Investigating the tendency of customers to adopt Internet of Things device based on the development of technology acceptance model (Case Study: beekeeping industry)

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Abstract

Technology usage and acceptance play a more pivotal role in various services and industries. Farming is among those industries that, in today's world, have quite adapted to new technology practices. This conceptual research paper is about the tendency of Iranian beekeepers to adopt new technologies such as IoT for their business. Beekeeping has always been considered a primitive industry or business in Iran. Therefore, it is far more challenging to persuade Iranian beekeepers that new technologies can facilitate and improve their business. The present study contributes to the literature by reviewing related technology acceptance models to investigate how likely it is for Iranian beekeepers to adopt new technologies for their businesses.

Key words: Technology Acceptance, IoT, Beekeeping, B2B marketing, Shared Economics

1. Introduction

Through data-driven agricultural decisions have risen during the era of rapid population growth, dietary changes, resource restrictions, and dietary alterations (Lee and Choudhury, 2017). Due to these changes, farmers are being forced to adopt adaptable IoT solutions to increase crop yield, decrease animal losses, and conserve water across a variety of agriculture activities. (Guerra, 2017). Farms raising livestock can monitor their pigs, cattle, chickens, and milk with cloud-based IoT tools and sensors. Similarly, In this study, an IoT device is going to be provided for beekeepers to make them familiar with how IoT can help them to manage their hives and apiary.

The rapid growth of new technologies has led to the emergence of various effects in all industries, which has improved performance, accelerated, and made things easier. However, the acceptance of technology by business owners or customers in various industries has not been without challenges. Considering what new technology consumers accept and use has led innovators and inventors to design and market a new system or product according to consumer behavior needs and wants (Vijayasarathy, 2004). The overall purpose of this study is to propose a conceptual model which demonstrates the behavior of Iranian beekeepers regarding the usage of the technological oriented product (Such as IoT) to understand their tendency through the technology acceptance model. Due to the fact that beekeepers are producers and business owners, the marketing dimension of this research is focused on business-to-business marketing.

Bees have lived with humans for a long time, often considered domestic animals. However, with or without the help of humans and private hives, they can also survive. No other animal serves man in as many different ways as the bee. Bees are kept full-time for entertainment and business, as a research animal for scientists, and also used as pollinators for fruits, seeds, and vegetables. Due to its social lifestyle and adaptability, this animal can survive in most parts of the world. (Wilson-Rich, Kelly Allin, 2014)

There were no bees before the evolution of blooming plants. Then, roughly 100 million years ago, plants started to acquire colorful exteriors and fragrant reproductive organs. Meanwhile, some wasps adopted a kinder way of life and stopped engaging in carnivorous hunting. From these wasp predecessors, bees developed, obtaining protein from the pollen offered by the plants in exchange for their pollination services (Wilson-rich, 2014).

Humans and honey bees have interacted for millions of years. Just like chimpanzees do now, our distant ancestors probably plundered wild bee colonies for honey. (Hicks et al., 2005). Africa is where both honey bees and people first appeared, yet both species left the continent multiple times. One of these migrations, in which Honey bees migrated to greater northern latitudes from their native tropical habitat, caused the bees to develop big colonies and accumulate massive stockpiles of food to withstand the harsh winters, which opportunistic humans observed and controlled (Kritsky, 2010).

The first beekeeper's identity has been lost to history forever. The oldest indication of human contact with bees may be a Mesolithic cliff art from 8,000 years ago that shows a human figure stealing the honey from a colony (Crane, 1999).

The Fifth Dynasty of the Old Kingdom, when the pyramids were built, is when the earliest proof of beekeeping was discovered. German Egyptologists discovered a modest bas-relief that depicts Egyptian beekeeping in the Sun Temple of the Pharaoh Ne-user-re, which is located south of the Sphinx and the Giza pyramids (Kritsky, 2010).

Humans learned over time that for better and more exploitation, they had to collect natural hives from different nearby places, for care and maintenance in one place. In other parts of the world, beehives were built, and bees were kept inside primitive hives. The type of primary hives varied depending on the environmental conditions of the area and the type of raw materials available, and the migration of the inhabitants of that area. In the forested parts of the world, bees were kept in their natural nest, the tree trunk. Indigenous people separated the trunk of a bee-containing tree from the rest of the tree for ease of care and harvesting, covered both ends, and placed a number of them together. Tree trunks can be laid horizontally or vertically. (Crane, 1999)

The difficulties bees face today, such as habitat loss, pesticide use, and lethal diseases, threaten not just the bees but all human existence (Wilson-rich, 2014). Beekeepers around the world confront growing challenges, and beekeepers in developing nations face the additional problem of solving these challenges with fewer resources. The four main types of constraints are biological, technical, trade, and institutional. The introduction of foreign honeybee species and races, honeybee diseases, parasites, and predators, the extinction of native species, the loss of habitat variety, and issues brought on by pesticide use are only a few examples of biological restrictions. (Bradbear, FAO, 2009). After years of beekeeping, beekeepers still face many problems in maximizing their exploitation. In this respect, the present study tries to shed light on the acceptance of IoT technology in the beekeeping industry by implementing a device invented and produced in the beekeeping industry to monitor the production of honey, collect, and analyze information.

IoT device is applicable on smartphones, and beekeepers can rely on its accurate and comprehensive information to optimize their honey production and use this information to prove the authenticity of their honey. Another feature of this device is hardware assistance to beekeepers to solve the significant problem of this industry, namely overwintering and eliminating pests without using chemicals. In other words, the use of Internet of Things technology is an effective solution to solve the problems of Iranian beekeepers. The present study attempts to propose a model for accepting this technology by Iranian beekeepers using the sharing-economy approach.

This research aims to investigate how likely it is that Iranian beekeepers will adopt IoT technology in their business. This study aims to look into the relationship between several independent variables and the technology's usefulness and ease of use. This will significantly help the study to determine how inclined beekeepers are to adopt IoT technology.

2. Literature Review

2.1 B2B Marketing

Business-to-business marketing is the practice of promoting products and services to other businesses so that they can complete and market their goods and services. This definition of business-to-business marketing emphasizes the customer nature of businesses and companies. Business-to-business customers, instead of end consumers, are companies, businesses, and organizations that can range from small family businesses to international companies (Wim j. Beymans, 2010). The marketing efforts of any type of organization that engages in trade with other businesses or organizations are referred to as "business-to-business marketing." (Trunbull, 1994).

Over the past 100 years, technological changes have considerably affected agriculture. In the meantime, innovations to raise yields, save costs, and improve product quality have increased dramatically (Schultz,1964, Cochrane,1993, Sunding and Zilberman, 2001). B2B marketing techniques have been applied to agriculture by marketing professionals, based on Foxall’s study (1979), which made a comparison between farmers' decision to buy tractors and the purchasing pattern of professional buyers in the sectors of manufacturing and services.

In B2B agricultural marketing, the effectiveness of distribution routes and the function of distributors were the main areas of focus (Weld,1917) and the goods-dominant logic, which dominated early marketing theory and primarily concentrated on agricultural goods as exchangeable commodities (Vargo and Lusch, 2004).

Nevertheless, currently, due to their ability to create real-time data through IoT on crop yield and weather forecast, In the agriculture sector, B2B buyers are acting more proactively in appraising the potential contribution of IoT as co-producers. This will ultimately help them increase their profitability (Mehta, 2017; Vargo and Lusch, 2006).

Based on previous research on IoT adoption by farmers, we have conceptualized a framework to evaluate beekeepers' tendency to adopt an innovative IoT device, wherein perceived ease of use and perceived usefulness affect behavioral outcomes in a B2B context.

2.2 Access-based services VS Owner-ship-based services

Access-based services have become more widespread as a substitute for ownership-based services as a result of the sharing economy's explosive rise (Bardhi, Eckhardt, 2012) (Schaefers, Moser, Narayanamuthy, 2018). Access-based services allow the customer to have access to a product, network, workforce, or space for a specified period, while the service provider retains full legal ownership (Schaefers, Wittkowski, Benoit, Ferraro, 2016). Access-based services can reduce consumer budget constraints and increase their sustenance or income (Schaefers, Wittkowski, Benoit, Ferraro, 2016) (Poppelaars, Bakker, Engelen, 2018). Access-based services are made possible by Smart Product-Service Systems (SPSS). Smart Product-Service Systems provide smart products and e-services to the consumer as an integrated solution (Pisciecelli, Cooper, Fisher, 2015) (Valencia, Mugge, Schoormans, 2015). For instance, bike sharing systems are SPSSs that integrate sensors and the global positioning system with mobile apps (as e-services) and smart bicycles (as shared products) (Lou, Wai Lai, Ide Lui. 2019).

Similarly, Beedar is a smart product-service system that includes a mobile application (as an electronic service) and a hive equipped with smart hardware (as a smart product). To succeed in launching an access-based service, smart product design and e-services of the smart product-service system are very important. Users only accept the smart product-service system in one case, which is to accept the smart product and related e-services (Lou, Wai Lai, Ide Lui. 2019).

2.3 Sharing Economy

Sharing economy means temporary access instead of permanent access and ownership of something (Habibi et al., 2017). Sharing platforms can provide tangible resources, including physical goods such as cars, homes, money, and space, and intangible resources, including services, data, talents, ideas, and knowledge. (Dreyer et al., 2017) (Habibi et al., 2017) There are two ways to access the items mentioned earlier. One is the economic transaction meaning paying money to obtain access, and secondis the exchange, which means that instead of paying money,another commodity will be provided to the provider. (Eckhadert, Houston, Jiang, Zeros, Rindflisk, Lamberton, 2019)

Smart product-service systems are an upgraded type of product-service systems that offer products and services as a solution to the consumer. In some research, the technology acceptance model for product-service systems has been used as an indicator of acceptance by consumers.

2.4 Internet of Things

We live in a fast-moving world where everything is interconnected. When these objects are connected, they become intelligent regardless of the Internet. The Internet of Things is an extensive network of interconnected objects that collects, stores, and uses available data in the environment. This technology is widely used in agriculture to monitor and optimize production. Sensors on IoT devices provide farmers with various data to help them maximize production (Ratnaparkhi, et al., 2020).

The main advantage of the Internet of Things is its ability to communicate with an unlimited number of machines on a large-scale wireless network (Mekki, 2019).

As shown in the figure, a typical Internet of Things architecture lists each component's functions:

- IoT Edge Devices
  Being able to process certain information makes them the intelligent IoT driver.
- IoT sensors
  Because of their connection to the cloud, they are able to send and receive data.
- Device provision
  aids in establishing connections amongst numerous gadgets that demand registration.
- IoT Gateway/Framework
  provides command, management, and control of devices and fixes a cloud hub for IoT devices.
- Stream Processing

Analyzes complex components.

- Machine Learning

enables the prediction and application of algorithms utilizing reliable data. Additionally, it evaluates and keeps the forecast updated in accordance with various scenarios.

- Reporting Tools

help with data storage and give batch processing the resources it needs.

- User management

Users or groups who are permitted to conduct an action on the device can be restricted or allowed. The capabilities of each user's application are used in this procedure.

2.5. Beedar Device

The Beedar device, which was invented to solve the problems of beekeepers, is a new and innovative product for Assisting beekeepers to monitor the hives accurately and overcoming apicultural challenges mentioned earlier such as overwintering and eliminating pests. The use of IoT technology in the beekeeping industry and the Beedar's solutions are proof of the product's innovation.

The main components of the Beedar device are hardware, software, and cloud computing server.

2.5.1. Hardware

The duty of this part is to collect information from the hives, send it for processing by the software, and control the temperature of the hive. The hardware part of the Beedar system consists of two parts:

· Data Collection Unit

The data collection unit (DCU) is installed inside the hive and has two main tasks: 1. Collection of information, including temperature, humidity, sound level, hinged door status, and frame weights. 2. Heating inside the hive using an electric heater.

· Local Control Unit

Each set of DCUs is connected to and controlled by an LCU. Some features of LCU are:

1- Saving information in the database 2- Web-based admin panel service 3- Connecting to the cloud server and updating information. 4- Siren, send SMS and make calls in case of theft or emergency. 5- GPS location of the apiary.

2.5.2. Software

The primary storage and processing unit of information is installed on the local control unit (LCU) and is available to the beekeeper at the apiary site. Beedar users are able to record and handle the affairs of their apiary. This panel is based on the web and consists of the following sections:

· Dashboard
· Inspections
· Operations
· Tasks
· Reports
· Consulting and FAQs

2.5.3. Cloud Computing Server

The dedicated space for each client on the Beedar main server provides access through the internet.

Despite the attractiveness of Beedar products for beekeepers, its high price has reduced market demand. Consequently, sharing economy concept has received a lot of attention. Therefore, beekeepers do not need to buy smart equipment to use it. They can provide the devices and install them in their hives through a platform provided on a sharing economy basis. Thus, the machine will be contributed to the beekeeper for five years, and the beekeeper will be obliged to provide half of the surplus honey produced, to the company providing this technology.

There are also other factors involved that beekeepers might or might not show a tendency to use Beedar, such as, not finding Beedar a fast and reliable product. Or they may be influenced by other well-known beekeepers who are currently using the device and have found it rewarding or vice versa. Therefore, beekeepers' behavior towards new technology and convincing them that it can be beneficial for their business is another challenge.

Beekeeping in Iran has high potential, but due to the problems mentioned earlier, they have not yet been able to make the most of it. The new device that has been invented, like any other innovative product, faces many challenges in entering the market.

2.6. Technology Acceptance Model

The adoption of new technologies by people has long been a topic of study in information systems literature. Several models have been created and utilized in this regard.

Models derived from sociology, psychology, and economics, for instance. In all of these models, the technology acceptance model is the most widely used theoretical framework for understanding how users or consumers accept new technologies. The technology acceptance model has evolved from the theory of reasoned action, which has been extensively studied by social psychology. (Taherdoost, 2017) According to the theory of reasoned action (Fishbein, Ajzen, 1998), human behavioral intention is influenced by tendencies, and tendencies are influenced by beliefs. Davis and other researchers have used these ideas in research into the adoption of new technologies. They used a technology adoption model to explain the impact of perceived usefulness and ease of use on users' intentions and actual product performance. According to Davis, Bagazi, and Warsaw, 1992 perceived usefulness is defined as the probability that the user will find the product effective in increasing their job performance, and perceived ease of use is also defined by how much the user sees working with the product effortless.

The technology acceptance model has been used in various information systems and related technologies (Fr. Davis, 1989). For example, wireless internet, mobile shopping, and e-learning. In most past technologies, perceived usefulness and ease of use are the two determining factors that influencing the adoption of new technology. The technology acceptance model first appeared in 1998, but it has been widely used so far and is still effective in predicting user behavior for new technology adoption. For example, in recent years, researchers have used this model to predict user behavior in mobile commerce (Lu, Wai Lai, Ide Lio. 2019).

2.7. The Unified Theory of Acceptance and Use of Technology 2

Vankatesh (2003) designed and developed the Unified Theory of Acceptance and Use of Technology from 8 models of technology acceptance. The initial model had four main pillars, but new variables have been added to the new model that measures their impact on consumer acceptance of technology, which includes expected performance, expected effort, social influence, hedonistic motivation, security risk, Risk of privacy, trust, facilitator terms, and price value. Subsequently, The Unified Theory of Acceptance and Use of Technology 2 has been extracted. (Vankatesh, et al. 2003)

The present study proposed a model using the technology acceptance model, Unified Theory of Acceptance and Use of Technology 2(UTAUT2) to study the acceptance of the smart product-service system developed (Beedar) by beekeepers and the marketing of this smart product-service system.

The technology acceptance model is based on two principles, and through them, the consumer acceptance of technology is measured. These two principles are Perceived usefulness (PU) and Perceived Ease of Use (PEOU) (Davis, F.D, 1898). Of all the variables that affect the use of a product, the above two are the most important. Perceived usefulness is defined as how much consumers believe that a product or application helps them do their job or task better, and perceived ease of use is defined in this manner that even if the end-user or consumer finds the product useful, they may believe that the product is too difficult to use, and the challenges of using the product outweigh the benefits.

On the other hand, the model of unified theory of acceptance and use of technology includes four main variables. Performance Expectancy, Effort Expectancy, social influence, and Facilitating Factors. But in the upgraded version, the unified theory of acceptance and use of technology 2 introduces three other variables, which are: price value, Hedonic Motivation of technology use, and Habit. (Aldorssari, Sidorova, 2018)

To conclude, based on research and experimental studies, two models of technology acceptance and the unified theory of acceptance and use of technology 2 are the most virile models for studying technology acceptance in various fields. In addition, an attempt has been made to adapt other factors affecting the perceived ease of use and perceived usefulness that has been used in various other studies to complete the model of this research.

3 Conceptual Framework and Hypotheses

The present study attempts to review researches conducted in the fields of new technology acceptance and sharing economy, in order to propose a framework for accepting new technology (Beedar) to enter the market of the beekeeping industry with the approach of sharing economy.

As mentioned earlier, the technology acceptance model (TAM) is the basis of the conceptual model of the present study. TAM considers perceived ease of use and perceived usefulness effective in influencing the intention to use an innovative product. (Fred D. Davis, 1998).

As it can be seen in the model above, several independent variables individually affect perceived usefulness or perceived ease of use, which ultimately affects the consumer's intention and decision to use the technological product. (Ronie H. Shroff, Christoper C. Deneen, 2011)

Researchers use different variables in various researches according to the technological products that they intend to study. Subsequently, the multiple models that have been used to create the model of this research will be examined.

In one study, researchers Lu, Wai Lai, and Yide Liu, 2019 examined the acceptance of a technological product by consumers. In this study, researchers examined the idea of using sharing bicycles, which are managed by the Internet of Things technology, as a product-service system in the city and the factors affecting its ease of use and perceived usefulness. In this research, the technology acceptance model has also been the basis of the conceptual model. This research divides the variables according to the technological product into two parts: the interactivity of mobile software and the smart sharing product.

Another model that has been studied to form the conceptual model of this research is the Unified Theory of Acceptance and Use of Technology 2.

Several variables have been used on the attitude toward new technology and, finally its use. From this model, influential variables such as performance expectancy and also social influence have been used for use in the primary model of this research, which can also be seen in the following models that will be introduced and have been used in subsequent models as a variable in the technology acceptance model.

These two variables have been selected from this model because the product being studied is relatively industrial and beekeepers, as producers are trying to increase production efficiency and the performance of people active in this industry, can also influence their decision. Personal factors such as security risk, trust, privacy, and hedonistic motivation will not be considered in this study. According to the main conceptual model of this research, which is the technology acceptance model, the relationship between these two variables on the perceived ease of use and the perceived usefulness will be discussed more in future models.

Finally, the technology acceptance model in online banking, which is based on the technology acceptance model, is examined.

In this model, researchers (Karjalouto, Mattila, Pento, 2002) believe that bank customers prefer online financial services to traditional banking because it allows them to pay less for the services. Therefore, price is a variable that affects the perceived usefulness of customers. Another variable that the researchers have addressed in this study is convenience, which means how effortless a technological product is to use, which has a positive effect on perceived usefulness. (Jean-Pierre Levy, Normand Bourgault, 2011)

Now, considering that beekeepers will be able to use the benefits of such a product without paying and instead provide organic honey to the owners of this technology, the price variable has been adapted from the mentioned model to enable the study of this relationship. According to the technological product of this research and the subject of sharing economy, the price variable is adapted from this model to be used in this research.

According to the complete description of the models, now the new model used in this research will be described.

In accepting the interactivity of mobile software of a smart product-service system, two factors of control and responsiveness affect the perceived ease at the same time.In the article Acceptance of Smart Product-Service Systems Technology, researchers (Lu, Wai Lai, Yide Liu, 2019) have concluded that the perceived control of a mobile application has a significant and positive relationship with the ease of use of a smart product-service system. Also, the perceived responsiveness of a mobile application is the same as the previous hypothesis and based on the findings of researchers (Lu, Wai Lai, Yide Liu, 2019) has a significant and positive relationship with the ease of use of a smart product-service system.

Conceptual and operational definition of the variables

Perceived control

Conceptual definition: Perceived control in the interaction process indicates the user's confidence in the execution of sent requests. (Song, Zinkan, 2008; McMillan, Hawng, 2002; Wu,1999)

Operational definition: The level of trust of the Iranian beekeeper in the execution of requests made by the mobile software of the Beedar device.

Perceived responsiveness

Conceptual definition: Perceived responsiveness means how timely a product and interactive system responds to a user's request. (Pituch, Lee, 2016)

Operational definition: The speed of responding to beekeeper requests done by the mobile software of the Beedar device.

Social influence

Conceptual definition: Social influence is the extent to which a consumer understands that influential people believe that they should use technology. Social acceptance is the effect of the opinions and ideas of others on the consumer's attitude towards the use of technology. (Vankatesh et al., 2003)

Operational definition: To what extent are ordinary beekeepersinfluenced by the beekeeping community and leading beekeepers to use the smart Beedar product?

Price Value

Conceptual definition: Price value is the consumer's understanding of the benefits he pays for a cost. In general, price value affects a consumer's behavioral intention to use technology. (Vankatesh et al., 2012)

Operational definition: The benefits that the beekeeper gets from using this product, considering that he will not pay for the product in the sharing economy plan.

Performance Expectancy

Conceptual definition: The degree to which a person thinks a system (product) can enable them to enhance their performance at work. Previous research reports that performance expectancy is an essential factor in measuring consumer acceptance of technology. (Vankatesh et al., 2003; Vankatesh et al., 2012)

Operational definition: The extent to which an Iranian beekeeper believes that the smart Beedar product can improve the honey production efficiency of hives and apiaries.

Perceived control is considered an internal system that focuses on efficacy. Through efficacy, users have control over the timing, content, and order of communications (Song, Zinkan, 2008; McMillan, Hawng, 2002; Wu,1999). Perceived control influences the ease of use perception profoundly (Cheng, 2014; Lee et al., 2015). Similar findings were made by Pitch and Lee (2006), indicating that controllability has a considerable beneficial impact on how easy e-learning systems are judged to be to use. Because of this, when a user learns that an SPSS mobile app is controllable, they can think about SPSS as being user-friendly.

Hypothesis 1: Perceived control of mobile software has a significant and positive relationship with the ease of use of a smart product-service system.

Hypothesis 2: Perceived responsiveness of a mobile application has a significant and positive relationship with the ease of use of a smart product-service system.

In the models of the Unified Theory of Acceptance and Use of Technology 2, the acceptance of farmer technology and online banking, the three variables of performance expectancy, price, and social influence were discussed. The hypotheses of this section are:

Social influence researchers (Khaled Amin, Lee, 2014) argue that social influence has a significant and positive relationship with the ease of use of a smart product-service system. Social influence is a strong indicator of technology acceptance and use (Vankatesh, 2012; Dwivedi et al., 2017). The beekeeper is influenced by reference groups or leading beekeepers, and this leads them to understand that this product is easy to use. Hence present study proposed:

Hypothesis 3: Social influence has a significant and positive relationship with the ease of use of a smart product-service system.

Previous studies confirmed that price value has a significant and positive relationship with the perceived usefulness of a smart product-service system (Jean-Pierre et al., 2011). The price value is known as the main construct in UTAU2 in consumer IT acceptance and use and has been found to be a strong indicator of behavioral intention (Fargnoli et al., 2018; Vankatesh et al., 2003). It should be noted that the beekeeper does not pay for the production of the product with the sharing economy plan, and the use of the benefits and capabilities of the machine for a certain period of five years is defined. According to the results of the present study, it is assumed:

Hypothesis 4: Price value has a significant and positive relationship with the perceived usefulness of a smart product-service system.

The degree to which a user expects that using technology will significantly improve their ability to perform their job is known as performance expectancy (Vankatesh et al., 2003; Vankatesh et al., 2012). Performance expectancy has a significant and positive relationship with the perceived usefulness of a smart product-service system (Norman Shaw, Ksenia Sergueeva 2018). The beekeeper expects to use this product to improve his job efficiency, which is to increase honey production. Therefore, the present study assumes:

Hypothesis5: Performance expectancy has a significant and positive relationship with the perceived usefulness of a smart product-service system.

In the technology acceptance model, perceived usefulness and ease of use are the two main incentives for adopting new technology. In addition, previous studies on this have shown that perceived ease of use has a direct and positive relationship with perceived usefulness (Davis, 1989). Additionally, previous technology adoption research has shown that perceived ease of use has a positive effect on perceived usefulness in the context of mobile apps (Hubert et al., 2017; Lai, 2015). the present study hypothesized:

Hypothesis 6: Perceived ease of use has a direct and positive relationship with perceived usefulness.

The perceived ease of use of a smart product-service system has a direct, significant, and positive relationship with the beekeeper's intention to accept and use the smart product-service system (Lu et al., 2019).

when the beekeeper finds the product or system (the smart product-service system) useful and convenient to use, he tends to use and accept it based on the technology acceptance model.
According to the points raised, the seventh and eighth hypotheses are assumed as follows:

Hypothesis 7: The perceived ease of use of a smart product-service system has a direct, significant, and positive relationship with the beekeeper's intention to accept and use the smart product-service system.

Hypothesis 8: The perceived usefulness of a smart product-service system has a direct, significant, and positive relationship with the beekeeper's intention to accept and use the smart product-service system.

4 Conclusions and Discussion

The present study has emphasized the role of new technologies in the agriculture sector and tries to shed light on beekeepers' determinant factors which form perception towards the acceptance of Internet of Things technology into their businesses by proposing a model including important indicators such as perceived control of mobile software, perceived responsiveness of mobile software, social influence, price value, and performance expectancy on intention to use internet of things technology.

The literature on information systems has examined "how" and "why" people adopt new information technologies (Vankatesh et al., 2003). Therefore, in the present study, to answer "why" and "how" questions, different variables in relevant disciplines have been chosen, such as technology, sociology, psychology, and economics. Two independent variables try to portray how Beedar's technological features can attract beekeepers' attention which can influence their perceived ease of use (Lu et al., 2019). And other independent variables such as price value, social influence, and performance expectancy (Aldossari, Sidorova, 2018) can assist this research in discovering how likely it is that beekeepers find the Beedar device easy to use, useful, and ultimately adoptable for their work.

Future studies can operationalize and examine the proposed model in the beekeeping industry. Finding from this research will assist technology-based companies in becoming deeply aware of factors affecting beekeepers' insights in order to design and develop new technological products for the beekeeping industry. Furthermore, findings in this research can help other researchers to discover service providers' intention toward accepting new technologies through this conceptual framework.

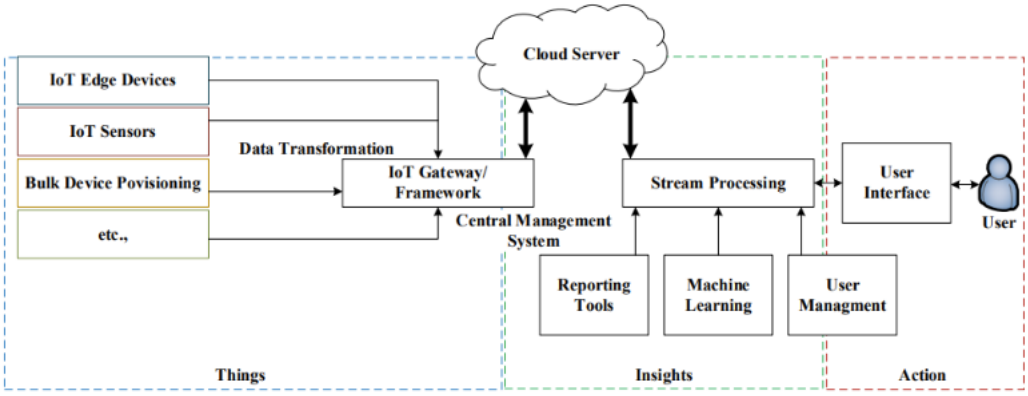


Figure 1 Description of Internet of things elements (Hassan et al., 2020)

Figure 2Beedar Device – Data Collection Unit

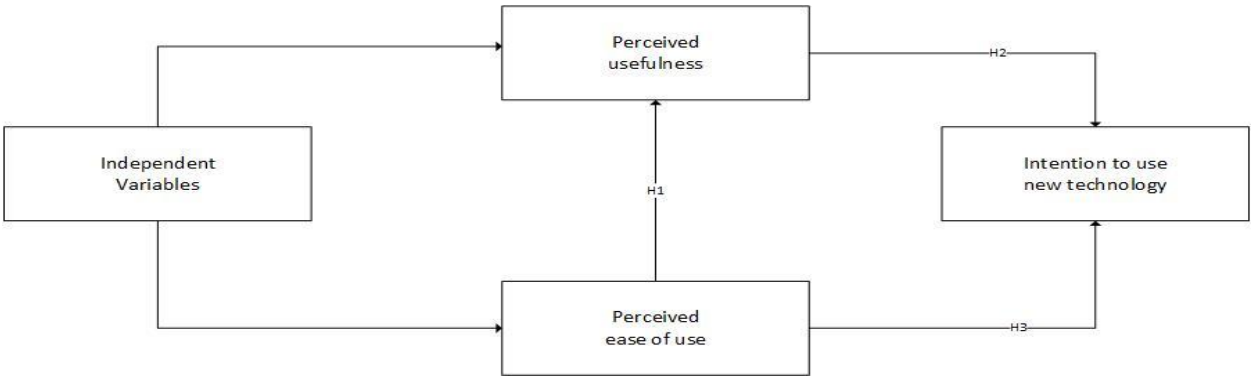
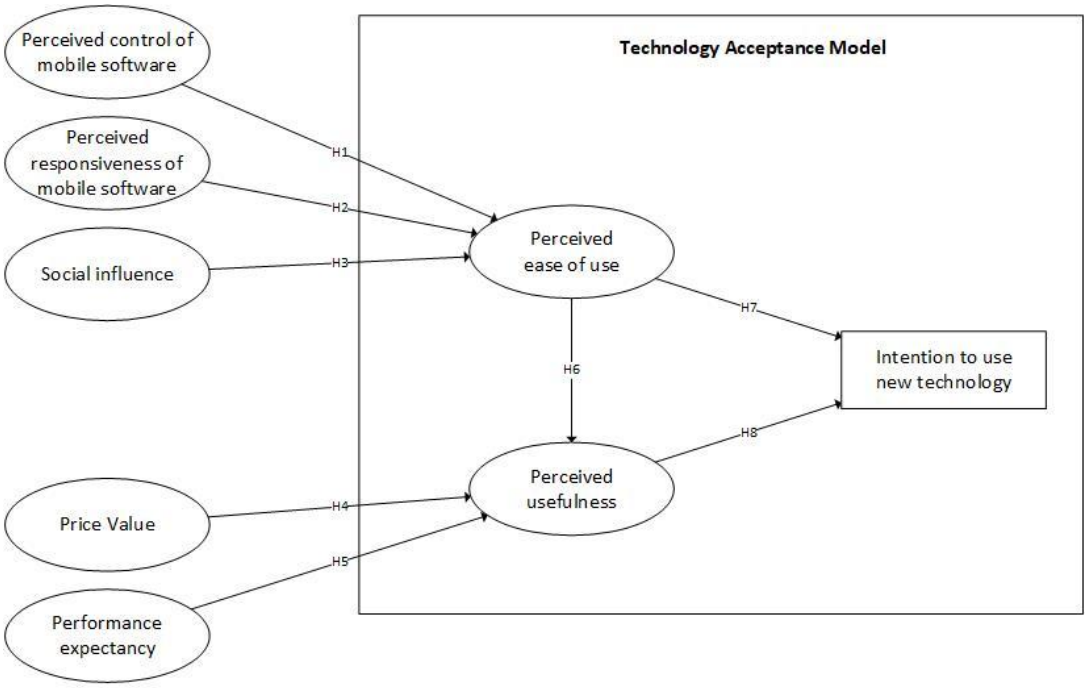


Figure 3 Technology Acceptance Model

The following table contains information regarding the studied relevant models to form the conceptual model of the present research.

Independent variables	**Mediators**	**Moderators**	**Dependent variable**	**Models**	**Context**	**Author and Year**
Trust	Perceived value Perceived Risk		IoT adoption	Conceptual	Agriculture	Jayashankar, Nilakanta, Johnson, Pushpinder, Burres, 2018
Perceived usefulness Relative Advantage Perceived Ease of Use	Intention to use ICT enabled product and service Adaptation		Actual use of ICT enabled Product and service	Farmer Technology Acceptance Model	Agriculture	Khaled Amin, Li, 2014
Performance Expectancy Effort Expectancy Social Influence Hedonic Motivation Security Risk Privacy Risk Trust	Attitude toward IoT		Behavioral Intention	Unified Theory of acceptance and use of technology 2	Smart Home	Aldossari, Sidorova, 2018
Facilitating Condition Price Value						
Perceived Communication Perceived Control Perceived Responsiveness Perceived Ubiquity	Perceived ease of use		The Intention to use the SPSSs	Technology Acceptance Model	Bike Sharing System	Lu, Lai, Liu. 2019
Perceived sustainability Network externality	Perceived usefulness					
Facilitating Conditions	Perceived usefulness	Behavioral intention	Actual Use	Unified Theory of	Agriculture	Zarafshani, et al., 2020

Available Resources				acceptance and use of technology 2		
Job relevance						
Computer self-efficacy	Perceived ease of use					
Subjective norm						
Age						
Computer Anxiety						
Value of openness to change	Reason for Adoption of IoT for smart Agriculture (Relative Influence, Social influence, Perceived convenience, perceived usefulness,)	Attitude towards adoption of IoT for smart agriculture	Adoption of IoT for Smart Agriculture	Unified Theory of acceptance and use of technology 2	Agriculture	Pillai, Sivathanu, 2020
	Reasons against adoption of IoT for Agriculture (Image barrier, Technological Anxiety, perceived price, Perceived risk)					
Farmer's age						
Farmer's Size						
Price	Perceived usefulness	Attitude towards using	Intention to use	Technology Acceptance Model	Online Banking	Mangin, Bourgault, Guerrero, 2011
Convenience						
	Perceived ease of use					



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Conceptual model of research

Figure 3. Conceptual model of research

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