on its positive and negative aspects. Despite these different definitions, the most widely accepted definition of perceived value is that of Zeithaml (1988), who identified four dimensions of value: (1) "low price," (2) "whatever I want in a product," (3) "the quality I get for the price I pay," and (4) "what I get for what I give.". Zeithaml (1988) synthetically defined perceived value as the consumer's overall assessment of the utility of a product based on the perception of what is received and what is given. The concept of perceived value is particularly relevant in the context of RVCs, as these products are relatively new and may not be well-understood by consumers. Thus, understanding the perceived value of RVCs can help companies design and market these products in a way that meets consumers' needs and expectations. This study refers to the perceived value of RVCs as the potential customer's overall perception of RVCs based on their benefits and sacrifices. By investigating the factors that contribute to perceived value in the context of RVCs, this study can help companies develop effective marketing strategies and improve the adoption and usage of these products by consumers. The perceived value of robotic vacuum cleaner (RVC) will positively effect intention to use.

Hypothesis 4: Perceived Value has a straight and positive effect on the intention to use of Robotic Vacuum Cleaner (RVC).

2.5.3.1. Perceived Benefit

Perceived value is a one of the concepts in marketing that has a role in consumer decision-making, brand loyalty, and overall business success. It refers to the worth or benefit that a consumer believes they will receive from a product or service in relation to the cost or sacrifice required to obtain it. This brief academic overview explores the fundamental aspects of perceived value, its significance in marketing, and its influence on consumer behavior. In other word, "Perceived value" pertains to how a

Sensitivity: Public

user assesses the value and practicality of a specific technology or system. It constitutes a critical factor in determining whether users will embrace and utilize a technology. Perceived value serves as an indicator of a consumer's intention to adopt, reflecting its utility by comparing the benefits against the sacrifices (Knight & Young Kim, 2007).

On the other hand, in the Unified Theory of Acceptance and Use of Technology (UTAUT) model, perceived value is not explicitly one of the core constructs, but it is related to other constructs within the model. The UTAUT model was developed to understand and predict users' acceptance and use of technology, especially information systems and technologies in organizational settings (Venkatesh, Thong, & Xu, 2012). Therefore, with the combination of the following five different constructs as performance expectancy, effort expectancy, hedonic motivation, time saving and energy saving, perceived value has been evaluated in this study.

Hypothesis 5: Overall perceived benefit positively effects the intention to use of Robotic Vacuum Cleaner (RVC).

2.5.3.1.1. Performance Expectancy

Performance Expectancy is the grade to which an individual believes that using a certain technology will support individual maintain improved performance (Mahande, 2018). It's classified under Perceived Benefit in our study which constitute performance expectancy. Performance expectancy is an users' belief which says that technology will make easier their daily activities (Venkatesh V. , Morris, Davis, & Davis, 2003). There are many studies in the literature figured out that performance expectancy is a crucial and important predictor for the technology usage in the long term. When users feel the benefits of the technology, it will encourage them to use the technology continuously (Lin S.-P. , 2014).

Another research which has been completed in health sector also shows that performance expectancy is a variable that impacts the users' intention to use technology (Wei, Vinnikova, Lu, & Xu, 2020).

Hypothesis 6: The performance expectancy has positively influence on the behavior intention to use of Robotic Vacuum Cleaner (RVC).

Additionally, there are many studies that examined the distinctions in acceptance behavior for gender between men and women (Meyers-Levy & Maheswaran, 1991); (Venkatesh & Morris, 2000). Men have shown to be usually more pragmatic and task-oriented than women. Furthermore, men generally feel more comfortable to tr your use new technologies. Conversely, when compared to men, women are observed to have a superior awareness of other's feelings, and, additionally they are much more affected by others. That's why, it can be said that men are mostly canalized by Performance Expectancy, while women are mostly canalized by Effort Expectancy and Social Influence. When comes to gender and age comparison in the literature, there is less attention for age in the literature. Young

Sensitivity: Public

users are mostly canalized by Performance Expectancy, while older users are mostly canalized by Effort Expectancy (Morris & Venkatesh, 2000; Venkatesh V. , Morris, Davis, & Davis, 2003).

2.5.3.1.2. Effort Expectancy

In purchasing process of the technological products, most of the consumers have an expectation about the product before use. This expectation is usually related to the level of effort required to use the product, i.e. the level of mental or physical effort required to use the product. Effort Expectancy is the grade of the ease of use associated with the specific technology usage and it incorporates the element of perceived ease of use and benefit. Technology adoption will be quickly adopted by its users if the capabilities of the technology are easy to use. Venkatesh et al. (Venkatesh V. , Morris, Davis, & Davis, 2003) describes the effort expectancy as the ease of using, If the individuals feel that it requires a little effort while using technology, they will definitely feel the relief.

Hypothesis 7: The effort expectancy has positively influence on the behavior intention to use of Robotic Vacuum Cleaner (RVC).

There are many studies in the literature to show the influences of the users' effort expectancies on the intention to use of the technology. Davis, Bagozzi, & Warshaw conducted the study "User acceptance of computer technology: a comparison of two theoretical models" that uses the technology Acceptance Model to examine the users' acceptance of new technologies and argues that the expectation of effort during use of the product is a key factor in product acceptance. The arcticle mostly indicates that technology acceptance is based on factors such as ease of use, usefulness, performance and effort expectancy. Davis, Bagozzi, & Warshaw (1992) provided a study "Extrinsic and intrinsic motivation to use computers in the workplace" and this article improves on the Technology Acceptance Model presented in the previous article and focuses more on the effort expectancy required for product use. The article argues that motivation for product use depends on factors such as product ease of use, usefulness of use, and effort of use. In the article, the relationship between employees' motivation for computer use in the workplace and their effort expectatcy is examined. The study "What drives mobile commerce? An empirical evaluation of the revised technology acceptance model" has been conducted by Wu and Wang (2005) and this article tests the Technology Acceptance Model in the context of mobile commerce. In the article, it is stated that factors such as usage effort and ease of use play an important role in the acceptance of mobile commerce applications.

As a result, the effort expectancy variable of the Technology Acceptance Model is an important factor in the acceptance of a product and many studies have been done on this subject. The effect of

Sensitivity: Public

effort expectancy level on product acceptance has been studied in different technological products and contexts.

2.5.3.1.3. Hedonic Motivation

In its broadest sense, hedonic shopping motivation is described as an individual's attempt to maximize their sense of pleasure while performing a specific action (Veenhoven, 2009). Hedonic shopping motivation, which is based on lowering unpleasant experiences and rising positive experiences by improving them (Ryan & Deci, 2001). Hedonism is associated with the drive for fulfillment and self-realization. According to Babin et al. shopping can lower stress levels, lift one's spirits, and naturally elicit a positive emotional response in one's heart (Babin, Darden, & Griffin, 1994). Hedonic value, according to Roy and Ng (Roy & Ng, 2011), is the typically very strong emotion that consumers have toward a product. They would take into account all possible emotions a product might evoke, as well as the costs they would incur and the benefits they would actually experience, such as feelings of pleasure, enjoyment, and escapism. Using a robot vacuum can provide an enjoyable experience for people with hedonic motivation. Using a robot vacuum can provide people with more free time and convenience by reducing the time and effort spent cleaning the house. Also, by using a robot vacuum, people can clean more efficiently and regularly, which can help people create a more pleasant environment in their homes. Therefore, the use of a robot vacuum can be an attractive option for people with hedonic motivation, reducing the time and effort spent on housekeeping, offering people more leisure time and an enjoyable lifestyle. The study of “Measuring the Hedonic and Utilitarian Sources of Consumer Attitudes” conducted by Batra and Ahtola, presents that "Appearance", "entertainment", "impulsive satisfaction", "emotional satisfaction" and "aesthetic satisfaction" were determined as the sources of hedonic motivation. This study is shown as an example of examining different dimensions of hedonic motivation in the field of consumer behavior (Batra & Ahtola, 1991).

> *Hypothesis 8: Hedonic motivation has a positive effect on the intention to use of Robotic Vacuum Cleaner (RVC).*

2.5.3.1.4. Time Saving

There are many academic articles on the importance of time saving benefit under perceived benefit when purchasing a robot vacuum cleaner. In the business and marketing literature, many studies have been conducted on the perceived benefits consumers perceive when purchasing a product. One of the academic articles on this subject is "A Framework for Evaluating the Costs and Benefits of Instrumentation in Smart Home Systems". This article examines the perceived benefits and costs of

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automated home technologies by consumers. The article highlights the importance of the time-saving benefit of automated home technologies. Another article “The Development Prospect of Cleaning Robot in Chinese Market in the Next Ten Years” conducted by Zang (2022) explains that robotic vacuum cleaners provide more free time to individual. Kadioglu (2020) also mentioned in their study that users think that robotic vacuum cleaners save time and cleans houses in detail, even while there is no person at home. This time saving benefit allows consumers to spend less time on cleaning and focusing on other work or leisure activities. As a result, there are academic researches showing that the benefit of saving time has an important place among the benefits perceived by consumers of automatic household cleaning devices such as robot vacuums. This benefit allows consumers to focus on other work or leisure activities by reducing the time they spend cleaning the house and is therefore an important factor for consumers looking to purchase a robot vacuum cleaner.

Hypothesis 9: Time Saving is positively linked to perceived value.

2.5.3.1.5. Energy Saving

Let's start with the 1900s, which historians refer to as the "Industrial Revolution" in domestic life. Electricity was installed in domestic settings, enabling the use of modern appliances like automatic dishwashers, televisions, and upright vacuum cleaners on a regular basis. In the 2000s, a century later, home life is undergoing a "Digital Revolution." The second generation of smart home technologies automates domestic labor, which the first wave reduced. Not only can you control these smart gadgets with your smartphone, but you can also schedule when your front door closes at night in addition to their ability to connect to the internet. Today, the definition of "smart" gadgets does not take the whole environmental impact into account. In general, Smart Home Technologies may help to lower energy consumption. However, according to the research (Nicholls & Strengers, 2019), robotic vacuum cleaners may consume more energy than consumers expected, and it well summarized the comparison of energy usages of robotic vacuum cleaners and traditional vacuum cleaners. SHTs (Smart Home Technologies) provide many different types of advantages. The most well-known are lifestyle advantages like ease of use, comfort, or safety. Robotic vacuums, often known as robotic vacuum cleaners, are the Smart Home Technologies (SHTs) equipment that have been adopted the most commonly. There are currently more than 17 million robotic vacuum cleaners in use all over the world and it expected to reach up to around 61 million in 2028 (Meticulous Research, 2021). Nicholls and Strengers (Robotic vacuum cleaners save energy? Raising cleanliness conventions and energy demand in Australian households with smart home technologies, 2019) looked into how these smart devices might affect society and the environment. The researchers examined the connection between robotic vacuum cleaners, cleaning standards, and overall energy consumption in Australian households through a series of in-home interviews and participant-led "technology tours," with interesting findings. Despite the fact that robotic vacuum cleaners are advertised as being more energy-efficient, the authors found

Sensitivity: Public

that people are using these appliances used more electricity. Robotic vacuum cleaners consume less electricity per hour than manual vacuums, which is why they are referred to as "energy-saving" equipment. The authors found that owners continued to use conventional vacuums for "proper" cleaning despite their expectations that robotic vacuums would displace manual ones. Even while it was entertaining, the robotic vacuum cleaners were ultimately the less effective compared to traditional one. Most households accepted the limitations of their robotic vacuum cleaners and filled in the gaps with additional human effort because they were influenced by the entertainment or emotional value of these devices. As a result, the robotic vacuum increased overall energy use rather than reducing it (Nicholls & Strengers, 2019).

Unlike this study (Nicholls & Strengers) made in 2019, well-known and best sellers brands communicate that robotic vacuum cleaners uses less energy than traditional vacuum cleaners. For instance, iRobot which is the key player in the global robotic vacuum cleaner market declared that its product completely convenient with the U.S. Department of Energy, EU and remaining major regulations in other regions on the consumption of power and energy efficiency (iRobot, 2023) by highlighting that Roomba robot vacuums that use vSLAM (Vision Simultaneous Localization and Mapping) technology can create a digital map of the room they are cleaning by calculating their position in real-time. This enables them to vacuum in straight lines, increasing efficiency. Additionally, they have a low power detection feature that prompts them to return to the charging station for recharging. If the comparison is being made between traditional vacuums and robotic vacuum cleaner, the difference in power consumption may resulted from the size of the house, the frequency of vacuuming routine and the efficiency of the vacuum you use.

And additionally knowing the differences between the conserving energy and energy efficiency. Energy conservation and efficiency are two differentiated concepts in the energy industry. Energy conservation includes changing behaviors and habits to use less energy, while energy efficiency includes using technology that consumes less energy to perform the same task. Examples of energy-efficient technology include smart home hubs like Constellation Connect, energy-saving light bulbs, smart thermostats, and large home appliances. So that, energy saving is directly affected by the selected model and brand. According to the study published by Smart Homeness (2022), Robot vacuums' energy efficiency can be measured in various ways. One common method is through energy efficiency ratings and labels, such as the Energy Star[7] label in the US, which indicates that the product meets certain energy efficiency standards set by the Environmental Protection Agency (EPA). Additionally, energy efficiency can be measured through direct measurement of energy consumption by measuring the vacuum's power usage over a period of time and converting that to kilowatt hours (kWh). This can provide a more

[7] "Energy Star is the trusted, government-backed symbol for energy efficiency helping us all save money and protect the environment through energy-efficient products and practices."

Sensitivity: Public

accurate representation of a vacuum's energy usage than a simple rating or label. Furthermore, as mentioned above, energy consumption is changing model by model. Smart Homeness look at the "Roborock S7 with a power consumption 68 watts" for 2 hours daily use and calculate the energy consumption with the following formula: E = P (W) x T (h) [kWh], "where E is energy consumption measured in kilowatt-hours (kWh), P is power measured in watts, and T is the time measured in hours".

E = P (W) x T (h) [kWh]

E = 68 W x 2 h ÷ 1000 [kWh]

E = 0.136 kWh

As a result, it is seen that 0.136 kWh of energy has been consumed which can be still reported as lower than any other home appliances.

Another calculation has been made for the other model with a power consumption of 33 wats and 1hour daily usage.

E = P (W) x T (h) [kWh]

E = 33 W x 1 h ÷ 1000 [kWh]

E = 0.033 kWh

As a result, it is seen that 0.033 kWh of energy has been calculated for the 1-hour usage of Roomba. which can be still reported as lower than any other home appliances.

It's worthy to note that the cost of running a robot vacuum is also directly affected by electricity rate, which changes according to the where user lives. However, the average cost of running a robot vacuum for an hour is around 2-3 cents. Additionally, a robot vacuum's energy consumption is influenced by multiple variables. The main factors that influence robot vacuum energy consumption are as follows:

a) the size and weight of the robotic vacuum cleaner, and motor power on energy consumption; if the RCV is larger, it will need more power to operate which causes higher energy consumption; more powerful motors might use more energy but depends on the RVC's cleaning mechanism if it is more efficient, RVC may need less power to operate.
b) sensors, navigation, and mapping technology of the owned robotic vacuum cleaner: mapping technology is very helpful which needs energy to make necessary mapping, likely sensors and navigations also need power to operate
c) Impacts of the special modes such as cleaning mode, runtime, and recharge time on energy consumption: Some unique modes like turbo mode might need more power to operate; the time of the recharging period also affects the energy consumption.

In a conclusion, in recent years robotic vacuum cleaners started becoming popular because of being its convenience, benefits, and ease of use. They totally serve automatically so that do not require such high physical effort from the users. When comes to energy consumption, robotic vacuum

Sensitivity: Public

cleaners are more energy-efficient than traditional vacuums in general. According to the measurement presented, even though the level of power consumption varies according to the model, most of the robotic vacuum cleaners use between 20 watts to 100 watts of power, while up to 1500 watts of power can be used up by traditional vacuums.

Hypothesis 10: Energy Saving is positively linked to perceived value.

2.5.3.1.6. Sustainability

Sustainability is a concept that has gained significant attention in recent years due to the increasing environmental, social, and economic challenges faced by the world. According to the Brundtland Report, sustainability is defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development , 1987). This definition highlights the importance of preserving natural resources and ensuring that they are not depleted for future generations. Another definition of sustainability is provided by the United Nations, which defines it as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations General Assembly, 2015). This definition emphasizes the importance of balancing economic, social, and environmental factors in decision-making processes. Sustainability is a complex and multifaceted concept, and there is no single definition that can fully capture its essence. However, the above definitions provide a good starting point for understanding what sustainability is and why it is important.

In recent years, the concept of sustainability has gained increasing importance as society recognizes the need to protect the environment and conserve resources for future generations. Home appliances, in particular, are subject to sustainability measures given their significant impact on the environment and energy bills of consumers. Energy efficiency is a major driver of sustainability in home appliances. Appliances that consume less energy can help reduce greenhouse gas emissions and save consumers money on energy bills. Governments in many countries have introduced regulations requiring manufacturers to meet minimum energy efficiency standards, leading to the development of new technologies and designs that reduce energy consumption in appliances (International Energy Agency, 2018). Another crucial aspect of sustainability in home appliances is the use of renewable resources. Appliances such as solar water heaters and wind turbines are designed to harness natural resources to provide energy, reducing reliance on non-renewable resources such as fossil fuels (Jiang, Zhang, & Li, 2019).

Hypothesis 11: Energy Saving is positively linked to sustainability.

Responsible disposal of products at the end of their life cycle is also critical to sustainability in home appliances. Many appliances contain hazardous materials that can harm the environment if not disposed of correctly. To address this problem, appliance manufacturers have implemented recycling programs

Sensitivity: Public

to ensure proper disposal and recovery of valuable materials (Eco-Cycle, 2021). Consumers play a vital role in promoting sustainability in home appliances by considering the factors mentioned above when making purchasing decisions. Energy-efficient appliances can reduce energy consumption, greenhouse gas emissions, and save consumers money on energy bills. Appliances that use renewable resources can reduce reliance on non-renewable resources, promoting a sustainable future. Proper disposal of appliances can prevent environmental harm, and recycling programs can ensure the recovery of valuable materials. The importance of sustainability in home appliances has been recognized by researchers, policymakers, and industry professionals. Governments' implementation of minimum energy efficiency standards has led to innovation in the appliance industry as manufacturers strive to meet these requirements. Research into the development of renewable energy sources for home appliances has also increased, with many studies focusing on the use of solar and wind power (Jiang, Zhang, & Li, 2019). In conclusion, sustainability is a crucial factor to consider when it comes to home appliances. Energy efficiency, the use of renewable resources, and responsible disposal are all critical components of sustainability. By making informed purchasing decisions, consumers can reduce their environmental impact and promote a sustainable future.

The most obvious advantage of the robotic vacuum cleaners is that they save users time that would otherwise be spent doing it themselves. While the initial versions needed updates, more recent models are built to prevent typical mistakes like getting stuck or obstacles on carpet.

2.5.4. Perceived Risks

Perceived risk is a crucial factor that influences consumer behavior as it relates to the uncertainty and adverse consequences associated with purchasing a product or service. It is an important consideration for marketers and businesses because it affects consumers' buying decisions and ultimately their satisfaction with a product or service. Dowling and Staelin (1994) defined perceived risk as the extent to which consumers believe that a product or service will result in negative outcomes or consequences. There are various dimensions of perceived risk, but among the most commonly used to estimate risk are performance and financial risk which are already included in our proposed research model under perceived risks.

Hypothesis 12: Overall perceived risk negatively effects the intention to use of Robotic Vacuum Cleaner (RVC).

In conclusion, perceived risk is an important factor that influences the consumer decision-making process. Marketers and businesses should consider the various dimensions of perceived risk, particularly performance and financial risk, when developing strategies to mitigate negative perceptions and increase consumer satisfaction.

Sensitivity: Public

2.5.4.1. Performance and Financial Risks

Performance risk is the potential for loss incurred when a brand or product fails to meet a consumer's expectations. Performance risk is the possibility that the product would malfunction and not function as intended and advertised, which would prevent the achievement of the desired results and outcomes (Lee, 2009). On the other hand, financial risk refers to the possibility of monetary loss incurred by the customer, including product repair or replacement and refunds, and also includes possible future costs as well as the perceived price at the point of purchase. Financial risk is characterized as the probability of a purchase resulting in financial loss and the cost of maintaining the good (Lee, 2009). It is important to note that the distinction between financial and performance risk is that the price of the product is an intrinsic component of financial risk, whereas price is not directly related to performance risk. This means that customers may perceive a high price as an indication of financial risk, but a lower price does not necessarily indicate low performance risk. Snoj et al. (2004) used perceived risk as the concept of sacrifice for mobile phone purchases. They found that people who purchased a mobile phone based on its perceived value were willing to make sacrifices to obtain it (Snoj, Pisnik, & Mumel, 2004), they viewed perceived fee (monetary) and technicality (non-monetary) as components of perceived sacrifice, which are similar to financial risk and performance risk, respectively.

In the technology acceptance model, performance risk is the risk that the expected performance during the use of a technology will differ from the actual performance, thus creating user dissatisfaction. For users to adopt a new technology, it is important that the benefits of the technology exceed the costs of its use. However, if the technology's performance is poor or unexpected difficulties arise with its use, users are likely to feel dissatisfied and reject the technology's acceptance. Performance risk may result from the user's perception of how well the technology is performing. For example, a user may expect high performance as advertised for a product but may actually perform less. In addition, if the user's expectations are higher than the technologies that the user has used before, the performance of the new technology may not be satisfactory and performance risk may arise. Performance risk is an important factor in consumers' decisions to accept or reject a new technology. Performance risk is also important if businesses adopt new technologies because the performance of new technology can affect the performance of the business and increase or decrease the competitive advantage of the business. Therefore, businesses should assess the performance risk of a new technology and carefully analyze whether the technology will actually meet expectations.

Hypothesis 13: Performance risk has a negative effect on the perceived value of usage Robotic Vacuum Cleaner (RVC).

Performance risks in adopting a technology such as a robot vacuum cleaner can be as following: cleaning performance of robot vacuums is one of the most important concerns of users. Users expect

Sensitivity: Public

robot vacuums to thoroughly clean floors, carpets and other surfaces, and to perform the cleaning process quickly and effectively. However, the cleaning performance of some robot vacuums may be insufficient, causing users to be dissatisfied. Regarding the navigation performance, robot vacuums use an accurate navigation system when moving between rooms and scanning around without hitting obstacles. However, some robot vacuums' navigation systems may be faulty, causing the robot to go the wrong way or crash into obstacles. Another risk could be about battery life; robot vacuums use a battery to complete the cleaning process. Battery life should meet the user's expectations and should run for at least a few hours on one charge. However, some robot vacuums may have a short battery life, meaning that the user has to charge the robot before completing the cleaning process. Risk of failure could be one of the risks since mechanical and electronic parts of robot vacuums carry a risk of failure. Failures may result in users incurring additional costs and loss of time when the robot needs to be repaired or replaced. These performance risks can play an important role in users' adoption of robot vacuums. Users experience the performance of robot vacuums and see if the technology lives up to expectations is a critical factor in technology acceptance. In addition, manufacturers of robot vacuums must continually improve and update their products to minimize performance risks.

In this research, UTAUT is a theory used to explain the process of adopting a new technology so that financial risk has been taken as one of the factors that affect the adoption of technology. Financial risk is the probability of financial losses associated with the acquisition and use of a technology. For many consumers to adopt a technology, costs are controllable, and the long-term benefits of the technology are likely to outweigh the cost of the investment. However, if the technology is costly or unexpected costs arise from its use, consumers may stop accepting the technology. Therefore, financial risk plays an important role in whether consumers adopt or reject a technology. In our study, financial risks might be like following; Robot vacuums can cost more than conventional vacuums; therefore, the investment cost would be higher. On the other hand, maintenance and repair costs of robot vacuums could be higher compared to traditional vacuums. In addition, robot vacuums can have a short lifespan and require frequent replacement. Although there are developed studies for battery life, robot vacuums can have a limited life and the cost of battery replacement can be high.

Hypothesis 13: Financial risk has a negative effect on the perceived value of usage Robotic Vacuum Cleaner (RVC).

Although they might be expensive, robotic vacuum cleaners are worthwhile purchases. They can clean difficult-to-reach spots while saving you time and energy. They are ideal for busy families since they can recognize barriers and move around them. Robotic vacuum cleaners require little maintenance. Users can quickly put them to clean and forget about them because they are fitted with cutting-edge features.

Sensitivity: Public

2.5.5. Intention to Use

In the Unified Theory of Acceptance and Use of Technology (UTAUT) model, "intention to use" is a crucial construct that represents a user's readiness and willingness to use a particular technology. This intention is a strong predictor of actual technology adoption and use (Venkatesh V. , Morris, Davis, & Davis, 2003).

Hypothesis 14: Perceived Value is positively linked to intention to use

RESEARCH MODEL DEVELOPMENT

This thesis study has been completed to investigate the role of brand image, perceived benefit (performance expectancy, effort expectancy, hedonic motivation, time saving and energy saving), perceived risks (financial risks and performance risks) in the intention use of individuals who are currently non-user of RVC (Robotic vacuum cleaner). During the research, defined constructs have been investigated within the context of UTAUT2 (Unified Theory of Acceptance and Use Technology) Venkatesh et al. (2012) and Stimulus Organism Response Model (SOR) developed by Houston and Rothschild (1977). With this respect, brand image has been determined as Stimulus, perceived value which includes perceived benefit and perceived risk have been determined under Organism. Kotler (2001) defines the brand image as “the set of impressions, beliefs and ideas that a person holds about an object" (p. 273) while Hsieh, Pan and Setiono (2004) explain as “a successful brand image allows consumers to recognize the needs that the brand satisfies and to distinguish the brand from its competitors and increases the probability that consumers will purchase the brand" (p. 252). Intention to use has been evaluated under Response in SOR model. As a result of the study, it is aimed to show that brand image and perceived value foretell the intention to accept RVC technology.

Data collection has been completed under descriptive research by utilizing an online survey. In total, 282 responders have been participated in survey however 59 of 282 responders had been eliminated since they are already users of the robotic vacuum cleaner. Therefore, 223 responders who are not currently using the robotic vacuum cleaner had been taken in the analysis. Whole forecasted variables and factors in the study well summarized in literature review part.

3.1. Research Purpose and Objectives

This study emphasizes the concept of Unified Theory of Acceptance and Use Technology-2 (UTAUT2) and Stimulus Organism Response Theory (SOR) by investigating the different areas that the models have been used and impacted areas. Moreover, detailed information has been provided in the literature review about the Robotic Vacuum Cleaner history, worldwide sales amount, technical information. Indeed, there are still limited studies in the literature about RVC (Robotic Vacuum

Sensitivity: Public

Cleaner). Thus, in this thesis study our main goal is to explore whether the effects on the RVC usage intention of users by applying UTAUT 2 and SOR. In order to proceed the analysis, quantitative data had been collected from the individuals who are currently non-users of the robotic vacuum cleaner.

3.2. Research Method

In order to address a research issue, initially a well-structured research plan must be developed. Essentially, a research design encompasses distinct elements. Firstly, it provides the necessary background information. Subsequently, it involves the choice between an exploratory or descriptive research approach. Following this, research methods and data analysis techniques are determined. Additionally, the formulation of data collection procedures and questionnaires takes place. Next, the process of sampling and specification of the sample size are defined. Ultimately, data analysis is conducted. The main research designs are exploratory and conclusive. Exploratory research is conducted to explore a research problem when little is known about it. It often involves preliminary investigation, open-ended questions, and unstructured data collection methods. The goal is to gain insights and a better understanding of the research problem. Conclusive research aims to measure hypotheses and investigate relationships among variables. Given that the purpose of this study is to test specific hypotheses, it falls under the category of conclusive research. Furthermore, conclusive research can be categorized into two types, namely, descriptive and causal as can be seen in the Figure 20. Causal research aims to establish a cause-and-effect relationship between variables. Researchers use experimental designs to drive one variable and observe its impact on another. The goal is to determine whether changes in one variable result in changes in another. Descriptive research seeks to describe and provide a comprehensive picture of a phenomenon. It involves collecting data to answer specific research questions and typically employs structured research methods, surveys, and standardized data collection instruments. There are two types of research under descriptive research as Cross-sectional and Longitudinal designs. The cross-sectional design is the more commonly used type, requiring data to be collected from a given sample only once. It, in turn, has two variants: single and multiple. In a single cross-sectional design, data is gathered from a single sample just once, whereas in a multiple cross-sectional design, data is collected from two or more samples, also just once. Conversely, a longitudinal design is another subtype, which involves collecting data from a fixed sample on multiple occasions. On the other hand, causal research is centered on identifying cause-and-effect relationships (Malhotra & Birks, 2007).

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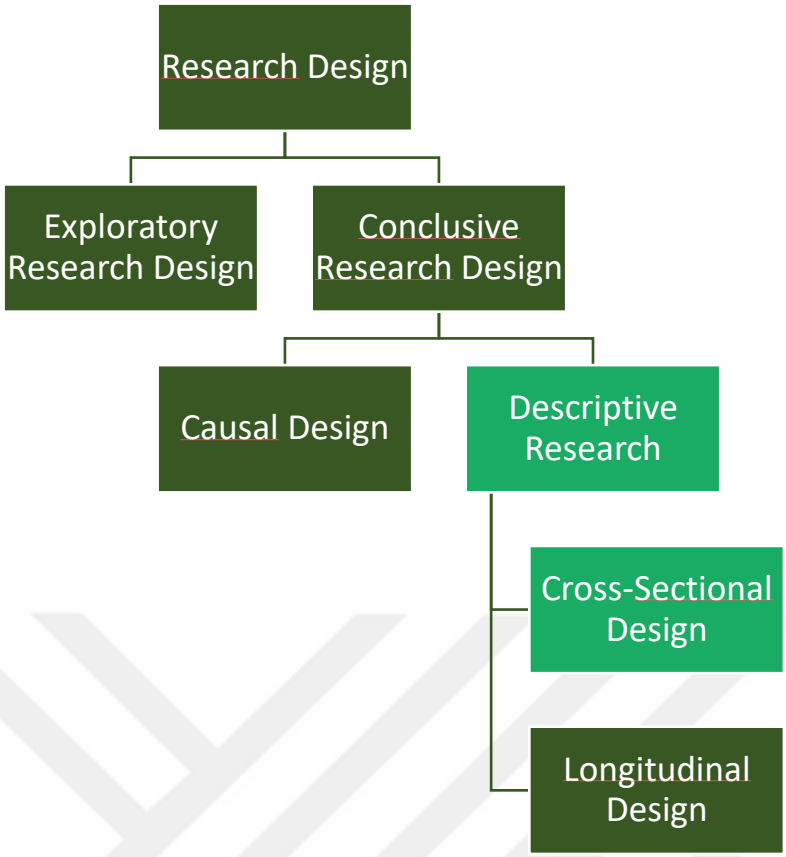


Figure 20. The Classification of Marketing Research Designs
Source: Malhotra, N. K., & Birks, D. F. (2007). *Marketing Research An Applied Approach* (3rd ed.). England: Pearson Education. P. 70

Since this thesis study aims to explore the effects of determined elements on the usage intention of RVC by applying UTAUT2 and SOR theory, it was necessary to use descriptive research. Since one sample has been used to collect the data only once, the samples design is a single cross-sectional. Additionally, the interview has been completed with the manager who is working at one of the well known brand in Turkiye and responsible for Small Domestic Appliances sales.

3.3. Research Model Development

The proposed research model has been provided as a graphical model. According to the existing studies in the literature -which have been analyzed during the literature review process- the research model has been created. As reported, there are very limited study that includes the brand image and perceived value determinants in the context of UTAUT2 and SOR. Since the different and valuable variables haven figured out in those studies including TAMs and extended models, model creation has directly been affected from the outcomes. Proposed research model can be seen in the figure 21.

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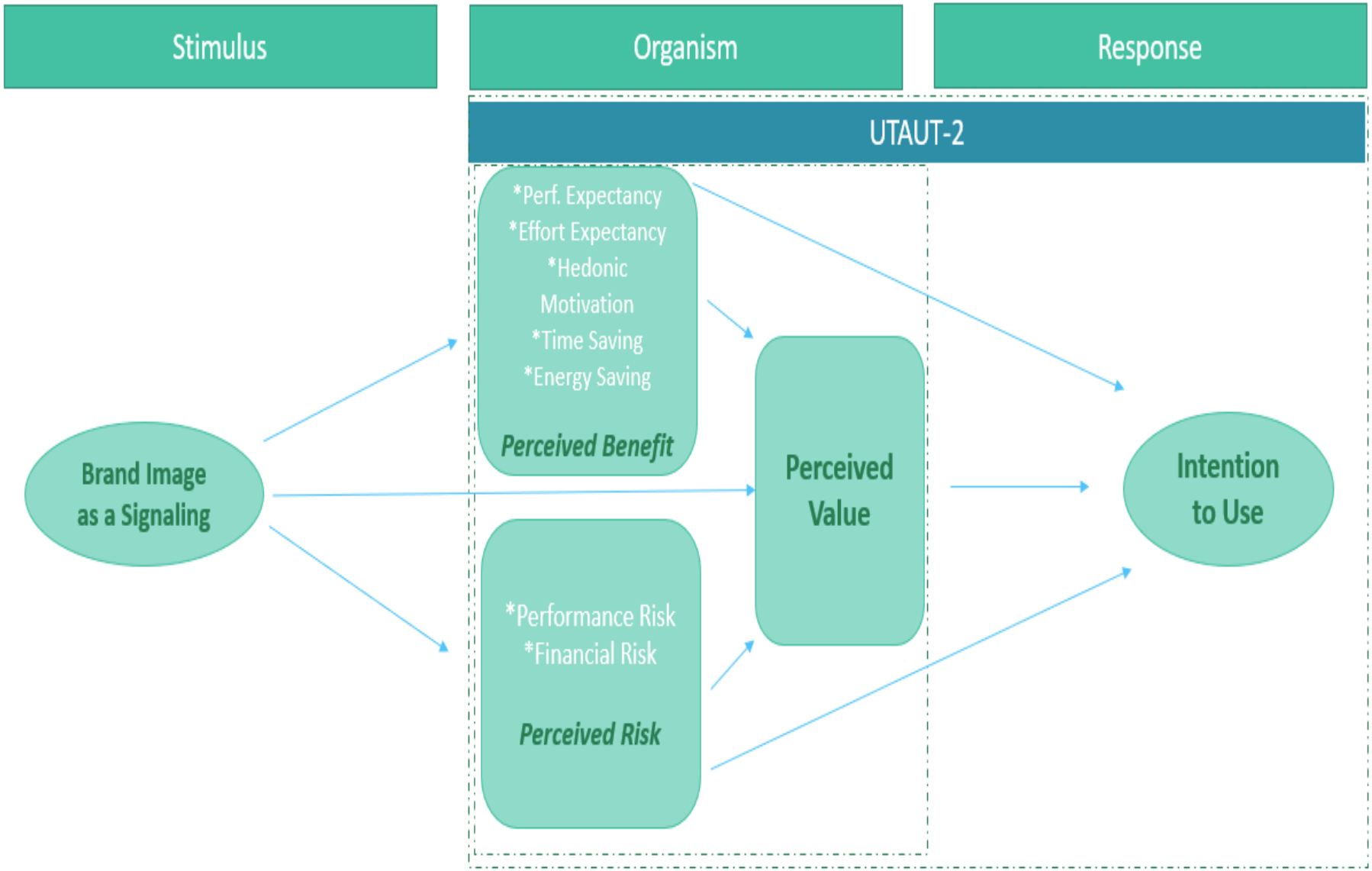


Figure 21: Proposed Research Model

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3.4. Hypothesis of the Study

As underlined in the previous sections, the aim of this thesis study is to explore the effects of brand image and perceived value including perceived benefit and perceived risks on the usage intention of RVC (Robotic Vacuum Cleaner) in the context of UTAUT2 and SOR theory. According to the conceptual model, hypotheses had been created as can be seen in the table 5.

The hypotheses are determined to demonstrate the effects of independent variables on dependent variables. Therefore, regression analysis will be completed in order to measure the relationship.

Table 5: List of Hypotheses

Item No	Hypotheses	Sources
	Stimulus: Brand Image as a Signaling	
H1	Brand Image is positively linked to perceived benefit	Erdem & Swait (2004)
H2	Brand Image has significant relation with perceived risk	
H3	Brand Image has significant relation with perceived value	
	Organism: Unified Theory of Acceptance and Use Technology-2 (UTAUT2)	
H4	Perceived Value has a straight and positive effect on the intention to use of Robotic Vacuum Cleaner (RVC).	Zeithaml (1988)
H5	Overall perceived benefit positively effects the intention to use of Robotic Vacuum Cleaner (RVC).	Developed by the Researcher
H6	The performance expectancy has a straight and positive effect on the intention to use of Robotic Vacuum Cleaner (RVC).	Wei, Vinnikova, Lu, & Xu (2020)
H7	The effort expectancy has a straight and positive effect on the intention to use of Robotic Vacuum Cleaner (RVC).	Venkatesh V., Morris, Davis, & Davis (2003)
H8	Hedonic motivation has a positive effect on the intention to use of Robotic Vacuum Cleaner (RVC).	Batra & Ahtola (1991)
H9	Time Saving is positively linked to perceived value.	Kadioglu (2020)
H10	Energy Saving is positively linked to perceived value.	Smart Homeness (2022)
H11	Energy Saving is positively linked to sustainability.	Jiang, Zhang, & Li (2019)
H12	Overall perceived risk negatively effects the intention to use of Robotic Vacuum Cleaner (RVC).	Dowling and Staelin (1994)
H13	Performance risk has a negative effect on the perceived value of usage Robotic Vacuum Cleaner (RVC).	Snoj et al. (2004)
H14	Financial risk has a negative effect on the perceived value of usage Robotic Vacuum Cleaner (RVC).	Snoj et al. (2004)
	Responses: Intention to Use	
H15	Perceived Value is positively linked to intention to use	Developed by the Researcher

Sensitivity: Public

3.5. Variables of the Study

As indicated in the previous parts, quantitative method has been used for the hypotheses examination. To do that, data collection has been made with survey and this survey has been created based on the items shared in the table 6.

In total, there are 5 separated variables, which are “Perceived Risks”, “Perceived Benefit”, “Perceived Value”, “Intention to use” and finally “Brand Image”. Each of these variables had been analyzed by different items which are based on the previous literature review. In total, 33 items are implemented to design the survey as a survey question. To examine all items, 5 points Likert scales had been used, ranging from “strongly don’t agree (1)” to “strongly agree”. In the first section, questions about currently used vacuum cleaner and its brand, how much the user know about robotic vacuum cleaner etc. Additionally, questions about demographic and socio-economic information had been asked to understand the basic characteristics of the sample group. Table 6 shows the used variables, items and the references from the literature.

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Table 6: List of Measured Items

Perceived Risks		**Performance risk (PR)**	**Source**
	PR1	I worry about whether RVC will not provide the level of benefits I expect	Stone and Grønhaug-1993
	PR2	It is uncertain that RVC will work satisfactorily	
	PR3	It is uncertain that RVC will perform the functions that were described in the advertisement	
		Financial risk (FR)	
	FR1	Using RVC entails financial risks due to potential higher maintenance and repair costs.	Grewal et al. (1994)
	FR2	Considering the potential investment involved, Purchasing and using RVC is risky	
	FR3	Using RVC carries financial risks	
Perceived Benefit		**Perceived Benefit**	
		Performance Expectancy	
	PE1	Using a robot vacuum cleaner will effectively remove dust and dirt from my home.	Venkatesh et al. 2003
	PE2	Using a robot vacuum cleaner will make the cleaning work in my house easier for me.	Venkatesh et al. 2003
	PE3	Using a robot vacuum will make cleaning jobs in my house less stressful for me.	Venkatesh et al. 2003
		Effort Expectancy	
	EE1	When using RVC, I think it will make my work easier.	Davis, Bagozzi, & Warshaw (1992)
	EE2	Using RVC does not require a lot of effort for me.	Davis, Bagozzi, & Warshaw (1992)
	EE3	When using RVC, I do not have to expend a lot of energy	Davis, Bagozzi, & Warshaw (1992)
		Hedonic Motivation	
	HM1	The use of RVC makes me feel exited	Batra & Ahtola (1991)
	HM2	The use of RVC gives me pleasure	
	HM3	Using RVC is truly fun	
		Time Saving	
	TS1	When using RVC, I think it will help me get things done faster.	Kadioglu (2020), Zhang (2022)
	TS2	By using RVC, I will save time in my daily routine work.	Kadioglu (2020), Zhang (2022)
	TS3	By using a robotic vacuum cleaner I can complete my tasks more quickly.	Zhang (2022)
	TS4	I can use the time saved from house cleaning with a robot vacuum for sustainability purposes.	Zhang (2022)
		Energy Saving	
	ES1	I believe that RVCs save energy.	Smart Homeness (2022)
	ES2	I believe that RVCs has the low energy consumption.	Smart Homeness (2022)
	ES3	I believe that low energy consumption of RVCs contributes to the sustainable environment	Jiang, Zhang, & Li (2019)
	ES4	The energy saving of RVCs encourages the use of technology in an environmentally friendly way.	Jiang, Zhang, & Li (2019)
Perceived Value		**Perceived Value (PV)**	
	PV1	I think that Using RVC offers value for money	Sirdeshmukh et al. (2002)
	PV2	Compared to the effort to put, using RVCs is useful to me	
	PV3	Compared to the time to spend, using RVCs is worthwhile to me	
	PV4	In general, i think that using RVCs delivers me good value	
Intention to use (IU)		**Intention to use (IU)**	
	IU1	Using RVC is worthwhile	Davis et al. (1989) and Venkatesh et al. (2003;2012)
	IU2	I intend to use RVC in the future	
	IU3	I predict I would use RVC in the future	
Brand Image		**Brand Image**	
	BI1	I have a good impression of brand image while choosing RVC	Nguyen & Leblanc (2001)
	BI2	For me, good brand image effects my decision to use RVC	Nguyen & Leblanc (2001)
	BI3	I think, having better brand image directly effects the decision to use RVC	Nguyen & Leblanc (2001)

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3.6. Sampling Design

Prior to conducting the survey, the target population had been defined, appropriate sampling techniques had been selected, and the sample size had been established. Further explanations had been shared in the next sections.

3.6.1. Target Population

The target population is a specific group of people from whom data is being collected (Malhotra & Birks, 2007). In this study, the target population is composed of individuals who are not using the robotic vacuum cleaner currently and university student.

3.6.2. Sampling Technique

The survey had been conducted from totally 282 respondents and 223 of them has taken place in the target population. Because 59 respondents are already user of the robotic vacuum cleaner. Hence, the survey is carried out using convenience sampling that is one of a non-probability sampling method. Convenience sampling falls within the category of non-probability sampling, and it involves the primary interviewer making the sample selection. Non-probability sampling, in fact, hinges on the researcher's choice in sample selection rather than relying on chance. In essence, respondents are chosen simply because they happen to be available at the right place and time. Furthermore, convenience sampling is a commonly employed method for surveys conducted over the Internet (Malhotra & Birks, 2007).

In order to reach aimed respondents survey had been shared by university lecturers with their students also. The data had been finally collected on the online survey form.

3.6.3. Sampling Size

According to the consideration from literature, the sample size plays a crucial role in data analysis, and it’s needed number to proceed the data analysis (Israel, 1992). The required sample size depends on the type of analysis being conducted. If the analysis involves descriptive statistics such as mean and frequencies, then nearly any sample size will be sufficient. However, for more advanced analyses like multiple regression, analysis of covariance, or loglinear analysis, a larger sample size is needed. In these cases, a good size sample, typically ranging from 200 to 500, is recommended. This larger sample size is particularly important for conducting more comprehensive state impact assessments.

The choice of sample size should be appropriate for the specific type of analysis being carried out. It is necessary to ensure that the sample size is adequate to obtain accurate and reliable results. Therefore, researchers should carefully consider the sample size requirements based on the complexity and

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objectives of their analysis. By selecting an appropriate sample size, researchers can enhance the validity and generalizability of their findings.

In this study, 223 responses were appropriate to use as a non-user of robotic vacuum cleaners and analysis has been completed accordingly.

3.7. Data Collection Method

Quantitative method had been used to collect the primary data with survey. In total 44 questions have been asked to respondents that includes demographic information, intention, motivation and behavior about the robotic vacuum cleaner. Six parts had been created in questionnaire. First part was explaining the research study and its aim. Second part includes the questions about available vacuum cleaner usage of respondents. Third part includes questions to measure the knowledge about robotic vacuum cleaner. Fourth part includes questions about main variable in the proposed research model as perceived benefit and perceived risks under perceived value, brand image and intention to use. 5 points Likert scale ranging from “strongly don’t agree (1)” to “strongly agree” had been used for fourth part. Fifth part includes the questions about size of house, house vacuuming frequency and reasons to desire using robotic vacuum cleaner. Sixth part includes the questions about demographic information. The online survey had been completed by using Google Forms. Responses had been gathered from Turkish citizens only and survey can be seen in the appendix both in English and Turkish.

3.8. Data Analysis Method

The collected data had been analyzed by using statistical program ADANCO 2.3.2. utilized partial least square path modeling (PLS-PM) to draw conclusions regarding the proposed hypotheses. Furthermore, since PLS is a Structural Equation Modeling approach, it empowers researchers to assess intricate connections among variables, encompassing their direct, indirect, and moderating associations, as discussed by Nitzl et al. (Nitzl, Roldan, & Cepeda, 2016).

RESEARCH FINDINGS

This section of the study will cover the examination of non-response bias, a descriptive analysis of respondents, an assessment of constructs, the model's goodness of fit, an analysis of the structural model, and the examination of group differences. Additionally, it will include outcome of the survey and its interpretation.

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4.1. Non-Response Bias Test

Non-response bias is a potential issue in survey research that occurs when individuals who do not respond to a survey differ systematically from those who do respond, leading to biased results. To assess non-response bias, researchers can conduct a non-response bias test. A non-response bias test involves comparing the characteristics of respondents and non-respondents to identify any significant differences. This can be done by analyzing demographic information or other relevant variables between the two groups. The goal is to determine if there are any systematic differences that may impact the generalizability of the survey results. To examine non-response bias, researchers often employ the extrapolation method and compare early and late responders. In a study by Rogelberg and Luong (1998), the authors define non-response bias as the difference between individuals who respond to a survey and those who do not, on variables relevant to the survey topic. bias, researchers can enhance the reliability and generalizability of their survey findings (Rogelberg & Luong, 1998). In this study also, in order to compare early and last responses to see whether there is difference between variable, t-test had been applied and there was no important at the level of 0,5 difference between the groups.

4.2. Descriptive Analysis of Respondents

As mentioned in the previous section, during survey data collection has been conducted from 223 respondents. To provide a well explained survey results, descriptive analysis has been completed. Including demographics, socioeconomic characteristics, and the participants' habits on vacuum cleaner usage had been provided.

4.2.1. Demographic and Socioeconomic Characteristics

The table 7 shows the demographic summary of the respondents.

The high attendees from females with percentage of 57,8% while the percentage of males is 41,3%. There are participants who do not willing to share their gender with the percentage of 0,9%. From the total of 223 respondents, 129 of them is female and 92 of them male. 2 respondents did not prefer to state the gender info.

The age group of 18-25 years has highest rate with 46,2%, the age of 26-35 years is following it with the percentage of 45,3%. It means that remarkable participation ratio is coming from 18-35 years with the percentage of 91,5%. In total, 204 respondents are available in this age group. 17 respondents are existing from 36-45 years with the percentage of 7,6%. And lastly, 2 respondents are available for the age of older than 46. Whole respondents are currently university student. 87 of total respondents is continuing university with the percentage of 39% in total respondents and 136 of them is continuing master's and PhD degree with the percentage of 61% in total respondents. The survey had been

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conducted from Turkish students. Finally, there are 5 different income level had been indicated in the survey; the group of 8.500₺ and below has the percentage of 27,4%, the group of 8.501₺ - 15.000₺ presents the percentage of 16,1%, the group of 15.001₺ - 28.000₺ presents the percentage of 26%, the group of 28.000₺ - 34.500₺ presents the percentage of 21,1% and lastly the group of 34.501₺ and above presents the percentage of 9,4%. The income levels had been asked on the Turkish Lira basis.

Table 7: Sample's Demographic and Socioeconomic Characteristics

Attributes	Distribution	Frequency	%
Gender	Female	129	57,8%
	Male	92	41,3%
	Not Stated	2	0,9%
Age	18-25 years	103	46,2%
	26-35 years	101	45,3%
	36-45 years	17	7,6%
	46 + years	2	0,9%
Education	University (Continuing)	87	39,0%
	Master's - PhD (Continuing)	136	61,0%
Income	8.500₺ and below	61	27,4%
	8.501₺ - 15.000₺	36	16,1%
	15.001₺ - 28.000₺	58	26,0%
	28.000₺ - 34.500₺	47	21,1%
	34.501₺ and above	21	9,4%

Source: Computed by the researcher

4.2.2. Vacuum Cleaner Usage Habits of the Sample Group

In order to see the frequency of vacuuming the house, the question had been asked to the participants. once a day and once a week together have the highest level with 124 respondents and twice a week follows up with totally 95 respondents.

Table 8: Frequency of Vacuuming the House of the Sample Group

Frequency	Not Stated	Female	Male	Grand Total
Once a day		71	23	94
Once a month			2	2
Once a week	1	13	16	30
Twice a week	1	45	49	95
Bi-weekly			2	2
Grand Total	**2**	**129**	**92**	**223**

Source: Computed by the researcher

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The table 9 also shows the distribution of currently used vacuum cleaners in the houses of respondents.

Table 9: Types of Vacuum Cleaner Currently Used

Bagged Vacuum Cleaner	61
Bagged Vacuum Cleaner, Bagless Vacuum Cleaner	4
Bagged Vacuum Cleaner, Upright Vacuum Cleaner	8
Bagless Vacuum Cleaner	65
Bagless Vacuum Cleaner, Upright Vacuum Cleaner	7
Other	3
Upright Vacuum Cleaner	75
Grand Total	**223**

Source: Computed by the researcher

4.2.3. Awareness about Robotic Vacuum Cleaner of the Sample Group

20 respondents with the percentage of 8,97% indicated that they currently do not consider the using Robotic Vacuum Cleaner. While 98 respondents with the percentage of 43,95% may consider the using Robotic Vacuum Cleaner. Lastly, 105 respondents with the percentage of 47,09% definitely consider the using robotic vacuum cleaner according to the initial question had been asked to participants in the third section of survey. Figure 22 shows the percentage distribution.

Table 10: Number of Respondents Considering the Using Robotic Vacuum Cleaner

Maybe	98
No	20
Yes	105
Grand Total	**223**

Source: Computed by the researcher

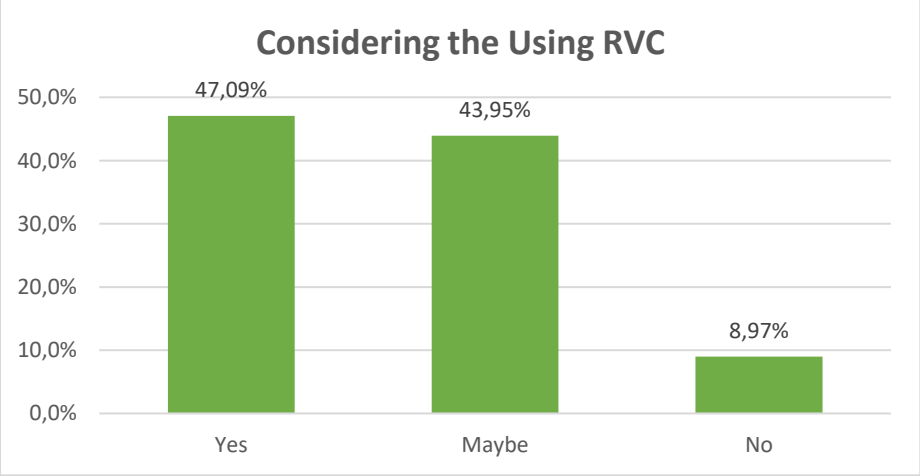


Figure 22: Consideration of the Using Robotic Vacuum Cleaner

Source: Computed by the researcher

Sensitivity: Public

In the third section of the survey, there was a specific question which was asking about the knowledgeable level of the respondents about the Robotic Vacuum Cleaner. According to results, 8 participants with the percentage of 3,6% have no idea about robotic vacuum cleaner so that maybe they consider the using robotic vacuum cleaner. 73 of the total respondents with the percentage of 32,7% indicated that they have very little knowledge. 89 respondents with the percentage of 39,9% indicated that they have some information about robotic vacuum cleaner. 35 respondents with the percentage of 15,7% specified that they have a good level of knowledge and lastly 18 respondents with the percentage of 8,1% indicated that they have very good level of knowledge.

According to the mentioned question in the third section, the details about number of respondents whether consider the using vacuum cleaner can be seen in the appendix 5.

Table 11: Knowledgeable Level of the Respondents about the Robotic Vacuum Cleaners

Level of Knowledge	Frequency	%
1 (have no knowledge)	8	3,6%
2 (have very little knowledge)	73	32,7%
3 (have some knowledge)	89	39,9%
4 (have good knowledge)	35	15,7%
5 (have very good knowledge)	18	8,1%
Grand Total	**223**	**100%**

Source: Computed by the researcher

4.2.4. Special Reasons to Desire Using Robotic Vacuum Cleaner

One of the last questions in the survey was asking to respondents about special reasons to desire using robotic vacuum cleaner. And some proposals had been also shared as having child and/or pet, having health issue, personal interest in technological products, the feeling of always having a clean home. And the respondents were allowed to make multiple choices and add their own special reasons as well. The table in the Appendix 6 shows all the special reasons' combinations which conducted from survey.

4.3. Analysis of the Constructs

4.3.1. Normal Distribution Test

The normal distribution test, also referred to as the normality test, is a statistical technique employed to ascertain whether a given dataset adheres to a normal distribution. Researchers across various domains like psychology, economics, and engineering routinely employ this test to evaluate the assumption of normality before proceeding with further statistical analyses. Skewness and kurtosis are

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important statistical measures used to understand the shape and distribution of data. They provide insights into the symmetry and the tail behavior of a dataset. Skewness is a measure of the asymmetry in the distribution of data. Kurtosis measures the thickness of the tails and the peakedness of a distribution. The acceptable range for Kurtosis and Skewness, as suggested by Tabachnick, Fidell, & Ullman (2013), falls within -1.5 and 1.5. Based on the results, it can be observed that the dependent variables exhibit a normal distribution, given that the values of Skewness and Kurtosis for all dependent variables fall within the range of +1.5 to -1.5. Even though the Kurtosis value for Brand Image (BI3= is slightly higher as 1.69, it still falls within an acceptable range. On the other hand, according to George and Mallery (2010), a Kurtosis value between +2 and -2 can also be considered acceptable in many instances.

At the beginning of the analysis, normal distribution test had been made by using ADANCO 2.3.2 and the results has been shown in the table 12.

Table 12: Findings of the Normal Distribution Test

Indicator	Skewness	Kurtosis
Performance Risk 1	0,135	-0,913
Performance Risk 2	-0,051	-0,818
Performance Risk 3	0,110	-0,561
Financial Risk 1	0,043	-0,860
Financial Risk 3	0,214	-0,872
Performance Expectancy 1	-0,715	0,241
Performance Expectancy 2	-0,901	1,152
Performance Expectancy 3	-0,770	0,388
Effort Expectancy 1	-0,773	0,399
Effort Expectancy 2	-0,618	0,319
Effort Expectancy 3	-0,406	-0,510
Hedonic Motivation 1	-0,418	-0,487
Hedonic Motivation 2	-0,734	0,195
Hedonic Motivation 3	-0,658	0,006
Time Saving 1	-0,963	1,117
Time Saving 2	-0,768	0,574
Time Saving 3	-0,958	1,063
Time Saving 4	-0,875	0,610
Energy Saving 1	-0,523	-0,070
Energy Saving 2	-0,412	0,047
Energy Saving 3	-0,543	-0,125
Energy Saving 4	-0,458	-0,211
Perceived Value 1	-0,680	0,045
Perceived Value 2	-0,527	-0,309
Perceived Value 3	-0,688	0,349
Perceived Value 4	-0,662	0,032
Intention to Use 1	-1,157	1,242
Intention to Use 2	-0,977	0,464
Intention to Use 3	-0,955	0,570
Brand Image 1	-0,914	1,279
Brand Image 2	-0,936	1,709
Brand Image 3	-0,929	1,695

Source: Computed by the researcher

Sensitivity: Public

4.3.2. Multicollinearity Test

In order to ensure the accuracy of the research findings, a thorough multicollinearity test was conducted on the variables. The purpose of this test was to identify and eliminate any potential correlation between two or more independent variables that could introduce errors or biases in the results. Multicollinearity arises when there is a high degree of correlation among independent variables, indicating that they are essentially measuring the same underlying concept but in different ways.

According to the guidance provided by George & Mallery (2010), a tolerance value less than 0.1 signifies a significant collinearity issue. This means that if the tolerance value falls below this threshold, it is crucial to address the collinearity problem in the data analysis. Furthermore, George & Mallery (2010) suggests that when the Variance Inflated Factor (VIF) values exceed 10, it raises concerns about the reliability of the regression coefficients. Therefore, it is essential to carefully examine the VIF values to ensure the validity of the regression analysis.

The results of the study have been shown in the table 13, it can be observed that all the VIF values were found to be less than 10. This provides reassurance that the data used in the analysis was free from multicollinearity issues. Consequently, we can have confidence in the accuracy and reliability of the research findings, as the potential biases arising from multicollinearity have been effectively addressed.

Table 13: The Values of VIF

Constructs	Items	VIF
Performance Expectancy	PE1	1.9810
	PE2	2.9919
	PE3	3.4362
Effort Expectancy	EE1	2.4065
	EE2	2.8651
	EE3	2.7280
Hedonic Motivation	HM1	3.9524
	HM2	5.3318
	HM3	5.1159
Time Saving	TS1	5.2010
	TS2	3.2804
	TS3	5.5520
	TS4	3.5364
Energy Saving	ES1	7.0200
	ES2	4.7230
	ES3	10.007
	ES4	9.0888
Performance Risk	PR1	4.2851
	PR2	3.3162
	PR3	3.7284
Financial Risk	FR1	2.4164

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	FR2	-
	FR3	2.4164
Brand Image	BI1	3.2507
	BI2	3.6022
	BI3	3.8416
Perceived Value	PV1	3.3762
	PV2	5.5411
	PV3	4.2814
	PV4	4.9754
Intention to Use	IU1	7.4520
	IU2	9.7478
	IU3	9.5942

Source: Computed by the researcher

4.3.3. Construct Reliability and Convergent Validity of the Constructs

Construct Reliability and Convergent Validity had been made before the conducting the structural model. The reliability of the components making up the model was assessed by analyzing their reliability levels, which were evaluated using measures such as Dijkstra-Henseler's rho (ρA), Jöreskog's rho (ρc), and Cronbach's alpha (α).

Validity can be determined according to Haier (2010) as "the extent to which research is accurate". Furthermore, there are different sort of measurement ways like face clarity, convergent validity and discriminant validity. Convergent validity can be measured by average variance extracted (AVE) and factor loading scores, additionally two of them need to be above 0.5 (Hair, 2010). In the analysis also those are above 0.5. In the study, AVE values are ranging from 0.7166 to 0.9221.

The Cronbach's Alpha has a value between 0 and 1. If the Cronbach's alpha coefficient is closer to 1, there is internal excellent consistency of the items in the scale. According to (George & Mallery, 2003), if Cronbach's Alpha value is above 0.90 which means there is perfect internal consistency, if it is above 0.80 which means there is good internal consistency, if it is above 0.70 it is acceptable and if it is above 0.60 which means it is questionable. On the other hand, if the value is above 0.50 which means there is a poor internal consistency and if it is below 0.50 which means it is unacceptable. It can be seen that the results of Alpha-Cronbach for factor loading of the exploratory factor analyzing data more than 0.5 which presents that there is a strong relation among the sub-factors for each indicated variable among each other. The range in the factor loading is between 0.8860 and 0.9728.

Table 14: Evaluation of scales for reliability and convergent validity

Constructs	Items	Loading	Dijkstra-Henseler's rho (ρA)	Jöreskog's rho (ρc)	Cronbach's Alpha	AVE
Performance Expectancy	PE1	0.7864	0.8860	0.8832	0.8812	0,7166
	PE2	0.8668				
	PE3	0.8830				

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Effort Expectancy	EE1	0.9561	0.9034	0.8917	0.8916	0.7349
	EE2	0.8585				
	EE3	0.7440				
Hedonic Motivation	HM1	0.8980	0.9488	0.9458	0.9452	0.8535
	HM2	0.9860				
	HM3	0.8843				
Time Saving	TS1	0.9096	0.9444	0.9440	0.9441	0.8084
	TS2	0.8884				
	TS3	0.8753				
	TS4	0.9222				
Energy Saving	ES1	0.9568	0.9694	0.9688	0.9686	0.8860
	ES2	0.8989				
	ES3	0.9593				
	ES4	0.9487				
Performance Risk	PR1	0.9227	0.9289	0.9285	0.9284	0.8125
	PR2	0.8904				
	PR3	0.8906				
Financial Risk	FR1	0.9900	0.9055	0.8805	0.8672	0.7891
	FR2	-				
	FR3	0.7733				
Brand Image	BI1	0.9118	0.9243	0.9246	0.9247	0.8036
	BI2	0.9107				
	BI3	0.8661				
Perceived Value	PV1	0.8657	0.9488	0.9480	0.9478	0.8202
	PV2	0.9323				
	PV3	0.9336				
	PV4	0.8996				
Intention to Use	IU1	0.9587	0.9728	0.9726	0.9726	0.9221
	IU2	0.9761				
	IU3	0.9457				

Source: Computed by the researcher

There is an exception for FR2 construct and received the following error message "*The estimates would imply a negative variance of the measurement error (Heywood cases) of the following indicator*" In structural equation modeling, Heywood cases refer to situations where the estimated parameters lead to a negative error variance. This is problematic because measurement error variances should be positive. That's why, it requires that the revision needs be made in the research model by removing this construct. Heywood cases in structural equation modeling (SEM) refer to situations where estimated parameter values result in a negative variance for a latent variable's indicator. This is problematic as variances must be non-negative. Heywood cases can occur due to modeling issues, data problems, or estimation methods. Resolving Heywood cases is crucial for valid SEM results (Bollen, 1989).

Construct Reliability (CR) assesses internal consistency, and CR values exceeding 0.70 indicate acceptable internal consistency (Hair, Black, Babin, Anderson, & Tatham, 2014). The researchers have employed the Dijkstra-Henseler's rho (ρA) reliability coefficient to evaluate and report construct reliability (Dijkstra & Henseler, 2015). Similar to CR, the ρA reliability coefficient should exhibit values of 0.70 or higher in exploratory research and values above 0.80 or 0.90 in more advanced research stages

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(Dijkstra & Henseler, 2015). In this study, the ρA reliability coefficient for each measurement construct exceeds 0.70. Jöreskog's rho (ρc), used as the composite reliability indicator, is considered as a measure of construct reliability. The construct reliability values has been presented in Table 14 ranging between 0.8805 and 0.9728. Consequently, all CR values are deemed acceptable since they surpass the 0.70 threshold.

Discriminant validity and Convergent validity are the main to way to analyze the construct validity. AVE means the average variance extracted (AVE) and standardized loading are determining the convergent validity. Another way is Discriminant validity which is "demonstrated by evidence that measures of constructs that theoretically should not be highly related to each other are, in fact, not found to be highly correlated to each other. Practically speaking, discriminant validity coefficients should be noticeably smaller in magnitude than convergent validity coefficients." In other words, it says each variables have its own unique characteristic (Hair, 2010).

In recent literature (Dijkstra & Henseler, 2015), the heterotrait-monotrait ratio (HTMT) has emerged as a widely used method to assess discriminant validity. This ratio provides a measure of the extent to which constructs that are theoretically distinct from each other demonstrate lower correlation with each other compared to constructs that are theoretically similar. By examining the HTMT, researchers can gain insights into the discriminant validity of their measures. Interestingly, there is some variation in the suggested thresholds for HTMT. Some researchers, such as Teo, Srivastava, and Jiang (2008), propose a threshold of 0.90. According to this perspective, HTMT values below 0.90 indicate satisfactory discriminant validity. On the other hand, Clark and Watson (2016) recommend more conservative thresholds, suggesting that HTMT values should be below 0.85 to ensure adequate discriminant validity. Overall, the use of HTMT in assessing discriminant validity highlights the importance of ensuring that the measures used in research accurately capture the distinctiveness of the constructs under investigation. By paying attention to the HTMT values, researchers can make informed decisions about the validity of their measures and enhance the robustness of their findings. In this study, results are quite ok as under 0,85 and 0,90 as can be seen in the table 15.

Table 15: Evaluation of correlation matrix and discriminant validity (HTMT)

Latent Constructs	**PE**	**EE**	**HM**	**TS**	**ES**	**PR**	**FR**	**BI**	**PV**	**IU**
PE										
EE	0.7537									
HM	0.6398	0.6175								
TS	0.7999	0.7561	0.6255							
ES	0.6234	0.5490	0.5896	0.6460						
PR	0.6306	0.4286	0.4507	0.4835	0.4566					
FR	0.4763	0.4316	0.2925	0.3690	0.3726	0.6754				
BI	0.3970	0.5049	0.4534	0.5434	0.4730	0.3292	0.2583			
PV	0.7868	0.6594	0.7505	0.7448	0.7518	0.6072	0.4987	0.4921		

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IU	0.7625	0.7091	0.7210	0.7487	0.5388	0.4941	0.4214	0.4905	0.7995

Source: Computed by the researcher

Furthermore, the values of Fornell-Larcker Criterion had also been used to assess the discriminant validity in this study. Fornell-Larcker Criterion, which "postulates that latent variable shares more variance with its assigned indicators with another latent variable in the structural model" (Hair et al., 2014). According to the conditions of Fornell-Larcker Criterion, it necessitates that the square root of each Average Variance Extracted (AVE) value is greater than its correlation with any other latent construct. In this study all variables satisfy the Fornell-Larcker criterion as can be seen in the table 16.

Table 16: Evaluation of correlation matrix and discriminant validity

Latent Constructs	**PE**	**EE**	**HM**	**TS**	**ES**	**PR**	**FR**	**BI**	**PV**	**IU**
PE	0.7165									
EE	0.5770	0.7349								
HM	0.4084	0.3807	0.8535							
TS	0.6388	0.5723	0.3926	0.8084						
ES	0.3812	0.3002	0.3482	0.4178	0.8860					
PR	0.3934	0.1846	0.2034	0.2336	0.2085	0.8125				
FR	0.2186	0.1787	0.0869	0.1325	0.1366	0.4430	0.7891			
BI	0.1567	0.2539	0.2054	0.2951	0.2236	0.1088	0.0661	0.8036		
PV	0.6138	0.4394	0.5638	0.5561	0.5652	0.3680	0.2449	0.2431	0.8202	
IU	0.5815	0.5082	0.5199	0.5613	0.2905	0.2440	0.1743	0.2405	0.6394	0.9221

Source: Computed by the researcher

Squared correlations, AVE in the diagonal

As shown in the table 17, except of FR2 all variables have the factor loadings higher than 0,7, thus all of them had been accepted. As mentioned in the previous sections, FR2 had been removed from the model. Since it has negative variance and according to Heywood cases, variances must be non-negative.

Table 17: Factor Loading of Variables

Variable	***Item***	***Content Description***	***Factor Loading***
Perceived Risks	-	**Performance risk (PR)**	
	PR1	I worry about whether RVC will not provide the level of benefits I expect	0.9227
	PR2	It is uncertain that RVC will work satisfactorily	0.8904
	PR3	It is uncertain that RVC will perform the functions that were described in the advertisement	0.8906
	-	**Financial risk (FR)**	
	FR1	Using RVC entails financial risks due to potential higher maintenance and repair costs.	0.9900
	FR2	Considering the potential investment involved, Purchasing and using RVC is risky	-
	FR3	Using RVC carries financial risks	0.7733

Sensitivity: Public

Perceived Benefit		**Performance Expectancy**	
	PE1	Using a robot vacuum cleaner will effectively remove dust and dirt from my home.	0.7864
	PE2	Using a robot vacuum cleaner will make the cleaning work in my house easier for me.	0.8668
	PE3	Using a robot vacuum will make cleaning jobs in my house less stressful for me.	0.8830
		Effort Expectancy	
	EE1	When using RVC, I think it will make my work easier.	0.9561
	EE2	Using RVC does not require a lot of effort for me.	0.8585
	EE3	When using RVC, I do not have to expend a lot of energy	0.7440
		Hedonic Motivation	
	HM1	The use of RVC makes me feel excited	0.8980
	HM2	The use of RVC gives me pleasure	0.9860
	HM3	Using RVC is truly fun	0.8843
		Time Saving	
	TS1	When using RVC, I think it will help me get things done faster.	0.9096
	TS2	By using RVC, I will save time in my daily routine work.	0.8884
	TS3	By using a robotic vacuum cleaner, I can complete my tasks more quickly.	0.8753
	TS4	I can use the time saved from house cleaning with a robot vacuum for sustainability purposes.	0.9222
		Energy Saving	
	ES1	I believe that RVCs save energy.	0.9568
	ES2	I believe that RVCs has the low energy consumption.	0.8989
	ES3	I believe that low energy consumption of RVCs contributes to the sustainable environment	0.9593
	ES4	The energy saving of RVCs encourages the use of technology in an environmentally friendly way.	0.9487
Perceived Value	***PV1***	I think that Using RVC offers value for money	0.8657
	PV2	Compared to the effort to put, using RVCs is useful to me	0.9323
	PV3	Compared to the time to spend, using RVCs is worthwhile to me	0.9336
	PV4	In general, i think that using RVCs delivers me good value	0.8996
Intention to use (IU)	**IU1**	Using RVC is worthwhile	0.9587
	IU2	I intend to use RVC in the future	0.9761
	IU3	I predict I would use RVC in the future	0.9457
Brand Image	**BI1**	I have a good impression of brand image while choosing RVC	0.9118
	BI2	For me, good brand image effects my decision to use RVC	0.9107
	BI3	I think, having better brand image directly effects the decision to use RVC	0.8661

4.3.4. The Model's Goodness of Fit

The Standardized Root Mean Square Residual (SRMR), dULS (difference in the unweighted least squares chi-square test), and dG (difference in the geodesic chi-square test) are statistics used to evaluate the overall model fit in structural equation modeling. These fit indices help researchers determine how well the proposed model matches the observed data. Lower values of SRMR and smaller positive values of dULS and dG indicate better fit, suggesting that the model adequately explains the relationships among variables (Hu & Bentler, 1999). These fit indices are considered as part of a comprehensive assessment of model fit alongside other commonly used indices like CFI and RMSEA. On the other hand, SRMR outperforms the 'goodness-of-fit' criterion (Tenenhaus, Vinzi, Chatelin, & Lauro, 2005) in terms of sensitivity and effectiveness. According to the quality criteria following three parameters

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should have values lower than the 95 percent (HI95) or 99 percent (HI99) bootstrap values, or the SRMR should be below 0.08 (Hu & Bentler, 1999).

For this study, the results can be seen in the table 18, according to the results three of the values are less then 99th percentile bootstrap value (HI99). It means that the data and the proposed model is proper, thus the model is acceptable in this framework.

Table 18: Total Model Fit Results

	Saturated Model		
Parameters	**Values**	**HI95**	**HI99**
SRMR	0.0303	0.0301	0.0328
dULS	0.4849	0.4791	0.5685
dG	0.8589	1.0415	1.3360

Source: Computed by the researcher

4.3.5. Analysis of The Structural Model

The analysis of structural model had been made by using ADANCO 2.3.2 software, t-statistic values and p-values all demonstrated significant path coefficients. As shown in both Table 19 and Table 20, the analysis yielded the following findings.

Table 19: Structural Model Results

Item	Effect	Effect	Path Coefficients	Standard Error	t-value	p-value
H1		Brand Image > Performance. Expectancy	**0.3958**	**0.0720**	54.986	**0.0000**
		Brand Image > Effort Expectancy	**0.5039**	**0.0891**	56.543	**0.0000**
		Brand Image > Hedonic Motivation	**0.4532**	**0.0747**	60.641	**0.0000**
		Brand Image > Time Saving	**0.5432**	**0.0744**	73.028	**0.0000**
		Brand Image > Energy Saving	**0.4728**	**0.0767**	61.665	**0.0000**
		Brand Image > Intention to Use	0.0682	0.0680	10.028	0.1580
H2	**BI > PR**	Brand Image > Financial Risk	-0.2570	-35.383	0.0726	**0.0002**
		Brand Image > Performance Risk	-0.3299	0.0676	-48.802	**0.0000**
H3	**BI > PV**		**0.0345**	**0.0631**	0.5473	0.2921
H4	**PV > IU**		**0.4494**	**0.1270**	35.388	**0.0002**
H5	**PB > IU**					
		Performance Expectancy > Intention to Use	0.1922	0.1339	14.350	**0.0757**
		Effort Expectancy > Intention to Use	0.1100	0.1124	0.9788	0.1639
		Time Saving > Intention to Use	0.1792	0.1048	17.100	**0.0437**
		Energy Saving > Intention to Use	-0.2311	0.0718	-32.208	**0.0006**
		Hedonic Motivation > Intention to Use	**0.2057**	**0.0760**	27.081	**0.0034**
H6	**PE > IU**		0.1922	0.1339	14.350	0.0757
H7	**EE > IU**		0.1100	0.1124	0.9788	0.1639
H8	**HM > IU**		0.2057	0.0760	27.081	**0.0034**

Sensitivity: Public

H9	**TS > PV**		0.1233	0.0907	13.598	0.0870
H10	**ES > PV**		**0.2804**	**0.0762**	36.784	**0.0001**
H11	**ES > PV**		**0.2804**	**0.0762**	36.784	**0.0001**
H12	**PR > IU**					
		Performance Risk > Intention to Use	0.0517	0.0749	0.6896	0.2452
		Financial Risk > Intention to Use	-0.1033	0.0637	-16.213	**0.0525**
H13	**PR > PV**		-0.0581	0.0613	-0.9478	**0.1716**
H14	**FR > PV**		-0.1128	0.0597	-18.884	**0.0295**

Source: Computed by the researcher

For H1, according to results, brand image has positive role in the perceived benefit which includes performance expectancy (PE) (ß=,3958; p=,000), effort expectancy (E) (ß=,5039; p=,000), hedonic motivation (HM) (ß=,4532; p=,000), time saving (TS) (ß=,5432; p=,000) and energy saving (ES) (ß=,4728 p=,000). Thus, H1 has strongly supported. Meanwhile, while brand image's effect on the intention to use has low level of coefficient here, when look at the indirect and direct effect table in the table 20 it can be seen that it has the strong effect on intention to use.

Additionally, while brand image has negative effect on (H2) overall perceived value which was containing originally five different variables as initiated above. Financial risk (FR) (ß=,-2570; p=,0002) and performance risk (ß=,-3299; p=,000) shows that negative relationship together with desired p values which shows the meaningful. Additionally, brand image has direct positive effect on the perceived value according to the results in indirect and direct result shown in table 20. Therefore, H2 is supported.

H3 suggests that brand image (BI) has effect on the perceived value (PV), (ß=,0345; p=,2921), although there is no meaningful p value, when we look at the indirect and direct effect analysis it can be seen that it has strong effect in both indirect and direct. That's why the H3 can be evaluated in two separated statement as H3a states that "Brand Image has significant relation with overall perceived value" which is not supported and H3b states that "Brand Image has significant relation with sub constructs of perceived value" which is supported.

H4 estimates that Perceived value (PV) has the strong effect on the intention to use (ß=,4494 p=,0002) and at the same time it has the strong and direct positive effect in the indirect and direct analysis shown in the table 20. H4 is supported.

H5 estimates that Perceived benefit's (PB) effects which includes performance expectancy (PE) (ß=,1922; p=,0757), effort expectancy (HM) (ß=,1100; p=,1639), hedonic motivation (HM) (ß=,2057; p=,0034), time saving (TS) (ß=,1792; p=,0437) and energy saving (ES) (ß= ,-2311 p=,0006) existing on intention to use. For Energy saving, there is negative relationship but with desire p value that is meaningful. For Effort expectancy, there was no meaningful result in the analysis since the p value higher than 0.05. Therefore, excluding effort expectancy construct, H5 is supported.

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H6 suggests that performance expectancy (PE) has an effect on the intention to use (IU) (ß=,1922; p=,0757), It also has a direct positive effect as can be seen in the table 20. Therefore, H6 is supported.

H7 suggests that effort expectancy (EE) has effect on the intention to use (IU) (ß=,1100; p=,1639), while p value is not meaningful and there is very low direct relation found in the table, H7 is not supported.

H8 estimates that hedonic motivation (HM) has an effect on the intention to use (ß=,2057; p=,0034) results shows that it's acceptable. Also, direct relation has been presented in the table 20. Thus, H8 is supported.

H9 estimates that time saving (TS) has effect on perceived value (PV) (ß=,1233; p=,0870), p value is meaningful while the coefficient shows slightly effect. In the meantime, there is a direct low level of positive effect in the indirect and direct effects analysis which can be seen in the table 20. Thus, H9 is supported.

H10 and H11 estimate that energy saving (ES) has effect on the perceived value (PV) (ß=,2804; p=,0001), according to the results it has a positive effect on the PV. H10 is supported.

H12 suggests that perceived risks have a negative effect on the intention to use; according to the results of performance risk (ß=,0517; p=,2452) and financial risk (ß=,-1033; p=,0525), there cannot be found an effect. H12 is not supported.

H13 estimates that performance risk (PR) has an effect on the perceived value (PR) (ß=,-0517; p=,2452), according to the results there is no significant role in perceived value. H13 is not supported.

H14 estimates that financial risk (FR) has an effect on the perceived value (PR) (ß=,-1128; p=,0295), according to the results there is no significant role in perceived value. H14 is not supported.

Table 20: Total and Indirect Effects

Item	Effect	Effect	Indirect effects	Total effect
H1	BI > PB	Brand Image > Performance Expectancy		**0.3958**
		Brand Image > Effort Expectancy		**0.5039**
		Brand Image > Hedonic Motivation		**0.4532**
		Brand Image > Time Saving		**0.5432**
		Brand Image > Energy Saving		**0.4728**
		Brand Image > Intention to Use	**0.4222**	**0.4904**
H2	**BI > PR**	Brand Image > Financial Risk		-0.2570
		Brand Image > Performance Risk		-0.3299
H3	**BI > PV**		**0.4585**	**0.4930**
H4	**PV > IU**			**0.4494**
H5	**PB > IU**			
		Performance Expectancy > Intention to Use	0.1165	**0.3087**
		Effort Expectancy > Intention to Use	-0.0261	0.0839
		Time Saving > Intention to Use	0.0554	**0.2346**
		Energy Saving > Intention to Use	0.1260	-0.1051

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		Hedonic Motivation > Intention to Use	0.1362	**0.3420**
H6	**PE > IU**		0.1165	**0.3087**
H7	**EE > IU**		-0.0261	0.0839
H8	**HM > IU**		0.1362	**0.3420**
H9	**TS > PV**			0.1233
H10	**ES > PV**			**0.2804**
H11	**ES > PV**			**0.2804**
H12	**PR > IU**			
		Performance Risk > Intention to Use	-0.0261	0.0517
		Financial Risk > Intention to Use	-0.0507	-0.1033
H13	**PR > PV**			-0.0581
H14	**FR > PV**			-0.1128

Source: Computed by the researcher

The coefficient of determination, often denoted as R-squared (R^2), is a statistical measure that represents the proportion of the variance in the dependent variable that can be explained by the independent variables in a regression model. In the context of regression analysis, R-squared is a crucial metric as it helps assess the goodness of fit of the model to the data (Montgomery, Peck, E.A., & Vining, 2012). Researchers and statisticians commonly use R-squared to assess the fit of regression models and understand how well independent variables explain the variation in the dependent variable. Researchers commonly use R-squared to evaluate the goodness of fit of regression models. It helps determine how well the model predicts the dependent variable based on the independent variables. (Hair, Black, Babin, Anderson, & Tatham, 2014). This high R-squared value suggests that the independent variables in the model are effective in explaining and modeling the behavior of the dependent variable. In this study, For perceived value and intention to use constructs, there are relative higher R Square results compared to others. It means that the independent variables are providing valuable insights into the factors that influence the dependent variable.

Table 21: R Square Results

Construct	**Coefficient of determination (R^2)**
Performance Expectancy	0.1567
Effort Expectancy	0.2539
Hedonic Motivation	0.2054
Time Saving	0.2951
Energy Saving	0.2236
Performance Risk	0.1088
Financial Risk	0.0661

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Perceived Value	**0.8031**
Intention to Use	**0.7593**

Source: Computed by the researcher

Table 22: Summary of Hypothesis Following the Measurement

Item No	Hypotheses	Supported	Not Supported
	Stimulus: Brand Image as a Signaling		
H1	Brand Image is positively linked to perceived benefit	X	
H2	Brand Image has significant relation with perceived risk	X	
H3	H3a. Brand Image has significant relation with overall perceived value H3b. Brand Image has significant relation with sub constructs of perceived value	X	X
H5	***Organism: Unified Theory of Acceptance and Use Technology-2 (UTAUT2)*** Overall perceived benefit positively effects the intention to use of Robotic Vacuum Cleaner (RVC).	X	
H6	The performance expectancy has a straight and positive effect on the intention to use of Robotic Vacuum Cleaner (RVC).	X	
H7	The effort expectancy has a straight and positive effect on the intention to use of Robotic Vacuum Cleaner (RVC).		X
H8	Hedonic motivation has a positive effect on the intention to use of Robotic Vacuum Cleaner (RVC).	X	
H9	Time Saving is positively linked to perceived value.	X	
H10	Energy Saving is positively linked to perceived value.	X	
H11	Energy Saving is positively linked to sustainability.	X	
H12	Overall perceived risk negatively effects the intention to use of Robotic Vacuum Cleaner (RVC).		X
H13	Performance risk has a negative effect on the perceived value of usage Robotic Vacuum Cleaner (RVC).		X
H14	Financial risk has a negative effect on the perceived value of usage Robotic Vacuum Cleaner (RVC).		X
	Responses: Intention to Use		
H4	Perceived Value has a straight and positive effect on the intention to use of Robotic Vacuum Cleaner (RVC).	X	

DISCUSSION

5.1. Evaluation of The Proposed Model and Revised Model

Revised model has been presented in the Figure 23. As can be seen that remarkable result came from brand image that has directly affected all UTAUT variables as highlighted in the previous section in the figure 23.

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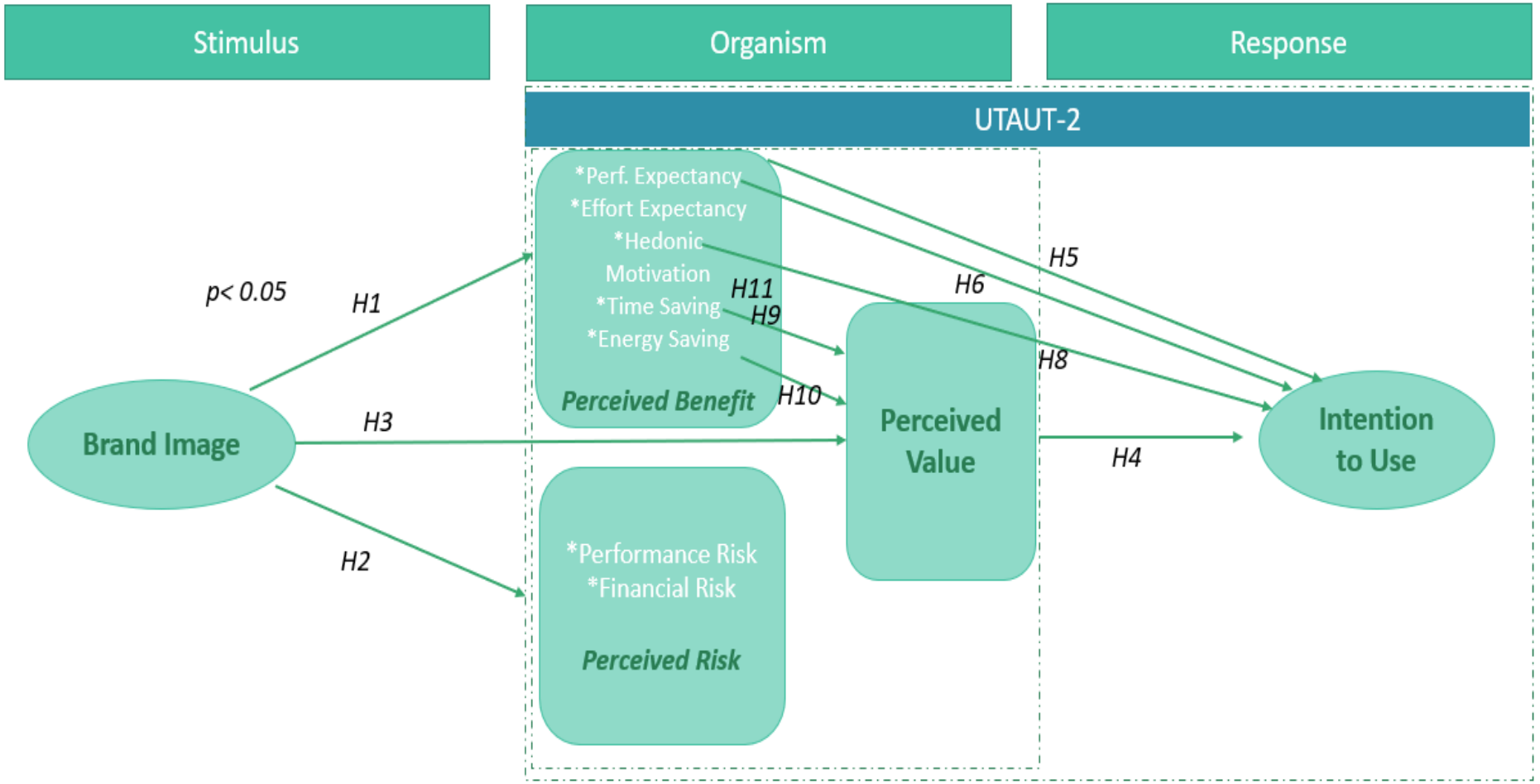


Figure 23: Revised Research Model

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In the study, the main aim is to see the effects of brand image on the perceived value and intention to use. According to the results of the analysis, brand image has direct impacts on all of the UTAUT variables as Stimulus in SOR theory. In the model there are five variables as performance expectancy, effort expectancy, hedonic motivation, time saving and energy saving under perceived benefit which was determined as Organism in SOR Theory. The results are similar with the study conducted by Benhardy et al. (2020) "Brand image and price perceptions impact on purchase intentions: mediating brand trust", brand image has significant effect during the purchase decision process. In this study as well, brand image has positive effects on all of these variables that combined under perceived benefit. A positive brand image can enhance users' perceptions of a technology's performance. If a brand is known for producing high-quality and effective products, users may have higher performance expectations for a technology associated with that brand. Furthermore, brand image can affect users' perceptions of how easy or difficult it is to use a technology.

A reputable brand might be associated with user-friendly and intuitive designs, leading to lower perceived effort in using their products, it is effort expectancy from induvial. Additionally, brand image has significant impact on various consumer-related variables, including hedonic motivation, energy-saving, and time-saving perceptions like involved in the research model. A positive brand image can enhance hedonic motivation, especially in the context of products or technologies designed to provide enjoyable or pleasurable experiences. When consumers associate a brand with quality, innovation, and positive experiences, it can trigger higher hedonic motivation to use products associated with that brand. For example, a brand known for cutting-edge and enjoyable technology products may stimulate users' motivation to engage with their offerings. Furthermore, the perception of energy-saving features in products can be influenced by brand image. Brands that are recognized for their commitment to sustainability and energy-efficient technologies are often trusted and instill higher confidence in consumers. This trust in the brand can create the belief that products associated with the brand are more energy-efficient, leading to positive intentions towards energy-saving. The results of this study have already demonstrated a direct effect of energy saving on sustainability. Similarly, brand image can also impact perceptions related to time-saving features in products. Brands that are associated with convenience, efficiency, and time-saving solutions can lead consumers to believe that products from these brands can save them time. As a result, this can influence their intentions to use these products. In summary, a positive brand image can shape consumers' expectations and trust in the brand's products, thereby influencing hedonic motivation, energy-saving perceptions, and time-saving perceptions. When consumers have a favorable view of a brand, they are more likely to attribute positive qualities such as enjoyable experiences, energy efficiency, and time-saving benefits to products associated with that brand. Finally, according to results, brand image has the effect on the perceived risks which includes performance and financial risks. Those are originally determined under organism in SOR theory in the research model. And based on the results there was no direct effect on the perceived value and intention

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to use from perceived risk. However, brand image has the direct effect on them. It's important to note that the specific effects of brand image on financial and performance risk related to robotic vacuum cleaners may depend on various factors such as the brand's reputation, the competitive landscape, and consumer preferences. Thao and Hai (2016) also conducted the study as “The effect of perceived benefits and perceived risks on intention to shop apparel online by white - collar women in Vietnam” and saw that there was less effect on the intention to shop from perceived risk. Users mostly focused on the perceived value and it’s benefits. Furthermore, Ahmad et al. (2020) has conducted the study “The Role of Perceived Benefits and Perceived Risks Towards the Consumers' Purchase Intention Via E-Commerce” and examined that financial risk did not affect online purchase intentions. Additionally, Bhatti and Rehman (2020) perceived benefit had positive effect on the online shopping behavior while the risk has negative influence. All of these relevant studies have been shown in the table 23.

Table 23: Research Examples from Literature Regarding Brand Image, Perceived Risks and Perceived Benefit

Subject of the Article	Item	Author	Year	Findings
Brand image and price perceptions impact on purchase intentions: mediating brand trust	Brand Image/Intention to use / buy	Benhardy et al.	2020	Brand image has significant effect
The effect of perceived benefits and perceived risks on intention to shop apparel online by white - collar women in Vietnam	Perceived risk / perceived benefit effects on intention to use	Thao and Hai	2016	Slightly effect of perceived risk while perceived benefit has strong effect
The Role of Perceived Benefits and Perceived Risks Towards The Consumers' Purchase Intention Via E-Commerce	Perceived Benefit / Perceived Risk	Ahmad et al.	2020	Financial risk did not affect online purchase intentions
Factors influencing consumers’ adoption and use of wearable technologies	Perceived Benefit / Perceived Risk	Pour, K.N.	2019	Perceived benefit has strong effect while perceived risk has no meaningful effect

On the other hand, performance expectancy, hedonic motivation, and energy saving has also direct positive relationship with perceived value. While hedonic motivation and energy saving have direct effect on the intention to use. Hedonic motivation refers to the pleasure and enjoyment that users experience when using a technology. When a technology provides a delightful experience, users are more inclined to continue using it. This is because the positive emotions associated with the technology contribute to the intention to use it. Additionally, the perception of energy-saving features in a technology plays a significant role. Users are increasingly aware of the environmental impact and cost savings offered by energy-efficient technologies. When a technology is perceived as energy-saving, it directly affects users' intention to use it because they recognize the value of the energy-efficient features (International Energy Agency, 2018). These factors, along with others such as performance expectancy and effort expectancy, collectively shape users' intention to adopt and use a technology or product. In

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the UTAUT model, these determinants help researchers and businesses comprehend the various factors that influence user acceptance and adoption of technology.

Additionally, perceived value can indeed have a direct and strong effect on the intention to use a product or technology. Perceived value is a critical factor in various acceptance and adoption models, such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). When users perceive a high value in using a product, it directly contributes to their intention to use it. The stronger the perceived value, the more motivated users are to adopt and use the product. Perceived value typically comprises two main components, as this study determined them as perceived benefit and perceived risks. First one, perceived benefit that users assess the benefits they expect to receive from the product. These benefits can include functionality, convenience, and satisfaction. Perceived sacrifice that users evaluate the sacrifices or costs associated with using the product, such as monetary cost, time, effort, or any perceived negative consequences (Zeithaml, 1988).

5.2. Brand Image and Perceived Value

The relationship between brand image and perceived value in influencing the intention to use technological products is an important area of study in marketing and consumer behavior. Research has shown that both brand image and perceived value play significant roles in shaping consumers' intentions to use technological products. Brand image encompasses the perceptions and associations that consumers have about a particular brand. It includes attributes like brand reputation, trustworthiness, and brand identity. A positive brand image can create trust and loyalty among consumers (Aaker, 1991). When consumers have a favorable perception of a brand, they are more likely to have a positive intention to use the brand's technological products. This is because a strong brand image can create an emotional connection and assurance of product quality, which enhances the intention to use. Perceived value refers to the consumer's assessment of the overall worth of a product or service in relation to its cost. In the context of technological products, consumers evaluate whether the benefits offered by the product outweigh the costs, which can include both monetary and non-monetary factors (such as time and effort). When consumers perceive a high value in using a technological product, they are more likely to intend to use it. High perceived value can be achieved through product features, functionality, convenience, and meeting specific needs (Sheth, Newman, & Gross, 1991).

This research also has shown that these two factors often interact and reinforce each other. A strong brand image can enhance perceived value by creating a positive bias towards the product, and higher perceived value can strengthen the positive perception of the brand. Together, they positively influence the intention to use technological products.

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5.3. Sustainability

As emphasized the importance of sustainability in the context of home appliances in the subject of Sustainability; sustainability is defined as meeting the present needs without compromising future generations' ability to meet their own needs. It involves energy efficiency, renewable resource usage, and responsible disposal. Energy-efficient appliances reduce energy consumption and greenhouse gas emissions, saving consumers money (International Energy Agency, 2018). Appliances using renewable resources reduce reliance on non-renewable ones. Proper disposal and recycling are essential for preventing environmental harm. Governments have implemented energy efficiency standards, fostering innovation, and research into renewable energy sources. Overall, sustainability in home appliances is vital for reducing environmental impact and promoting a sustainable future (Jiang, Zhang, & Li, 2019).

In the survey there were two specific statements about the relationship between sustainability and energy saving under Perceived Value.

CONCLUSION

6.1. Academical Indications and Further Research Directions

Based on the available academic studies on robotic vacuum cleaners, there are several academic implications to consider. As listed in the table 3, these studies have highlighted like structural design of robotic vacuum cleaner efficiency and effectiveness, user experience and technology acceptance, impacts on the household dynamics, technological advancement etc. When we look at the efficiency and effectiveness, we can say that researchers have mainly analyzed the efficiency and effectiveness of robotic vacuum cleaners in terms of cleaning performance and time-saving capabilities. these studies have shown that robotic vacuum cleaners can effectively clean various types of surfaces and can potentially save time for users. As, we also underlined during our study, performance expectancy and time saving are quite crucial benefits for the individuals. They can use the saved time as they desire. On the other hand, another highlighted point is user experience and acceptance of the technology. Academic studies mostly examined the users' experiences and acceptance of robotic vacuum cleaners. As can be seen in this study as well, this study has used wider factors and differentiated constructs. On the other hand, researchers also have investigated factors such as ease of use, trust in the technology, and user satisfaction. These studies have indicated that users generally find robotic vacuum cleaners convenient and beneficial, although there may be initial concerns about trust and control. Having robotic vacuum cleaner has directly impact on household dynamics; researchers have also looked into the impact of robotic vacuum cleaners on household dynamics. They have studied how the presence of these devices affects household responsibilities, division of labor, and social interactions. These studies have found that robotic vacuum cleaners can alleviate some cleaning tasks and contribute to more equal distribution of household chores. For the technological advancements and future development: Academic studies on

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robotic vacuum cleaners have contributed to technological advancements and future development in this field. They have identified areas for improvement, such as navigation capabilities, obstacle detection, and autonomous decision-making. These studies have provided insights for further research and innovation in the design and functionality of robotic vacuum cleaners.

It is important to note that the academic implications may vary across different studies and research contexts. Further exploration of specific academic studies on robotic vacuum cleaners can provide more detailed and comprehensive insights into their implications. For instance, Trust, privacy, sustainability and social interactions would be main areas to conduct the study about robotic vacuum cleaner. Especially, after the launch of robotic vacuum cleaner with camera has created concern among some people. Furthermore, since the factor loadings are higher than 0.7, it's reported that two of them ES3 and ES4 had been accepted and they were about energy saving under sustainability topic, it can be seen in the table 14 named as evaluation of scales for reliability and convergent validity. On the other hand, when we look at the indirect and direct effects under structural model, each construct has the effect on perceived value in a positive way. With the parallel to what we found from the research results; similar findings have been noticed in the interview made with head of Small Domestic Appliances Department at well-known company in Turkiye. According to her, many areas which can be investigated in the future research such as privacy, sustainability, trust, social influence, innovation in the design and functionality are existing. For instance, as she stated due to having round shape, RVCs are not very good to clean the corners, but now D shape versions are existing in the market as a solution for this problem.

6.2. Managerial Implications

According to the available studies in the literature about robotic vacuum cleaners, it can be seen that there are several managerial and marketing implications to consider. First, improving the efficiency will be constant desire from customer so that with the necessary improvements they can increase the operational efficiency by automating the cleaning process, allowing for more time to be allocated to other tasks. Cost saving is another crucial point for both side customer and seller. From the customer perspective, they would not want to pay more and get the benefit from best price. In the house, they would like to see the less energy consumption with an efficient cleaning service that will be minimizing the need for manual cleaning. On the other hand, Enhancing the customer experience is valuable point. Robotic vacuum cleaners can provide a convenient and hassle-free cleaning experience for customers, leading to higher satisfaction and loyalty. From the managerial perspective, having such technological product in their range will allow them to be differentiated brand from competition and attract the tech-savvy customers. This is related to the brand reputation also. Incorporating robotic vacuum cleaners into a product line can enhance a brand's reputation for innovation and technological advancement. By doing this, they need to well analyze the preferences and needs of customers who are interested in robotic vacuum cleaners can help tailor marketing strategies to effectively reach and engage this specific market

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segment. Furthermore, after sales support needs to be visible and well enough to the users including maintenance and troubleshooting services, can contribute to customer satisfaction and repeat purchases. Lastly, listening the end user always and be aware of the market trends are critical points needs to be done by managers.

When look at the features and innovations on the robotic vacuum cleaner, there are several features and innovations that they can consider implementing to stay competitive and meet customer demands. For instance, investing in advanced mapping and navigation technologies to improve the efficiency and effectiveness of the robotic vacuum cleaner. This can include features like real-time mapping, obstacle detection, remote control, and room-specific cleaning. Another example is having the integration of smart home. Enabling compatibility with popular smart home platforms, such as Amazon Alexa or Google Assistant, to allow users to control the robotic vacuum cleaner with voice commands and integrate it into their existing smart home ecosystem. Additionally, multi-surface cleaning would bring the attention. robotic vacuum cleaners can be developed that can effectively clean different types of surfaces, such as carpets, hardwood floors, and tiles. This can be achieved through adjustable suction power, specialized brushes, and sensors to detect surface types. Finally, app-based control and monitoring is essentially great which offers the user-friendly mobile app that allows customers to remotely control the robotic vacuum cleaner, schedule cleaning sessions, and monitor its progress. Additional features like cleaning history and personalized cleaning settings can enhance the user experience. Furthermore, self-emptying functionality which is the feature that it automatically empties its dustbin into a larger container and this operation reduces the frequency of manual maintenance and enhance convenience for customers. At the filtration system there might be used the advanced filtration systems like HEPA filters to improve indoor air quality by capturing fine dust particles and allergens. In order to support the aims on the sustainability, battery life and charging efficiency might be enhanced battery life and charging efficiency by focusing on improving battery technology to extend the runtime of the robotic vacuum cleaner per charge.

This will be the one of the sustainability and eco-friendly features. energy-efficient operation, recyclable materials, and low noise levels might be also called as sustainability and eco-friendly features. In this study also, according to the results energy saving is directly linked to sustainability by respondents. Lastly, managers should always be aware of and identify the specific needs and preferences in the target market and most updated coming trends among the products.

With the parallel to outcomes from this study, findings from interview also shows that there are always opportunities to differentiate the brand on this product group; listening to market trends including any feature and innovations such as self-emptying functionality, air purifying, connected RVC, remote control features, having user friendly app, mopping the floor with spinning function, cleaning the mop itself, those features require less effort from user (Effort Expectancy). All will allow users to save a time from daily cleaning the house. As she underlined, people are willing to pay more for further high-tech features

Sensitivity: Public

6.3. Research Limitations

In this study, the sample group had been selected from Turkish university student without age constraint. Therefore, the more comprehensive studies might be conducted by researchers by taking in to consideration of the different field of the using robotic vacuum cleaner. On the other hand, research limitations related to the study of robotic vacuum cleaners in Turkey may include limited research focus, status of the market and adaptation, effect of the cultural and economic factors, data availability, generalizability, Economic Constraints etc. In Turkey, the main limitation would be the lack of the extensive research focus specially on the robotic vacuum cleaner, it directly affects the availability of the existing data and findings. Availability of relevant data for conducting research, such as consumer surveys or sales data specific to robotic vacuum cleaners, may be limited. Access to such data can significantly affect the depth and scope of research. Moreover, understanding the adoption and market dynamics of robotic vacuum cleaners in Turkey may be challenging due to limited market data and relevant studies. This can hinder a comprehensive analysis of the factors influencing adoption. Additionally, Turkish consumers' adoption of robotic vacuum cleaners may be influenced by unique cultural and economic factors. A limitation may arise from insufficient research on how these factors impact the adoption of such technology. When comes to generalizability, findings from studies conducted in Turkey might not be directly generalizable to other countries or regions due to cultural, economic, and market differences. Researchers should be cautious about making broad generalizations based on Turkish-specific findings. Furthermore, due to being the trendy technological advancement, the field of the robotic vacuum cleaner is rapidly evolving the new features and technologies. Research may quickly become outdated if not regularly updated to reflect the latest advancements and consumer preferences. Another limitation is the selected sample characteristics. The characteristics of the sample used in research (e.g., demographics, location) may not fully represent the diversity of the Turkish population, which can limit the generalizability of findings. As underlined at the beginning, the target sample was Turkish university students who are not currently using the robotic vacuum cleaner. This study has examined the intention to use of the robotic vacuum cleaner with the university students however, for the further research in order to examine the economic constraints the wider sample group specially might be chosen. Economic factors, such as affordability and willingness to invest in such technology, can be a limitation in Turkish households. Research might need to address the potential constraints on purchasing high-tech appliances like robotic vacuum cleaners. As a summary, in order to overcome these constraints, forthcoming studies in Turkey should concentrate on comprehending the unique aspects of the Turkish market, consumer inclinations, cultural impacts, and economic limitations concerning robotic vacuum cleaners. Furthermore, scholars should remain mindful of the swiftly evolving technological landscape, ensuring their research stays current with the latest advancements in the field.

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Sensitivity: Public

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Sensitivity: Public

APPENDIXES

Appendix 1- Questionnaire in Turkish

ROBOT SÜPÜRGE KULLANIM NİYETİ ÜZERİNE AKADEMİK ARAŞTIRMA

Sayın katılımcı,

Bu anket, Marmara Üniversitesi Sosyal Bilimler Enstitüsü'nde Prof. Dr. Taşkın Dirsehan danışmanlığında yürütülen Pazarlama Anabilim Dalı Yüksek Lisans tezi kapsamında 'Robot Süpürge kullanım niyetinin' incelenmesine yönelik olarak hazırlanmıştır.

Soruların doğru ya da yanlış cevapları yoktur ve cevaplar sadece bilimsel amaçlarla kullanılacaktır. Anketi yanıtlamak üzere zaman ayırdığınız ve katkı sağladığınız için teşekkür ederiz.

Robot Süpürge Örnek Kullanım Görselleri



Sensitivity: Public

Mevcut Süpürge Bilgileri

Açıklama (isteğe bağlı)

Evinizdeki mevcut süpürge tipi nedir(dik süpürge, torbalı/torbasız süpürge, robot süpürge, vb.)? *






- [ ] Torbalı süpürge
- [ ] Torbasız süpürge
- [ ] Dik süpürge
- [ ] Robot süpürge
- [ ] Diğer

Evinizdeki mevcut süpürge markası nedir? *

Kısa yanıt metni

Sensitivity: Public

Akıllı Süpürge Bilgisi

Açıklama (isteğe bağlı)

Akıllı süpürgelerle ilgili ne kadar bilgi sahibi olduğunuzu düşünüyorsunuz? *

	1	2	3	4	5	
Hiç bilgi sahibi değilim	○	○	○	○	○	Son derece bilgi sahibiyim

Güncel durumda robot süpürge kullanıyor musunuz? *



- ○ Evet
- ○ Hayır

Bir önceki soruya cevabınız hayır ise Robot süpürge kullanmayı düşünüyor musunuz?

- ○ Evet
- ○ Belki
- ○ Hayır

Sensitivity: Public

Evinizdeki mevcut süpürge tipi nedir(dik süpürge, torbalı/torbasız süpürge, robot süpürge, vb.)? *



- [ ] Torbalı süpürge
- [ ] Torbasız süpürge
- [ ] Dik süpürge
- [ ] Robot süpürge
- [ ] Diğer

Evinizdeki mevcut süpürge markası nedir? *

Kısa yanıt metni

Sensitivity: Public

Sonraki bölümde yer alan ifadeleri kendi düşüncenize göre 'Kesinlikle Katılmıyorum' (1), 'Kesinlikle Katılıyorum' (5) aralığında, siz uygun seçeneği belirtiniz.

Performans Riskleri *

	Kesinlikle Katılıyorum (5)	Katılıyorum (4)	Ne Katılıyorum Ne Katılmıyorum (3)	Katılmıyorum (2)	Kesinlikle Katılmıyorum (1)
Robot süpürgenin beklediğim düzeyde fayda sunacağından endişeliyim.	○	○	○	○	○
Robot süpürgenin reklamda anlatılan fonksiyonları yerine getireceğinden şüpheliyim	○	○	○	○	○
Robot süpürgenin tatmin edici şekilde çalışacağı kesin değildir.	○	○	○	○	○

Finansal Riskler *

	Kesinlikle Katılıyorum (5)	Katılıyorum (4)	Ne Katılıyorum Ne Katılmıyorum (3)	Katılmıyorum (2)	Kesinlikle Katılmıyorum (1)
Robot süpürge kullanımı finansal riskler taşımaktadır.	○	○	○	○	○
Potansiyel toplam harcama göz önüne alındığında, robot süpürge satın almak ve kullanmak risklidir.	○	○	○	○	○
Robot süpürge kullanımı yüksek bakım ve onarım maliyetlerinden dolayı finansal riskler içermektedir.	○	○	○	○	○

Sensitivity: Public

Performans Beklentisi *

	Kesinlikle Katılıyorum (5)	Katılıyorum (4)	Ne Katılıyorum Ne Katılmıyorum (3)	Katılmıyorum (2)	Kesinlikle Katılmıyorum (1)
Robot süpürge kullanmak evimdeki temizlik işlerini benim için daha az stresli hale getirecektir	○	○	○	○	○
Robot süpürge kullanımı evimden tozu ve kiri etkili bir şekilde temizleyecektir.	○	○	○	○	○
Robot süpürge kullanmak evimdeki temizlik işlerini benim için daha kolay hale getirecektir.	○	○	○	○	○

Effor Beklentisi *

	Kesinlikle Katılıyorum (5)	Katılıyorum (4)	Ne Katılıyorum Ne Katılmıyorum (3)	Katılmıyorum (2)	Kesinlikle Katılmıyorum (1)
Robot süpürge kullanırken çok fazla enerji harcamam gerekmez	○	○	○	○	○
Robot süpürge kullanımı benim için çok fazla çaba gerektirmez	○	○	○	○	○
Robot süpürge kullanımının işimi kolaylaştıracağını düşünüyorum.	○	○	○	○	○

Sensitivity: Public

Hedonik Motivasyon *

	Kesinlikle Katılıyorum (5)	Katılıyorum (4)	Ne Katılıyorum Ne Katılmıyorum (3)	Katılmıyorum (2)	Kesinlikle Katılmıyorum (1)
Robot süpürge kullanmak zevklidir	◯	◯	◯	◯	◯
Robot süpürge kullanmak beni heyecanlandırır	◯	◯	◯	◯	◯
Robot süpürge kullanmak eğlencelidir	◯	◯	◯	◯	◯

Zaman Tasarrufu *

	Kesinlikle Katılıyorum (5)	Katılıyorum (4)	Ne Katılıyorum Ne Katılmıyorum (3)	Katılmıyorum (2)	Kesinlikle Katılmıyorum (1)
Robot süpürge kullanarak işlerimi daha hızlı bir şekilde tamamlayabilirim.	◯	◯	◯	◯	◯
Robot süpürge kullanarak işlerimi daha hızlı halledebileceğimi düşünüyorum.	◯	◯	◯	◯	◯
Robot süpürge kullanarak günlük rutin işlerimde zaman kazandırır	◯	◯	◯	◯	◯
Robot süpürge kullanarak ev temizliğinden tasarruf ettiğim zamanı sürdürülebilirlik amacıyla başka bir iş için kullanabilirim.	◯	◯	◯	◯	◯

Sensitivity: Public

Enerji Tasarrufu *

	Kesinlikle Katılıyorum (5)	Katılıyorum (4)	Ne Katılıyorum Ne Katılmıyorum (3)	Katılmıyorum (2)	Kesinlikle Katılmıyorum (1)
Robot süpürge kullanımının sürdürülebilir çevreye katkıda bulunduğuna inanıyorum.	○	○	○	○	○
Robot süpürgelerin enerji tüketiminin düşük olduğuna inanıyorum.	○	○	○	○	○
Robot süpürgelerin enerji tasarrufu sağladığına inanıyorum	○	○	○	○	○
Robot süpürgelerin çevre dostu ürünler olduğunu düşünüyorum.	○	○	○	○	○

Algılanan Değer *

	Kesinlikle Katılıyorum (5)	Katılıyorum (4)	Ne Katılıyorum Ne Katılmıyorum (3)	Katılmıyorum (2)	Kesinlikle Katılmıyorum (1)
Kullanım için gereken çaba ile karşılaştırıldığında, RVC kullanmak benim için faydalıdır.	○	○	○	○	○
Genel olarak, robot süpürge kullanmanın bana iyi bir değer sunduğunu düşünüyorum.	○	○	○	○	○
Robot süpürgenin harcadığım paranın karşılığını verdiğini düşünüyorum.	○	○	○	○	○
Harcaması gereken zaman ile karşılaştırıldığında, RVC kullanmak benim için değerlidir.	○	○	○	○	○

Sensitivity: Public

Kullanım Niyeti *

	Kesinlikle Katılıyorum (5)	Katılıyorum (4)	Ne Katılıyorum Ne Katılmıyorum (3)	Katılmıyorum (2)	Kesinlikle Katılmıyorum (1)
Robot süpürge kullanacağımı tahmin ediyorum.	◯	◯	◯	◯	◯
İleride Robot süpürgeyi kullanmaya düşünürüm.	◯	◯	◯	◯	◯
İleri Robot süpürge kullanma niyetim var.	◯	◯	◯	◯	◯

Marka İmajı *

	Kesinlikle Katılıyorum (5)	Katılıyorum (4)	Ne Katılıyorum Ne Katılmıyorum (3)	Katılmıyorum (2)	Kesinlikle Katılmıyorum (1)
İyi bir marka imajı robot süpürge kullanım kararını etkiler.	◯	◯	◯	◯	◯
iyi yapılanmış bir RVC markası RVC kullanınım kararını etkiler.	◯	◯	◯	◯	◯
Robot süpürge markasının farklılaştırılmış bir imajı vardır.	◯	◯	◯	◯	◯

Sensitivity: Public

Robot Süpürge Kullanımına Dair Ek Bilgiler

Robot Süpürge kullanımındaki özel sebepleriniz aşağıdakilerden hangisi/hangileri olabilir? Birden fazla seçenek seçebilirsiniz. *

- [ ] Teknolojik ürünlere kişisel ilgim var
- [ ] Sağlık problemlerimden dolayı
- [ ] Çocuklu ve/veya evcil hayvanlı evde sağladığı faydalardan dolayı
- [ ] Evimin sürekli temiz olması hissiyatı
- [ ] Diğer: _____

Lütfen yaşadığınız eviniz büyüklüğünü belirtiniz *

- ◯ < 50m2
- ◯ 51m2 - 100m2
- ◯ 101m2 - 150m2
- ◯ 151m2 - 200m2
- ◯ > 200m2

Lütfen yaşadığınız evdeki (salon hariç) oda sayısını belirtiniz. *

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4 ve/veya daha fazla

Lütfen yaşadığınız evin ne sıklıkla süpürüldüğünü belirtiniz *

- ◯ Günde bir kere
- ◯ Haftada iki kere
- ◯ Haftada bir kere
- ◯ İki haftada bir
- ◯ Ayda bir kere

Sensitivity: Public

Lütfen Yaşınızı Belirtiniz *

- ◯ 18-25 yaş
- ◯ 26-35 yaş
- ◯ 36-45 yaş
- ◯ 46 yaş ve üzeri

Lütfen cinsiyetinizi belirtiniz *

- ◯ Kadın
- ◯ Erkek
- ◯ Belirtmek İstemiyorum

Lütfen eğitim durumunuzu belirtiniz *

- ◯ İlköğretim
- ◯ Lise
- ◯ Üniversite (Devam Ediyor)
- ◯ Üniversite Mezunu
- ◯ Yüksek lisans - Doktora (Devam Ediyor)
- ◯ Yüksek lisans – Doktora Mezunu

Lütfen aylık ortalama geliriniz belirtiniz (TL) *

- ◯ 8.500 ve altı
- ◯ 8.501 - 15.000
- ◯ 15.001 - 28.000
- ◯ 28.000 - 34.500
- ◯ 34.501 ve üstü

Sensitivity: Public

Appendix 2- Questionnaire in English

Dear participant,

This survey has been prepared for the purpose of examining the 'Intention to Use Robot Vacuum Cleaner' within the scope of the Master's thesis in the Marketing Department, under the supervision of Prof. Dr. Taşkın Dirsehan, at Marmara University Institute of Social Sciences.

There are no right or wrong answers to the questions, and the responses will be used solely for scientific purposes.

Thank you for taking the time to complete the survey and for your contribution.

Sample Usage Images of Robot Vacuum Cleaner



Sensitivity: Public

Existing Vacuum Cleaner Information

Evinizdeki mevcut süpürge tipi nedir(dik süpürge, torbalı/torbasız süpürge, robot süpürge, vb.)? *






- [ ] Bagged Vacuum Cleaner
- [ ] Bagless Vacuum Cleaner
- [ ] Upright Vacuum Cleaner
- [ ] Robotic Vacuum Cleaner
- [ ] Other

What is the current vacuum cleaner brand in your house? *

Yanıtınız

Sensitivity: Public

Information about Robotic Vacuum Cleaner

How knowledgeable do you consider yourself to be about smart vacuums?" *

	1	2	3	4	5	
I have no knowledge,	◯	◯	◯	◯	◯	I am extremely knowledgeable.

Are you currently using a robot vacuum? *



◯ Yes

◯ No

If your answer to the previous question is no, are you considering using a robot vacuum?

◯ Yes

◯ Maybe

◯ No

Sensitivity: Public

In the following section, please indicate the option that best reflects your opinion on a scale of 'Strongly Disagree' (1) to 'Strongly Agree' (5).

Performans Risks *

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
It is uncertain that RVC will perform the functions that were described in the advertisement	○	○	○	○	○
It is uncertain that RVC will work satisfactorily	○	○	○	○	○
I worry about whether RVC will not provide the level of benefits I expect	○	○	○	○	○

Financial Risk *

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
Considering the potential investment involved, Purchasing and using RVC is risky	○	○	○	○	○
Using RVC carries financial risks	○	○	○	○	○
Using RVC entails financial risks due to potential higher maintenance and repair costs.	○	○	○	○	○

Sensitivity: Public

Performance Expectancy *

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
Using a robot vacuum cleaner will make the cleaning work in my house easier for me.	○	○	○	○	○
Using a robot vacuum cleaner will effectively remove dust and dirt from my home.	○	○	○	○	○
Using a robot vacuum will make cleaning jobs in my house less stressful for me.	○	○	○	○	○

Effort Expectancy *

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
When using RVC, I think it will make my work easier.	○	○	○	○	○
When using RVC, I do not have to expend a lot of energy	○	○	○	○	○
Using RVC does not require a lot of effort for me.	○	○	○	○	○

Hedonic Motivation *

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
The use of RVC gives me pleasure	○	○	○	○	○
The use of RVC makes me feel exited	○	○	○	○	○
Using RVC is truly fun	○	○	○	○	○

Sensitivity: Public

Time Saving *

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
By using a robotic vacuum cleaner I can complete my tasks more quickly.	○	○	○	○	○
I can use the time saved from house cleaning with a robot vacuum for sustainability purposes.	○	○	○	○	○
When using RVC, I think it will help me get things done faster.	○	○	○	○	○
By using RVC, I will save time in my daily routine work.	○	○	○	○	○

Energy Saving *

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
I believe that low energy consumption of RVCs contributes to the sustainable environment	○	○	○	○	○
I believe that RVCs has the low energy consumption.	○	○	○	○	○
The energy saving of RVCs encourages the use of technology in an environmentally friendly way.	○	○	○	○	○
I believe that RVCs save energy.	○	○	○	○	○

Sensitivity: Public

Perceived Value *

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
I think that Using RVC offers value for money	○	○	○	○	○
Compared to the effort to put, using RVCs is useful to me	○	○	○	○	○
In general, i think that using RVCs delivers me good value	○	○	○	○	○
Compared to the time to spend, using RVCs is worthwhile to me	○	○	○	○	○

Intention to Use *

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
Using RVC is worthwhile	○	○	○	○	○
I intend to use RVC in the future	○	○	○	○	○
I predict I would use RVC in the future	○	○	○	○	○

Brand Image *

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
I think, having better brand image directly effects the decision to use RVC	○	○	○	○	○
I have a good impression of brand image while choosing RVC	○	○	○	○	○
For me, good brand image effects my decision to use RVC	○	○	○	○	○

Sensitivity: Public

Additional Information About Robotic Vacuum Usage

What could be your specialreasons for using a robot vacuum? You can select multiple options. *

- [ ] Having a interest in technological products
- [ ] Having health issue
- [ ] Due to the benefits it provides in households with child and/or pets
- [ ] The feeling of always having a clean home
- [ ] Other

Please specify the size of the home you live in. *

- ◯ < 50m2
- ◯ 51m2 - 100m2
- ◯ 101m2 - 150m2
- ◯ 151m2 - 200m2
- ◯ > 200m2

Please specify the number of rooms in your home (excluding the living room). *

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4 and/or more

*

Please indicate how often your home is swept.

- ◯ Once a day
- ◯ Twice a week
- ◯ Once a week
- ◯ Bi-weekly
- ◯ Once a month

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Age *

- ◯ 18-25 years
- ◯ 26-35 years
- ◯ 36-45 years
- ◯ 46 + years

Gender *

- ◯ Female
- ◯ Male
- ◯ I prefer not to specify

Education *

- ◯ Primary School
- ◯ High School
- ◯ University (continuing)
- ◯ University Graduate
- ◯ Master's - Ph.D. (continuing)
- ◯ Master's - Ph.D. Graduate

Please specify your average monthly income (in TL) *

- ◯ 8.500 and less
- ◯ 8.501 - 15.000
- ◯ 15.001 - 28.000
- ◯ 28.000 - 34.500
- ◯ 34.501 and above

Sensitivity: Public

Appendix 3- Measured Items in the Survey in Turkish

Algılanan Risk		**Performans Riski**	**Kaynak**
	PR1	Robot süpürgenin beklediğim düzeyde fayda sunmayacağı konusunda endişeliyim.	Stone and Grønhaug-1993
	PR2	Robot süpürgenin tatmin edici şekilde çalışacağı kesin değildir.	
	PR3	Robot süpürgenin reklamda anlatılan fonksiyonları yerine getireceği kesin değildir.	
		Finansal Risk	
	FR1	Robot süpürge kullanımı yüksek bakım ve onarım maliyetlerinden dolayı finansal riskler içermektedir.	Grewal et al. (1994)
	FR2	Potansiyel toplam harcama göz önüne alındığında, robot süpürge satın almak ve kullanmak risklidir.	
	FR3	Robot süpürge kullanımı finansal riskler taşımaktadır.	
Algılanan Fayda		**Algılanan Fayda**	
		Performans Beklentisi	
	PE1	Robot süpürge kullanımı evimden tozu ve kiri etkili bir şekilde temizleyecektir.	Venkatesh et al. 2003
	PE2	Robot süpürge kullanmak evimdeki temizlik işlerini benim için daha kolay hale getirecektir.	Venkatesh et al. 2003
	PE3	Robot süpürge kullanmak evimdeki temizlik işlerini benim için daha az stresli hale getirecektir	Venkatesh et al. 2003
		Effor Beklentisi	
	EE1	Robot süpürge kullanımının işimi kolaylaştıracağını düşünüyorum.	Davis, Bagozzi, & Warshaw (1992)
	EE2	Robot süpürge kullanımı benim için çok fazla çaba gerektirmiyor	Davis, Bagozzi, & Warshaw (1992)
	EE3	Robot süpürge kullanırken çok fazla enerji harcamam gerekmiyor.	Davis, Bagozzi, & Warshaw (1992)
		Hedonik Motivasyon	
	HM1	Robot süpürge kullanmak beni heyecanlandırıyor.	Batra & Ahtola (1991)
	HM2	Robot süpürge kullanmak bana zevk.	
	HM3	Robot süpürge kullanmak gerçekten eğlenceli.	
		Zaman Tasarrufu	
	TS1	Robot süpürge kullanarak işlerimi daha hızlı halledebilirim.	Kadioglu (2020), Zhang (2022)
	TS2	Robot süpürge kullanarak günlük rutin işlerimde zaman kazandırır	Kadioglu (2020), Zhang (2022)
	TS3	Robot süpürge kullanarak işlerimi daha hızlı bir şekilde tamamlayabilirim	Kadioglu (2020), Zhang (2022)
	TS4	Robot süpürge kullanarak ev temizliğinden tasarruf ettiğim zamanı sürdürülebilirlik amacıyla başka bir iş için kullanabilirim.	Zhang (2022)
		Enerji Tasarrufu	
	ES1	Robot süpürgelerin enerji tasarrufu sağladığına inanıyorum	Smart Homeness (2022)
	ES2	Robot süpürgelerin enerji tüketiminin düşük olduğuna inanıyorum.	Smart Homeness (2022)
	ES3	Düşük enerji tüketimli robot süpürge kullanımının sürdürülebilir çevreye katkıda bulunduğuna inanıyorum.	Jiang, Zhang, & Li (2019)
	ES4	Robot süpürgelerin enerji tasarrufu, teknolojinin çevre dostu bir şekilde kullanılmasını teşvik eder.	Jiang, Zhang, & Li (2019)
Algılanan Değer		**Algılanan Değer**	
	PV1	Robot süpürgenin harcadığım paranın karşılığını verdiğini düşünüyorum.	Sirdeshmukh et al. (2002)
	PV2	Kullanım için gereken çaba ile karşılaştırıldığında, RVC kullanmak benim için faydalıdır.	
	PV3	Harcaması gereken zaman ile karşılaştırıldığında, RVC kullanmak benim için değerlidir.	
	PV4	Genel olarak, RVC kullanmanın bana iyi bir değer sunduğunu düşünüyorum.	
Kullanım Niyeti		**Kullanım Niyeti**	
	IU1	Robot süpürgeyi kullanmaya değer görüyorum.	Davis et al. (1989) and Venkatesh et al. (2003;2012)
	IU2	Robot süpürge kullanım niyetim var.	
	IU3	Robot süpürge kullanacağımı tahmin ediyorum.	
Marka İmajı		**Marka Imajı**	
	BI1	Marka imajının robot süpürge seçerken olumlu etkisinin olduğunu düşünüyorum.	Nguyen & Leblanc (2001)
	BI2	İyi bir marka imajı robot süpürge kullanım kararımı etkiler.	Nguyen & Leblanc (2001)
	BI3	Daha iyi bir marka imajının robot süpürge kullanım kararını direkt olarak etkilediğini düşünüyorum.	Nguyen & Leblanc (2001)

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Appendix 4: Types of Vacuum Cleaner Currently Used

Types of Vacuum Cleaner Currently Used

Bagged Vacuum Cleaner	61
Bagged Vacuum Cleaner, Bagless Vacuum Cleaners	4
Bagged Vacuum Cleaner, Upright Vacuum Cleaner	8
Bagless Vacuum Cleaner	65
Bagless Vacuum Cleaner, Upright Vacuum Cleaners	7
Other	3
Upright Vacuum Cleaner	75
Grand Total	**223**

Appendix 5: Knowledgeable Level and Consideration of the Using Robotic Vacuum Cleaner

Knowledgeable Level of the Respondents and Their Consideration about the Using Robotic Vacuum Cleaner

	Frequency	%
1 (have no knowledge)	**8**	**3,6%**
Maybe	7	3,1%
Yes	1	0,4%
2 (have very little knowledge)	**73**	**32,7%**
Maybe	31	13,9%
No	10	4,5%
Yes	32	14,3%
3 (have some knowledge)	**89**	**39,9%**
Maybe	47	21,1%
No	4	1,8%
Yes	38	17,0%
4 (have good knowledge)	**35**	**15,7%**
Maybe	11	4,9%
No	5	2,2%
Yes	19	8,5%
5 (have very good knowledge)	**18**	**8,1%**
Maybe	2	0,9%
No	1	0,4%
Yes	15	6,7%
Grand Total	**223**	

Source: Computed by the researcher

Sensitivity: Public

Appendix 6: Frequency of Vacuuming the House of the Sample Group

Frequency	Not Stated	Female	Male	Grand Total
Once a day		71	23	94
Once a month			2	2
Once a week	1	13	16	30
Twice a week	1	45	49	95
Bi-weekly			2	2
Grand Total	**2**	**129**	**92**	**223**

Source: Computed by the researcher

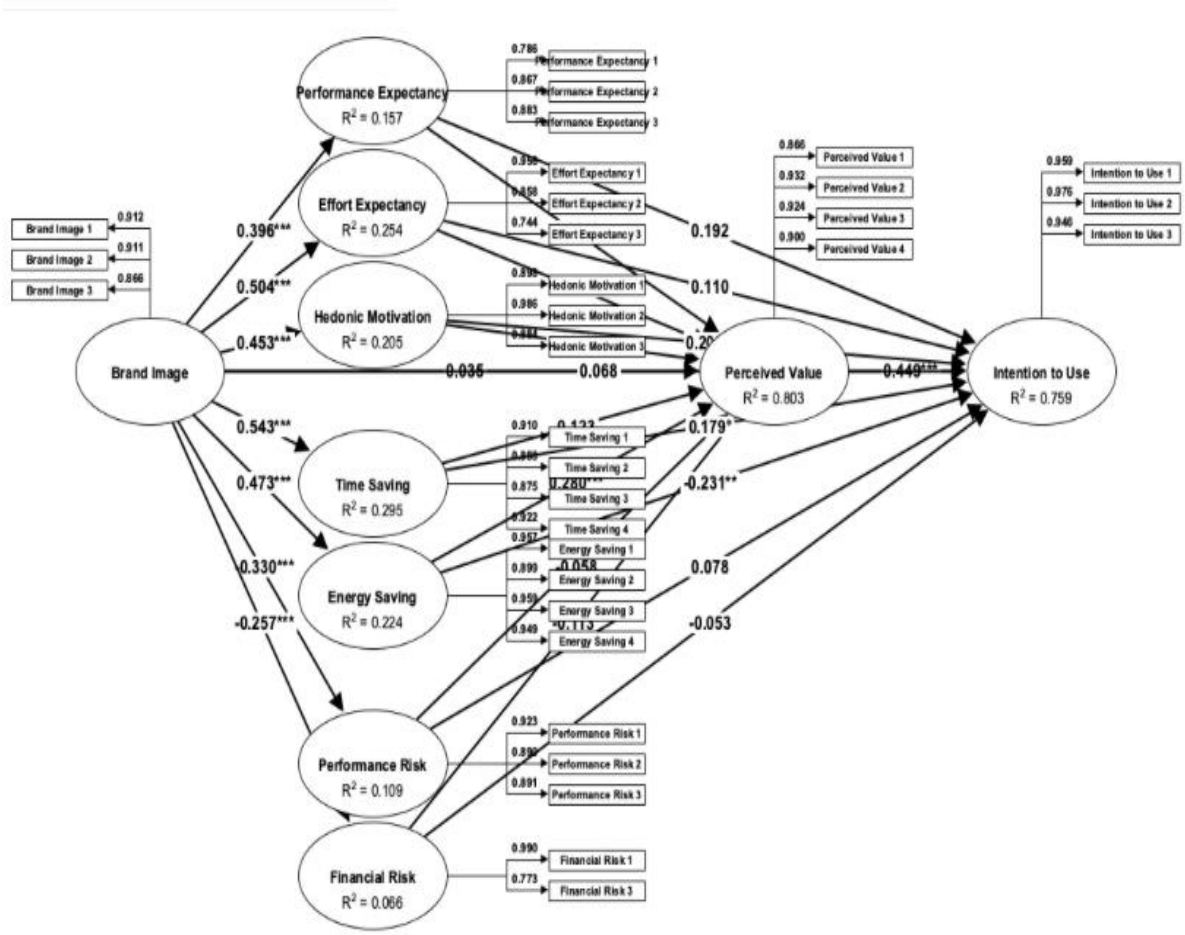
Appendix 7: Special Reasons to Desire Using Robotic Vacuum Cleaner

Special Reasons	Frequency	%
Having child and/or pet	16	*7,2%*
Having child and/or pet, the feeling of always having a clean home	26	*11,7%*
Having child and/or pet, the feeling of always having a clean home, it will help me vacuuming less frequently	1	*0,4%*
The feeling of always having a clean home	79	*35,4%*
Ease of use to have clean house	8	*3,6%*
Having health issue	10	*4,5%*
Having health issue and having child and/or pet	5	*2,2%*
Having health issue and having child and/or pet, the feeling of always having a clean home	3	*1,3%*
Having health issue, the feeling of always having a clean home	13	*5,8%*
Personal interest in technological products	17	*7,6%*
Personal interest in technological products, Having child and/or pet	6	*2,7%*
Personal interest in technological products, having child and/or pet, the feeling of always having a clean home	6	*2,7%*
Personal interest in technological products, having child and/or pet, the feeling of always having a clean home, time saving	1	*0,4%*
Personal interest in technological products, the feeling of always having a clean home	24	*10,8%*
Personal interest in technological products, the feeling of always having a clean home, ease of use to have clean house	1	*0,4%*
Personal interest in technological products, having health issue	1	*0,4%*
Personal interest in technological products, having health issue, having child and/or pet, the feeling of always having a clean home	3	*1,3%*
Personal interest in technological products, having health issue, the feeling of always having a clean home	2	*0,9%*
Time Saving	1	*0,4%*
Grand Total	**223**	

Source: Computed by the researcher

Sensitivity: Public

Appendix 8: Path Analysis of the Model



Source: Developed by researcher with ADANCO

Sensitivity: Public