T.C.

ISTANBUL AYDIN UNIVERSITY

INSTITUTE OF SOCIAL SCIENCES

PREDICTING THE ADOPTION OF WEARABLE HEALTH TRACKING DEVICES: AN APPLICATION OF DIFFUSION OF INNOVATION THEORY

THESIS

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Department of Business

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DECLARATION

I hereby declare that all information in this thesis document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results, which are not original to this thesis.

Ziya ŞEHBENDEROĞLU

This thesis is dedicated to:

My whole family, my beloved parents

&

My lovely fiancé Afnan

FOREWORD

First of all, I would like to express my endless gratitude to Allah for being who I am right now and helping me to find patience, strength within myself to complete this thesis.

I would also like to thank my family not only for teaching me to chase my dreams and never give up, but also for encouraging me through my whole life journey. I cannot express how grateful I am for having such a loving parent that always believes in me. Moreover, my sisters Dania and my twin Douaa are my source of inspiration and engine that helps me to improve and move on. Nevertheless, I cannot mention the patience and support that my fiancé showed within this period of my life. Behind of any my success there is a hard work of my beloved Afnan.

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March, 2019 **Ziya ŞEHBENDEROĞLU**

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ABBREVIATIONS

AGFI	: Adjusted Squared Multiple Correlations
AmI-S	: Ambient intelligent space
AMOS	: Analysis of a Moment Structures
CFA	: Confirmatory Factor Analysis
CFI	: Competitive Fitness Index
DOI	: Diffusion of Innovation theory
ERP	: Enterprise Resource planning system
GFI	: Goodness-of-Fit statistic
HTD	: Health Tracking devices
ICT	: Information and Communications Technology
IoT	: Internet of Things
NFI	: Normed Fit Index
PS	: Physical space
RMSEA	: Room Mean Square Error of Approximation
SEM	: Structural Equation Modeling
SMC	: Squared Multiple Correlations
SMC	: Squared Multiple Correlations
SRMR	: Standardized Root Mean Square Residual
TAM	: Technology Acceptance Model
TPB	: Planned behavior theory
TRA	: The reasoned of action theory
VR-S	: Virtual Space

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GİYİLEBİLİR SAĞLIK İZLEME CİHAZLARININ BENİMSENMESİNİN TAHMİN EDİLMESİ YENİLİK YAYILIMI TEORİSİ UYGULAMASI

ÖZET

Bu çalışmada, Türkiye pazarındaki müşterilerin giyilebilir teknolojiyi kullanma ve benimseme konusundaki algılarını analiz etmek amacıyla Everett Rogers'ın inovasyon yayınım modelini uygulanmıştır. Likert tipi, online tasarlanmış bir anket yoluyla 210 gönüllünün cevapları alınmıştır. Veriler, SPSS sürüm 24 ve AMOS sürüm 23 ile doğrulayıcı faktör analizi (CFA) ve yapısal eşitlik modellemesi (SEM) ile analiz edilmiştir. Temel olarak beş hipotez incelenmiştir. Bağımlı değişken (benimseme) ile diğer dört bağımsız değişken (izafi fayda, uyum, denenebilirlik ve gözlemlenebilirlik) arasında pozitif bir ilişkinin varlığı kabul edilmiştir. Ancak, sadece bir değişkenin (karmaşıklık) benimsemeye olumsuz etkisi olduğu düşünülmektedir. Bu araştırma, giyilebilir sağlık izleme cihazlarının benimsenmesinin seçilen pazarda bir trend haline gelip gelmeyeceğini öngörmeye yönelik bir denemedir. Diğer taraftan, sonuçlar önceki çalışmalarla karşılaştırıldığında şaşırtıcı ve ilginçti. İki hipotezin kabul edildiği ve diğerlerinin reddedildiğini gösteren araştırma, benimseme üzerinde uyum ve karmaşıklığın etkisini göstermiştir. Uyumun benimseme üzerinde olumlu etkisi olduğu onaylanmıştır ve bu da giyilebilir sağlık izleme cihazlarının (HTD) yaşam tarzı, inanç ve değerlerle uyumlu olmasının önemini yansıtmaktadır. Bu arada, benimseme üzerinde karmaşıklığın olumsuz bir etkiye sahip olduğu görüşü de desteklenmiştir. Bir başka deyişle sadelik, Türkiye pazarında giyilebilir cihazların kullanımı hassas ve kritik bir nokta olarak görülmektedir. Reddedilen faktörler ise izafi fayda, denenebilirlik ve gözlemlenebilirlikti. Sonuçların anlaşılması için çalışılan pazarın, örneğin Türkiye pazarının göz önünde bulundurulması ve giyilebilir sağlık izleme cihazlarının hala genç kabul edildiğinin bilinmesi gerçekten çok önemlidir. Bu nedenle, müşteriler bunu denemek bile istemeyebilir. Buna ek olarak faydalar hedef kitle açısından yeterince açık olmayabilir ve bu faydalar bazı nedenlerden dolayı anlaşılamayabilir. Bu nedenle, kullanıcının bu tür cihazları benimsemeyerek elde edeceği avantajların anlatılması çok önemlidir.

Anahtar Kelimeler: *Nesnelerin İnterneti, giyilebilir ürünler, teknolojinin benimsenmesi, tüketici davranışı, sağlık ve fitness, Sağlık izleme cihazları.*

PREDICTING THE ADOPTION OF WEARABLE HEALTH TRACKING DEVICES: AN APPLICATION OF DIFFUSION OF INNOVATION THEORY

ABSTRACT

This study applied Everett Rogers' innovation diffusion model to analyze the perceptions of customers in Turkish market toward using and adopting wearable technology. 210 voluntarily responses were collected via Likert type online designed questionnaire. Data were analyzed by SPSS version 24 and AMOS version 23, through confirmatory factor analysis (CFA) and structural equation model (SEM). Basically, five hypotheses were investigated. It is assumed there are positive relationships between the dependent variable (The Adoption) and the other four independent variables (Relative advantage, Compatibility, Trialability and Observability). However, just one of the independent variable (Complexity) considered having a negative relationship with the Adoption. This study is a try to foresee whether the adoption of wearable health tracking devices is going to become a trend in the chosen market. Moreover, the finding was surprising and interesting comparing with previous studies. Where it revealed acceptance for two hypotheses and rejecting the rest, the supported factors were compatibility and complexity's impact on adoption. Compatibility was confirmed to have a positive effect over the adoption, which reflects the importance of wearable health tracking devices (HTD) to be compatible with lifestyle, beliefs and values to Turkish market. Meanwhile, complexity was supported by having a negative effect on the adoption. In other words, simplicity is considered by Turkish market as a sensitive and critical point in term of use of wearables. In this study, the rejected factors are Relative advantage, Trialability and Observability. It is really essential for the results, to be understood while considering the market that has been studied, for example, wearable HTD in Turkish market is still considered young. Therefore, customers might not even think of trying it. Add to that, the benefits might not be clear enough to the target customers or they are not able to see and understand those benefits for some reasons, thus, it is very critical to explain the advantages that are the user is going to gain by adopting such devices.

Keywords: *Internet of Things, wearables, technology adoption, consumer behavior, health and fitness, Health tracking devices.*

1. INTRODUCTION

1.1 Statement of the Problem

In producers or innovators' working life there is a goal that every one of them struggle to make it real, making their products or innovations become every day's talk. Many companies, individuals or even group of people dream to make enormous profit out of their product, and to increase the profit they need to increase the sales. However, the majority of people won't buy the innovation unless it crosses the chasm, which was defined by Roger in DOI theory to be the gap between Early Adoptors and Early Majority (Roger, 2003). Nowadays, one of the most popular innovations is wearable devices, which is the area of focus for this thesis. Such devices provide users with the ability of monitoring health statue. For instance; tracking of data and communication with a doctor, heart rate monitoring and calories burn count during exercise or physical activity. Moreover, this innovation gives the ability for syncing with the smart phone and other devices, interaction with social media and planning and scheduling of daily routines. Global shipments of wearable devices are forecast to reach 125.3 million units in 2018, up 8.5% from 2017, according to the International Data Corporation (Framingham, Mass., 2018).

However, this technology is still considered young in Turkish market, as the applied questionnaire through this study shows 85.6% of the particpants don't use wearable devices. This research is trying to invastigate this problem by applying DOI theory's factors (relative advantage, compatibility, complexity, trialability and observability) to understand user adoption of such HTD. The findings would give insights whether the adoption of wearable health tracking devices is going to cross the chasm. With the mentioned questionnaire, the participants' responses will be analyzed via SPSS and AMOS, in order to find out what factors influence the adoption process, then, making comments on the findings. The findings of this research are expetcted to help to predict and give wearable HTD’s innovators valuable feedback in all means, which would provide a very critical insights in developing marketing strategies.

1.2 Purpose of the Study

Overall, the aim of this research is to apply a theory “Diffusion of Innovation” (Roger, 2003) on the adoption of wearable HTD in Tuekey. Essentially this research is trying to assess whether the five factors of the theory (relative advantage, compatability, complexity, trialability and observability) have any impact on user adoption of wearavle HTD. Analyzing the collected data would give feedback in order to make action to improve the wearable HTD’s chance spreading over Turkish market.

1.3 Research Questions

In accordance with the purpose of the study following research question was formulated:

- What factors influence user adoption of wearable health tracking devices?

Sub-questions:

- Is there a positive relationship between Relative Advantage and the Adoption of wearable health tracking devices?
- Is there a positive relationship between Compatibility and the Adoption of wearable health tracking devices?
- Is there a negative relationship between Complexity and the Adoption of wearable health tracking devices?
- Is there a positive relationship between Trialability and the Adoption of wearable health tracking devices?
- Is there a positive relationship between Observability and the Adoption of wearable health tracking devices?

1.4 Originality / Value

Although wearables are spreading more widely and their popularity and adoption in markets will reach 189.9 million units in 2022, according to the International Data Corporation (Framingham, Mass., 2018). The number of researches that studying the diffusion of such innovation remain limited. This thesis is an attempt amongst the primary scientific researches which investigate the adoption of wearable HTD in Turkish market.

1.5 Thesis Outline

This thesis consists of six main chapters:

Chapter 1, as Introduction part of the study includes the statement of the problem, objective of the research, formulated research questions and originality of the study.

Chapter 2 reviews available literature dedicated to background of Smart devices and Internet of Things, as well as background of Diffusion of innovation theory in general and its factors. Additionally, literature review has been conducted on background of the adoption of wearable health tracking devices and previous studies made on this regard.

Chapter 3 depicts research model designed for this study and formulated hypotheses based on previous studies.

Chapter 4 describes the methodology of the research with research design, sample size, implemented survey tools and techniques subtopics.

Chapter 5 is dedicated for analyzing the data with a help of statistical techniques. This chapter also reveals the outcomes of the research.

Chapter 6 proposes managerial implications based on research results and discusses research results. Additionally, it provides limitations of the study that can be used for future research.

2. LITERATURE REVIEW

2.1 Background of Smart devices

Nowadays, Smart Devices are used over the world almost every place, every time by everyone. Its role kept increasing in our daily life until no one can even imagine his/her life without it. Its essential role in our daily life cannot been argued. There are many applications for the smart devices, such as mobile smart devices, smart cards, RFID, smart home, wearable devices, etc. These Smart environments consist of devices such as sensors, controller and computers that are embedded in, or operate in. These devices are strongly context-aware of their physical environment in relation to their tasks. Smart devices can have the awareness of specific user activities. For example, gates which acting when individuals moving toward those gates. The action that is taking is happening typically independently without any command or involvement by the walkers. However, the focus nowadays is on finding more complex models of interaction of the smart devices, and aiming to enhance the corporation between the smart devices itself. For instance, an intelligent camera inside a room is able to collaborate with smart lights to adjust them so increase the ability to have a clearer picture or video to be recorded.

In this research, it is going to examine the adoption of health tracking devices, which is one of the wearable family generated as an application of the smart devices. (Poslad, 2013).

2.1.1 Smart devices definition

Smart devices have been an area of focus for many companies and research centers last years. The term -smart device- is used to refer to devices that automatically gather information about users or their environment to assist them in gaining knowledge about themselves and/or taking action. Other terms that have been used to refer to smart devices are personal informatics systems in conference on human factors in computing system, 2010 and quantified self in conference on human factors in computing system, 2014. Smart devices usually supposed to have a variety of functions and objectives as information and communication technology gadgets, e.g., laptop, cell phones, moreover, in order to get the benefits of many common various implementation these devices are used as a platform, no matter this implementation is established distantly by a server or regionally on the equipment. Variety of types are existing as intelligent gadgets and appliances. Which usually have a tendency to be used personally by a particular person with modified setting. In this gadgets type, the control unit and interacting point located in the intelligent equipment. The major features of the gadgets mentioned above are defined in the following: movable, reachable effective applications and non-continuous power charging needed (synchronization, promotion, etc.). Usually devices are destined to be multipurpose as a result of easy reachable and accessible feature, and facilitate the ability to interoperation, multipurpose at work time. Yet, achieving a balance while comparing two desirable but incompatible features is something people tend to refuse, since they do prefer to have advantages from the device as much as possible, so this issue is in a declined level, which is required the system to keep up hardware parts and to provide an additional effective adjustable ability to interoperation work time. Computers usually tend to be considered firstly as multi-functional PC or host computers with server, including kind of demonstration system for showing the data and for sure some tools which used to enter the data such as pointing tools or a mouse and a keyboard. As human beings, they have tendency to deal with gadgets and appliances which include monocular built-in and computing machinery system, for example home devices, as well as dealing with complicated apparatuses which have multiple built-in computing machinery system. Weiser draw attention to a point, where he pointed out a tendency to change from a lot of users per computer, to just one user for each computer, furthermore, heading to number of computers for one user. Devices which rely on computing system technology are heading to achieve effectiveness in size and lighter in weight, economical to be produced. Thus, devices can become widespread, made more movable and can appear less irritating. Weiser took into consideration a variety of device sizes in his early work from wearable centimeter-sized devices (tabs), to hand-held decimeter-sized devices (pads) to meter sized (boards) displays.

ICT Pads to give users the ability to reach the phone features and information and communications technology tabs to follow merchandise which are used widely. Another advantageous way for screening to a lot of customers is wall displays, for cooperative operation and showing massive complicated designs such as charts. Another way for screening, horizontally oriented as surface computers or vertically, is board appliances (Poslad, 2013).

2.1.2 Some of smart devices applications.

The applications of smart devices entered our daily routine without even any permission or request, starting with looking at your phone in the morning to know the time, and finishing with moment that you are setting the alarm on your smart phones for the next day. The products of smart devices vary so widely, some of them at home e.g. Smart home, some of them on the transportations e.g. Smart cards, some are used in the marketing e.g. RFID, and others in different places and situations, e.g. wearables and smart watches.

2.1.2.1 Smart home

Sergey Balandin, Sergey Andreev and Yevgeni Koucheryavy identify the term Smart home in their book, Internet of Things, Smart Spaces, and Next Generation Networking, 2013, as a house includes various extremely developed intelligent interrelated appliances. Consequently, the circumference of this type of homes is able to understand, know, analyze, logically thinking and expectation about the action that might be acted by a user and can based on that react appropriately (Ma et al., 2005). All what these appliances and devices are doing is to follow the requirement and wants of a user in order to make life's quality much higher. There was an association in Netherlands in 2007 named Smart home association, this association identify the kind of homes as it is the home that is doing services in a home environment by using the technology in order to raise the comfort and quality for whom is living at home (Bierhoff et al., 2007). However, there is a question which wort asking, what can this technology add as an application in an intelligent house? Trying to answer this question, basically, three factors are making this intelligent home environment: Firstly, ambient intelligent space (AmI-S) which is refer to the computers and sensors that are set up in the environment, so they can interact with the user actions by automatic smart sensibility. For example: when it is talking about the smart table in the room. This kind of technology will increase the comfort and happiness, in addition, it would help in daily activities such as cleaning or taking care of a baby. Secondly, virtual space (VR-S) in created from information and communication technology devices, like smart furniture and walls which have a connection with a network. This part is responsible for some kind of activities such as tele-learning and tele shopping…etc. Thirdly, physical space (PS) and which is joint with virtual space (VR-S), this is in fact the conventional space where people are with their bodies. Of course, the impact of this evolutions in technology will extend to cover the style of life in the future and housing needs, through increasing the comfort, appropriate way to live by offering more technical possibilities. User Centered Framework is designing to cover consumers and the new style of life and locative tendency, in order to better understanding what these updating in technology will impact marketing strategies and real state administration.

Previously, there was a dream cold "Smart house", because of the development in the technical fields, nowadays there is a chance to understand that dream better. These homes have reputable "Possibilities of Sustainability"; they are described to be able to develop energy maintenance, repose, wellness, safety, space and time usage. A superior realization of the role that can Smart Home represent in real estate scope is offered by knowing all these capabilities. Add to that, what would make Smart house foreseeable and accomplishable is connecting this "Possibilities of Sustainability" to the "Trends of Sustainability" and waiting for the results.

2.1.2.2 Radio frequency identification

In the last few years, researchers and producers has a focus area which is RFI the technology of Radio Frequency Identification (Sarac et al., 2010; Ju et al., 2008). What cause this wave of interest into RFID is the fact that this technology is quicker than barcode technology by ten to twenty times. This technology is system which has the ability to identify automatically objects using radio signal within its domain with no inconsistency (Vlachos, 2014; Muller-Seitz et al., 2009; Inlogic, 2013; Enasys, 2014; Roberti, 2013). This technology was clarified by Tajima in 2007 as it is tags consisted system including a micro size chip and an antena, plus a reader which is electronical device, its responsibility to transfer data between the tag and the database, and a software that acts as a bridge between the operating system or database and applications, which gathering and filtering the information in order to avert invalidity and provide (ERP) the enterprise resource planning system with the filtered data so the system will administer the processes. The radio frequency identification system basically includes tags with control over the frequency, devices called readers and a system operates tagging operation. This technology is an advanced automatic system which is superior than the scanning system called manual barcode. As Vlachos explained in 2014. Based on many elements, as an example industrialization setting and possible revenue, this technology is vastly changeable in terms of cost and paid price. (Sarac et al., 2010). Moreover, this technology applications develop generally the ability to make profit and the quality of the achieved work through developing the ability to trace and the availability of a product (Gaukler, 2010; Aiello et al., 2015). Since this technology is informing and acting basing on the consumers demands, its accuracy is described to be extremely functional and dynamic method in stock management (order and forecast) (Vlachos, 2014). Add to that the fact that this technology is able to play a critical rule in designing, applying, developing and managing supply chains and producing processes (Ngai et al., 2010; Jimenez et al., 2013), moreover, RFID is able to decrease stock issues and matters due to its developed actual-time informative database availability (Bottani et al., 2010; Kok and Shang, 2014). Major properties of RFID are illustrated in figure 2.1, as it is quick, affordable and efficiently cost tool, that provides for every object an automatic specific code, it has feature such as actual-time detecting and tracing, location details and information, effective operations management, observability, enormous customized production, standardized work, visualized and mentoring operations…etc. In addition to the previously mentioned advantages, RFID can further help in improving, delivery of client's ordering delivery, manufacturing control, stock control...etc. (So, 2010; Huang et al., 2010; Qu et al., 2013; Chongwatpol and Sharda, 2013).

Figure 2.1: RFID Properties

Resource: RFID impacts on barriers affecting lean manufacturing, 2016

2.1.2.3 Wearables

Even though the debut of Hamilton Puslar P1 where digital wristwatches come into sight digital by 1972 primarily, the one that was able to do more than showing the date and time as a first smart watch appeared in 1982 by introducing Sieko's Puslar NL C01, which included memory with the ability to be programmed by the user (Charlton, 2013). Throughout the early 1980s Seiko kept going to improve smart watch technology, by introducing a new series which are Data 2000 and RC-1,000 with the ability to offer an exterior keyboard for entering information and transferring by using a cable from laptops and desktops (Marshall, 2013). As the improvement of technology increased, reducing sizes, and the ability to produce a greater number of products with low-priced and quicker performance, smart watches began to be promoted into the new version by integrate a growing amount of intelligent advantages with having higher capacity of computing. In 2000 a tram was created by IBM and Citizen to improve a wristwatch which using Linux as an operating system and created a trial model of intelligent watch, the WacthPad, with the following features: 32-bit CPU, memory with 16 MB, scanning the fingerprnt ability, and a mic (Chalrton, 2013). By using the radio FM wave to transfer the data, a smart watch with wireless connectivity named SPOT was introduced by Microsoft in 2003. Even though the idea about the future of smart watches which is wireless technology was understood by Microsoft, however, not FM but Bluetooth was the technology that formed the existing smart watch trend (Marchall, 2013). The continuing improvement of phones and devices based on the technology of communication and information has generated a superb medium where users utilize both phones and intelligent watches concurrently. Of course, intelligent watches are not awaited to be used instead of smartphones, but to help in particular for gathering beneficial info from a paired device as satellite equipment via Wi-Fi connection system and supplying more leisure, quicker, functional and practical information reachability, particularly when using a smartphone can be unpractical way of use, and smart watches is processing the information with less exacting and effort. This feature of smart watches differentiates them from other mobile accessories, which make them technologically and psychologically magnificent communication tools that worth deeper research and discussion.

Health tracking wearable

A lot of different kind of information got to be gathered so an individual’s health situation and lifestyle can be understood and assessed; which needed to be combined in order to have a comprehensive indicator of their well-being. However, in general it is not unpretentious to trace people’s personal activity data based on factors evaluated in the home from use of devices, except a person lives just by himself, motion in chambers, transfer from couch and seats and closing of windows. Thus, while the IoT assumes that if kitchen devices and other observing devices were connected, that might lead to a wealthy set of data that can be considered to supply related information on household activities, more straight observations are essential on an individual basement. This observation can be done by carried devices by people and or through wearables which are attached to or within their bodies.

Wearables – pros and cons

The wave of attention in wearable technologies in last years might be indicated by to a number of causes, the five described below can be mentioned as bunch of them:

- Increasing in users' concern in medical technology, particularly with more tendency to precaution lifestyle and aiming for maximal fitness;
- New concern in adjusted and personal digital healthcare programs which provided by apps for smartphones and tablet devices;
- The accessibility of nearly global wireless connection by Wi-Fi and phones networks;
- Contemporary developments in electronics and sensing technologies which become smaller, lighter and power-efficient gadgets; and
- Functional and strong wearable, added to movable computing power and software.

Despite these reasons, many obstacles needed to be overcome before users changing existing technologies with wearable devices in term of supporting living technologies. The advantages and the obstacles are compared in Table 1-2. It is fortunate that fast procedure is being made in order to meet and overcome the challenges to wholesale adoption (Doughty, K., and Appleby, A. (2016).

Table 2.1: The benefits and challenges in introducing wearable health technologies.

The benefits and challenges in introducing wearable health technologies		
Benefits	challenges	Comments
1- Monitoring health status continuously. 2- Improve the ability to manage their devices. 3- Providing direct feedback to users. 4- Provide remote monitoring of lifestyle and medication adherence. 5- Offer standards measurement method to the community. 6- Allows measurement of key parameters in new and direct ways.	1- It requires a lot of resources which can only be available for rich people. 2- Improve the experience of the users so they all can be used these devices. 3- Making them sufficiently robust (and waterproof) to avoid accidental damage. 4- Offering discreet feedback so that information is not accidentally shared. 5- Making sure that users aesthetically pleasing, easy to sync with smartphones. 6- Having new methods of measurement accepted by the medical experts.	1- Body heat/motion can provide power. 2- Potential users may have cognition issues. 3- 3D printing allows gor simple cases. 4- Smartphones apps can be customized. 5- Wearables as fashion items offer simplicity. 6- Data needs analysis to improve outcome.

Resource: Doughty and Appleby 2016

2.2 Background of IOT

The Internet of Things (IoT) is a term which means a connected set of anybody, anything, anywhere, any service, and any network, no matter when. The IoT is an embody in next version of technologies that is able to affect the entire business world and can be considered as the interconnection of unparalleled defenation intelligent objects and devices within today's Internet basement with expanded advantages. Advantages usually contain the developed connection of these appliances, machines or gadgets, framework, and applications that exceed device-to-device situations. Thus, almost in all domains making machine's role bigger is something desirable. Variety of resolution for many implementations such as intelligent city, traffic jam, wasting of management, safety issues, economics issues, manufacturing observation, and medical and wellness issues were supplied by the IoT technology. The Internet of Things (IoT) identify intelligent devices as the ultimate building blocks in the improvement of cyber-physical smart. The IoT has a lot of application fields, as well as health care. The IoT revolution is regeneration the up to date health care with encouraging technological, economic, and social fields.

2.2.1 IOT and health tracking devices

The revolutionary IoT has faced a burst of activity and innovation in the healthcare field, thrilling contractors and enterprise capital firms. The term came to light as a collection of newly established business and big companies, which are ready to participate in what might be a huge market, besides providing products and technologies. This sector supplies an inclusive record of innovations for a superior perception of the Internet of Things situation in healthcare domain. A trial model of sensor for wearable was produced by Edisse with actual-time tracing, activity detection and alarms. The normal features of any phone are fundamentally included such as SMS, Global Positioning System, internet connection via phone's network, and an acceleration measurement device to reveal abnormal event, for instance; informing the responsible part after recording a falling down action, a baby and his mother (Islam et al,. 2015). Withings has improved a bunch of healthcare gadgets, containing a number of applications for scale measuring, a blood pressure devices and applications, and a children observer (Islam et al,. 2015). A company from China has produced a device with a virtual storage and computation basement working as a platform for managing medicinal photocopying and information called miPlatform, with Three-Dimensional picture on web, visualized and post-processed, and remotely treatment (Islam et al,. 2015). In Chinese medical industry, Neusoft has supplied broad IT solutions and personal healthcare network services, and their services is also available for medical centers, communal health care establishments and health administration. Healthcare services based on the Internet of Things, which was the domain that Neusoft has focused on (Islam et al,. 2015). A fitness smartwatch band is able to issue intelligent announcements in order to inform the users to make the decision whether to act differently or to carry on with their way of acting which called Garmin's Vivosmart (Islam et al,. 2015). With plentiful modern sensors, a wearable which is Jawbone's UP3 is providing the users with a whole image of their healthy condition, and contains tracing for actions, sleeping situation, training guidance and monitoring for the heart condition (Islam et al,. 2015). As it can be seen in Fig. 2.2, with the ability to observe and compute human's pulsation, the degree of both, heat and blood's oxygen in the body, a wearable with these features was made by Angel, this wearable provides the smartphone of the user with these pivotal details (Islam et al,. 2015). Researchers have produced an adequately built-in and thin wearable with blood pressure sensor, that has the ability to be utilized to submit continuous observing for an extended run, with causing no annoyance to the user while he is doing his daily activities, the research has been held in Korea (Noh, 2014). A collection of Internet of Things healthcare appliances has been improved containing a Wi-Fi, blood pressure observation, oxygen and blood glucose level observation and more. These appliances have been developed by a laboratory group called iHealth (Islam et al,. 2015).

In health tracing domain, a lot of wrist wearable devices have been produced, such as Misfit, Fitbug Orb, Omate truesmart smartwatch, Samsung smartwatches, Amiigo Activity Tracker, Fitbit wearable and more.

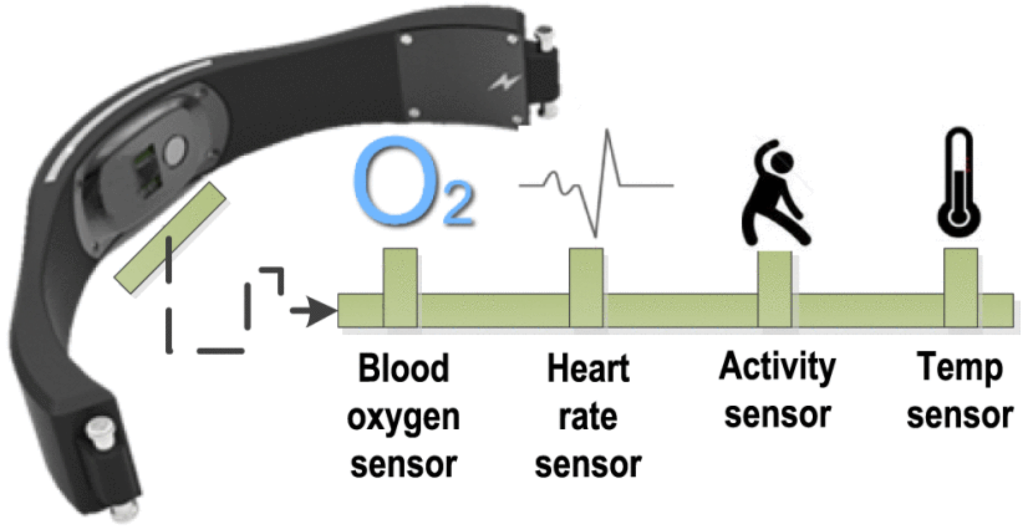

Figure 2.2: Positions in different sensors in angel

Resource: The IoT for Health Care 2015

In the next two tables the IoT healthcare situation and observation of some well-known technology companies and IoT implementations in healthcare can be seen.

Table 2.2: Internet of Things in health care.

Infirmity/ condition	Sensors used; operations; IoT roles/connections
Diabetes	A non-invasive opto-physiological sensor; the sensor's output is connected to the TelosB mote that converts an analog signal to a digital one; IPV6 and 6LoWPAN protocol architectures enabling wireless sensor devices for all IP-based wireless nodes.
Wound analysis for advanced diabetes patients	A smartphone camera; image decompression and segmentation; the app runs on the software platform in the smartphone's system-on-chip (SoC) to drive the IoT.
Heart rate monitoring	Capacitive electrodes fabricated on a printed circuit board; digitized right on top of the electrode and transmitted in digital chain connected to a wireless transmitter; BLE and Wi-Fi connect smart devices through an appropriate gateway.
BP monitoring	A wearable BP sensor: oscillometric and automatic inflation and measurement; WBAN Connect smart devices through an appropriate gateway.
Body temperature monitoring	A wearable body temperature sensor; skin-based temperature measurement WBAN Connect smart devices through an appropriate gateway.
Rehabilitation system	A wide range of wearable and smart home sensors: cooperation, coordination, event detection, tracking, reporting, and feedback to the system itself; Interactive heterogeneous wireless networks enable sensor devices to have various access points.
Medication management	Delamination materials and a suit of wireless biomedical sensors (touch, humidity, and CO2); the diagnosis and prognosis of vitals recorded by wearable sensors; the global positioning system (GPS), database access, web access & RFIDs, wireless links, and multimedia transmission.
Wheelchair management	WBAN sensors (e.g., accelerometers, and ECG, and pressure); nodes process signals, realize abnormality, communicate with sink nodes wirelessly, and perceive surroundings: smart devices and data center layers with heterogeneous connectivity.
Oxygen saturation monitoring	A pulse oximeter wrist by Nonin; intelligent pulse-by-pulse filtering; ubiquitous integrated clinical environments.

Table 2.2: (con) Internet of Things in health care

Infirmity/ condition	Sensors used; operations; IoT roles/connections
Eye disorder, skin infection	Smartphone cameras; visual inspection and/or pattern matching with a standard library of images; the clouds-aided app runs on the software platform in the smartphone's SoC to drive the IoT.
Asthma, chronic obstructive pulmonary disease, cystic fibrosis	A built-in microphone audio system in the smartphone; calculates the air flow rate and produces flow-time, volume-time, and floe-volume graphs; the app runs on the software platform in the smartphone's SoC to drive the IoT.
Cough detection	A built-in microphone audio system in the smartphone; an analysis of recorded spectrograms and the classification of rainforest machine learning; the app runs on the software platform in the smartphone's SoC to drive the IoT.
Allergic rhinitis and nose-related symptoms	A built-in microphone audio system in the smartphone; speech recognition and vector machine classification; the app runs on the software platform in the smartphone's SoC to drive the IoT.
Melanoma detection	A smartphone camera; the matching of suspicious image patterns with library of images of cancerous skin; the app runs software platform in the smartphone's SoC to drive the IoT.
Remote surgery	Surgical roast systems and augmented reality sensors; roast arms, a master controller, and a feedback sensory system giving feedback to the user to ensure telepresence; real-time data connectivity and information management system.

Resource: The IOT for health care Resource.

Table 2.3: The internet of things status and visions of some well-known technology firms.

Firm	Status and vision
CISCO	CISCO is ready to provide converged systems based on unrelated networks and can introduce effective algorithm for handling cumulative traffic loads originating from massively deployed IoT healthcare devices with advanced data analysis. In addition, it can offer clients a new class of intelligent applications to increase efficiency without losing security. CISCO has worked with leading healthcare organizations to develop a medical-grade network architecture.
Microsoft	Microsoft has forced on using an intelligent system to uncover the potential of IoT-based healthcare solutions. Intelligent systems provide the backbone of technologies that allow for the capture of health data from devices to ensure required connectivity. Microsoft has business intelligence tools capable of extracting important insights from collected data.
Google	Google has opened its code for an open-source physical web standard for the IoT, which can be considered an attempt to arrange an easier approach to communicate with connected medical devices.
Samsung	Samsung Electronics, together with University of California, San Francisco, has established a digital health innovation lab to develop new smart health technologies. In addition, Samsung together with IMEC (a leading bio-sensing research institute), has developed the Simband platform, an open reference design for sensor modules. Samsung's goal is a ubiquitous and seamless user experience for better health for everyone with no additional complexity.
Qualcomm	The 2net Platform of Qualcomm Life offers a set of wireless health solutions that can capture and deliver health device data to integrated portals and databases from almost all wireless medical devices of users. Such data can be stored in a system to integrate security and interoperability Qualcomm is trying to develop intelligent, intuitive, and innovative IoT healthcare solutions.
Intel	Intel-powered devices can strengthen information security and improve interactions between doctors and patients. Intel emphasize real-time synchronous communications systems and health data streaming, which can help reduce the cycle time and improve the first-time quality of many existing medical workflow environments. Intel's vision is to bring about IoT-based healthcare solutions anytime, anywhere.

Table 2.3: (con) The internet of things status and visions of some well-known technology firms.

IBM	IBM redefines value and success in health care through the notion of smarter health care. IBM has helped to develop a set of IoT devices through partnerships of other renowned firms across the world. It focuses on a series of health care solutions such as connected home health, data governance for health care, and health analytics for health care providers.
Apple	Apple has publicly claimed the IoT as an ultimate technology. The apple watch can be considered a smart watch, a fitness tracker, or a heart monitor. The Memorial Hermann healthcare system relies completely on Appel's solutions to provide efficient and connected healthcare services focusing on secure access, physician gains and better care.
Wind River Systems	Wind River has developed a cloud and business logic model for medical solutions based on the IoT, it designed specialized gateways, data centers, supervisory/ data aggression systems, and device control systems/sensors for this purpose. This model is expected to improve medical services facilitating life-enhancing aid for patience and providers.
Deutsche Telekom	Deutsche Telekom follows the concept of a secure healthcare internet system. It serves as a bridge between associated stakeholders. Researchers on the team focus on developing technologies that can help healthcare services gradually become personal, local, and digital instead of being centrally organized.
GSMA	GSMA, an association of mobile operators and related firms, has launched connected living programs to bring the mobile industry and healthcare stakeholders together to deliver sustainable mHealth solutions over an intelligent and secure IoT network
ThingWorx	ThingWorx solutions are used by many firms to develop connected healthcare products. ThingWorx enables firms to efficiently enter a connected product space.
Numerex	Numerex in one of the top providers of IoT solution and offers stakeholders required support for designing ne mHealth products and converting wired legacy systems into wireless ones.
Machine Research	Machine Research has worked on developing a set of solutions for connected healthcare system based on the IoT. Topics covered by its research team include AAL, remote clinical monitoring, clinical trials, connected medical environments, and telemedicine.
Aeris	Aeris is ready to deliver IoT solutions for remote patient monitoring, medical device manufacturers, and healthcare providers.
Eurotech	Eurotech design connected medical and healthcare products that can serve as building blocks for large systems.

2.3 Background of Diffusion of Innovation Theory

Diffusion of innovations is a theory that explains how, over time, and why ideas and technological innovations gain momentum and diffuse through a specific population. Based on this theory, there are five factors which influence adoption of innovation:

- Relative advantage.
- Compatibility.
- Complexity.
- Trialability.
- Observability.

This study is going to focus on applying these five factors on wearable health tracking devices in Turkish market, investigating the results and answering the question, is it going to reach the Early Majority level and crossing the Chasm? (Geoffrey Moore, 2001).

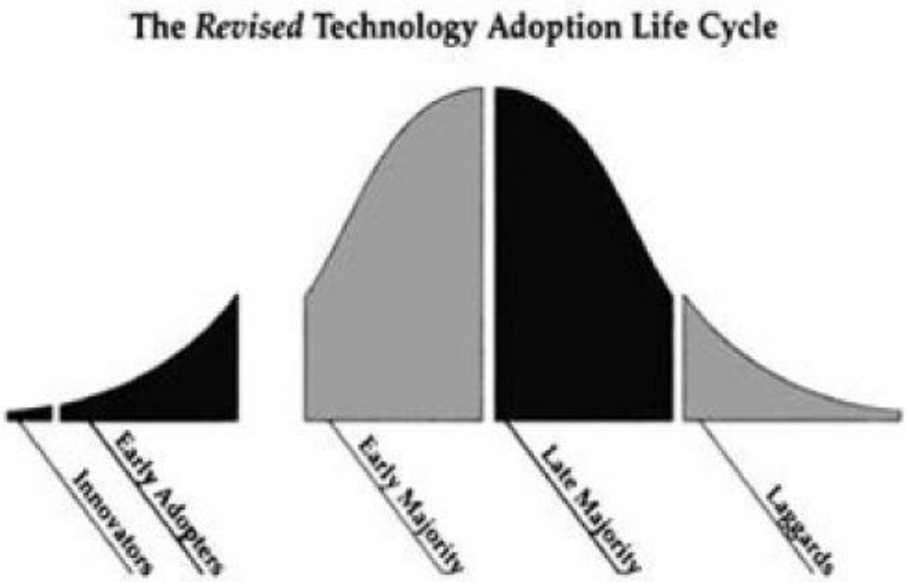

Figure 2.3: Crossing-The-Chasm

|**Resource:** Geoffrey Moore October 2001

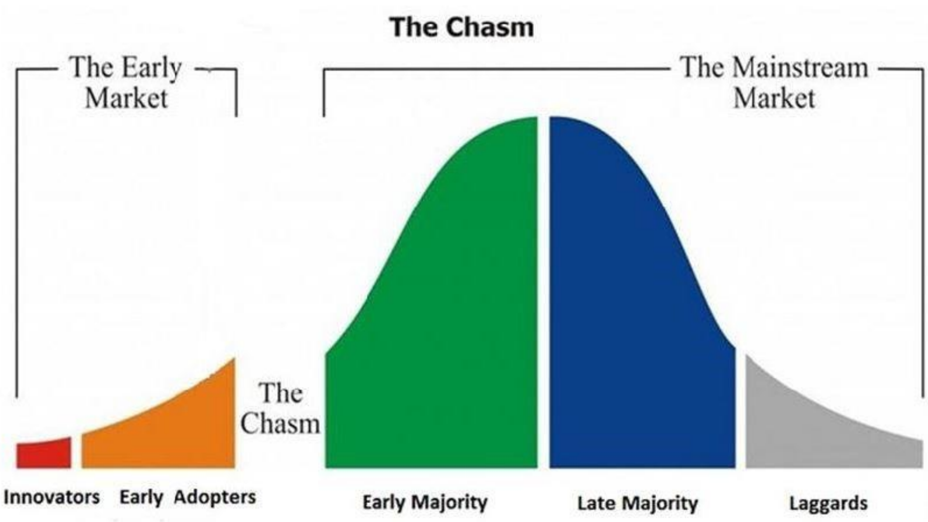

Figure 2.4: Crossing-The-Chasm

Resource: Geoffrey Moore October 2001

Five adopter categories were established:

- Innovators: this category is explained to include people who are willing to try an invention firstly and mostly before anyone else. They are described to be adventurous and concerned in innovations and fresh concepts. This category has the tendency to take venture and usually the new ideas are improved by them.
- Early Adaptors: this category includes people who symbolize the leaders of opinion in a community. They like to play a leader role and adopt new chances. They knew deeply the importance of changing and so they adopt new ideas with comfort. plans to address those people contain explaining the way of use and providing information on applications.
- Early Majority: usually people in this category is not commanders; however, they accept modern conceptions before the normal individual. They typically need to see evidence that the innovation works before they are willing to adopt it.
- Late Majority: these people are skeptical of change and will only adopt an innovation after it has been tried by the majority.
- Laggards: these people are bound by tradition and very conservative. They are very skeptical of change and are the hardest group to bring on board.

2.3.1 Relative advantage

Relative Advantage is an observation of the advantages and benefits of adopting a specific innovation, improvement over something already existing. Innovations that have a clear, unambiguous advantage in either effectiveness or cost-effectiveness are more easily adopted and implemented. The potential adopter must first calculate its relative strengths. What is the advantage over the older wearable? What improvements does it hold? What other benefits in terms of ease-of-use, additional software packages, etc. does it present? “Relative advantage is a sine qua non for adoption” (Greenhalgh et al., 2004) Conclusion: If someone finds an advantage in CB, the individual will be more likely to adopt it.

2.3.2 Compatibility

It is also required to be diffused that an innovation has to be compatible with the values, beliefs, past history, and current needs of the adopters. Innovations that are compatible with the intended adopters' values, norms, and perceived needs are more readily adopted. How well does it fit into a person's needs, usage patterns and/or current value the user has? How consistent it is with the values, experiences, and needs of the potential adopters? Conclusion: If an innovation was more compatible with a person's lifestyle and cognitive characteristics, it would be more likely to be assimilated into an individual's life.

In the second parameter of the studied theory, the focus is on the subject of integration between the product, which is health tracking device, and the user.

2.3.3 Complexity

Basically, Innovations that are perceived by users as simple to use are more easily adopted. And here, by mentioning complexity, it refers to the level of difficulty that the potential adopters encounter with the innovation. How difficult it is to be understood and used. In order to overcome this barrier, it is considered that complexity can be reduced by practical experience and demonstration, which leads us to the next factor: Trialability. Conclusion: The more complex or the more difficult the innovation is to understand, the less likely it will be adopted, and its diffusion will occur more slowly.

2.3.4 Trialability

Innovations with which the intended users can experiment are adopted and assimilated more easily, is another characteristic that determines the rate of diffusion. The extent at which the innovation can be tested or experimented with before a commitment to adopt is made. Being able to test the innovation or try it out will facilitate the rate of adoption. Conclusion: If the innovation can be experimented with or taken out for a "test drive" it is more likely to be utilized.

2.3.5 Observability

The extent to which the innovation provides tangible results. Initiatives to make the benefits of an innovation more visible increase the likelihood of their assimilation. The innovation will likely spread through the target population faster if the benefits are visible and tangible. Conclusion: The easier it is to see the advantages of an innovation, the faster it will diffuse throughout society.

2.4 Previous Studies on HTD adoption

A lot of theories have been applied in the previous time to define the elements that have impact over the adoption of innovation in the past. For example, the reasoned of action theory (TRA), planned behavior theory (TPB) by Fishbein and Ajzen in 1975, the model of technology acceptance (TAM) (Chen et al., 2011). Privacy calculus theory (PC) (Dinev and Hart, 2006) and Diffused Innovation Theory (Rogers 1995, 2002, 2004). The articles that studied the adoption in Turkey of HTD particularly have relatively small number, However, if the focus is looking to the wearable scope (even out Turkey), more papers and research that have been done can be found. Moreover, the subject area lies within marketing, health care, information & knowledge management, library studies, communication, e-commerce disciplines and adoption. Reviewed articles about HTD adoption were published within 2009- 2018 time period. Large portion of the studies applied primary data obtained through surveys. For instance, according to a survey was held in 2014 by Nielsen Corporation, 70% of the population in America have some knowledge and idea about wearable devices, especially Smartwatches, which are popular (Nielsen, 2014). By 2020 there is a prediction about the annual shipments of wearable devices to increase 500 million units (Gartner, 2015). Smart watches innovation has been promoted extensively and publicized in ICT manufacture, due to its multi-implementation. Which fulfill wide types pf customers' concern. Where its focus covers intercommunication and intelligent features besides bodybuilding, health observation and location detection (McIntyre, 2014).

If the focus goes further more into the health care field, research paper written by Adem Karahoca, Dilek Karahoca and Merve Aksöz in 2018, titled Examining intention to adopt to IoT in healthcare technology products, which was conducted among Turkish people only, can be found. The main finding of this study is that the factors related to technology acceptance and image, significantly affect individuals' decision to adopt IoT healthcare products. This information may help product designers to pay attention to all these factors when they design an IoT healthcare product. The main limitations of reviewed articles were related to: sampling that may not represent whole population, sample size, secondary data (commercial companies or producers), HTD adoption having dynamic nature etc.

To review related articles within HTD adoption scope following databases have been used:

- Emerald insight
- Researchgate
- Google Scholar
- Ieeexplore
- Wiley
- Sciencedirect
- Springer

Following keywords were used while searching the relevant artilces:

- Health tracking device
- IoT
- Smart device
- Health care technology
- Technology acceptance
- Wearable

3. RESEARCH MODEL DEVELOPMENT AND HYPOTHESES FORMULATION

3.1 Conceptual Model

The research model of the study is depicted in Figure 3.1. The model visually describes the framework of variables to be examined: Theory's factors and HTD adoption. The relationship within the variables will be tested in order to measure to which extent they impact each other. Theory's factors are independent variable, while the adoption is dependent variable.

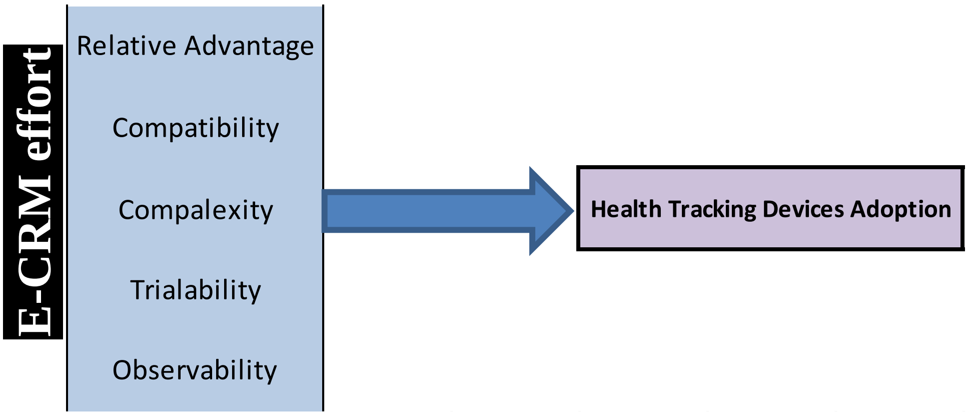

Figure 3.1: Research Model.

3.2 Relative advantage

According to E.M. Rogers theory's Diffusion of Innovation theory (1962) innovators should continuously focus on the five factors that the theory discussed in order to enhance their products' chance to cross the Chasm, as these factors have impacts on user's adoption. Such adoption behaviors motivate the other categories' intentions to repurchase over the target market, which lead to increase sales level and reduce price sensitivity.

Diffusion of Innovation Theory (Rogers, 1995, 2002, 2004) seeks to explain how novel ideas, products and practices are adopted by members of a specific social group, so using this theory may aid conceptualization of change processes when new technologies are adopted and diffused through health care organizations. This theory has been used in recent years in a review examining dissemination of innovative treatment approaches to substance dependence more generally (Miler et al., 2006). However, this review did not focus on technology-based treatment approaches, but instead included more traditional human-facilitated treatments. Relative advantage has been defined by Roger as the grade in which an invention is recognized as being superior in term of benefits than the concept it is replacing (Roger, 2003). Yet, those five attributes represent the basement that the researcher relies on in order to make research's hypothesis. Relative advantge is the first factor which is the degree to which an innovation is understood as being better than the idea it supersedes (Rogers, 1995). Relative advantage through this theory has the meaning of an innovation to be economic profitability by utilize this invention, being affordable is also a benefit, the advantages of utilizing an invention are immediate (Aizstrauta et al., 2015).

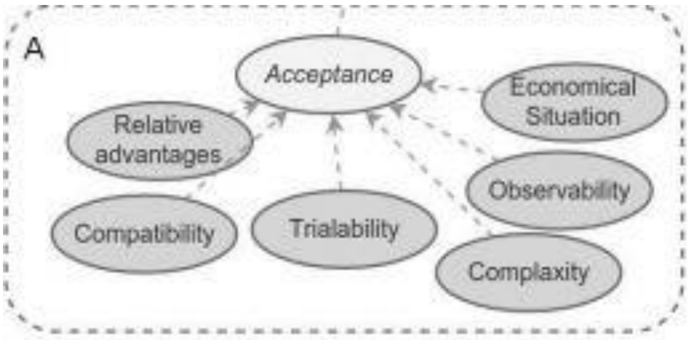

Figure 3.2: Part of IASAM model in SD notation

Resource: Insight Maker Aizstrauta et al., 2015.

Since the more the user is getting benifits out of using the innovation, the more it is likely to be adopted. Therfore, this attribute has been considered to have a positive relationship with the adoption of an innovation. As a consequence of the above-mentioned discussion following hypothesis has been proposed:

Hypothesis 1: Relative Advantage of using wearable health tracking device has a positive relationship with Adoption with such technology.

3.3 Compatibility

The second element in the DOI is compatibility, which means how much an invention is considered to be compatible with familiar values, beliefs, experiences and needs (Rogers, 1995). Relative advantage and Compatibility were considered similar in several diffusion studies, though they are theoretically different. Rogers explained compatibility as the extent to which an invention is considered to be harmonious with the existing values, experiences, and needs of possible users (Roger, 2003). Compatibility based on this theory, is measuring how much is the innovation compatible with existing values, skills, and work practices of potential adaptors.

In the literature, decrease in some kind of discomfort is an advantage of using a specific technology, as important as using this technology advances the social prestige of the user. The use of technology is positioned as compatible with social/cultural values and belief, as well as compatible with client needs. That is to say, the more comfort and suitable the user feels toward any innovation the more he tends to adopt it in his daily life (Aizstrauta et al., 2015). Another way to define compatibility is explaining it by the degree to which an innovation is perceived as being consistent with existing practices or habits and routines (Vijayasarathy LR. 2002). Accordingly, following hypothesis has been proposed:

Hypothesis 2: Compatibility of using wearable health tracking device has a positive relationship with Adoption with such technology.

3.4 Complexity

Aside from other critical points, the attribute of inventions which participate in the invention acceptance procedure and emphasizing on how complicated the innovation is by Roger. He pointed out that researchers who are studying diffusion should focus on the complex of a product from the point of view of investigation and testing. Which is an essential, and a critical point. Add to that the fact which has been proved by observation, where many recent inventions were unsuccessful and others were successful mainly because of its degree of complication, finding out that not all inventions are equal in term of complexity

(Rogers, 2003). A very sensitive point for the target market is how much the innovation is relatively difficult to understand and use; in other words, as a user, he or she should be considered a used technology as effortless, clear and simple in term of use. Otherwise, the risk of losing the interest and engagement of the protentional customers is regrettably high. Hence, the recovery strategies intended to prevent complication of using a product by customers should include following ideas: simpleness, clarity, understandability and post- service (Aizstrauta et al., 2015). Complexity was identified by Roger as the grade to which an invention is considered as comparatively complicated to be understood and used (Roger, 2003). As Rogers believed, complexity is reverse to the other factors, where it has negative correlation with the average of acceptance. Therefore, complexity is extremely important obstacles to be got over for any innovation in its adoption process. A technological invention may challenge teachers to change their teaching method to merge the technological invention into their tools (Parisot, 1995), therefore, there may be various degree of complication. If hardware and software are user-friendly, then they may be accepted to be used successfully for the explanation of course lessons (Martin, 2003). Based on discussion above following hypothesis has been proposed:

Hypothesis 3: Complexity of using wearable health tracking device has a negative relationship with Adoption with such technology.

3.5 Trialability

According to Rogers (1995) Trialability is the fourth element that influences the adoption process, this factor focuses mainly on how much important to experiment and test the innovation by a user. Trialability defined as the factor of the invention that make the innovation easier if someone wanted to try it out. (Rogers, 2003). The invention might be tried out with an experimental base without unneeded extra work and cost; it may be applied progressively and yet offering a fine positive advantage; there are many mechanisms that enable the users to easily try the technology in order to make his/her mind, such as (free download, Trial versions, prototypes and so on) (Aizstrauta et al., 2015). As long as the user has the chance to try an innovation as he more likely to find out its advantages and get involved in the acquiring process. Based on Rogers definition, trialability is the extent to which an invention might be tried out on a restricted principle" (Roger, 2003). Also, trialability has a positive correlation with the rate of acceptance. To make an innovation adopted faster, make it available to be tried as much as possible. Accordingly, following hypothesis has been formulated:

Hypothesis 4: Trialability of using wearable health tracking device has a positive relationship with Adoption with such technology.

3.6 Observability

Observability means the results and benefits of the innovation`s use can be easily observed and communicated to others, in other words, observability is the degree to which the results of using an invention is identical and can be explained with ease to others. As it was defined by Rogers (Roger, 1995). Another definition for observability is the results and benefits of technology is easily visible by potential users. (Aizstrauta et al., 2015). This is the last characteristic of innovations. Rogers defined observability as "the degree to which the results of an innovation are visible to others" (Roger, 2003). Role modeling (or peer observation) is the key motivational factor in the adoption and diffusion of technology (Parisot, 1997). Similar to Relative Advantage, Compatibility, and Trialability, observability also is positively correlated with the rate of adoption of an innovation. Logical speaking, the more the advantages and outcomes of a product are clear and noticeable to others, the higher are the odds of buying and conduct that product by customers. Taken into consideration discussion above following hypothesis has been formulated:

Hypothesis 5: Observability of using wearable health tracking device has a positive relationship with Adoption with such technology.

In conclusion, Rogers discussed the idea which assumes that inventions providing more relative advantage, compatibility, simplicity, trialability, and observability will be accepted faster than other ones. Rogers does warn, "having a new idea accepted and spread, even when it has clear benefits, is hard" (Roger 2003), that is to say having all these variables with the appropriate relationship with the innovation would lead to speed up the innovation-diffusion process.

Research showed that all these factors have impact on faculty members' likelihood of adopting a new technology into their teaching methods (Anderson et al., 1998; Bennett, and Bennett, 2003; Parisot, 1997; Slyke, 1998; Surendra, 2001).

4. RESEARCH METHODOLOGY

4.1 Research Design

This study aims to determine impact of DOI factors on the adoption of health tracking devices. At the same time, it is intended to measure the relationship between the variables that may influence consumer attitude toward the studied innovation. To meet research objective quantitative research methods were implemented for this study. Primary data was obtained via self-administered online questionnaires. Online surveying has following advantages: elimination of survey related cost, time efficient, less social pressure on respondents as they feel anonymous (Smith and Albaum, 2005). Structural Equational Model (SEM) is considered to be suitable method to meet objectives of this research as it applies different types of models to describe relationships within respected variables and conducts quantitative tests for a research model. One of the advantages of SEM related to the fact that it is universal for different research subjects. Moreover, SEM is able to test and evaluate various and complex models (Schumacker and Lomax, 2010). SEM covers regression, path and confirmatory analysis. The variables in current research can be divided as latent and observed. Latent variables are those variables that cannot be measured directly. As latent variables cannot be observed directly, they are being signified by observed variables which are being measured by means of surveys, tests etc. In contrast observed variables are being used to designate latent variable (Byrne, 2010). Research stages for this study started with research idea, which further followed by related literature review phase. Based on reviewed literature research questions and hypotheses were formulated.

In order to test research questions and hypotheses, research design phase took a place and proceeded with required data collection. Collected data was measured and analyzed by the means of statistical tools. The research has been finalized by interpretation of the outcomes and conclusion.

4.2 Procedures

Online survey tool, the survey participants were required to fill in online survey that consisted of two main parts like: demographics of the respondents and variables related questions. However, before the questionnaire was distributed among participants necessary approvals were obtained from Istanbul Aydin University ethics committee. A scanned version of the approval is provided in Appendix C. The participants were given information about the objectives of the survey in advance along with guidelines.

4.3 Study Sample

The online questionnaire empowered by Google forms was distributed among online users in Turkey. The target group was including who had any smart device and they were over 15 years old. 210 people participated in the survey within two weeks. The survey questionnaire was carried out online due to the fact that the online survey can be accessible from anywhere, anytime by anyone. Social networks such as Facebook, WhatsApp, Telegram, social IoT and technology Facebook groups, and e-mail contacts were used. Finally, a total of 210 responses (68 females, 141 males) were used in data analysis. (89.7%) of the participants stated that they have a medium and above level of interest in technological developments and innovations. Convenience sampling was used in this study, which is a type of nonprobability sampling in which people are sampled simply because they are "convenient" sources of data for researchers. In probability sampling, each element in the population has a known nonzero chance of being selected through the use of a random selection procedure. Nonprobability sampling does not involve known nonzero probabilities of selection. Rather, subjective methods are used to decide which elements should be included in the sample. In nonprobability sampling, the population may not be well denned (Lavrakas, 2008). Moreover, convenience sampling may be the only option available in certain situations. For example, “it may be that an organisation you intend to use as a case study is ‘convenient’ because you have been able to negotiate access through existing contacts” (Saunders et al., 2012). Nevertheless, researchers often need to select a convenience sample or face the possibility that they will be unable to do the study. Although a sample randomly drawn from a population is more desirable, it usually is better to do a study with a convenience sample than to do no study at all, assuming, of course, that the sample suits the purpose of the study (Gall et al., 1996). For this research study, the criterion was the ownership of any smart device. Because, people who have a smart device can be a potential user of any IoT healthcare product in the near future. It is expected that the sample is well representative for the research purpose.

4.4 Survey Instruments

As current research concentrates on quantitative research techniques Likert type surveys were chosen for collection of the data. In the first part of the survey, participants were asked specific type of the questions in order to obtain information that will reflect demographics and customer profile. This included gender, age, education level, salary, device usage, smart device that used frequently, evaluation of the relationship between user and new innovations, operating system being used for participant's smart device, where and how long do the participant is using his smart device, and finally, whether the participant does use wearable devices or not and the reason behind his answer. The second part of the survey included questions that aimed to measure the research variables which are relative advantage, compatibility, complexity, trialability, observability, and health trucking device adoption. Variable questions were used in previous researches for examining the above-mentioned variables, such as Moore and Benbasat (1991), Venkatesh and Davis (2000), Ntemana and Olatokun (2012), Franceschinis et al., (2017), Kim et al., (2019). Likert point 5 scale was used for measurement of research items as follows: 1 (strongly disagree), 2 (disagree), 3 (neutral), 4 (agree), 5 (strongly agree). Survey questions were prepared based on antecedent studies that validated research items. The questionnaires were available in English. Full version of the questionnaires and table that depicts the sources of the adapted questions are provided in Appendixes A and B.

4.5 Statistical Techniques

The statistical methods and tools that were applied to this research are: Confirmatory Factor Analysis (CFA) and Structural Equational Model (SEM). Thanks to CFA relationship between the factors as well as their observed variables can be measured (Byrne, 2010). At the same time CFA is able to evaluate the validity of the measures. CFA is tightly linked to SEM which is one of the widely used data analysis technique. SEM provides an ability to test the theories in a quantitative manner and relies on error factor. The main difference that exists between CFA and SEM is the fact that CFA concentrates on latent and observed variables relationship, while SEM covers structural path among focus (latent) variables. CFA is able to stand out as a solely analysis as well as part of SEM (Harrington, 2009). IBM SPSS version 24 and IBM SPSS AMOS version 23 statistical software were used to conduct the analysis for this research. AMOS stands for "analysis of moment structure" and integral part of SPSS that can be used both for SEM and CFA considered in this study. This software provides an ability to design a path diagram as well as reflecting the estimates on illustrated graphics (Byrne, 2010). On the other hand, SPSS is one of the oldest and commonly used statistical software. SPSS is appropriate for analysis of primary data obtained through questionnaire and able to carry our wide range of statistical techniques (Huizingh, 2007). SPSS analysis has been applied in order to process the data and prepare it for further SEM analysis carried out in AMOS.

5. DATA ANALYSIS

5.1 Respondent Profile

The sample for current study consisted of 210 responses. 67.5% of the respondents were male and 32.5% of the respondents were female. The age of survey participants varied between 15 and above 40 years, whereas the mean age was 26.2 years old. The majority of the participants (54.3%) have bachelor's degree. Considerable part of the survey participants (85.6%) don't use wearable devices (Table 5.1). In this table percentages may not sum up to 100% due to missing data

Table 5.1: Demographic profile of respondents.

Demographics Profile		Frequencies	Percentage (%)
Gender			
	Male	141	67.5
	Female	68	32.5
Age			
	15-20	14	6.7
	21-25	84	40.2
	26-30	66	31.6
	31-40	31	14.8
	41 and above	14	6.7
Education			
	High school	15	7.1
	Bachelors	114	54.3
	Masters	73	34.8
	PhD	6	2.9
	Other	2	1
Using wearables			
Experience	Yes	31	14.9
	No	178	85.6

Regarding time consuming per day on participants' devices (personal computer, smart phone, tablet, etc.). 51.7% of the respondents spend more than 5 hours, 39.2% spend 3-5 hours and 9.1% spend less than 3 hours (Figure 5.1). In this figure percentages may not sum up to 100% due to missing data.

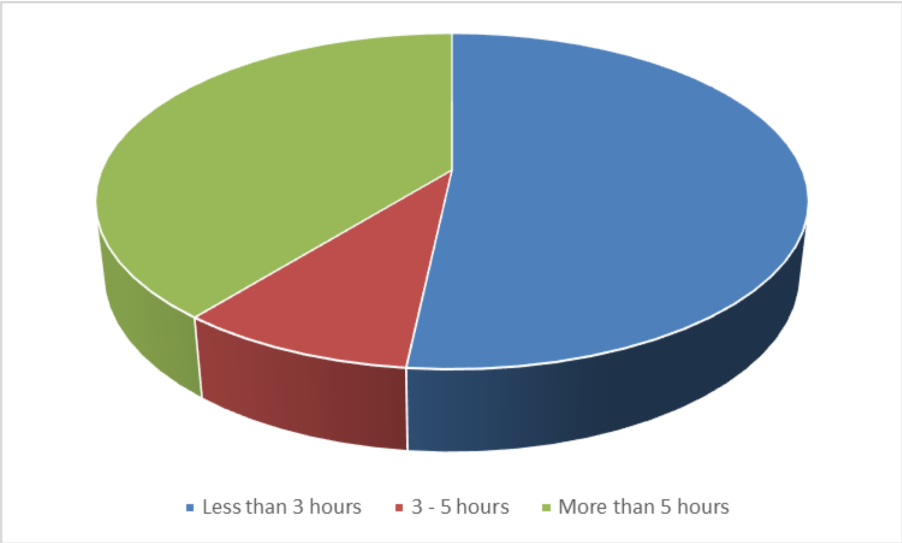

Figure 5.1: Respondent's smart devices usage per day.

The most preferred OS for smart devices was Android with 65.1% percentage. Moreover, 189 participants use smart phone most of the time (Figure 5.2).

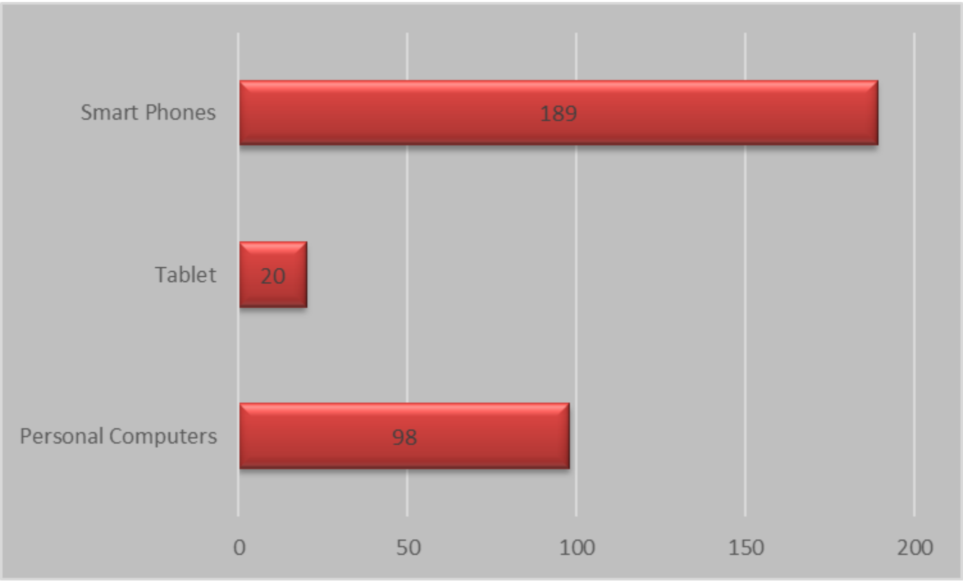

Figure 5.2: Device preferences of respondents.

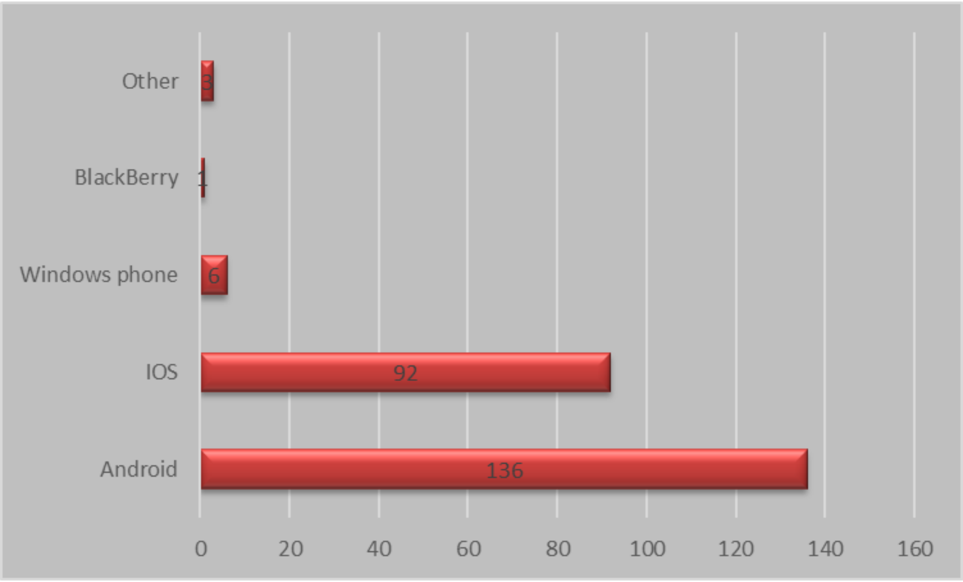

Figure 5.3: Percentage of used operating system by participants.

5.2 Validity and Reliability Assessment

Validity and reliability are valuable part of quantitative research that mainly concentrate on measurement aspects. Validity focuses on checking if variables are being measured in an accurate manner. The role of validity is critical as certain abstract factors (latent variables) can't be measured directly due to their nature. That's why for research purposes such variables should be evaluated and measured indirectly with a help of instruments like questionnaires. Each question serves as a manifest variable allotted to disclose the latent variable as much as possible. Hence, development of accurate measurement instrument along with proper manifest is vitally important and not easy task to fulfill. As a result, in case the measurement of latent variable was not designed in a correct way, all further analysis will have no value (Muijs, 2010). While measuring the instruments for validity, the degree of freedom from systematic error is taken into consideration. Systematic error may occur based on many reasons like: measuring instrument, the environment within the research is being conducted, the instrument user, the subject. In general, validity can be assessed in many forms:

- Construct validity
- Content validity
- Criterion validity.

Current study concentrates on construct validation, specifically focusing on:

- Convergent validity
- Discriminant validity

In order to demonstrate convergent validity, the measures (at least two) dedicated to measure latent variable should be related within the same construct. While for demonstration of discriminant validity the measures that represent different latent variables should not be more related that they are within the same construct (Smith and Albaum, 2005).

The second way of evaluating the quality of the measurement instrument is reliability assessment. Within measurement process, the measurement error always takes place. Accordingly, reliability related to the degree to which test results are free of this error. In case of unreliability, moving to further tests will be pointless. Moreover, the measurements that are not reliable will cause insignificant relationship between other variables that consequently prevent the ability to have a clear picture about the outcomes. Likewise, unreliability is a common reason for insignificant relationship among variables in a research (Muijs, 2010) and refers to the fact that the scale cannot be valid as well. Additionally, the reliability examines how consistent the measured item is among respondents and steadiness of the characteristics across time period (Smith and Albaum, 2005). The thresholds suggested by Hair et al. (2010), Gefen and Straub (2005) to assess validity and reliability are as follows:

Reliability:

- CR (Composite Reliability) > 0.7

Convergent Validity:

- AVE (Average Variance Extracted) > 0.5

Discriminant Validity:

- MSV (Maximum Shared Variance) < AVE
- Square root of AVE > inter-construct correlations

For conducting CFA it is important to ensure reliability, convergent and discriminant validity. Table 5.2 depicts the resume of validity and reliability assessment conducted for this research. It was carried out based on Correlations and Standardized Regression Weights tables withdrawn with a help of Amos software. Convergent validity has been established and evidenced by AVE that is above 0.5. The reliability has also been established and evidenced by CR which is above 0.7. In general discriminant validity has been revealed as well and evidenced by MSV being less AVE, except Relative Advantage where slight fluctuation took place (as MSV and AVE difference for this factor was insignificant 0.042, this flaw was not taken into consideration).

Table 5.2: The resume of Validity and Reliability Assessment.

	CR	AVE	MSV	MaxR(H)	OBS	REA	CPA	COL	TRI	ADO
OBS	0.844	0.645	0.494	0.864	**0.803**					
REA	0.905	0.657	0.699	0.909	0.698	**0.811**				
CPA	0.922	0.703	0.699	0.930	0.703	0.836	**0.839**			
COL	0.787	0.560	0.108	0.852	-0.021	-0.196	-0.212	**0.748**		
TRI	0.849	0.655	0.365	0.889	0.604	0.603	0.553	-0.043	**0.809**	
ADO	0.910	0.591	0.566	0.915	0.627	0.692	0.752	-0.329	0.561	**0.768**

5.3 Normality Assessment

Normality assessment is one of the approaches of data screening. Normally skew and kurtosis reflect non-normality of the data on variable basis. They might take place individually as well as simultaneously. Skewness is a statistical measure that refers to measuring asymmetry of distribution data from the mean. Figure 5.4 shows examples of positive skew (when big portion of the scores lower than mean) and negative skew (when big portion of the scores above the mean) relative to normal curve (Klein, 2011).

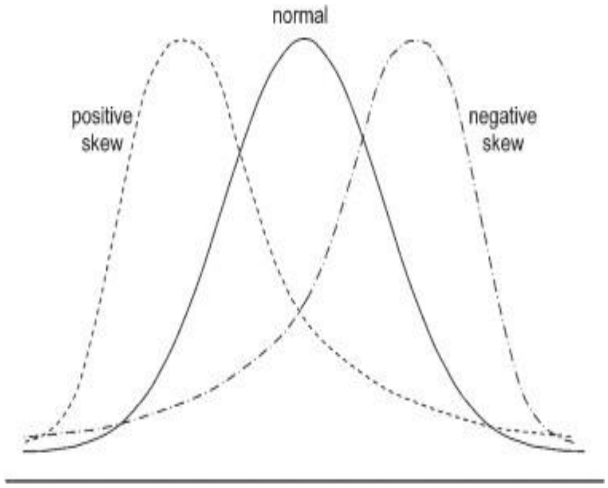

Figure 5.4: Examples of positive and negative skew

Resource: Klein, 2011

Kurtosis on other hand is a statistical measure that indicates if the data is heavy-tailed and has higher peak (positive kurtosis) or if the data is light-tailed and has lower peak (negative kurtosis) comparing to a normal distribution. In descriptions distributions that have positive kurtosis are being called as leptokurtic and distributions that have negative kurtosis are known as platykurtic. Figure 5.5 depicts examples of positive and negative kurtosis in comparison with normal curve. The distributions that are skewed normally have positive kurtosis, which means that fixes applied for corrections of skew has a possibility to rectify kurtosis related issues. Classic tests (e.g. z-test) dedicated to measure normality of the data distribution might not be useful for large sample size cases. This mostly related to the fact that even slight fluctuations comparing to normality can be significant statistically (Klein, 2011).

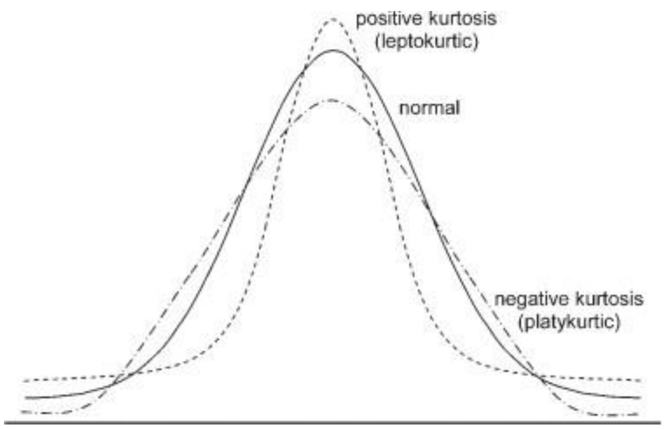

Figure 5.5: Examples of positive and negative kurtosis

Resource: Klein, 2011

In order to conduct SEM analysis, it is important to ensure that the given data is multivariate normal. It is related to the fact that SEM covers large sample for analysis purposes. Accordingly, it is necessary to conduct data screening and specifically to check if data meets normality requirements. Most of the studies have concluded that generally acceptable range for KI is the value of 3. In case the value is more than 3 it refers to positive kurtosis and if less it refers to negative kurtosis. However, it is also known that most of statistical tools and software rescale this value to 0 (Byrne, 2012).

Table 5.3: Rescaled Standardized Kurtosis Index and Skew Index.

Variable	min	max	Skew	c.r.	kurtosis	c.r.
Theadoption7	1.000	5.000	0.005	0.030	-0.483	-1.405
Theadoption6	1.000	5.000	-0.030	-0.172	-0.764	-2.222
Theadoption1	1.000	5.000	-0.257	-1.496	-0.795	-2.313
Theadoption2	1.000	5.000	-0.047	-0.275	-0.987	-2.870
Theadoption3	1.000	5.000	-0.007	-0.042	-0.904	-2.629
Theadoption4	1.000	5.000	-0.247	-1.434	-0.766	-2.229
Theadoption5	1.000	5.000	-0.415	-2.416	-0.497	-1.446
Observability1	1.000	5.000	-0.025	-0.148	-0.395	-1.147
Observability2	1.000	5.000	-0.287	-1.672	-0.567	-1.648
Observability3	1.000	5.000	-0.391	-2.277	-0.493	-1.434
Trialability1	1.000	5.000	-0.574	-3.338	-0.673	-1.957
Trialability2	1.000	5.000	-0.641	-3.731	-0.452	-1.313
Trialability3	1.000	5.000	-0.755	-4.393	-0.071	-0.207
Complexity3	1.000	5.000	-0.221	-1.288	-0.794	-2.308
Complexity4	1.000	5.000	-0.089	-0.518	-0.579	-1.683
Complexity5	1.000	5.000	-0.457	-2.661	-0.630	-1.833
Compatibility1	1.000	5.000	-0.095	-0.551	-0.742	-2.159
Compatibility2	1.000	5.000	-0.102	-0.596	-0.733	-2.132
Compatibility3	1.000	5.000	0.066	0.384	-0.403	-1.171
Compatibility4	1.000	5.000	0.084	0.489	-0.864	-2.514
Compatibility5	1.000	5.000	-0.262	-1.522	-0.532	-1.548
RelativeAdvantage1	1.000	5.000	-0.201	-1.169	-0.265	-0.770
RelativeAdvantage2	1.000	5.000	-0.157	-0.916	-0.448	-1.303
RelativeAdvantage3	1.000	5.000	-0.234	-1.364	-0.735	-2.136
RelativeAdvantage4	1.000	5.000	-0.160	-0.931	-0.639	-1.858
RelativeAdvantage5	1.000	5.000	-0.375	-2.182	-0.605	-1.758
Multivariate					131.942	24.633

For studies focusing on large samples within SEM scope following thresholds are recommended to conduct normality assessment:

- When absolute values of Skewness Index > 3.0 the data distribution is considered as extremely skewed (Klein, 2011).
- When absolute values of Kurtosis Index > 8.0 to over 20.0 the data distribution depicts “extreme” kurtosis (Klein, 2011).
- Byrne (2012) citing West et al. (1995) suggested that when an absolute Kurtosis value is > 7.0, it refers to significant departure from normality.

Table 5.3 includes normality assessment conducted through AMOS software. Obtained results meet normality criteria set above.

5.4 Confirmatory Factor Analysis (CFA)

CFA focuses on revealing the relationship of the observed factors with their latent factors. Hence, regression paths that connect above mentioned variables were checked and evaluated. Table 5.4 depicts these relations within hypothesized model are highly significant (*** refers to $p < 0.001$).

Table 5.4: CFA Factor Loadings.

			Estimate	S.E.	C.R.	P
RelativeAdvantage5	<---	RelativeAdvantage	1.000			
RelativeAdvantage4	<---	RelativeAdvantage	0.911	0.077	11.888	***
RelativeAdvantage3	<---	RelativeAdvantage	1.074	0.075	14.249	***
RelativeAdvantage2	<---	RelativeAdvantage	1.042	0.073	14.373	***
RelativeAdvantage1	<---	RelativeAdvantage	0.906	0.071	12.797	***
Compatibility5	<---	Compatability	1.000			
Compatibility4	<---	Compatability	1.163	0.075	15.537	***
Compatibility3	<---	Compatability	1.029	0.067	15.442	***
Compatibility2	<---	Compatability	1.138	0.073	15.561	***
Compatibility1	<---	Compatability	0.954	0.073	13.061	***
Complexity5	<---	Complexity	1.000			
Complexity4	<---	Complexity	0.609	0.070	8.767	***
Complexity3	<---	Complexity	0.786	0.072	10.838	***
Trialability3	<---	Trialability	0.750	0.077	9.788	***
Trialability2	<---	Trialability	1.114	0.077	14.549	***
Trialability1	<---	Trialability	1.077	0.091	11.875	***
Observability3	<---	Observability	1.023	0.080	12.843	***
Observability2	<---	Observability	1.060	0.079	13.475	***
Observability1	<---	Observability	0.759	0.082	9.308	***
Theadoption5	<---	TheAdoption	1.000			
Theadoption4	<---	TheAdoption	0.925	0.090	10.260	***
Theadoption3	<---	TheAdoption	1.142	0.081	14.025	***
Theadoption2	<---	TheAdoption	1.108	0.088	12.643	***
Theadoption6	<---	TheAdoption	0.936	0.088	10.615	***
Theadoption1	<---	TheAdoption	1.019	0.089	11.504	***
Theadoption7	<---	TheAdoption	0.902	0.078	11.494	***

As per Klein (2011) for conducting a CFA at least two indicators are needed for each factor. This study included minimum three and maximum seven indicators per factor. In order to measure relative strength of the observed variable to explain latent variable Standardized Regression Weights was obtained. In general, values of the estimates demonstrate strong contribution (Table 5.5). Based on literature review the research model has been hypothesized and with a help of collected data its goodness-of-fit is being tested (Byrne, 2010).

Table 5.5: Standardized Regression Weights.

			Estimate
RelativeAdvantage5	<---	RelativeAdvantage	0.773
RelativeAdvantage4	<---	RelativeAdvantage	0.770
RelativeAdvantage3	<---	RelativeAdvantage	0.849
RelativeAdvantage2	<---	RelativeAdvantage	0.852
RelativeAdvantage1	<---	RelativeAdvantage	0.806
Compatibility5	<---	Compatability	0.732
Compatibility4	<---	Compatability	0.879
Compatibility3	<---	Compatability	0.878
Compatibility2	<---	Compatability	0.882
Compatibility1	<---	Compatability	0.812
Complexity5	<---	Complexity	0.896
Complexity4	<---	Complexity	0.583
Complexity3	<---	Complexity	0.732
Trialability3	<---	Trialability	0.687
Trialability2	<---	Trialability	0.917
Trialability1	<---	Trialability	0.807
Observability3	<---	Observability	0.839
Observability2	<---	Observability	0.868
Observability1	<---	Observability	0.692
Theadoption5	<---	TheAdoption	0.726
Theadoption4	<---	TheAdoption	0.707
Theadoption3	<---	TheAdoption	0.855
Theadoption2	<---	TheAdoption	0.811
Theadoption6	<---	TheAdoption	0.735
Theadoption1	<---	TheAdoption	0.766
Theadoption7	<---	TheAdoption	0.769

According to Hooper et al. (2008) there are three types of model fit indices considered by researchers:

- Absolute fit indices ($\chi2$/df, RMSEA, SRMR, GFI and AGFI)
- Incremental fit indices (CFI and NFI)
- Parsimony fit indices (PGFI and PNFI; AIC and CAIC)

Recommended thresholds that will help to determine the goodness of fit are followings:

- p-value > 0.05 (Hooper et al., 2008)
- CFI ≥ 0.95 (Hu and Bentler, 1999); (Schreiber et al., 2006)

- GFI - the values close to 1.00 demonstrate good level of fit (Byrne, 2010)

- AGFI > the values close to 1.00 demonstrates good level of fit (Byrne, 2010)

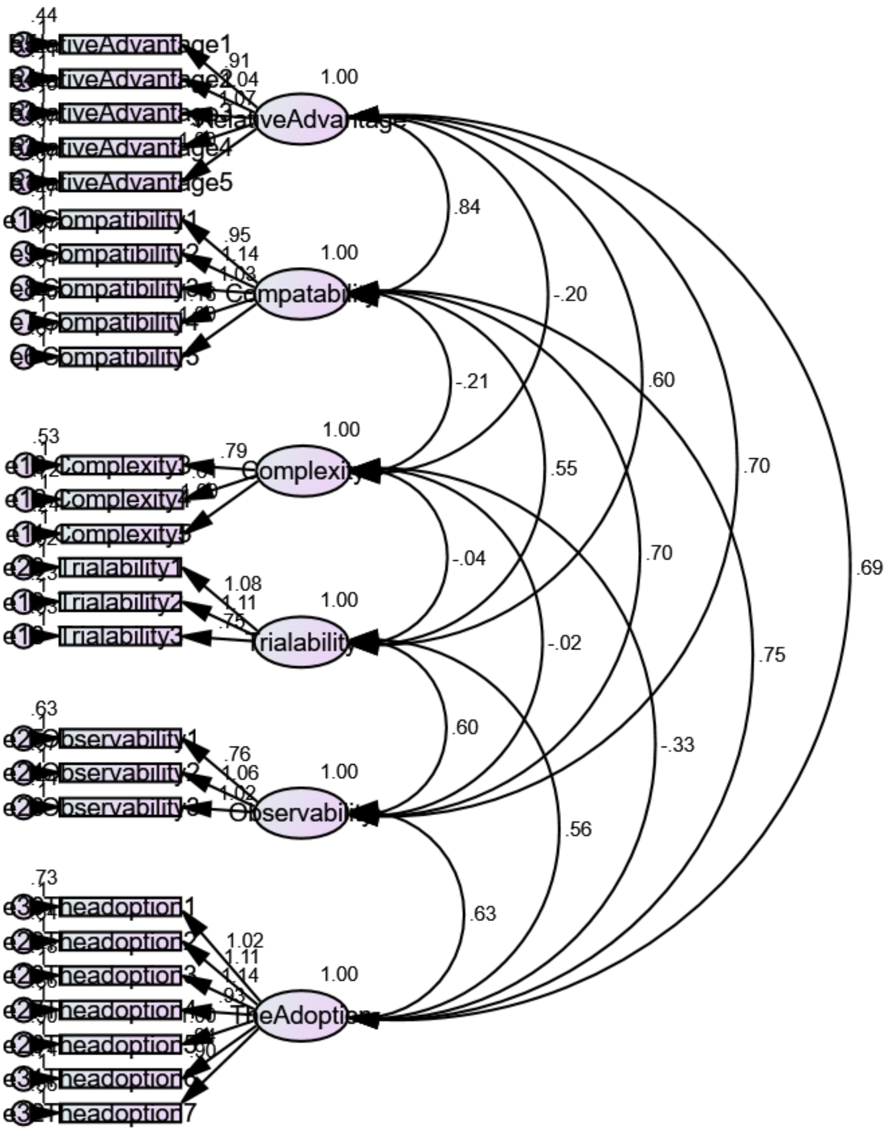

Figure 5.6: CFA model.

- SRMR ≤ 0.05 (Byrne, 2010) or ≤ 0.08 (Schreiber et al., 2006)

- RMSEA – the values between 0 and 0.08 (Hooper et al., 2008) or ≤ 0.06 to 0.08 (Schreiber et al., 2006) demonstrate good level of fit

- PCLOSE > 0.05 (Byrne, 2010)

The model depicted in Figure 5.6 was adapted after certain re-evaluations and re- calculations made relying on modification indices obtained through Amos version 23. Modification indices propose fixes to be made in order to solve conflicts between suggested and estimated model. The role of modification indices is significant as in CFA regression lines cannot be added for model fit as regression lines between observed and latent factors already have been applied. For this reason, for CFA analysis modification indices related to covariances are being considered. However, it is important to note that only error terms that belong to the same factor can be covaried and the priority is given to the modification indices with a higher value. While conducting CFA analysis there were 351 distinct sample moments identified which refers to the number of elements available in sample covariance matrix. 63 parameters were estimated which is leaving 288 degrees of freedom. With Chi-square value of 682.189 the probability level equals to 0.000. Table 6-5 demonstrates model fit analysis of the hypothesized model. Reviewing above mentioned parameters (Chi-square value, degree of freedom and p-value) can be considered as a first step for a quick overview regarding model fit.

Table 5.6: Model Fit Analysis for CFA.

Measure	Result	Comment
Chi-square/df (cmin/df)	2.369	Good
p-value	0.000	
CFI	0.867	Good
GFI	0.651	
AGFI	0.749	Moderate
SRMR	0.074	Good
RMSEA	0.082	Moderate
PCLOSE	0.000	

Hooper, Coughlan and Mullen (2008) citing Hu and Bentler (1999) highlights that the Chi-Square value is a common statistical measure used to measure generic goodness-of- fit that evaluates the extension of nonconformity among fitted covariances matrices and sample. It is also known that Chi-Square is very sensitive related to a sample size. Hence, as an alternative $\chi 2/df$ evaluation method has been proposed in order to minimize this effect (Hooper et al., 2008). Good model fit can be recognized when $\chi 2/df$ is less than value of 3, $\chi 2/df$ value of current research being equal to 2.369 indicates one of the first signs of goodness-of-fit. Despite the fact that RMSEA (root mean square error of approximation) has been introduced in 1980 by Steiger and Lind, its valuableness has been recognized recently and it is being considered as one of the most informative fit indices. RMSEA helps to eliminate sample size related issues by analyzing to which extent hypothesized model along with optimally chosen parameter estimates would match the population's covariance matrix (Byrne, 2010). As RMSEA value within current study is between 0.05 - 0.10, it indicated moderate-fit of the model. PCLOSE stands for closeness of fit and is a measure that indicates good level of RMSEA within population (Byrne, 2010). PCLOSE value of 0.000. SRMR (Standardized Root Mean Square Residual) is another absolute measure of fit that linked to the correlation residuals. SRMR refers to the difference between observed and hypothesized correlation matrices. It is important to note that SRMR is sensitive towards factor covariances that are not specified in CFA while analyzing measurement models (Klein, 2011). As SRMR value equals to 0.074 in current research and it is less than 0.09 model fit from this perspective can be recognized. Hooper, Coughlan and Mullen (2008) citing Tabachnick and Fidell (2007) state that GFI (goodness-of-fit statistic) and AGFI (adjusted goodness-of-fit statistic) were initially introduced by Jöreskog and Sorbom as an alternative analysis to Chi-Square test. Both GFI and AGFI calculate nonconformity between the model that has been fitted along with covariance matrix in a given population. The only difference that AGFI having an ability to adjust according to the number of degree of freedom in a given model (Byrne, 2010). As GFI and AGFI are sensitive to sample size current research has adopted a threshold recommend by Byrne (2010) which states that values close to 1.00 indicate good model fit. The results of GFI and AGFI of current study 0.651 and 0.749 respectively meet these recommendations. As NFI (Normed Fit Index) has a tendency of not being reliable when it comes to large sample sizes, Competitive Fitness Index (CFI) has been recommended for assessing the model fit (Byrne, 2010). CFI assumes that all latent variables are not correlated and contrasts hypothesized model with null model (Hooper et al., 2008). According to Hu and Bentler (1999) the threshold for CFI is the value ≥ 0.95. CFI within this study being equal to 0.867 confirms that the model is fit. Based on results discussed above it can be concluded that hypothesized model demonstrated well fit according to collected data within this study.

5.5 Hypotheses Testing (SEM)

Structural Equation Modeling concentrates on analyzing and evaluating relationships between hypothesized latent variables. Moreover, SEM provides larger extent of options related to relationship among latent variables comparing to CFA and imply two components:

- measurements model (basically CFA itself)
- structural model

As measurement model has been analyzed earlier, current section focuses on structural model. Structural model (Figure 5.7 depicts interrelationship between latent and observable variables where several regression equations take place. (Schreiber et al., 2006).

Figure 5.7: Structural Equation Model.

In order to examine hypotheses global and local tests will be conducted (Figure 5.8). For hypothesis to be supported it is critical for local test to be passed. At the same time, it is important to note that initially global test should be met for local test to make sense. Basically, hypotheses that have significant p-value but with poor model fit lose their reliability. Another global test to be conducted is R-squared. Respectively, in case of significant p-value and model fit, but low R-square hypotheses cannot be supported as relationships tested do not reflect adequate variance in endogenous variable (Gaskin, 2016).

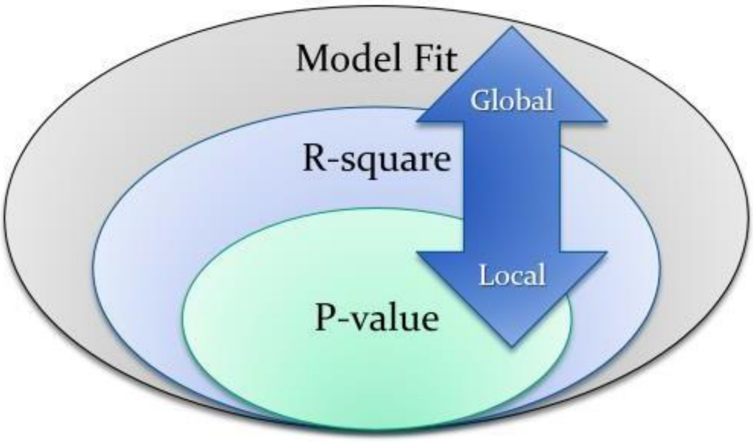

Figure 5.8: Hypotheses support through global and local tests

Resource: Gaskin, 2016

Model fit statistical results conducted for structural equation model are provided below and based on obtained results it can be concluded that hypothesized structural equation model has overall good fit.

- Chi-square = 682.189 with 288 degree of freedom
- Chi-square/df = 2.369
- p-value = 0,000
- CFI = 0.867
- GFI = 0.651
- AGFI = 0.749
- RMSEA = 0.082
- PCLOSE = 0.000

R-squared is also known as Squared Multiple Correlations (SMC) indicates the variance level (percentage) reflected by predictors of the factors in question (Byrne, 2010). R- squared values are within 0 and 100%. In other words, higher the value of R-squared, better sample data matches the model. SMC values for hypothesized structural model are depicted in table 5.7 and based on these results it can be concluded that overall predictors explain respective variable relatively well.

Table 5.7: Squared Multiple Correlations

Predictor Variable	Estimate
TheAdoption	0.400
Theadoption7	0.587
Theadoption6	0.533
Theadoption1	0.608
Theadoption2	0.694
Theadoption3	0.758
Theadoption4	0.527
Theadoption5	0.631
Observability1	0.462
Observability2	0.742
Observability3	0.700
Trialability1	0.643
Trialability2	0.831
Trialability3	0.468
Complexity3	0.527
Complexity4	0.338
Complexity5	0.811
Compatibility1	0.648
Compatibility2	0.765
Compatibility3	0.761
Compatibility4	0.764
Compatibility5	0.535
RelativeAdvantage1	0.640
RelativeAdvantage2	0.717
RelativeAdvantage3	0.713
RelativeAdvantage4	0.583
RelativeAdvantage5	0.597

Lastly, thanks to p-value hypotheses were analyzed in terms of being supported or not (Table 8-5). Relative Advantage (H1: ß= 0.090, S.E.= 0.179 and $p>0.05$) as Adoption feature has been **not** confirmed to have a positive impact on the adoption of Health tracking devices. However, Compatibility (H2: ß= 0.438, S.E.= 0.175 and $p<0.05$) as Adoption feature show positive impact on the adoption of health tracking devices. Complexity (H3: ß= -0.222, S.E.= 0.088 and $p<0.05$) as Adoption feature demonstrated negative impact on the adoption of Health tracking devices. Trialability (H4: ß= 0.178, S.E.= 0.112 and $p>0.05$) as Adoption feature did not show positive impact on the adoption of Health tracking devices. Finally, Observability (H5: ß= 0.159, S.E.= 0.140 and p>0.05) as Adoption feature did not demonstrate a positive impact on the adoption of Health tracking devices.

The summary of the hypotheses testing is provided in Table 9-5.

Table 5.8: Regression Weights.

			Estimate	S.E.	P
TheAdoption	<---	RelativeAdvantage	0.090	0.179	0.614
TheAdoption	<---	Compatability	0.438	0.175	0.012
TheAdoption	<---	Complexity	-0.222	0.088	0.012
TheAdoption	<---	Trialability	0.178	0.112	0.114
TheAdoption	<---	Observability	0.159	0.140	0.255

Table 5.9: Hypotheses Testing Results.

Hypotheses	Relationships	Status
H1	ADO←REA	Not Supported
H2	ADO←CPA	Supported
H3	ADO←COL	Supported
H4	ADO←TRI	Not Supported
H5	ADO←OBS	Not supported

6. DISCUSSION AND CONCLUSION

6.1 Discussion of Findings and Conclusion

Primary data has been obtained for analysis of research questions and hypotheses testing purposes. In total there were 203 volunteer completed participants of the survey. As this study made use of quantitative research techniques, Likert type survey has been implemented. Received responses represent both genders (67.5% of males and 32.5% of females). The age of the respondents varied from 15 to above 40 years and 54.3% of them have bachelor’s degree. 90.4% of the respondents indicated mobile phone as most option to be used. Before starting statistical analysis, validity and reliability assessment have been applied. These assessments are significant part of quantitative research that focus on measurement issues of the factors. Validity analysis focuses on checking if variables are being measured in an accurate manner. Meanwhile, reliability focuses on the extent to which results are free of the measurement error. The factors within this research demonstrated adequate validity and reliability. Another step that should not be omitted in quantitative research is data screening process. This step was vital as it is important to make sure that the obtained data is clean and useable. One data screening method have been implemented: normality assessment. Within the scope of normality assessment skewness and kurtosis of the results have been evaluated and the data met normality criteria. As a result, collected data was considered useable, valid and reliable for further statistical analysis.

It is beneficial for two participants in the adoption cycle, firstly, the producer or the innovator who can get via this research an enormous amount of information and what really considered as a sensitive point to the potential customers and adaptor for wearable health tracking devices in the Turkish market. Yet, it is a huge insight for the marketers those who are using IDO’s factors as a methodology to analyze the target market and build a marketing strategy, specially, with the surprising outcomes due to the human behaviors which described as non-stable and inconstant. Diffusion of Innovation theory claim that four of its factors (Relative advantage, Compatibility, Trialability and Observability) have a “positive” relationship with the studied innovation (dependent variable), on the other hand, just one of its factors (which is Complexity) has a “negative” relationship (Roger, 2003). Moreover, many researches have shown the impact of Relative Advantage on the adoption have a positive impact, as an example Relative advantage and the Precived Usefilness of electronic teaching framework is described to have a positive correlation (Lee et al., 2011). However, it is observed by the result that the first factor positive relationship with the adoption of wearable health tracking devices has been rejected!. Furthermore, the fourth and fifth factors, which are Trialability and Observability, have not been confirmed having a positive relationship with the adoption. Therefore, it can be noticed that there are no fixed roles to deal with human, particularly, from country to another where there are many other factors that should be taken into consideration while a market is being studied (Durability and Social risk as an examples).

By doing SEM analysis via AMOS the result was conducted, and showed that just two of the hypothesis have been confirmed (2^{nd} and 3^{rd} hypothesis), this insight draw attention of those whom might be concerned in this field (Health tracking devices and its spread over a the Turkish population) from both sectors, healthcare sector, production and innovation sector, knowing that Complexity effects the adoption negatively is very important point, nevertheless, taking into consideration how this market or community evaluate his relationship with technology. Add to that, Compatibility has a critical impact and influence over the adoption, lead the way of thinking that should marketing planners follow.

In general, the objective of this research was to identify and analyzes the impact of DOI theory’s factors over the wearable health trucking devices and its adoption over the Turkish market. Based on the research findings, it can be concluded that wearable health tracking devices adoption by Turkish market significantly impacted by the 2^{nd} and 3^{rd} factors, while the other factors should be seriously reconsidered.

6.2 Implications

Most of the companies that are focusing on the adoption of their innovations are aware of the fact that one theory cannot be treated as the only resource for predicting the human behavior, nor relying on many so they would get lost. Nowadays, customers have a power of information, especially when it comes to technology and innovation, and the modern lifestyle made the mission far more complicated since the behavior of any population is getting effected by many factors which lead us to a complex phenomenon. With this wide range of options and variety choices and this unstable behavior, trying to predict the future becomes a high-risk job. It is vital to understand needs and wants of the potential users as well as meeting their expectations for generating satisfaction and loyalty respectively. DOI theory is a tool that meets requirements mention above in certain extent. By defining commonly discussed Diffusion of Innovation theory features current study focused on its five factors: relative advantage, compatibility, complexity, trialability and observability. All of mentioned features demonstrated direct impact on wearable health tracking devices. It is important findings for innovators or interested in healthcare sector that may believe that they are meeting customer expectations, needs and wants without paying attention to the features mentioned above in their marketing strategies. Yet, the features that have been studied have a strong basement which is the theory itself, however as the result shows, relative advantage trialability and observability, as an example, have not been approved to have positive relationship with the adoption of wearable health tracking devices.

The producers of wearable health tracking devices that allocate big portion of the budget and effort for marketing activities to improve its portion and attract more customers to adopt their product, should make sure that their background in terms of adoption's factors is indeed performing in way how it guarantees to create loyal customer base for a long run. At the same time, the results of this study should alert them that those whose do not have strong adoption framework, to rethink existing strategies and reconsider available adoption approach for further improvements. Nevertheless, not only considering one theory, but extend their strategies to cover as much as the limitations allow.

Another important finding is the fact that the second adoption feature compatibility, has a positive impact on the adoption process over the studied market. That is to say, being well matched and in harmony with the life style, way of thinking, and how customers love to live. Causing no conflict with Turkish culture, philosophy and values, is very critical point to customers in this market. For example, focusing on the ability of non-stopping monitoring health condition for elder in the family, with no need to a doctor, would convince customers in this market to but this devices. This demonstrates importance of adoption features that may enhance the chance to adopt wearable health tracking devices by customers one way or another. The third factor, which is complexity, was supported as well. However, having a negative relationship with the adoption. The mentality of customers in Turkish market tend to like simplicity in term of use, they would give up adopting any product or innovation easily once they consider it complicated. The more they feel wearable HTD simple, the more they would buy and use it. As a marketing strategy, it would be a good start to introduce these wearables as traditional watch with more features. Convincing them that basically they as simple as normal watches in term of use with more benefits. Eventually, those who interested in this field are concerned with these features as critical measures. As an attempt to explain the rejected factors, most important point is to try to understand it while considering the market that has been studied, for example wearable HTD in Turkish market, is still considered young. Therefore, they might not even think of trying it, so trialability as a studied factor is not considered to effectively impact this population. Moving to Relative Advantage and Observability as a studied factors, since this technology is walking its first steps in Turkish market, its benefits might not be clear enough to the target customers or they are not able to see and understand those benefits for some reasons, thus, it is very critical to explain the advantages that are the user is going to gain by adopting such devices, on the other hand, it is believed to be the marketer duties to find out the potential reasons that rely behind this situation.

6.3 Limitations and Recommendations for Future Researches

As other studies have some limitations, this study also has some drawbacks similarly. A qualitative research should be done to examine and analyze the extent to how much DOI theory's factors reflect the elements that truly guide the adoption process of wearable health tracking devices. This means marketers, producers and mindful of healthcare sector must also consider doing more research about any other potential factors, as well as giving the accurate value to each parameter.

Another important part of the study is to find which factors among the five factors that DOI suggests particularly impact the decision making among the Turkish market. In the future research, the results might be changed in one or more factors due to the nature of human being behavior, in the other hand, this research finding still presents a crucial background of the Turkish market interest in the field of wearable health tracking devices, so the users of this outcome can achieve advantages by getting good insight on Turkish market or another one, as long as human being share same characteristics in a way or another! As well as, taking into consideration that this study took place in Istanbul (which has almost 25% of Turkey's population) which might not be enough to reflect the whole market. Therefore, it is recommended to include more cities in the future studies.

Another thing should be taking care of is even though respondents prior filling in surveys were given detailed information about its purpose and objective, surveys carried self-reported nature. Moreover, as the adoption process has dynamic nature, obtained results might not be actual after certain period of time and the model might require specific updates and modifications in the future. Nevertheless, convenience sampling is also considered as a limitation in this study, that's to say, in the future studies it might be recommended to apply other tools. Finally, the limited time was another constraint that researcher faced during research period. Taking into consideration above mentioned limitations researchers may conduct new studies with improved models and hypotheses that will let to have better understanding about the adoption of wearable health tracking devices in Turkey. It will be interesting to direct future researches to have mixed outcomes that will include more than one theory's factors. In this way, the picture as a whole can be seen and fill in existing gaps in a more efficient manner. Despite the fact that structural equation modeling requires minimum of 200 responses as a sample size, covering large samples will help to represent bigger portion of the population and generalize outcomes.

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APPENDICES

Appendix A: Main Survey Items Sources
Appendix B: Survey Questionnaire (English Version)
Appendix C: Istanbul Aydin University ethics committee questionnaire approval

Appendix A: Main Survey Items Sources

Variable	№	V-code	Question	Source
Relative Advantage	1	RA 1	Using wearable health tracking devices enables me to preview my health situation more quickly.	Moore, G. C., and Benbasat (1991)
	2	RA 2	Using wearable health tracking devices improves my performance.	
	3	RA 3	Using wearable health tracking devices gives me greater control over having a healthy life.	
	4	RA 4	Using wearable health tracking devices improves the quality of work I do with my smart devices	
	5	RA 5	Overall, I find such technologies to be advantageous in my life.	
Compatibility	6	CP1	Using wearable health tracking devices is compatible with all aspects of my life.	Moore, G. C., and Benbasat (1991)
	7	CP2	I think that using wearable health tracking devices fits well with the way I like to live.	
	8	CP3	Using wearable health tracking devices is completely compatible with my current situation.	
	9	CP4	Using wearable health tracking devices fits into my life style.	
	10	CP5	Health tracking devices usage doesn't contradict with my daily life routine.	
Complexity	11	CO1	Using wearable health tracking devices requires a lot of mental effort to understand.	Moore, G. C., and Benbasat (1991)
	12	CO2	Using wearable health tracking devices can be frustrating.	
	13	CO3	Using wearable health tracking devices requires high technical skills.	
	14	CO4	Using wearable health tracking devices is an easy way to conduct life activities.	
	15	CO5	People around me describe the using of these devices as easy and simple.	
Trialability	16	TR1	I want to be able to try wearable health tracking devices for at least one month.	Moore, G. C., and Benbasat (1991) / Ntemana T. J & Olatokun W. (2012)
	17	TR2	I want to be able to use wearable health tracking devices on a trial basis to see what it can do for me.	
	18	TR3	It is better to experiment with wearable health tracking devices before adopting it.	
	19	TR4	It was easy to use such wearable more frequently after trying them out.	
	20	TR5	Trying such technology in health observing before the adoption is common in my circle of friends.	
Observability	21	OB 1	I was influenced by what I observed as the benefits of using wearable health tracking devices.	Moore, G. C., and Benbasat (1991) / Ntemana T. J & Olatokun W. (2012)
	22	OB 2	I would have no difficulty telling others about the results of using wearable health tracking devices.	
	23	OB 3	I believe I could communicate to others the outcomes of using such devices.	
	24	OB 4	I observe how others use health tracking devices before I use them.	
	25	OB 5	I have observed how much useful these devices are via the popular press and media.	

The adoption	26	AD1	I love to use innovation, such as health tracking devices, that empress other.	C. Franceschinis, M. Thiene, R. Scarpaet al. (2017)
	27	AD2	I like to own such innovation (health tracking devices) that distinguishes me from other who do not use this product.	
	28	AD3	I prefer to try innovative products, such as health tracking devices, with which I can present myself to other people.	
	29	AD4	If a new health tracking device gives me more comfort than my current one, I would not hesitate to buy it.	
	30	AD5	If a new health tracking device makes my work easier, then this new product is a "must" for me.	
	31	AD6	Acquiring health tracking devices makes me happier.	
	32	AD7	Health tracking device make my life exciting and stimulating.	

Appendix B: Survey Questionnaire (English Version)

This survey is about predicting the adoption of wearable health tracking devices and its future over Turkish market. Your participation in this survey is completely voluntary and all of your responses are anonymous. You can exit from the survey at any step. The collected data will only be used to answer the research questions. The survey data will not be shared with other 3rd parties.

It will take between 6-9 minutes to fill the survey after watching the attached video. Thanks in advance for your participation.

If you require any further information about this survey, please send an email to this address: diaashahbandar@gmail.com Master student Diaa Shahbandar / Istanbul Aydin University.

Part 1. Respondent Profile

1. Gender
    - Male
    - Female

2. Age
    - 15 – 20
    - 21 – 25
    - 26 – 30
    - 31 – 40
    - Above 40

3. Education
    - High School
    - Bachelors
    - Masters
    - Doctorate
    - Other

4. Salary scale (TL Monthly)
    - Not working
    - 1000 – 2000
    - 2000 – 3000
    - 3000 – 4000
    - Above 4000

5. How do you evaluate your relation with the Tech innovation? (Where is 1 lowest and 5 is the strongest)

6. Which kind of devices do you use most of the time?

- Smart Phone
- Tablet
- Personal Computer

7. Which kind of mobile operating system do you use?

- Android
- IOS
- Windows phone
- BlackBerry
- Other

8. Where do you use your device (Smart phone, PC, Tablet) most of the time?

- Home
- Outside (Office, University...etc.)
- Transportaions (Bus, Metro…etc.)

9. How many hours do you spend using your device (Smart phone, PC, Tablet) in a day?

- Less than 3 hours
- 3 – 5 hours
- More than 5 hours

10. Do you use any wearable devices (smart watch...etc)?

- Yes
- No

11. If YES, what are your reasons for using wearables?

- Using the phone's features effectively.
- I like keeping up with innovations.
- More practical in use.

12. If NO, what are your reasons for not using wearables?

- The price (Most of them are expensive)
- It is not practical (usually it got broken easily)
- Too complicated to use
- Don't understand the real benefits of such technologies

Part 2. Main survey items

Relative Advantage

13. Using wearable health tracking devices enables me to preview my health situation more quickly.
14. Using wearable health tracking devices improves my performance.
15. Using wearable health tracking devices gives me greater control over having a healthy life.

16. Using wearable health tracking devices improves the quality of work I do with my smart devices
17. Overall, I find such technologies to be advantageous in my life.

Compatibility
18. Using wearable health tracking devices is compatible with all aspects of my life.
19. I think that using wearable health tracking devices fits well with the way I like to live.
20. Using wearable health tracking devices is completely compatible with my current situation.
21. Using wearable health tracking devices fits into my life style.
22. Health tracking devices usage doesn't contradict with my daily life routine.
Complexity
23. Using wearable health tracking devices requires a lot of mental effort to understand.
24. Using wearable health tracking devices can be frustrating.
25. Using wearable health tracking devices requires high technical skills.
26. Using wearable health tracking devices is an easy way to conduct life activities.
27. People around me describe the using of these devices as easy and simple.
Trialability
28. I want to be able to try wearable health tracking devices for at least one month.
29. I want to be able to use wearable health tracking devices on a trial basis to see what it can do for me.
30. It is better to experiment with wearable health tracking devices before adopting it.
31. It was easy to use such wearable more frequently after trying them out.
32. Trying such technology in health observing before the adoption is common in my circle of friends.
Observability
33. I was influenced by what I observed as the benefits of using wearable health tracking devices.
34. I would have no difficulty telling others about the results of using wearable health tracking devices.
35. I believe I could communicate to others the outcomes of using such devices.
36. I observe how others use health tracking devices before I use them.
37. I have observed how much useful these devices are via the popular press and media.
The Adoption
38. I love to use innovation, such as health tracking devices, that empress other.
39. I like to own such innovation (health tracking devices) that distinguishes me from other who do not use this product.
40. I prefer to try innovative products, such as health tracking devices, with which I can present myself to other people.
41. If a new health tracking device gives me more comfort than my current one, I would not hesitate to buy it.
42. If a new health tracking device makes my work easier, then this new product is a "must" for me.
43. Acquiring health tracking devices makes me happier.
44. Health tracking device make my life exciting and stimulating.

Appendix C: Istanbul Aydin University ethics committee questionnaire approval:

T.C.
İSTANBUL AYDIN ÜNİVERSİTESİ REKTÖRLÜĞÜ
Sosyal Bilimler Enstitüsü Müdürlüğü

Sayı : 88083623-044
Konu : Anketler

Sayın Ziya ŞEHBENDEROĞLU

Tez çalışmanızda kullanmak üzere yapmayı talep ettiğiniz anketiniz İstanbul Aydın Üniversitesi Etik Komisyonu'nun 11.03.2019 tarihli ve 2019/04 sayılı kararıyla uygun bulunmuştur.

Bilgilerinize rica ederim.

e-imzalıdır
Prof. Dr. Ragıp Kutay KARACA
Müdür

15/04/2019 Enstitü Sekreteri NESLİHAN KUBAL

Evrakı Doğrulamak İçin : https://evrakdogrula.aydin.edu.tr/enVision.Dogrula/BelgeDogrulama.aspx?V=BENU3DMBL

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