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**EXPLAINING ORGANIZATIONAL ADOPTION OF  
TECHNOLOGY: THE CASE OF CLOUD PLATFORMS  
FOR INTERNET OF THINGS**



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## ABSTRACT

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The internet of things (IOT) is a vision that represents a world of connected devices which are identifiable and may have capabilities to sense and act on the surrounding environment.

Almost every item in the planet has the potential to become part of the IOT. The data exchange between these devices requires that cloud technologies are applied. These cloud computing platforms already exist and need to adapt to the specific needs of the IOT in order to cope with the high demands of the IOT, for example handling the Big Data generated by the IOT devices. Nonetheless, little is known about the adoption levels of these platforms.

In the past the UTAUT2 has been used to help explain technology adoption. However, the UTAUT2 was developed to explain consumer adoption, failing to investigate organizational adoption of technology. Furthermore, the role of the manager of the organization, a crucial one in the decision making process, has not been taken into account. Moreover, in the context of studying cloud computing the construct of Security needs to be taken into account to better investigate the adoption of this technology. The UTAUT2 does not include Security as a construct.

The objective for this thesis is to explain the adoption of cloud for IOT by organizations. For this purpose a new framework derived from UTAUT2 is proposed. This framework modifies the UTAUT2 by replacing Hedonic Behavior with Eudaimonic Well-Being and extends it by including Security as a construct. The modified framework has been empirically validated by using a survey that had been administered to a panel of managers from ICT companies from Finland. The results confirmed that the framework is useful in discovering the adoption of technology by organizations when considering the manager as an influencer of the decision to adopt and that the new constructs contribute positively towards the Behavioral Intention to use the technology, specifically in the case of cloud computing for IOT.

Keywords: internet of things, Cloud, technology adoption, organization as consumer, UTAUT2, security, eudaimonic well-being

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# 1 Introduction

The study of technology acceptance and adoption in a context of information technologies has interested researchers for a long time. Theories and methods have been developed that allow inferring consumer behaviour and even to predict it, although the main driver has been to verify or predict success or failure of an Information Technologies project.

The concept of cloud computing is no longer a novelty. The adoption level of the cloud computing technology seems to be reaching a desirable state since 2012. The concept of internet of things (IOT) become at about the same time a vogue term, although the term itself had already been introduced in 1999 by Kevin Ashton. The possible number of devices generating data in the context of internet of things generates predictions of 50 (Ericsson, 2011) to 1000 billion connected devices (Sol, 2009). It seems logical that cloud computing may be a fit to solve partially the issues connected to this amount of data.

Because little is known of the adoption of cloud platforms which are specific to the internet of things, this research applies the Unified Theory of Acceptance and Use of Technology, second extension UTAUT2, and further extended it to include security as a construct, in order to tackle properly the technology chosen, cloud computing for the internet of things, and eudaimonic well-being replacing the hedonic behaviour construct, to explain the factors behind the adoption of these cloud platforms by organizations, represented in the decision to adopt the technology, by the manager.

The following are this research's contribution to the body of knowledge: (i) develop a framework that can effectively be utilized to study the adoption of technology by organizations, by incorporating eudaimonic well-being and measuring it against the manager of the organization (replaced hedonic behaviour in the UTAUT2) and by extending the framework via inserting Security as a factor (in order to target the technology: cloud computing for IOT) and (ii) discover the status of adoption of cloud for IOT.

## 1.1 Definition of key terms

Definitions for the key terms are provided on TABLE 1.

TABLE 1 Definitions

<b>Terminology</b>	<b>Explanation</b>
internet of things	The internet of things is a vision that represents a world of connected devices which are identifiable and may have capabilities to sense and act on the surrounding environment.
Radio frequency identifier - RFID	RFID stands for one concretization of technology for automatic identification and data capture (AIDC). Hence forth, a RFID enabled tag must provide for automatic identification, location on real time and even extend capabilities to sensorial information of the environment. RFID is at the core of the IOT vision as it enables the "everything, everywhere, every time" paradigm and ubiquitousness of networked things.
Smart Tags/Objects	Said of objects that have the usual capabilities of wireless connectivity, memory and also possess extended ones of autonomy, proactivity in behaviour, sensorial context awareness, collaborative communication and task performing to mention a few.
Sensors	These provide to an object, capabilities to digitalise the environment where an object resides. There are different types of sensors that answer to different aspects of the environments, roughly at a holistic level these correspond mostly to the human sensorial capabilities, such as vision, smell, tact, hearing, etc.
Actuators	We can look at actuators as switches. As an example we utilise actuators every day: a light switch, a remote control for a garage door, a TV remote or a heater thermostat control.
Device connectivity (discrete versus continuous)	In the context of IOT and RFID, some tags are active and continuously transmit their data, while other are passive and only connect after receiving a transmission signal by a reader, hence discretely connected. As a rule, usually the later uses less energy.
Hedonism	Hedonism refers to the basic motivational principle of approaching pleasure and avoiding pain (Freud, 1952; see Kahneman, Diener, & Schwartz, 1999).
Eudaimonia	Eudaimonia is the central subject of Aristoteles Ethics for one. Ethics is related to the resolution of concepts for right and wrong giving direction to what is considered right in the human social context. It is placed side by side with the ability of taking practical or ethical decisions, also known as 'pronesis', which in turn may be interpreted as practical intelligence. For the ancient Greeks, ethics and intelligence, either theoretical (sofia) or practical, were some of the necessary virtues to take the path to happiness. Virtues are a sort of qualities that a human being not only possesses but definitively excels on and is passionate about so that consequently that person feels intensively alive. Eudaimonic well-being can be seen as the result of an ethically correct behaviour of someone. In a simpler form, eudaimonia is practical, i.e., with a practical sense or effective goal seeking - or ethical wisdom - that is, in the author view, the innate ability to make decisions based on personal moral and being aware of the impact of the outcome from those decisions in the society.



## 1.2 Background of the Study

The advance of technology, following closely Moore's law, has allowed the wide spread use of small devices capable of obtaining data from the surrounding environment practically on their own or better with the add-on of low-powered sensors. For example, Radio-Frequency Identification (RFID) tags are a common presence in the retail, logistics and other industries where a huge amount of objects needs to be tracked and uniquely identified. Industries such as farming are deploying projects to track in real-time the health condition of animals, barns living conditions, amongst other sensorial input. Also at the end consumer side, the self-tracking paradigm, an activity where devices measure several areas of the individual such as heart beat, temperature, calories burnt or ingested is well alive and growing. Users can keep their generated data and even share in some cases with a group of other users. Apple recently launched yet another product, the Apple watch, together with a new default App in the iPhone 8. This combination is obviously targeted to the growing number of self-targeting users.

All these devices with their sensors generate a huge amount of data that needs to be mined so to allow decision processes to happen, either by the humans owning that data or even directly by the same environment of devices in machine to machine context, which then may, via their actuators, influence the context or environment where they live. For example, a refrigerator may send a sms to the house owner with a shopping list, or an industrial refrigerator may lower the internal freezing process when it reaches optimal temperature. A semaphore may turn the light to green as a vehicle is approaching causing the usage of the car breaking system and other elements to decrease.

Although storage prices have decreased in the past few years, along with the increase of technology, other resources are necessary for example, to process the data, for data mining and to achieve real-time updating of monitoring dashboards. A cohesive format or protocol to move the data in and out of the devices is necessary. One solution for this issue is to utilize Cloud resources (Arkko & Höller, 2013; Mazhelis & Tyrvaïnen, 2014; Wallin, Kling, Holm, Skog, & Blockstrand, 2013), that is, Infrastructure, OS Platform, Software as a service, the three service models of the cloud model or paradigm. These offerings would need to be integrated as cloud platforms specific for the internet of things.

The body of knowledge on adoption concerning internet of things and cloud for internet of things, specifically in the area of manager perception of cloud for internet of things is minimal at the time of writing this thesis.

An opportunity is presented to contribute to the body knowledge: the discovery of the elements that concern perception of cloud for internet of things; taking the UTAUT2 theory as a basis for this study and extending the theory to explain the adoption of cloud for IOT. The developed framework constructs are used to evaluate the consumer perception of cloud for internet of things and her

intention to use cloud for internet of things. The underlying purposes of this research are: to validate consumer perception of the characteristics of cloud for internet of things and find the influence of that perception on adoption of cloud platforms for internet of things. In this context, the consumer is the organization and is represented by the manager. The targeted individuals are holding managerial positions or have similar decision power within the organization and are able to influence the adoption of cloud for internet of things of their companies in the context proposed by diffusion of innovations, "Power organization managers should adopt photovoltaics, but they don't. These potential adopters have knowledge, but not experience, with this disruptive technology" (Rogers, 2010).

### **1.3 Research problem, research objectives, and research question**

The internet of things is a ubiquitous subject that accordingly has been receiving a great deal of attention on the press and on social networks. For example on LinkedIn, there are over 200 groups of interest focused on internet of things or one of its areas, summing about 500.000 people that at least once showed interest on the matter from either a technical or business point of view. Big ICT companies and corporations, like CISCO, IBM, Microsoft, along with many start-ups focused on the internet of things vision, are drawn to the subject and are racing for a spot on the outcome from the vision of the internet of things. Available predictions point us to different numbers of devices connected in the near future to the internet of things and although all these forecast a positive outlook in the growth of connected devices, they do not precise on whether these are referring to radio frequency identification devices (RFID) simple or last generation RFID smart tags or even if Smart Items (computers in a micro format) are a significant part of it. This fact is important because of the connectivity mode of those devices to the internet, discrete versus continuous and the correspondent amount of data extracted from the devices. The promise of 50 (Ericsson, 2011) to 1000 billion (Sol, 2009) devices connected to the network carries implicitly the load of an exponentially correspondent amount of data, coming and going from the devices.

The huge amount of IOT data needs to be persisted and also mined intelligently. This, together with the advanced performance and scalability characteristics of contemporary cloud computing platforms, leads the IOT community to assume that cloud platforms will be adopted for the Internet of Things. This assumption remains largely unconfirmed, as there is a lack of studies in the literature on the adoption of such platforms. Therefore, this research proposes the following goals: to find out whether technology adoption by an organization can be explained by focusing in the organization manager as the decision maker; and to discover the status of adoption for cloud for IOT platforms.

Some cloud computing offerings have been made available in the case of internet of things, these offer the usual service models and target mostly the

internet of things producers, i.e. those who create and or deploy products internet of things related, and these add a set of services offerings specific to the IOT.

However, even though Cloud computing on its own seems to be moving towards wide acceptance and use towards an already late majority of target consumers (Vasseur, 2010), we have little or no indication on the adoption and usage of the Cloud platforms which are specific to the internet of things. Neither do we have available studies or research which focuses specifically on its adoption and usage now and in the future. Some studies do refer to cloud for internet of things referring to a contribution to the amount of data that needs to be handled (OECD, 2012), unfortunately without conclusive results on whether the data is channeled to cloud computing platforms specific for internet of things. Nonetheless there appears to exist some consensual recognition on the need for further research focusing on internet of things and big data (Beaty, 2013; Vermesan et al., 2011) towards an implementation over a cloud based paradigm.

With this research the actual adoption level of cloud platforms for the internet of things will be described and the reasons behind adoption of new technologies by organizations will be explained. This may allow business on the field making educated decisions on how to target customers. Furthermore, the purpose of the study is one of clarifying the base for the companies offering cloud for internet of things so that they may take appropriate actions concerning consumer perception and maybe attempt to modify that perception positively. This may allow the consuming organizations managers to better negotiate product level agreements or to a better understanding of the cloud for internet of things platform offerings in the area of security, such as standards or certification for security in their products. This research has the potential to become a good starting point for future studies concerning internet of things, Cloud platforms for internet of things and technology adoption in a context of business evangelization towards the technology.

The internet of things is a concept that is getting its attention by the media and the business community. Managers are interested to know if the promise of billions of dollars in the internet of things industry is a reality and in that case what is needed to accommodate their organization to enter that market. But there are issues which are strongly opposing an immediate decision on adoption of cloud for internet of things and internet of things itself: the novelty of the subject for one, on the other side the wide scope that is inherent of using the term internet of things because it implies a certain level of comprehension of the underlying terminology by the companies willing to enter this brave new world.

In the past the UTAUT2 has been used to help explain technology adoption. However, the UTAUT2 was developed to explain consumer adoption, not to investigate organizational adoption of technology. Furthermore, the role of the manager of the organization, a crucial one in the decision making process (Amini, Bakri, Sadat Safavi, Javadinia, & Tolooei, 2014; Ekufu, 2012; Tran, Páez, & Sánchez, 2012) , has not been taken into account. Moreover, in the context of studying cloud computing the construct of Security must be taken into account

to better investigate the adoption of this technology (Alharbi, 2014; Bhattasali, Chaki, & Chaki, 2013; Black, 2013). The UTAUT2 does not include Security as a construct.

In this study the UTAUT2 was taken as a solid base to build a new framework, modified and extended to fit cloud for IOT. The need to take into consideration the manager as the influencer of the decision (Rogers, 2010) lead to integrate Eudaimonic Well-Being (to replace hedonic Behavior), since this construct aligns with an emotional status of the manager (Tran et al., 2012; Véronique & No, n.d.). Finally the context of cloud needs to be investigated with a focus on security (Opala & Adviser-Sharum, 2012; Pearson & Benameur, 2010; Singh & Bhattacharjya, 2012), so Security as a construct was added to the framework.

This framework was designed with the aim of answering the research questions, along with sub-questions, that are formulated as follows:

1. Can the adoption of technology by an organization be explained by the UTAUT2 extended framework when applied to a manager, having the manager as the representative of the organization? (bellow are sub questions)
  - a) Does the manager eudaimonic well-being have an influence on the decision to adopt the technology?
  - b) Is the organization's manager perception of security in cloud for IOT influencing the decision to adopt cloud for IOT?
2. What is the status of adoption for cloud computing platforms which are specific to the internet of things?

The question on eudaimonic well-being is necessary because it's a new incorporation on the framework developed in this research. The question on security is necessary because the framework needs to be applied on the focus technology, cloud for IOT. These sub questions are dependent and explained by the answer to the first question which will be answered by analysing the results from the framework part of the survey as these give indication of the Behavioural Intention to use cloud for IOT. The second question will be answered by the descriptive statistical analysis conducted on the second part of the survey.

To provide an answer to the above questions, the research tested the following hypotheses:

H01: the decision to adopt a technology in an organization context cannot be explained when taking the perceptions on the manager in charge of the decision.

Ha1: the decision to adopt a technology in an organization context can be explained when taking the perceptions on the manager in charge of the decision.

## **1.4 Outline of the thesis**

This thesis contains 6 chapters: chapter 1 explains the field of study, the concepts within, the research problem and highlights the objectives of the research; chapter 2 provides the literature review and expands on a layered structure to explain the reach of the domain in which the cloud for IOT technology is contained and the knowledge area where this research is placed; chapter 3 explains how the UTAUT2 is taken as a basis and why and how it is modified and extended; chapter 4 expands on how the framework created directs the survey methodology utilized and how it is performed; chapter 5 narrates the statistical analysis, along with an interpretation of the open end questions and chapter 6, summarizes the results, discusses its implications and limitations, and takes inference in the shape of conclusion on the results and the research contribution to science.

## 2 Literature review

### 2.1 Big data justifying cloud computing

To understand 'Big Data' one must first gain a notion of how sizing is defined according to the International System of Units (SI) which will be taken as a reference because SI is the most commonly measurement system utilized when referring to data. Social Influence defines the bit as the unitary value in computing, it represents a state either of hardware or software, usually 0 or 1. Although there is no defined standard for a byte, it is assumed 'de facto' that it contains 8 bits, because this is the most common architecture in existing computer architectures. Being the zettabyte a multiple of the unit byte for digital information; the prefix 'zetta' indicates multiplication by the seventh power of 1000 or  $10^{21}$  in the International System of Units (SI). In FIGURE 1 we can see the SI prefixes that indicate factors of power to a unit value.

Factor	Name	Symbol	Factor	Name	Symbol
$10^1$	deka	da	$10^{-1}$	deci	d
$10^2$	hecto	h	$10^{-2}$	centi	c
$10^3$	kilo	k	$10^{-3}$	milli	m
$10^6$	mega	M	$10^{-6}$	micro	$\mu$
$10^9$	giga	G	$10^{-9}$	nano	n
$10^{12}$	tera	T	$10^{-12}$	pico	p
$10^{15}$	peta	P	$10^{-15}$	femto	f
$10^{18}$	exa	E	$10^{-18}$	atto	a
$10^{21}$	zetta	Z	$10^{-21}$	zepto	z
$10^{24}$	yotta	Y	$10^{-24}$	yocto	y

FIGURE 1 SI prefixes (NIST, n.d.)

Although the term Big data is utilised to refer to a great amount of data, either in flow of movement, persisted or in treatment, i.e. in data mining process, it seems to be impossible to quantify Big Data to form its concrete defini-

tion. The size that we could define today as minimal for a quantity or flow of data to be considered Big Data, would not make much sense in a near future or even at the same time for different domains of, for example industries (Shrestha, 2014). What reaches the threshold of big Data for an air traffic controller would not make sense for a search engine on the web or even for a small country.

In this regard, the usage of Big Data, has been associated previously to IOT in areas as distinct as healthcare (Gad, 2011), financial services, call center, IT services, ecommerce and multi-channel integration. Continuing this list, other areas that are directly related to IOT and generating big amount of data are energy efficiency, telecommunications and transportation (Yunan, 2012). Furthermore, the IOT is directly associated with the Big Data event by being one of the enabler technologies that collaborate to improve processes for example in supply chain management (Zaslavsky, Perera, & Georgakopoulos, 2013) and which are glued together by cloud computing and its ability to aid in the processing of Big Data (Reed, Gannon, & Larus, 2011).

### **2.1.1 Cloud computing and Security**

The team at the National Institute of Standards and Technology (NIST, n.d.) defines Cloud computing has a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction (Mell & Grance, 2011). This cloud model promotes availability and is composed of five essential characteristics, three delivery models, and four deployment models. The former refers to the service type as being PAAS - platform as a service, SAAS - software as a service and IAAS - infrastructure as a service, and the later refers to the ownership being private, public, hybrid and community models.

The definition of trust in a technology may be described generically as the level of confidence a consumer has that the consumed product or service will reach pre-defined expectations (Kautonen, 2008). Projecting onto this research, we can further assume that an organization will trust the service provided by a cloud computing provider as long as some set of predefined service level agreement (SLA) is respected by the provider to an also pre-defined level of compliance with the SLA (Kurta, 2010).

Furthermore, the components that influence trust in cloud computing may be enumerated tentatively as performance and speed, availability and resilience, ease of use, backup and security concept, support, update and price (Alharbi, 2014). It must be stated that although security is a necessary item to obtain trust in this context, it is not enough. Nevertheless considering that security is deemed the upmost contributor factor to that trust level (Vijay Venkatesh, 2013) and that trust level is associated with the behavioural intention to adopt cloud computing (Pearson & Benameur, 2010), it can be said of security to greatly

have an effect on the adoption outcome of cloud computing by consumers (Opala & Adviser-Sharum, 2012; Pearson & Benameur, 2010; Weisbecker, 2012).

Causes of security risks in cloud computing are a combination of the security risks that advent from the different technologies integrated into it. For example data movement between networks, as well multi tenancy, i.e. shared resources on the same virtual or physical machine, further complicates the issue of security in cloud computing. The usual network firewall deployments, such as demilitarized zones seem not to be possible to implement. And the exploitation points of the operating systems are still a factor of risk in the cloud as they are in the non-virtualized world (Opala & Adviser-Sharum, 2012). The issue with public clouds is that resources are shared and optimized, which in turn may mean that 'catch all' patterns for security are used and these may not conform to what the organization "had in mind" or even utilizes on their own IT installation. Security is now a shared concern and handled on a similar manner for all tenants, at least in the cloud provider realm. This may mean that the consumer needs to implement own set of security measures aside those on the cloud service agreement. Cloud services are known to suffer from outages, which in turn forces the consumer to implement redundancy outside the cloud provider realm.

Measures may be taken to mitigate the security risk and present a more trustworthy outlook into a cloud computing provider's set of offerings. Buyer beware attitude may be directed by simple check-list or questions lists such as the ones provided by (Singh & Bhattacharjya, 2012): 1. Where is the data? 2. Who has access? 3. What are your regulatory requirements? 4. Do you have the right to audit? 5. What type of training does the provider offer their employees? 6. What type of data classification system does the provider use? 7. What are the service level agreement terms? Furthermore the Cloud Security Alliance (CSA) publishes and maintains a set of recommendations, from a customer point of view for cloud security verification and implementation, to direct where the customer should take action either directly by implementing the items or by demanding those from the provider.

### **2.1.2 Security as a factor for cloud computing adoption**

Oracle reported earlier in 2014 that they became the second biggest SaaS supplier only surpassed by Salesforce (Relations, 2014), then later in 2015, the financial report that Oracle presented concerning the year 2014, showed a continuation of that growth trend and declared a "Total SaaS, PaaS and IaaS Cloud Revenue Up 29% to \$527 Million and Up 33% in Constant Currency". The biggest supplier of SaaS services in the form of a CRM product, is Salesforce, whom in turn declared a revenue of 4 billion for the same year, improving from the previous year on about 33% from 3 billion US dollars. A Goldman Sachs study predicts a 30% compound annual growth rate (CAGR) from 2013 through 2018 for cloud computing, with SaaS taking the majority of 59% from that number. Another report by Cisco, on the same period predicts a drop from 15%



down from 13% in 2013 for PaaS and for IaaS a drop of 28% down from 44% in 2013. Amazon AWS, the biggest supplier of cloud computing services had in 2014 revenue a little below \$7 billion US. Because Amazon does not publish their AWS results separately, this number is obtained from anecdotal evidence found on the web, namely the fact that Amazon organization rules demand that revenues be declared separately as soon as they pass the 10% margin contribution and that Amazon declared about \$74 billion in 2014. Google stands behind it with about \$1 billion revenue for 2013. While adding these numbers gives a size below \$20-\$30 billion dollars market size, this sum is a number still far away from the \$100's billion dollars promised industry. And, although the tendency for the overall cloud computing business seem to be for growth, some or most of the smaller companies seem to be struggling to survive with little or no profit being announced.

This presents itself as a warning sign that not all is well in the cloud computing business and although it is not possible at the moment to uncover the causes of this, nor to point out if these causes would be internal or external factors, some other evidence exist that indicates that security is still a main factor when moving a business into a cloud model, and that a deficient level of security may also weight negatively on the decision. According to the Bitglass Cloud Security Report 2015, "Strategic, organization-wide cloud adoption is taking hold as new technologies to secure cloud applications gain a greater foothold. But even in the midst of continual cloud fiascos, security concerns persist as the elephant in the room, with most cloud customers continuing to ignore basic security mechanisms.", later the report concludes with the following: "for the cloud to reach its incredible potential, business cloud customers must address security gaps that represent significant threats, especially to large organizations and those in heavily regulated industries.". Furthermore, Bitglass Cloud Adoption Report noted that 52 percent of large companies and one-third of small and medium businesses (SMBs) are not moving to the cloud because of security concerns.

## **2.2 Internet of things**

The internet of things represents a vision that is getting the attention of managers from many areas, such as agriculture, health, media, mobile and consumers. Organizations want to be on board and consequently not miss what may be the next big thing after the internet.

Ericsson predicts that 50 billion devices will be connected to the internet in 2020 (Ericsson, 2011). The devices will interact autonomously with the environment, generating data in huge amounts. In order to allow these devices to acquire information from a context or environment, sensors are used. Actuators may exist in the device so that it may interact with the same context or environment. The vision of internet of things touches areas such as construction, education, energy-utilities, financial Services-Banking, government, health care,

IT – Manufacturing, IT – Services, cloud service providers, telecommunications, travel/leisure/hospitality, manufacturing (auto) and many others.

The growth of interest in the internet of things seems to have been originated by the applications based on Radio-Frequency Identification (RFID) technology. In fact the term and idea of internet of things is actively researched at the Auto-Id Labs.

*“The AutoIDLabs are the leading global research network of academic laboratories in the field of internet of things and comprises seven of the world’s most renowned research universities located on four different continents” (autoidlabs.org, 2014).*

But the internet of things has evolved from a notion of simple things, such as the aforementioned interconnected tags, to tags that are incorporating memory, battery, sensors and actuators, according to the Auto-Id labs website. As a consequence the AutoIDLabs and their extensive research on what is instrumented in the internet of things context is another contribution to the internet of things vision. The AutoIdLabs Electronic Product Code (EPC) and its equivalent competing standard Unique/Universal/Ubiquitous Identifier (uID) architecture are on the leading edge of the technologies that contribute positively to the internet of things oriented vision.

*“A new era of ubiquity is coming where humans may become the minority as generators and receivers of traffic and changes brought about by the Internet will be dwarfed by those prompted by the networking of everyday objects” (Botterman, 2009). FIGURE 2*

Further, Smart Items in the internet of things are objects that incorporate intelligent agent(s) (Bassi & Horn, 2008) that are able to act on their own, while reading from the environment in collaboration with other Smart Items. When we add to the previous internet of things equation more enablers such as Near Field Communications (NFC) and Wireless Sensor and Actuator Networks (WSAN), the vision of internet of things evolves from a things connected vision to become an always available, always connected, always aware or ubiquitous vision (Alliance, 2014; Strategy & Unit, 2005), and may now be perceived as a “internet oriented” vision (Atzori, Iera, & Morabito, 2010). Furthermore, the capability of some devices to intelligently communicate and collaborate towards common goals with a range of identifiable devices leads us to another vision type, a semantic oriented one (Bassi & Horn, 2008). In FIGURE 2, we can see how the intersection of these three visions becomes a unified version of the possible internet of things visions and consequent paradigm (Atzori et al., 2010).

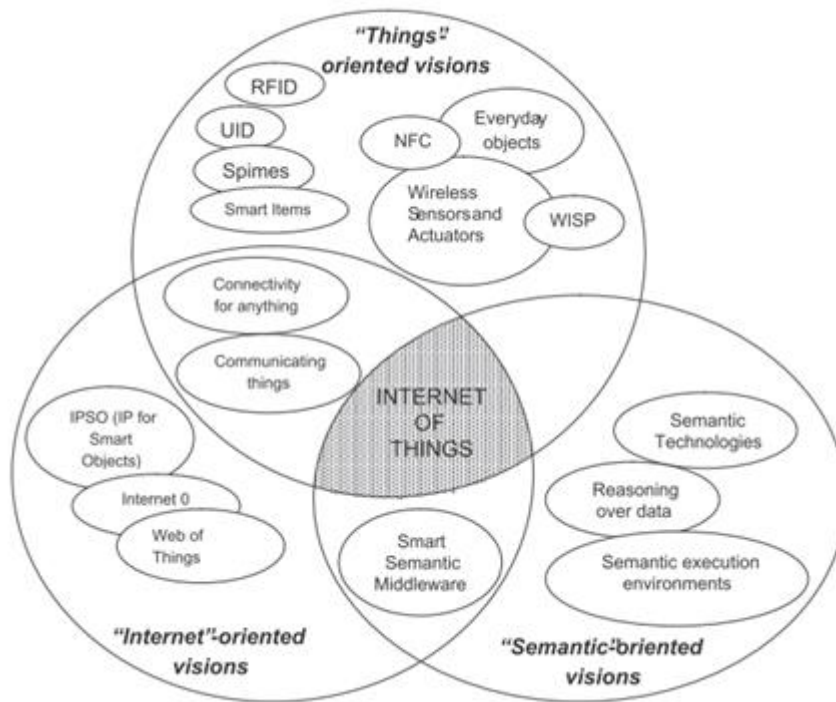


FIGURE 2 Internet of things” paradigm as a result of the convergence of different visions (Atzori et al., 2010)

### 2.2.1 Security in a IOT context

It can be said that along with the IOT issues pertaining networking and movement of data, there are a range of concerns inherited from the cloud computing concept and extended to the peculiarities of the internet of things. Security remains as the number one concern for most companies willing to move their IT efforts to the cloud, while other concerns are the lack of control on the cloud environment and lack of compatible internal infrastructure (TechTarget.com, 2013).

The above issues are now combined to a new series of security issues that concern cloud platforms for the internet of things, namely: protocol support, energy efficiency, resource allocation, identity management, ipv6 deployment, service discovery, quality of service provisioning, location of data storage, security and privacy, unnecessary communication of data (Aazam, 2014), threats of service availability, user information abuse and revealing risks in cloud computing, security risks caused by open ability of TCP/IP protocols, unauthorized operation and access risks, viruses risks, information revealed risks caused by electromagnetic radiation (Li, Chao, & Ping, 2012).

According to (Roman, Zhou, & Lopez, 2013) the basis of the IOT vision are tenets that stay on the way of security in the areas of accessibility with “access anyhow, anytime” and global connectivity with “access anyone”.

These issues of security are part of a wider context that as demonstrated (Alharbi, 2014; Kiruthika & Deepa, n.d.), has an effect on the level of trust on

cloud computing by potential consumer companies. Heterogeneity of devices, servers, gateways imply a myriad of different protocols that must be made secure by utilizing cryptography efficiently at low-data rates. Protocols must be optimized and become lightweight adapting to the reality of the IOT and the key management systems associated with it must be optimized to handle the amount of devices and systems interconnected in the IOT vision. The number of devices connected requires that universal identity management is made efficient to a level where these are supported, along with the necessary handling of authentication and authorization mechanisms. Privacy must be handled from the beginning on a user centric manner, so to increase the confidence level on the IOT and help remove the stigmas of “big brother” that is controlling our lives. Trust and governance must be well planned; from the user point of view and from an official governance point of view. Users should feel that they are in control of what happens and accept the uncertainty of the future interactions made possible by the nature of the IOT and at the same time, governance at a wider level must provide transparency and be aware of the risks coming from an overbearing control. Fault tolerance must be in place to a) maintain levels of service and to b) detect and prevent failure by redirecting action to alternatives zones (Roman et al., 2013).

### **2.2.2 Cloud platforms for the internet of things**

The existing deployment models for cloud as defined by the NIST, include Infrastructure, Platform and Software as a service. On top of that, cloud platforms for the internet of things (cloud for IOT) add a set of specific services, such as a) application programming interfaces (API) as a service, composed by a set of create-read-update-delete (CRUD) operations to allow control of the data flow in and out the devices towards the cloud storage; b) data mining and processing using the computational resources of the cloud, c) and services for presenting the outcome on dedicated dashboards. These might be complemented by specific offerings that are appealing to developers, as ides, programming languages and technologies, or to engineers, such as device brands and models or protocol support.

Different models have been proposed for cloud for IOT architectures or blueprints. For example, the need to coordinate the set of responses, requests from and into sensors and actuators via enabling technologies, such as a compatible set of SOA based protocols, is necessary for integration of different inputs and outputs from the wide ecosystem of devices, so that real time data flow between interest parties in the process is possible. Also, network capabilities and technologies, such as http protocol are needed to reliably allow the internet of things to happen. Autonomous data mining and decision making capabilities are necessary, to carry out in real time the data mining as a way to compensate the poor or non-existing processing power of the devices, and finally storage and computing processing power capabilities such as the offered by

cloud computing have been mentioned before as enablers of the internet of things vision (Llorente, 2012).

### 2.2.3 Security in a Cloud platform for IOT computing context

IDC presented its IOT predictions for 2015 during the “IDC FutureScape: Worldwide internet of things 2015 Predictions Web conference”. From the ten enumerated predictions, of interest to this study are the first two. The first prediction points to a usage of cloud by IOT, claiming that in the next five years, cloud platforms will host more than 90% of the produced data, which makes for a very positive outlook of the adoption of cloud for IOT. However, that first prediction is somehow contradicted by the second prediction which states that in a closer time range, of only two years, 90% of all IT network will have at least one breach which is related to IOT. Fact is that the IOT and its cloud based businesses are a quite big area for cyber-attacks of different types, appealing to hackers worldwide. Furthermore (Bhattachali et al., 2013) state that aside the fact that full protection is at present not possible when using the existing security frameworks and that transmission of data and critical data storage are highly sensitive security items, they categorize lack of trust as the main concern in the context of cloud for IOT. In this research (Bhattachali et al., 2013) state that classic cryptography is not adequate for cloud for IOT because it needs more computation that what is available usually in this devices environment. One other item of relevance is the fragmentation that exists throughout a series of different hardware that in turn utilise yet another series of communication protocols which makes the tasks of managing and controlling very difficult and increases the effort needed to secure them.

## 2.3 Technology adoption

Adoption of technology has been the focus of research for a while now, and several theories or methods have been developed as frameworks to assist on measuring and/or predicting it. We shall focus on the relevant one, such as Diffusion of innovations theory (DOI) and Unified Theory of Acceptance and Use of Technology Model extension (UTAUT2).

What causes consumers to incline towards using one product or another? How, does this decision and awareness move from the lab to the mass markets? At what level we define the product as successful or good enough and ready to enter the next stage of diffusion? A recent example is the Apple introduction to the market of the iPhone in 2007 as a device that combined a group of well know technologies, some not in a state of broad acceptance or adoption, at least at the time, such as the web kit, a rendering engine for web browsers. While others technologies used, such as the touch screen technology, were known by the public, these were rejected or had a modest adoption level. HIP was the

leader and mostly a solitary player on this area and Nokia itself had relatively unsuccessful experiences with its 'communicator' devices (S90 series of Symbian) and was a disbeliever of the touch screen acceptance by the masses.

What factors contribute to the consumer perception of a new product positively leading to adoption? How does the product owner find the correct decision influencers for the relevant group of consumers of a stage of adoption and for the next group of consumers in the adoption chain? Are these influencers the same ones and they move from stage to stage along with the product? How are they identified and how can they be approached and evangelised? When is the right time to present a technology to a target market segment? Microsoft had been trying to push the tablet concept since 2004 with little success but recently (2013) Apple and later Samsung became the major players in the mobile computing area disturbing the dominance of the desktop PC platform itself.

The cloud as a concept has been around for a while and is still at an early adoption stage itself, though according to (BusinessWire, 2013) has had some relative degree of success while keeping some issues to be solved, such as security along with an increase in the complexity for managing enterprise IT.

Since 2012, Techtargget ([www.techtargget.com](http://www.techtargget.com)) has been conducting a survey on the adoption of cloud computing. The result is that the rate of public and private clouds is not growing as predicted, amongst business (TechTarget.com, 2013). Issues such as security, lack of control on the cloud environment and lack of compatible internal infrastructure are pointed out as the main obstacles to cloud adoption. This apparent inability to move on to the next level of adoption might have a negative effect on the adoption of cloud platforms specific to the concept of internet of things.

On the other hand, Forrester Research predicts a value of \$159.3 billion for the cloud market by 2020. Also Gartner Research stated that cloud computing would be a \$150 billion business by 2014.

According to (Perko, 2008), "Acceptance models, such as the UTAUT, are intended to be used in studies of IS and IT adoption by individuals, thus they are not appropriate for studying the adoption of service-oriented architecture in the organizational context. Instead, Fichman's IT Diffusion Framework or a similar framework should be used." Nonetheless while Perko's work focuses on a well know and defined subject (which in turn has its focus on standardization and on delivering a blueprint that solves a problem, SOA), the subject of the internet of things is still not a realization, but a vision and a paradigm. So tackling an area such as cloud computing, another wide subject, specific to the internet of things, utilizing those frameworks, would be a huge effort that requires a much more solid base of knowledge and existing research than the one we have available today. This is not to say that Fichman's IT Diffusion Framework or Diffusion of innovations should not be used, rather that seems to be a logical follow up to the results of this thesis.

Furthermore although other works exist, that are used in the context of organizations, one of the constructs that seems prevalent seems to be a managerial awareness of the technology, rather than individual choice. Yet another

construct that gather consensus in the literature is perceived trust and, interchangeably, security (Alharbi, 2014; Bhattasali et al., 2013; Kautonen, 2008; Kiruthika & Deepa, n.d.; Pearson & Benameur, 2010; Weisbecker, 2012; Yan, Zhang, & Vasilakos, 2014).

Consequently to obtain a starting point in the case of the adoption of Cloud for internet of things it is necessary choose or develop a framework that would allow us to understand the adoption reach for the cloud platforms focused on internet of things which incorporates the previous constructs. In this regards, in spite on the UTAUT2 limitations that will be presented next, it is the best fitting theory for this research. Furthermore, the UTAUT2 firstly has the added ability to be extremely flexible towards new contexts and secondly to have been extensively used on the study of cloud computing adoption by organizations (Alharbi, 2014; Mursalin & Al, 2012; Opala & Adviser-Sharum, 2012; Serben, 2014; Xu, 2014).

### 2.3.1 UTAUT

In 2003 a study on eight (8) existing and prevailing theories on individual acceptance was conducted and as a result these theories were unified into what is now the Unified Theory of Acceptance and Use of Technology model (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003). The constructs of each theory were analysed for differences and commonalities, then reduced to a set that further had the respective validity and reliability measured. The researchers found that four constructs had significance for new studies and also influenced directly a user's intention of using information technology and that these constructs were influenced by yet four moderating variables: Gender, age, experience, and voluntariness of use. The framework is composed of four constructs, performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC) which in turn influence the behavioural intention (BI) of the user to adopt a technology (Viswanath Venkatesh, Morris, Davis, & Davis, 2003; Viswanath Venkatesh, Thong, & Xu, 2012). Behavioural intention and facilitating conditions influence technology usage. The individual UTAUT constructs are defined as follows:

- Performance expectancy is the degree to which using a technology will provide benefits to consumers in performing certain activities
- Effort expectancy is the degree of ease associated with use of a technology
- Social influence is the extent to which consumers perceive that other people, whom are important to them, believe they should use a particular technology
- Facilitating conditions is defined as the consumer's believe that structural and technological resources exist in the environment, that is, in the organization.

“According to UTAUT, performance expectancy, effort expectancy, and social influence are theorized to influence Behavioural intention to use a technology, while behavioural intention and facilitating conditions determine technology use. Also, individual difference variables, namely age, gender, and experience are theorized to moderate various UTAUT relationships” (Viswanath Venkatesh et al., 2012).

### 2.3.2 UTAUT2

While the previous UTAUT work had targeted users mainly in the context of employees of an organization that intended to deploy new technology, a few years later, in 2012, the same researchers proceeded to re-evaluate their previous work on the UTAUT in the light of extending it towards a consumer context.

The new theory then formulated was called UTAUT2. UTAUT2 incorporated into UTAUT three new constructs: hedonic motivation, price and habit. Furthermore, some relationships were altered. Also from UTAUT are utilized several moderator variables; age, gender and experience. These seem to together have an effect on Behavioural intention and usage as FIGURE 3 exemplifies.

Compared to UTAUT, the extensions proposed in UTAUT2 produced a substantial improvement in the variance explained in Behavioural intention (56 percent to 74 percent) and technology use (40 percent to 52 percent) (Viswanath Venkatesh et al., 2012).

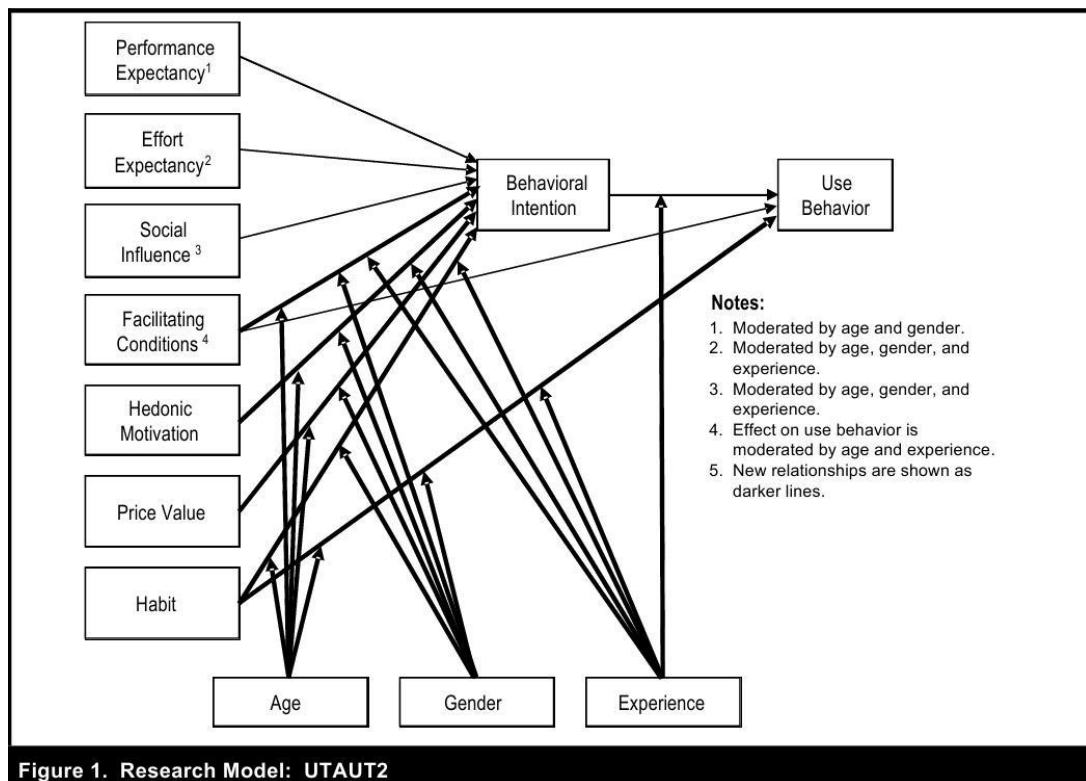


Figure 1. Research Model: UTAUT2

FIGURE 3 Model UTAUT2 (Viswanath Venkatesh et al., 2012)



The new constructs are defined as:

1. Hedonic motivation: the positive emotion of individual immediate satisfaction. In technology context it refers to the level of pleasure or joy the consumer feels when utilising that technology.
2. Price value: The return over investment that the consumer is aware of. This construct does not refer to the monetary quantity rather to the quality obtained when weighted against the amount paid for the product.
3. Habit: This construct is defined in the UTAUT as the degree to which the consumer automatically performs actions or behaviours with the technology because these had been performed previously successfully.

Although the UTAUT2 has been used successfully in the study of technology adoption by organizations, the truth is that the framework is used only partially without justification on why only some of the factors were utilized. In this regard, this research presents a novel approach and modifies the UTAUT2 so that it may be utilized on the context of organizational technology adoption, by replacing hedonic behaviour by eudaimonic well-being. This replacement provides an important improvement to the UTAUT2. The UTAUT2 has also been applied previously to the study of adoption of cloud computing and extended to accommodate the construct 'security'. In this research these changes will be applied to the UTAUT2 and justified further in the next chapters.

## **2.4 Manager as the representative of an organization, in the context of a technology adoption**

In the light of the UTAUT original framework, the targeted subject was a user that within an organization would be subjected to or imposed the usage of a technology. The examples of such technology, in the realm of information technologies, are a wireless terminal versus a desktop wired, or a new system for handling paying or ordering of goods. In the light of the usage given to the framework by a wide number of researchers, the authors decided to extend the UTAUT into a version 2 (UTAUT2), that in turn would have a slightly different target, before a user, now a consumer of the technology, that is, someone who freely decides to experiment with a new technology. However, it has been noted that the UTAUT (Lahtinen, 2012; Mursalin & Al, 2012; Sargent, Hyland, & Sawang, 2012; Serben, 2014; Uzoka, 2008), as well as some other technology acceptance theories or frameworks, such as the technology acceptance model (TAM) (M. Williams, Rana, Dwivedi, & Lal, 2011), have been using the theory also to determine the level of adoption of a technology, not simply by an individual consumer but one of an organization as a consumer of a technology, where the decision to move towards the adoption of that technology belongs

logically to the manager (Lease, 2005). Previously this person, usually a manager, had been identified as someone in the organization, that holds the responsibility of taking the decision of adopting the technology or that is otherwise able to exert influence on that decision.

There must be a champion of innovations that are highly uncertain, or else they may indeed die. But champions of less radical innovations are often middle managers (Rogers, 2010).

In the past, diverse efforts have been made to explain the adoption of innovations and technologies and although different theories, frameworks and models have been taken into consideration, either in full or partially to guide the research investigation, these have had sometimes different formulations and disagreed on the direction to take, i.e. UTAT focusing on the point of view of users of the technology and diffusion of innovations (DOI) leaning towards an analysis of a set of factors within the innovative technology itself. Still, these theories, frameworks and models, mostly agree on analysing levels of perception about the technology that is acquired or developed by the consumer when faced with the set of intrinsic qualities from the technology, formed by properties and relations in between them (Lease, 2005).

#### **2.4.1 Perception of technology influencing the adoption decision**

Perception of a technology may be defined as the understanding of the technological innovation properties, its internal relationships and external collaborations and how these may be used to take advantage of that technology, (Lease, 2005; Moore, 1999; Sargent et al., 2012). The perception of a technology may be related to its adequate cost-effectiveness, reliability, organizational need and function effectiveness (Sargent et al., 2012). Furthermore in their research, Sargent et al. concluded that the manager perception of a technology influences the decision to adopt it in the organization. Attitude towards some technology is a required set of mind to enter the process of deciding to adopt or reject a technology (Rogers, 2010), as are the perceptions about a technology strong factors on the decision process.

To evaluate the perception by an organization of a certain technology, a researcher would need to interview several individuals from different areas of concern in the organization to span most of the knowledge areas. The utilization of ethnological methods is also recommended. However it has been noted in previous research that a negative perception of technology by managers, would influence negatively the decision of adoption (Moore, 1999). Furthermore, there appears to be a relation between personality type of managers, affect and technology adoption (Uesugi, Okada, & Sasaki, 2010), which may mean that an individual that has a more positive outlook of his life, will not only take decisions of moving towards more risky endeavours, but will assume those decision much faster (Véronique & No, n.d.). Research has concluded that not only emotions have a direct effect on the decision making process (Kennedy &

Mather, 2007) but also that a parallel relation exists between emotions and decision process, indicating that positive emotion, i.e. achievement, approach type of emotions lead to a better and faster decision process, while the antagonistic and resignation types of emotion would stand on the way of a clear decision process (Ma & Wang, 2009).

#### **2.4.2 Emotional decision process**

Evidence points to a clear influence of emotions into the human decision process, showing us that positive affect leads to better decision process and that this is applied also into an organization decision process (Isen, 1984). Emotional intelligence is regarded as a contributor factor in managerial decision process making it possible for leaders to effectively move forward on their decision process (Ilies, Morgeson, & Nahrgang, 2005), and this contributes to leader's well-being in the sense of life fulfilment, i.e. an eudaemonic state. Furthermore, according to (Sayegh, Anthony, & Perrewe, 2004), "in critical decision situations (...) a manager experiences a myriad of both cognitive processes and intuitive and emotional reactions that interact instantaneously during the decision process". A manager utilises then her emotional state aid in the decision processes that include situations critical to survival (Sayegh et al., 2004), high risk decision processes (Kennedy & Mather, 2007). Also in a manager daily work life, emotions play a significant role and align directly with decision making, facilitating the process and influencing the result of that decision process (Ashkanasy & Ashton-James, 2007; Isen, 1984; Ma & Wang, 2009).

A study conducted on 126 subjects concluded that positive emotions, such as happiness, have a direct effect on increasing the intention to use a technology and reduces the risk perception of that technology (Ma & Wang, 2009). Accordingly in this research it is argued that the relation between a manager or eudaimonic well-being and her decision process regarding technology adoption is a direct one influencing the organization decision of adopting a technology.

## 3 Framework development

### 3.1 Conceptual Framework Design

When performing research, in the face of a research question, a researcher may first try to find a theory that could explain the phenomena under study; in the lack of an existent theory she may then proceed to develop a new one (Jarvinen, 2000). However, it is possible than an existing theory may be utilized as a basis for the new one or as in the case of this research, to extend the original theory or framework.

Adoption of technology as a research subject has generated interest for a while and consequently, some theories have been developed to try to explain it. Moreover, recently the UTAUT have been expanded to move focus from a user onto a consumer adoption point of view. Furthermore this research moves on from that position evolving to place the focus not in a consumer as an individual but into an organization that may adopt a technology, being that organization represented by an individual manager. In this sense the UTAUT2 framework seems to be an appropriate fit for a basis to this study's framework and to contribute to a reach towards the research goals. These research goals are: to find out whether technology adoption by an organization can be explained by focusing on the organization manager as the decision maker and to discover the status of adoption for cloud for IOT platforms. To achieve these goals, a solid base framework or theory is necessary to help explain the process used to arrive to the conclusions. In this regard we chose to utilize an extension of the Unified Theory of Acceptance and Use of Technology 2 (Venkatesh, Thong, & Xu, 2012). Yet another reason behind choosing UTAUT2 is that its constructs allow generating a good overview on the phenomena under study, without forcing further segmentation of those phenomena into too many areas that may require separate attention to understand properly. That stands for a measurable and manageable effort. Moreover the UTAUT2 is a good candidate because it allows for extension. Previous studies on technology acceptance, for example concerning web applications, have extended the UTAUT2 (Alrawashdeh, Muhairat, &

Alqatawnah, 2012; Xu, 2014) also extensions to UTAUT2 have been done in the area of mobile devices (Huang, Kao, Wu, & Tzeng, 2013; Kao, 2014).

During previous research several variables have been used to extend the UTAUT and identified with a positive level of correlation to an adoption of cloud computing (Alharbi, 2014; Bhattasali et al., 2013; Black, 2013; Ekufu, 2012; Llorente, 2012; Opala & Adviser-Sharum, 2012; Paquet, 2013; Pearson & Benameur, 2010; Singh & Bhattacharjya, 2012; Vijay Venkatesh, 2013; Weisbecker, 2012). However, security as a part of perceived trust, is a consensual construct influencing the adoption on these technologies (Alharbi, 2014; Pearson & Benameur, 2010; Weisbecker, 2012). Similarly several studies have focused their attention on business adoption of cloud computing and applied UTAUT to validate results (Alharbi, 2014; Black, 2013; Opala & Adviser-Sharum, 2012; Vijay Venkatesh, 2013) or TAM (Ekufu, 2012; Paquet, 2013; Rahman, 1998) or even outside the usual acceptance model frameworks (Amini et al., 2014), the overall tendency is to place the manager as a representative of the organization on what concerns taking the decision to adopt or reject a technology. Moreover, recent anecdotal evidence also points to the fact that the cloud computing adoption status is greatly influenced by managers rather than technical personnel.

The framework developed in this thesis is based on the UTAUT2, including constructs of, Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Facilitating Conditions (FC), Price Value (PV), Habit (H) and Behavioural Intention (BI) and an extension to the UTAUT2 into two more constructs: (i) Eudaimonic well-being (EWB) replacing Hedonic Motivation and (ii) Security.

In this research it is argued that while hedonic behaviour, i.e. the basic behaviour of moving away from pain or searching for pleasure, may be an item most correctly applied for a situation of consumer adoption of technology, as is the case of the UTAUT2, it is however more appropriate for an organization, when represented by its technology decision maker, to apply another point of view on human happiness: eudaemonic well-being. According to (Straub, 2009) emotion needs to be taken in consideration when providing conditions for good adoption levels of a technology. Furthermore, the impact of the result from decisions by a manager, may affect gravely her personal well-being, as a result of the way she is understood by the surrounding environment. This environment may be composed of, for example, employees of the organization affected by the ethical consequences of the decision, in the sense that a bad decision may cause direct or indirect damage to the organization and for example, it may lead to a poor economic performance and cause lay-offs. Furthermore, higher management may want to review the performance of the manager, in search of answers on why a bad decision causes financial damage to the organization and also in the sense that a decision that is contrary to the higher management believes or vision for the organization, may cause ill-feeling towards the manager that took the decision. The fact that the manager is aware of the outcome from his decision influences the decision process. This phenomena is described ac-

According to the Freudian view of how humans move away from pain and seek well-being (Damghani, Taghavifard, & Moghaddam, 2009; Kinicki & Williams, 2011). This point of view on intuitive decision taking by a manager has been defended before in the works of (Kinicki & Williams, 2011; Sayegh et al., 2004). Demonstratively the developed framework is presented in

FIGURE 4 that shows the modification of the UTAUT2 framework by replacing hedonic behaviour by eudaemonic well-being and extending it to accommodate the construct of Security.

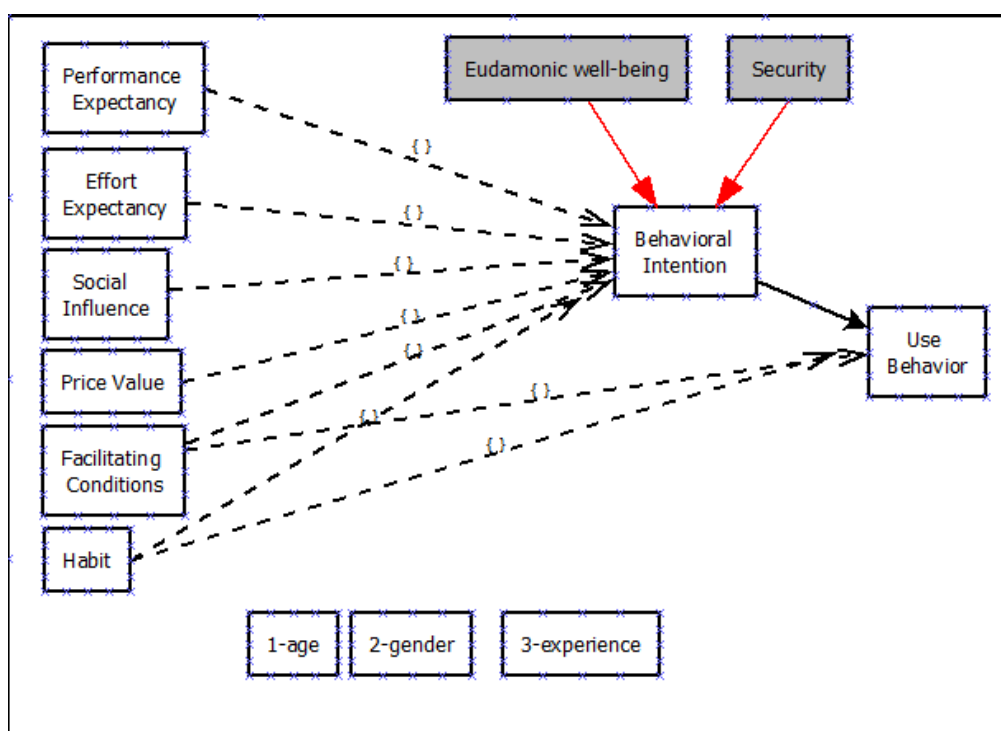


FIGURE 4 UTAUT2 extended to include security and eudaemonic well-being

Compared to UTAUT, the extensions proposed in UTAUT2 produced a substantial improvement in the variance explained in Behavioural intention (56 percent to 74 percent) and technology use (40 percent to 52 percent) (Viswanath Venkatesh et al., 2012). Furthermore the UTAUT has been used in its full format in previous studies (Y. Michael; Rana Nripendra; Dwivedi Williams & Lal, 2011). In this research the UTAUT2 framework is utilized in almost its full scope, hedonic behavior being replaced by eudaemonic well-being, security added as an independent variable in an attempt to obtain similar confidence level of results as per the original study.

## 3.2 The Independent Variables

The UTAUT has been widely adopted as a basis model to justify research in the field of user adoption. However, while most of the previously conducted research only cites the UTAUT, about only 10% has adopted the framework partially and as little as 3.5% utilized the framework in its totality (M. Williams et al., 2011). Moreover the UTAUT was originally developed to be utilized in the study of user technology adoption research, defining the user as an individual working for an organization which in turn suggests the technology to use.

Many researchers, have chosen to utilize the UTAUT has a basis for their work in the field of cloud adoption, where the context is no longer a simple user but that of an organization that is a consumer of it, and in the process some developed either a new model or framework, supported partially by some of the constructs of the UTAUT and consequently have dropped some of these constructs (M. Williams et al., 2011). Moreover, Hedonic behavior has previously been dropped from the UTAUT2 framework and according to (Im, Hong, & Kang, 2011) this is because the context of the study was a utilitarian one (basic need satisfying, that of an online banking service) versus a hedonic one (immediate pleasure seeking, as is an MP3 player).

### 3.2.1 Eudaimonic well-being

Researchers have always had an interest on the human, interest on the search for happiness, in the shape of different types of affect. This search for happiness usually is divided into two contexts, the hedonic one with its quick affect rewards, such the one obtained by experiencing a good meal, and the eudaimonic meaningful one, such as the gratification for growing a child or doing good deeds for the community.

For this research a trial survey was conducted amongst field experts. This initial survey had the questionnaire based on the original UTAUT2 with security as an extension. These subjects were mostly from the members of The internet of things Council (<http://www.theinternetofthings.eu/members>). The results of the trial survey indicated reluctance by the field experts on scoring the hedonic behavior construct related questions and supported the choice of eudaimonic well-being as a contributing variable towards the use behavior. In this context, the result of a decision or action is not a hedonic - immediately acquired - behaviour, as is the case of deciding to adopt cloud computing for IOT, which is a decision that will affect first the consumers of the products that are forth enabled and as a consequence, later affects the organization implementing these products and this effect on the organization in turn reflects on the manager that was responsible for the decision, for example on how he is viewed by his peers. The manager's decision process is then greatly influenced by this forecasting of her own eudaimonic well-being (Ashkanasy & Ashton-James, 2007; Isen, 1984; Kennedy & Mather, 2007; Ma & Wang, 2009; Sayegh et al., 2004).

While in the UTAUT2 the consumer was the decision maker on the adoption and the holder of the hedonic behavior, in this research the UTAUT2 constructs focus are moved from a direct consumer of the technology, into an indirect usage by an organization where the organization is represented by the decision maker, that is, the manager in charge of the decision. In a context of a small organization or corporation (represented by the manager) the hedonic well-being of the decision maker is not affected by the reward obtained by using the technology directly but by obtaining a positive response on having taken the correct decision, an ethical and practical one, on what concerns adopting the technology into the organization. A state of well-being in this case is more related to a eudaimonic motivated meaningful decision. This is the case of a leader, manager or any other influencer of the decision making process. This process of influence is for example performed by means of knowledge in the technological field or simply by taking political or social actions near higher management. Summarizing, a manager in charge of the decision of adopting a new technology would then utilize her gut-feeling when performing the decision (Tran et al., 2012). This emotional feedback is fed by her wish to be accepted, respected and recognized as an ethical leader that takes correct and effective decisions (Véronique & No, n.d.).

### 3.2.2 Security

During previous research several variables have been identified with a positive level of correlation to an adoption of cloud computing (Alharbi, 2014; Bhattasali et al., 2013; Black, 2013; Ekufu, 2012; Llorente, 2012; Opala & Adviser-Sharum, 2012; Paquet, 2013; Pearson & Benameur, 2010; Singh & Bhattacharjya, 2012; Vijay Venkatesh, 2013; Weisbecker, 2012).

Trust in a technology context, has been defined previously as a set of properties that the product or service must have to produce positive levels of acceptance (Alharbi, 2014; Pearson & Benameur, 2010). The non-existence or low levels of these properties diminish trust in the technology which reduces usage and adoption intent. High trust level is an influencer to continuous utilization or adoption of the technological artefact. However, from the extensive list of properties that are nominated for cloud computing and IOT, security is the one that prevails as the main factor in influencing the level of trust in a technology and directly influencing the adoption decision towards the technology. Hence Security as a part of perceived trust, is a consensual construct influencing the adoption on these technologies (Alharbi, 2014; Pearson & Benameur, 2010; Weisbecker, 2012). Following this trend, this research adapts security as a construct that directly influences the Behavioural intention to adopt the technology and also the usage behavior.



### 3.2.3 UTAUT2 modified

The remaining independent variables are taken directly from the UTAUT2 and these are:

- a) inherited from the UTAUT:
  - a. Performance Expectancy as the measure of value obtained when the consumer uses the technology. Performance Expectancy has an influence on Behavioural Intention and is moderated by age and gender.
  - b. Effort Expectancy as the measure of how easy or hard it is to use the technology. Effort Expectancy has an influence on Behavioural Intention and is moderated by age and gender and experience.
  - c. Social Influence measuring the influence of important others on the consumer decision to adopt the technology. Social Influence has an influence on Behavioural Intention and is moderated by age and gender and experience.
  - d. Facilitating Conditions measuring the consumer perception of the contextual enablers for technology usage. Facilitating Conditions has an influence on Behavioural Intention and is moderated by age and experience.
- b) new to the UTAUT2 are:
  - a. Habit: measuring the automation of a behavior related to the technology usage and influences Behavioural Intention. Habit has an influence on Behavioural Intention and is moderated by age, gender and experience. Habit also influences directly Usage Behavior.
  - b. Price Value: measuring the notion of the return for investment. Price Value has an influence on Behavioural Intention and is moderated by age and gender and experience.
- c) the UTAUT2 is extended on the following manner:
  - a. Eudaimonic Well-being replaces Hedonic behavior measuring a long lasting sense of accomplishment by doing the ethical decision. Eudaimonic Well-Being has an influence on Behavioural Intention.
  - b. Security is added to the model because it is the major contributor to trust in a technology. Security has an influence on Behavioural Intention.

The model maintains the moderators from the original UTAUT2:

- Age moderating Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions
- Gender moderating Performance Expectancy, Effort Expectancy and Social Influence

- Experience moderating Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions

This research continues to adopt the UTAUT2 dependent variables, which are Behavioural Intention which describes Use Behavior. Behavioural Intention influences directly Use Behavior while Behavioural Intention itself is influenced by all the independent variables. Use Behavior is also influenced directly by Habit and Facilitating Conditions.

### **3.3 Summary**

With this research the actual adoption level of cloud platforms for the internet of things will be described along with the intention of future usage and the reasons behind adoption of new technologies will be explained. A framework based on UTAUT2 is developed by replacing Hedonic behavior with Eudaimonic well-being and by incorporating Security as a construct.

Moreover, this newly developed framework shall be in the next sections, empirically validated in the context of cloud for IOT via a survey instrument.

## 4 Methodology

This research strives to discover the factors that influence technology adoption in an organizational context and to discover the adoption status of the cloud platforms for internet of things. It develops a framework based on the UTAUT2 (V. Venkatesh et al., 2012) and elaborates beyond its constructs by replacing hedonic behaviour for eudaimonic well-being and integrating the construct of security. This action places this research in the domain of theory testing and theory creating, and, since it is not possible to control the level or input of the independent variable, as these are qualities of the participants whom in turn are randomly selected, then this may be considered a field study that accordingly will follow on the methodology utilized when developing the UTAUT2. In this regard, the empirical part of this study is enabled by a field survey methodology and survey methods are utilized. This research is also driven by a theory creating approach while developing a new framework based on the UTAUT2.

### 4.1 Survey

A survey is a standard research instrument that allows collecting information from a sample population for scientific purpose (Järvinen, 2012). Its design allows quantifying a population's set of attributes, usually by having a set of questions which are asked to the sample. This sample should be big enough to allow for statistical treatment. The questionnaire may have open or closed type questions and these should be derived from the model or framework or theory used or even from the hypotheses of the study (Kasunic, 2005). The answers to the question may be given on a scale, such as Likert type. At some points in a questionnaire, open questions may be used. Moreover, according to (Kasunic, 2005), a survey research methodology is composed in seven phases as can be seen in FIGURE 5. The researcher may start her research by asking a question and hence identifying an area of interest or problem to be solved. The question can be formulated in the form of: 'which theory explains the phenomena under

study' (Jarvinen, 2000) which in turn helps on deciding on the research methodology to follow. In the case of a survey field study, the next step is to identify the target audience and then proceed to the design phase, composed of a sampling plan to discover the size of the population under scrutiny and how to target that population in a relevant manner, i.e. making sure that the responses come from a representative sample. The survey instrument, the questionnaire, is then designed and written in an appropriate manner to allow easy analysis and simplifying the understanding of the questions. Following, a pilot survey should take place. The intention of the pilot survey is that by targeting experts in field, some relevant feedback can be provided to improve the quality of the instrument in terms of relevancy and easy interpretation. Finally, the questionnaire should then be made available and at the end of a pre-determined period of data collection, the obtained data should be analysed and the report written.

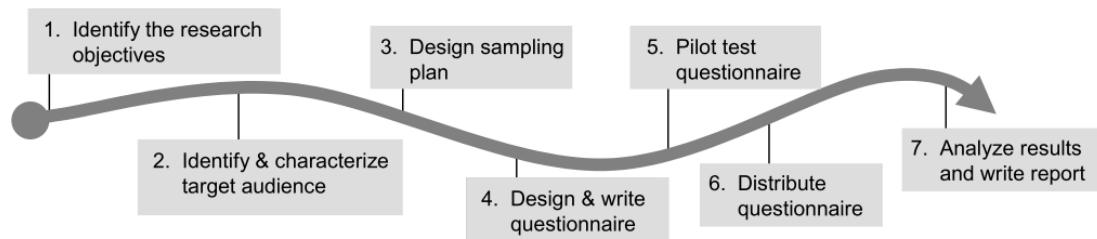


FIGURE 5 Seven stages on survey research by (Kasunic, 2005)

The survey designed for this study contains 3 different areas: demographics, adoption status and the UTAUT2 extended framework questions. On the second part of the survey, concerning status of adoption, some open end questions are utilized. The third part of the survey is composed by questions that obtain data for the developed framework. Because of the original framework research, the Likert scale adopted is the same 7 scale Likert as used by the original study where the UTAUT2 framework was developed.

A descriptive analysis is used to assess how a manager perception of technology influences the adoption of the technology. Correlation is used to explain relationships between independent variables and the impact on adoption of the technology of cloud for internet of things.

## 4.2 Design of the survey

In this study, the goal of finding whether the adoption of a technology in an organizational context, could be explained by applying a UTAUT extended framework, was pursued by following a survey methodology in a theory developing and testing context. Furthermore, in the field study, it was not possible to manipulate variables, however the survey instrument includes an area of

demographics where the moderator variables (age, experience and gender according to the UTAUT2 framework) are obtained and quantified.

The sample size was of about 1256 individuals. These matched the universe under scrutiny of high and mid-level managers in companies that are in ICT area of business. Thus it should have made possible to obtain at a rate of 15-20% return response, about 300 usable responses to be further analyzed. In fact, only 70 responses were obtained, making the final result just a little below the minimum reasonably needed to perform multiple regression, 10 replies per construct, that is, 80 responses. However, the statistical results proved satisfactory.

The survey was initially administered via online media and was performed in two parts: a pilot survey for selected participants which are experts on IOT and a formal survey to collect the data for the research. The pilot was distributed via email to a panel of participants from the members of The internet of things Council (<http://www.theinternetofthings.eu/members>).

After analyzing the replies from the pilot, it became apparent that one of the constructs taken from the UTAUT2, Hedonic Behavior, was not appropriate for an organizational context. Because of this the framework was further developed to have this construct replaced by Eudaimonic well-being. After the redesign, the survey was made available to a sample of the general target population. The link to the survey was added to posts placed on social media sites as Facebook and LinkedIn on interest groups and also on forums of online magazines that specialize on areas such as internet of things, cloud, sensor network or M2M. This allowed the randomization of the sample to happen naturally. However, this first attempt to create interest on the survey did not obtain a considerable amount of responses. The second attempt is performed by acquiring the panel of contacts from panel providers companies. The list requested focused on mid and high level managers, from companies in technology business area.

The panel was composed of high and mid-level management individuals acting in ICT related companies and it was obtained by ordering it from a commercial source. A total of 1256 contacts were obtained with the following criteria: contact Title: C-Level, Director, manager, VP; Department: IT; Countries: Finland. This group represents the most capable organizations to enter cloud for IOT adoption because they are knowledge intensive and in the majority are also internet/networked technology oriented. The sample was cleaned for mistakes and only one of the emails was removed.

An online survey tool was utilized to build the survey. The three different areas of the survey: demographics, status feedback and framework were further separated into smaller pages for better viewing and questions were placed into groups composed of sets to have these randomised. The order of the groups is always the same and the set of questions is then randomized within the groups of sets. Further, inside each set may be one or more questions that in turn are always presented in the same order.

The survey was conducted during the spring/summer of 2015 by using an online commercial survey tool. The respondents were invited to respond by email, which in turn contained a button link to the survey that was controlled by a token to avoid double entries.

The survey instrument is available in appendix 1.

### 4.3 Data Analysis, Validity and Reliability

Statistical analysis was conducted on the results from the questionnaire, towards the research questions, by utilizing descriptive statistics, reliability and multiple regression analysis (Brace, 2000). Descriptive statistics was utilized to obtain the actual status of adoption for cloud computing for IOT while multiple regression analysis measure relationships between the constructs and the dependent variable.

Firstly the chosen methodology focused on the correlations between the dependent variables and the independent variable of Behavioral Intention, applying the extended and modified UTAUT2 framework, secondly empirical analysis was performed to access the reliability of the constructs as variables. The relationships were studied to understand the influence of the constructs over the dependent variable.

The questions concerning the UTAUT2 constructs were reused without modification (Viswanath Venkatesh et al., 2012), while the question for security was taken from previous studies (Opala & Adviser-Sharum, 2012; Paquet, 2013; Pearson & Benameur, 2010; Singh & Bhattacharjya, 2012; Vijay Venkatesh, 2013). Finally the question on the new construct, eudaimonic well-being was developed in this thesis and had as a reference the questionnaire for eudaimonic well-being (Waterman et al., 2010).

Because the UTAUT2 based framework developed in this study, is an instrument created from complex collaboration between the constructs, a factor analysis was conducted using Cronbach alpha to assure that the framework was still reliable in its totality, as well as in its parts and in order to assure that the framework was indeed of use for the research. Analysis of variance (ANOVA) was conducted to discover whether there are statistical differences between the constructs, Spearman  $\rho$  was applied to measure the strength of correlation between the variables and chi-square test of independence was performed to determine whether there is a relationship between two categorical variables.

Comparing to previous studies where the UTAUT2 was utilized, applying it to an organization as a consumer of a technology, while focusing on the manager perception of the technology as the main power towards the decision to adopt or reject the technology, this research provides a better and clearer comprehension of the process of influence that may lead an organizational to adoption of a technology, which was, in this research, the cloud for IOT, and this

way the research was able to contribute positively to the body of knowledge of cloud computing for IOT.

#### **4.4 Ethical Considerations**

This empirical research is mainly quantitative, with the exception of some open questions that were used for analyzing the status of adoption for cloud for IOT in the second part of the survey which concerned the status of adoption for cloud for IOT. The research fundamentally obtained support from the UTAUT2 framework in order to develop a comprehensive new framework that is intended for analyzing the factors influencing the adoption of a technology and specifically the adoption of cloud for IOT.

While collecting the data, the survey was made anonymous, and targeted individuals were given a choice to decline responding to it, via a clickable link. The survey was conducted in UK English and in Suomi, Finland's major national language. In addition, the goals of the research were made clear to all participants, before they had to fill in the questionnaire.

## 5 Results analysis

This chapter will present a statistical analysis of the surveyed data.

The response contained around 70 replies which was just about enough to validate the framework. Before proceeding with the analysis, the 70 respondents were checked for data normality and missing data. One answer was removed. SPSS was used to conduct the following analysis on the data gathered: descriptive analysis to position and help narrate the results, reliability analysis to assure that the measured items were the items intended to be measured, analysis of variance (ANOVA) to discover whether there were statistical differences between the constructs, Spearman  $\rho$  to measure the strength of correlation between the variables, chi-square test of independence to determine whether there was a relationship between two categorical variables and multiple regression analysis to allow predicting the value of the dependent variable.

The following sections present the results of the survey following the structure of the questionnaire. The first part of the questionnaire addressed demographic information which included the moderators for the framework, namely Age, Experience and Gender. The second part handled cloud for IOT adoption while the third and last part of the questionnaire dealt with obtaining data concerning the framework constructs.

### 5.1 Demographics Descriptive Statistics

In this section are presented the analysis of the descriptive statistics. Initially the demographic items of the study participants are described. These include age, gender and experience which are part of the framework developed for this study. TABLE 2, shows that the respondent's age was above the age of 30 and very few (9%) are above 60 years old. The respondents were majorly male (94%) while most respondents held higher educational degrees.



TABLE 2 Demographic items

Variables		N(69)	%
Age	31-50	34	49.3
	51-60	29	42.0
	61 and older	6	8.7
Gender	Female	4	5.8
	Male	65	94.2
Education	High school Diploma	7	10.1
	Technical Degree	16	23.2
	Bachelor Degree	12	17.4
	Master Degree	29	42.0
	Doctorate Degree	2	2.9
	Other	3	4.3

On TABLE 3 are presented the descriptive statistics for the job related items of the respondents. The respondents majority were a mid to high level manager, ranging from manager to CxO and the experience level is higher (27.5%) for a point of than less than 2 years of experience, the organizations with experience between 2 and 5 years are about 13% and those with experience bigger than 5 years are about 17% of respondents organizations. 60% of organizations are small businesses and 35% are corporations. Only one governmental agency replied to the survey. Accordingly 55% or organizations serve less than 500 users and 20% serve more than 10.000 users. The biggest representation for an industry is IT-Services with 52% of the respondents.

TABLE 3 Demographic items (job related)

Variables		n(69)	%
Title	IT/Security/Operation Manager	3	4.3
	Director of IT/Operations	12	17.4
	Vice President of IT	3	4.3
	Chief Technology Officer (CTO)	10	14.5
	Chief Information Officer (CIO)	2	2.9
	Other IT Management Position	7	10.1
	Developer enthusiast	1	1.4
	Developer professional	5	7.2
	Other	26	37.7
Title Other	Title summed	43	62.3
	CEO	8	11.6
	Consultant	1	1.4
	Country Manager	1	1.4
	Director, non-IT related	1	1.4
	Muu	9	13.0
	Other	13	18.8
	Regional Director	1	1.4
Experience	Toimitusjohtaja	1	1.4
	None	29	42.0
	Less than 2 years	19	27.5
	Two years to less than 5 years	9	13.0
Organization	Five years or more	12	17.4
	Small business	41	59.4
	Corporation	24	34.8
	Government	1	1.4
Users	Other	3	4.3
	Less than 500	38	55.1
	501 users to less than 1000	9	13.0
	1,000 users to less than 10,000	8	11.6
industry	10,000 users or more	14	20.3
	Construction	1	1.4
	Energy/Utilities	2	2.9
	Financial Services/Banking	2	2.9
	Government	2	2.9
	IT - Manufacturing	4	5.8
	IT - Services	36	52.2
	Cloud Service Providers	6	8.7
	Professional, Technical, and Business Services (non-IT)	3	4.3
	Telecommunications	2	2.9
	Travel/Leisure/Hospitality	1	1.4
	Manufacturing (Auto)	4	5.8
	Retail	1	1.4
	Agriculture and forestry	1	1.4
Other	4	5.8	
Total	69	100.0	

## 5.2 Adoption status data analysis

The state of cloud for IOT adoption for ICT companies was determined by asking the respondents to assess what their company's relation to cloud for IOT was. TABLE 4 describes the status of cloud for IOT adoption. Using the information in the table reasons behind the adoption decision will be enumerated and enhanced with data extracted from the answers concerning date of adoption, budget allocated to cloud for IOT and challenges discovered during implementation.

TABLE 4 Organization's relation to Cloud for IOT

Organization's relation to Cloud for IOT	N(69)	%	Adoption Status
We are not aware of Cloud for IOT	6	8.7	Not Adopted
We are aware of Cloud for IOT, but have not tried to learn more about it.	19	27.5	Not Adopted
We are actively seeking knowledge of Cloud for IOT what is, how it works and why it works	9	13.0	Not Adopted
We have learned about Cloud for IOT characteristics and are currently assessing Cloud for IOT's potential benefits for us	13	18.8	Not Adopted
We are currently preparing for the decision of either adopting or rejecting Cloud for IOT	2	2.9	Not Adopted
We are currently implementing Cloud for IOT with one or more selected pilot projects	5	7.2	Adopted
We have implemented one or more pilot projects and have decided to expand our adoption of Cloud for IOT	4	5.8	Adopted
We are already committed to Cloud for IOT and are widely implementing it	11	15.9	Adopted

As can be seen from FIGURE 6, the survey reveals that 8,7% of organizations are not aware of cloud for IOT; 27,5% of organizations claim to be aware but have no interest on pursuing IOT at the moment; 13% claim to be actively investigating IOT and cloud for IOT; 13% of organizations claim to have learned about cloud for IOT and are investigating potential benefits; 2% of organizations are pondering whether to reject or adopt cloud for IOT; about 5% are implementing IOT pilot solutions that span cloud for IOT; some 4% of organizations have gone through the piloting solutions state and moved on to expanding cloud for IOT adoption; finally 11% of the inquired organizations are well into implementing cloud for IOT solutions as part of their business strategy.

On the challenges that exist when pursuing Cloud for IOT, the survey shows us that for organizations who are aware but do not try to pursue cloud for IOT, an issue is the move to cloud based computing itself, since the actual

systems are not in the cloud. Further, four organizations simply do not find an interest on cloud for IOT while one has had only rare needs to take on projects into cloud for IOT, and pricing and contracts options are confusing for two of the organizations. Those whom are at a stage of investigating cloud for IOT at a functional level claim that:

- Understanding the hardware universe is difficult,
- There is a customer lack of interest
- The size of IOT makes it very hard to gain a knowledge level good enough in order to be able focus so to align with business strategy
- One of the organizations simply is unable to find a way to use cloud for IOT

From the companies that are on a phase of finding out how to retrieve benefits from cloud for IOT, the issues pointed were:

- Finding areas to create products of customer interest
- Coordinating the effort between actors when developing the products
- Adapting business processes to the cloud for IOT space efficiently
- Communicating the new business models to create awareness at higher management on a way that sustains improved decision making and other item was security issues concerning authentication.

Organizations at a stage of deciding on adoption or rejection of cloud for IOT stated that:

- They claim to be at a very early stage of this process
- One organization finds that the knowledge curve is still very hard at this point.

From those organizations piloting solutions on cloud for IOT we see that:

- One stated that making the solution ready in a timely manner and regulatory items were pressing issues
- One claimed a slight unsuccessful project and other organization reported the opposite, that is, a slightly successfully achieved solution in cloud for IOT

The organizations that moved on towards expanding adoption of cloud for IOT have mixed points of views on challenges met: while half of organizations claim that the technology is ready, these also state that on the customer side there is some inertia to get an interest on cloud for IOT enabled products and needed technology upgrades are kept lagging initiative, however the other half claims that the technology is still in its infancy and 'bugs' with levels ranging from simple to severe are a constant and even that the solutions are not well integrated, rather 'sporadically' adapted to customer needs, the organizations at

this level have had overall successful projects, delivered on time, on budget and on scope (see TABLE 5).

Organizations which are at a status of widely adopting cloud for IOT claim issues such as customer education on security concerns, for example moving knowledge away from protection that exist in company servers to the cloud and on the subject of new products and ideas, the development of a value chain and ecosystem is challenging, so is developing a product that is balanced in functionality and simplicity of use and finally that the costs calculation is also challenging because of different levels of pricing associated to usage of cloud.

**Which of the following is the best description of your organization's relation to Cloud for IOT?**

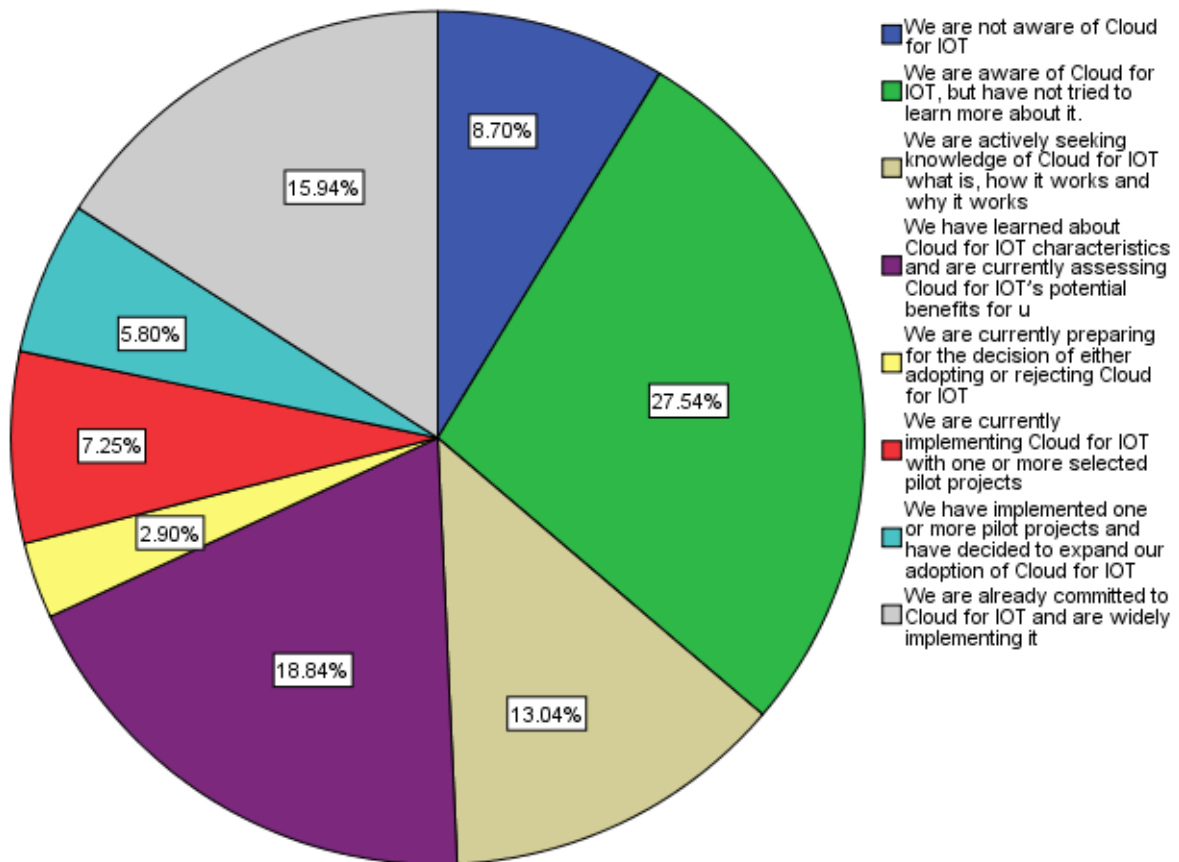


FIGURE 6 Phases of adoption for cloud for IOT

The majority of the organizations that have adopted cloud for IOT, either at pilot or full level claim to have had reasonable to good success in their entrepreneurship in cloud for IOT and this is presented in TABLE 5. However two companies which were at adopting cloud for IOT phase claimed a rather high level of failure. In resume, 90% of the adopting organizations claim a very good level of success at all modes of delivery: time, scope and budget.

TABLE 5 Cloud for IOT projects success rate

		n	%	Valid %	Cumulative %
Success Level	4.00	1	1.4	11.1	11.1
	5.00	2	2.9	22.2	33.3
	6.00	3	4.3	33.3	66.7
	7.00	3	4.3	33.3	100.0
	Total	9	13.0	100.0	
Missing	System	60	87.0		
Total		69	100.0		

An organization is considered to have had adopted cloud for IOT if it is at a state of a) just decided to adopt Cloud for IOT, b) currently implementing Cloud for IOT with one or more selected pilot projects, c) have implemented one or more pilot projects and have decided to expand our adoption of Cloud for IOT, d) are already committed to Cloud for IOT and are widely implementing it. Below in FIGURE 7 is displayed that the adoption status for cloud for IOT is about 32%.

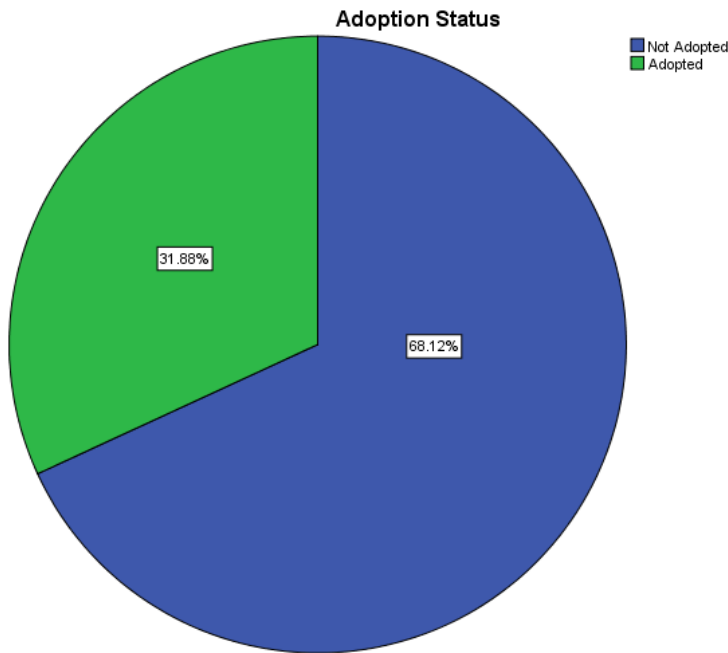


FIGURE 7 Adoption Status for cloud for IOT

On budget allocated: as shown in FIGURE 8, organizations at the adoption state reserve a mean of 17.5% for cloud for IOT solution, taken from the budget for new initiatives in IT. However this value is increased parallel to the organization adoption level of cloud for IOT. In FIGURE 8 below it is observed that organizations initiate their entrepreneur taking on cloud for IOT by allocating a small percentage of 10% of their budgets, which continues until a final stage of full adoption is reached. This is when the budget may be then increased all the way to 100% of available budget for new projects.

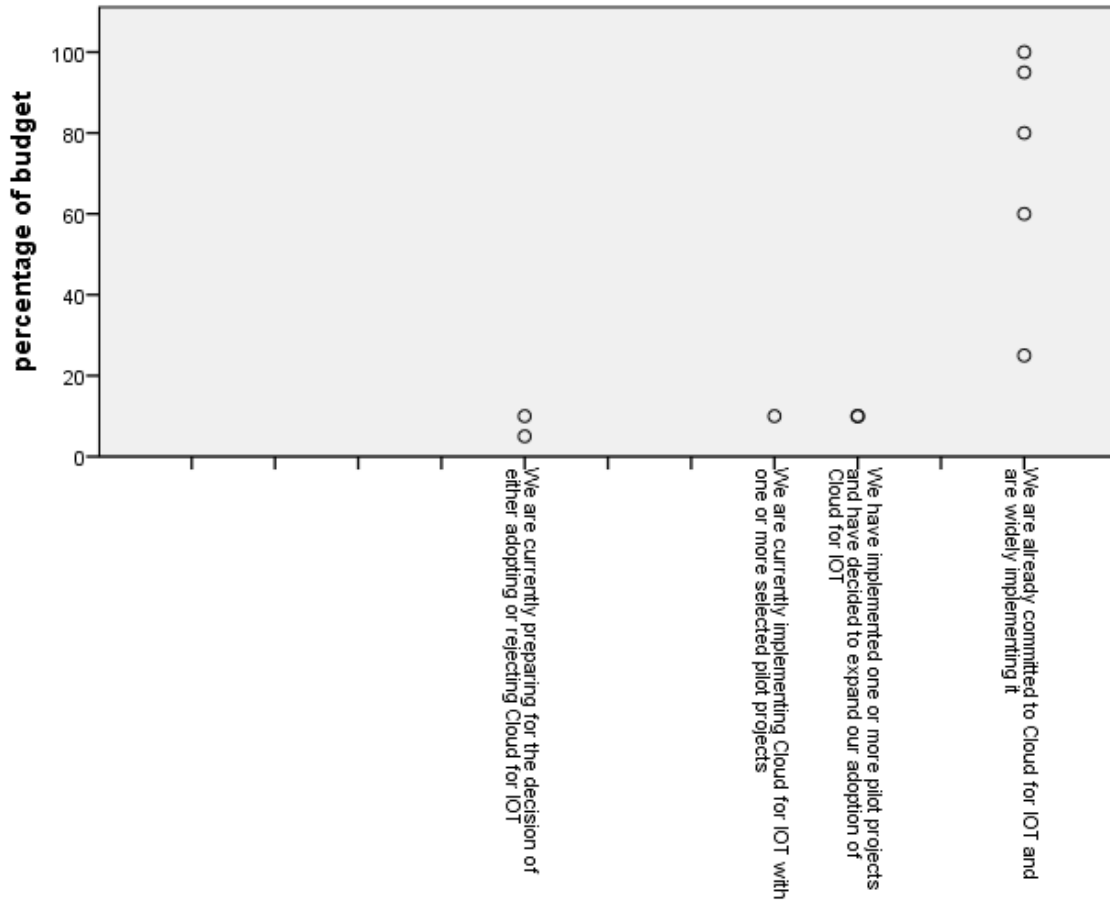


FIGURE 8 Budget allocation per adoption level

Cloud for IOT adoption rates throughout the years may be seen in TABLE 6. From the result of the survey, considering the entire amount of respondents, only 23% filled in this data, nonetheless it is apparent that adoption rate increases after 2013, from 19% to 31%. However, most organizations seem to adopt cloud for IOT in the space of one year after initiating the first project.

TABLE 6 Year of first project using Cloud for IOT

		<b>N(69)</b>	<b>Percent</b>	<b>Valid Percent</b>
Valid	2004	1	1.4	6.3
	2005	1	1.4	6.3
	2009	2	2.9	12.5
	2010	1	1.4	6.3
	2011	1	1.4	6.3
	2012	1	1.4	6.3
	2013	3	4.3	18.8
	2014	5	7.2	31.3
	2015	1	1.4	6.3
		Total	16	23.2
Total		69	100.0	

By analysing the responses given by the cloud for IOT adopters, it becomes obvious that most projects are quite successful and deliver on time, on budget and on specification while delivering the initial set of requirements. This is presented in TABLE 7. However about 11% of organizations experienced projects where a negative result was achieved.

TABLE 7 Success for cloud for IOT projects (5 - slightly successful, 6 - mostly successful)

<b>Project delivery</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
on time			1	2	4	2
on budget			2	2	3	2
with all features and functions	1			4	1	3
with the benefits and value expected	1			4	1	3

Scale: 2) Mostly unsuccessful to 7) Completely successful. Count: 9 organizations

This research has the goals of (i) discovering the status of adoption for cloud for IOT and (ii) explaining the reasons behind it. Moreover, the study proposes to relate that level of adoption with a specific framework which in turn has been developed from the UTAUT2 and extended to include constructs of security and eudaimonic well-being. Next it is presented a reflection on how these goals have been achieved.

#### *What is the status of adoption for cloud for IOT?*

According to the survey results the adoption of cloud for IOT has started roughly in 2004 and slowly increased until 2013, the year where more organizations start their attempts to be a part of the IOT world by creating pilot projects. In 2015 we see an adoption rate of 23% for cloud for IOT concerning the target sample which in turn corresponds to the universe of potential cloud for IOT adopters. Overall 2013 and 2014 are the years of biggest adoption of cloud for IOT, where levels of 19% and 31% are respectively reported. However many companies are still unaware of cloud for IOT, about 8%, while others are aware at some level but do not see the need or reason to endeavour cloud for IOT. The previous is then added to the remainder that decided not to adopt cloud for IOT, which amounts to a 68% of non-adopters of cloud for IOT.

#### *Is the level of adoption influenced by the manager as champion of a technology and by security concerns?*

Although there are limitations arising from the data obtained from the questionnaire, such as the geographical limitation, i.e., respondents were from Finland, Europe, several respondents did made clear that security was a top concern, either when there is it the lack of it or if there is the need to assure and demonstrate it. The need of communicating the concepts and innovating ideas related to cloud for IOT products and concepts is also present in several testimonials, from influencing internal stakeholders to bringing awareness to final consumers of the product that is created around a cloud for IOT concept.



There appears to be a wide range of concerns that worry the organizations endeavouring cloud for IOT. Moreover, several organizations have pinpointed that security at different areas is an item to take into consideration even if it means simply to educate the customers. Concerns span also the need to evangelize the decision makers towards cloud for IOT products and capabilities thereof, either at customer side or internally so to that business goals may be satisfactorily achieved and consequently allow further increase on adoption levels of cloud for IOT. These findings are in sync with the framework that was developed and presented with this research; to be more precise, they correspond to the items of Security and Eudaimonic well-being discussed below, the later affecting directly the organization manager.

### 5.3 Reliability Assessment

Internal consistency reliability was tested by using Cronbach alpha on the 8 constructs across 32 questions from the survey. Cronbach alpha is used typically when multiple Likert items are summed to create a composed scale as is the case in the framework part of the questionnaire. Cronbach alpha is used in social science literature because it gives a measure of reliability that can be obtained in one single application of a questionnaire. The global value was .971, which is higher than the required .7 value, in order to have a consistent set of scales with multiple items. The Cronbach alpha for the scales which were obtained by analyzing the items separately reveals also a good consistency between the items, ranging from .7 to .97 values. However 3 items had Cronbach  $< .7$  which would indicate that these items may need to be deleted. By analyzing the means and standard deviation, these were observed to be values close to the remainder means and standard deviation, for this reasons, the items were left included. Summarizing, the items were composed and TABLE 8 shows Cronbach alpha  $> .7$  for all items except for effort expectancy, price value and security which indicates some rewording might be needed in the questionnaire; however these values are  $> 0.6$  which is an acceptable value for Cronbach alpha.

TABLE 8 Cronbach alpha for framework items

Variables	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Performance Expectancy	.871	.931
Effort Expectancy	.666	.942
Social Influence	.838	.933
Facilitating Conditions	.710	.940
Eudaimonic Well-Being	.851	.932
Price Value	.699	.941
Habit	.862	.932
Behavioural Intention	.881	.930
Security	.656	.943

#### 5.4 Summary statistics for the framework constructs

The framework constructs were assessed by utilizing a seven (7) point Likert scale, as in the original UTAUT. Each construct was represented in the questionnaire by several items; these items were then combined and averaged to obtain a set of composed variables. A higher result represents a higher level of impact on adoption of cloud for IOT and reversely a lower result would mean a lower level of cloud for IOT adoption. These are visible on TABLE 9 along with the respective descriptive statistics. The highest average value was Eudaimonic Well-Being and the lowest average value recorded was Habit. Nonetheless, the remainder averages have close values between 4.16 and 4.65.

TABLE 9 Summary statistics for extended UTAUT2 framework constructs

Constructs	N		Mean	Std. Deviation	Minimum	Maximum
	Valid	Missing				
Performance Expectancy	67	2	4.60	1.624	1	7
Effort Expectancy	67	2	4.46	1.341	1	7
Social Influence	68	1	4.37	1.665	1	7
Facilitating Conditions	69	0	4.65	1.589	1	7
Eudaimonic Well-Being	68	1	4.78	1.485	1	7
Price Value	68	1	4.59	1.212	1	7
Habit	67	2	3.85	1.828	1	7
Behavioural Intention	68	1	4.59	1.747	1	7
Security	68	1	4.16	1.114	1	7

To find out whether the data is normally distributed it was tested for skewness and kurtosis. The kurtosis value measures the whether the data is peaked or flat relative to its normal distribution. It is assumed that a normal distribution will have skewness values between -2 and +2. The constructs showed in TABLE 10 values for skewness between -.596 and -.156 with standard error  $\leq .293$ , consequently the data is considered to be normally distributed.

TABLE 10 Skewness and Kurtosis values for the constructs

	N		Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Minimum	Maximum
	Valid	Missing						
Performance Expectancy	67	2	-.474	.293	-.090	.578	1	7
Effort Expectancy	67	2	-.326	.293	.117	.578	1	7
Social Influence	68	1	-.231	.291	-.463	.574	1	7
Facilitating Conditions	69	0	-.423	.289	-.337	.570	1	7
Eudaimonic Well-Being	68	1	-.707	.291	.364	.574	1	7
Price Value	68	1	-.394	.291	1.250	.574	1	7
Habit	67	2	-.156	.293	-.858	.578	1	7
Behavioural Intention	68	1	-.515	.291	-.363	.574	1	7
Security	68	1	-.596	.291	1.036	.574	1	7

## 5.5 Correlations

To determine if two variables are linearly related to each other, bivariate correlation may be used. If the variables are non-parametric and one or both scales is neither interval nor ratio, then a non-parametric test, such as Spearman may be used. This is also the case because the data are represented by ordinal scales. However, although correlation does not prove the existence of a relation between cause and effect, it is useful because it shows that this relationship exists.

In TABLE 11, the Spearman  $\rho$  (rho) is shown, along with explanation of the values obtained. The Spearman's rho statistics measure the rank-order association between two scale or ordinal variables. Spearman works regardless of the distributions of the variables. Below is presented the description of the Spearman results.

There was a significant correlation between Performance Expectancy and Behavioural Intention ( $\rho = .782$ ,  $n=67$ ,  $p<0.0005$ , two-tailed). There was a significant correlation between Effort Expectancy and Behavioural Intention ( $\rho = .534$ ,  $n=67$ ,  $p<0.0005$ , two-tailed). There was a significant correlation between Social Influence and Behavioural Intention ( $\rho = .740$ ,  $n=68$ ,  $p<0.0005$ , two-tailed). There was a significant correlation between Facilitating Conditions and Behavioural Intention ( $\rho = .636$ ,  $n=68$ ,  $p<0.0005$ , two-tailed). There was a significant correlation between Eudaimonic Well-Being and Behavioural Intention ( $\rho = .756$ ,  $n=68$ ,  $p<0.0005$ , two-tailed). There was a significant correlation between Price Value and Behavioural Intention ( $\rho = .622$ ,  $n=68$ ,  $p<0.0005$ , two-tailed). There was a significant correlation between Habit and Behavioural In-

tention ( $\rho = .826$ ,  $n=67$ ,  $p<0.0005$ , two-tailed). There was a significant correlation between Security and Behavioural Intention ( $\rho = .608$ ,  $n=68$ ,  $p<0.0005$ , two-tailed).

The results for Spearman calculations in TABLE 11 are in line with the UTAUT2 framework previous results, confirming the original hypotheses. Accordingly, the correlations for Eudaimonic Well-Being and Security are also significant. Summarizing, all constructs were significantly correlated with Behavioural Intention, including the newly introduced Eudaimonic Well-Being and Security.

TABLE 11 Correlations utilizing Spearman's rho for the constructs

			PE	EE	SI	FC	EWB	PV	H	BI	S
Spearman's rho	PE	CC	1.000								
		Sig. (2-tailed)	.								
		N	67								
	EE	CC	.630**	1.000							
		Sig. (2-tailed)	.000	.							
		N	66	67							
	SI	CC	.699**	.499**	1.000						
		Sig. (2-tailed)	.000	.000	.						
		N	67	67	68						
	FC	CC	.599**	.698**	.543**	1.000					
		Sig. (2-tailed)	.000	.000	.000	.					
		N	67	67	68	69					
	EWB	CC	.763**	.536**	.780**	.536**	1.000				
		Sig. (2-tailed)	.000	.000	.000	.000	.				
		N	67	67	68	68	68				
	PV	CC	.659**	.479**	.594**	.564**	.575**	1.000			
		Sig. (2-tailed)	.000	.000	.000	.000	.000	.			
		N	67	67	68	68	68	68			
	H	CC	.742**	.575**	.775**	.673**	.767**	.618**	1.000		
		Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.		
		N	66	67	67	67	67	67	67		
	BI	CC	.782**	.534**	.740**	.636**	.756**	.622**	.826**	1.000	
		Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.	
		N	67	67	68	68	68	68	67	68	
	S	CC	.539**	.346**	.552**	.370**	.545**	.534**	.560**	.608**	1.000
		Sig. (2-tailed)	.000	.004	.000	.002	.000	.000	.000	.000	.
		N	67	67	68	68	68	68	67	68	68

\*\* . Correlation is significant at the 0.01 level (2-tailed). CC = Correlation Coefficient

## 5.6 Analysis of the Variance (ANOVA Two-Way)

In order to investigate the statistical differences between the constructs from the developed framework (UTAUT2 extended), an analysis of variance (ANOVA Two-Way) was performed. The independent variables were Performance Ex-

pectancy (PE), Effort Expectancy (EE), Facilitating Conditions (FC), Social Influence (SI), Habit (H), Price Value (PV), along with extension to UTAUT2 independent variables being, Security (S) and (replacing from UTAUT2 Hedonic Behavior) Eudaimonic Well-Being (EWB). The ANOVA (Two-Way) investigates also the influence strength on the effect of the each of the previous constructs into the dependent variable: Behavior Intention, when moderated by Age and Experience. The UTAUT2 and the framework developed in this study also include Gender as a moderator. However, there were only four respondents for which Gender had the value 'Female'. Consequently the moderator 'Gender' was dropped from this analysis.

### 5.6.1 Performance Expectancy effect on Behavioural Intention (moderated by age and experience)

On TABLE 12 the results indicate that: there was a significant main effect of Performance Expectancy ( $F(6, 29) = 20.959$ ,  $p < 0.0005$  see TABLE 12, FIGURE 9 below); meanwhile there was no significant interaction for construct Performance Expectancy when moderated by Age of respondent  $F(5, 29) = 0.297$ ,  $p = 0.911$ ) nor when moderated by Experience of respondent  $F(11, 29) = 0.610$ ,  $p = 0.805$ ).

TABLE 12 ANOVA (Two-Way) – Performance Expectancy effect on Behavioural Intention moderated by Age and Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	176.107 <sup>a</sup>	37	4.760	4.928	.000
Intercept	523.198	1	523.198	541.654	.000
Performance Expectancy	121.469	6	20.245	20.959	.000
Performance Expectancy * Q2	1.433	5	.287	.297	.911
Performance Expectancy * Q6	6.478	11	.589	.610	.805
Error	28.012	29	.966		
Total	1620.000	67			
Corrected Total	204.119	66			

a. R Squared = .863 (Adjusted R Squared = .688); Q2 = Age; Q6 = Experience

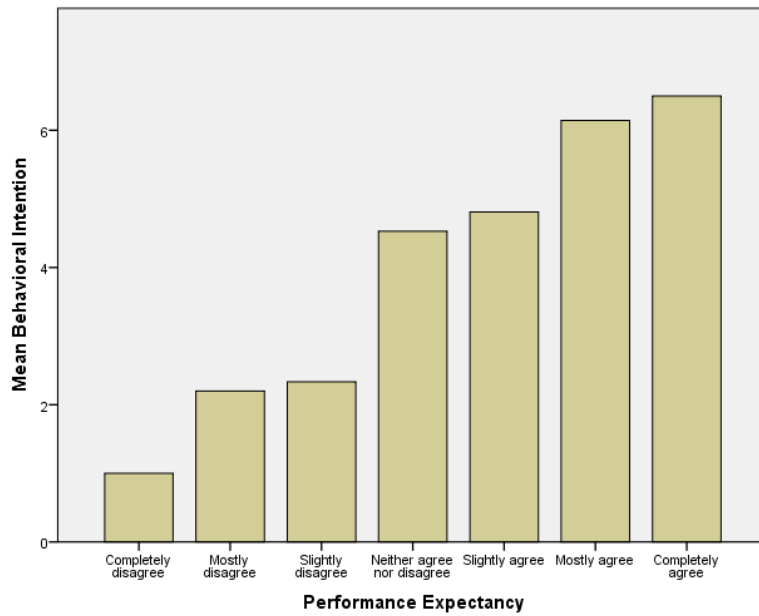


FIGURE 9 Effect of Performance Expectancy over Behavioural Intention

### 5.6.2 Effort Expectancy effect on Behavioural Intention (moderated by age and experience)

In TABLE 13 are the ANOVA (two-way) results for Effort Expectancy over Behavioural Intention when moderated by Age (Q2) or Experience (Q6). The results are: there was a significant interaction for the construct Effort Expectancy  $F(6, 32) = 3.944, p = 0.005$  (see FIGURE 10 below); meanwhile there was no significant interaction between the construct Effort Expectancy and the moderator Age of respondent  $F(4, 32) = 0.034, p = 0.998$ ; ) nor when moderated by Experience of respondent  $F(9, 32) = 1.199, p = 0.330$ .

TABLE 13 ANOVA (Two-Way) – Effort Expectancy effect on Behavioural Intention moderated by Age and Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	136.191 <sup>a</sup>	34	4.006	1.887	.037
Intercept	515.777	1	515.777	242.974	.000
Effort Expectancy	50.228	6	8.371	3.944	.005
Effort Expectancy * Q2	.287	4	.072	.034	.998
Effort Expectancy * Q6	22.898	9	2.544	1.199	.330
Error	67.929	32	2.123		
Total	1620.000	67			
Corrected Total	204.119	66			

a. R Squared = .667 (Adjusted R Squared = .314)

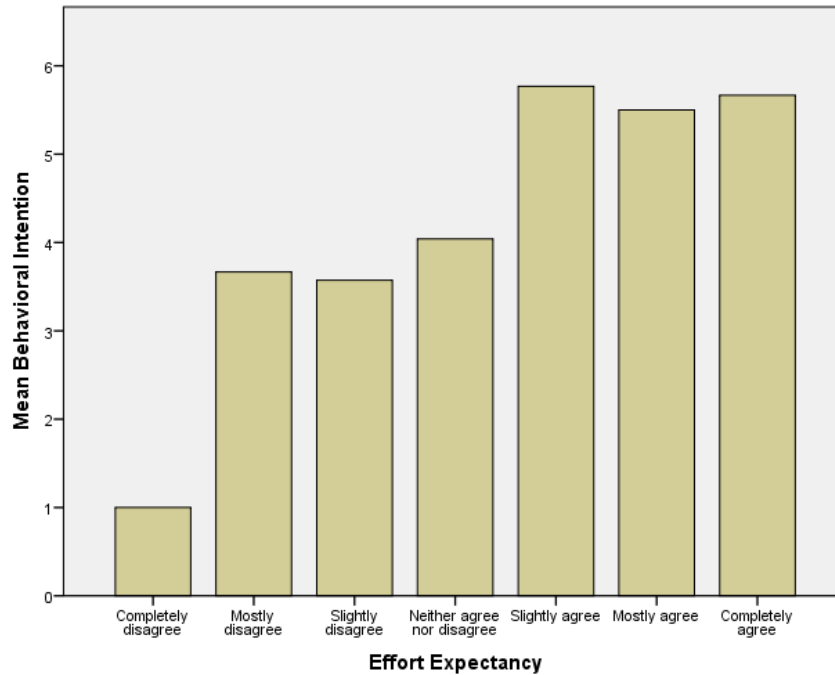


FIGURE 10 Effect of Effort Expectancy over Behavioural Intention

### 5.6.3 Social Influence effect on Behavioural Intention (moderated by age and experience)

In TABLE 14 are the ANOVA (two-way) results for Social Influence over Behavioural Intention when moderated by Age (Q2) or Experience (Q6). The results are: there was a significant interaction for the construct Social Influence,  $F(6, 32) = 26.652$ ,  $p < 0.005$  (see FIGURE 11 below); meanwhile there was no significant interaction between the construct Social Influence and the moderator Age of respondent  $F(6, 32) = 2.180$ ,  $p = .071$ ) nor when moderated by Experience of respondent  $F(10, 32) = 1.767$ ,  $p = 0.108$ ).

TABLE 14 ANOVA (Two-Way) - Social Influence effect on Behavioural Intention moderated by Age and Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	183.137 <sup>a</sup>	35	5.232	7.849	.000
Intercept	526.011	1	526.011	789.016	.000
Social Influence	106.609	6	17.768	26.652	.000
Social Influence Q2	*8.721	6	1.453	2.180	.071
Social Influence Q6	*11.781	10	1.178	1.767	.108
Error	21.333	32	.667		
Total	1636.000	68			
Corrected Total	204.471	67			

a. R Squared = .896 (Adjusted R Squared = .782)

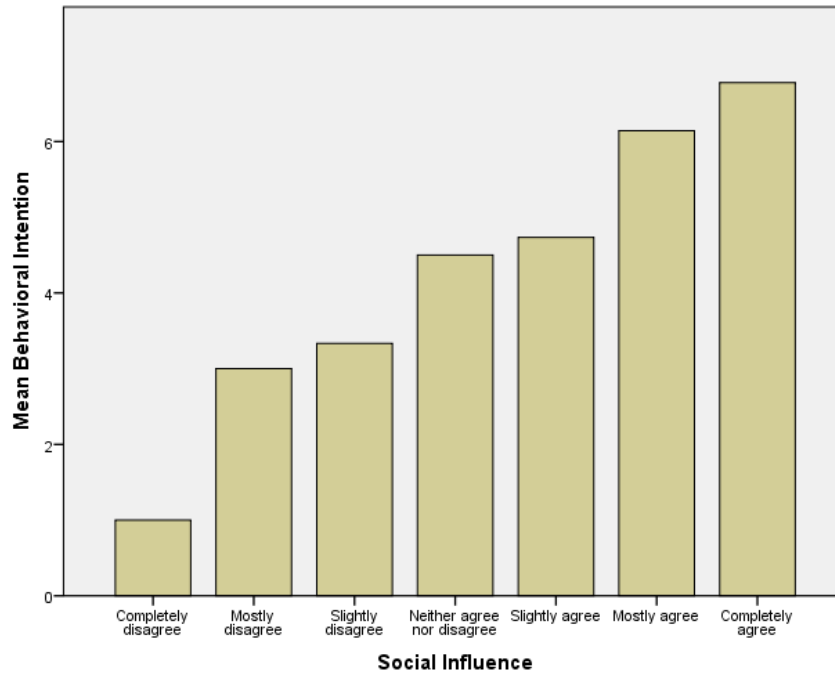


FIGURE 11 Effect of Social Influence over Behavioural Intention

#### 5.6.4 Facilitating Conditions effect on Behavioural Intention (moderated by age and experience)

In TABLE 15 are the ANOVA (two-way) results for Facilitating Conditions over Behavioural Intention when moderated by Age (Q2) or Experience (Q6). The results are: there was a significant interaction for the construct Facilitating Conditions,  $F(6, 34) = 6.323$ ,  $p < 0.005$  (see FIGURE 12 bellow); meanwhile there was no significant interaction between the construct Facilitating Conditions and the moderator Age of respondent  $F(7, 34) = .627$ ,  $p = 0.730$  nor when moderated by Experience of respondent  $F(9, 34) = 1.826$ ,  $p = 0.099$ ;

TABLE 15 ANOVA (Two-Way) - Facilitating Conditions effect on Behavioural Intention moderated by Age and Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	145.887 <sup>a</sup>	33	4.421	2.566	.004
Intercept	518.556	1	518.556	300.954	.000
Facilitating Conditions	65.368	6	10.895	6.323	.000
Facilitating Conditions * Q2	7.566	7	1.081	.627	.730
Facilitating Conditions * Q6	28.313	9	3.146	1.826	.099
Error	58.583	34	1.723		
Total	1636.000	68			
Corrected Total	204.471	67			

a. R Squared = .713 (Adjusted R Squared = .435)



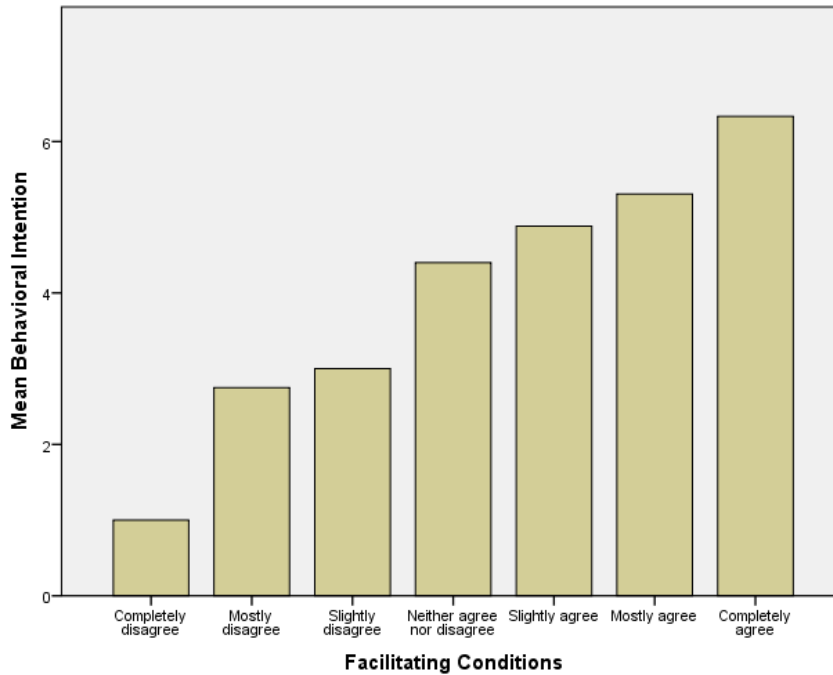


FIGURE 12 Effect of Facilitating Conditions over Behavioural Intention

### 5.6.5 Eudaimonic Well-Being effect on Behavioural Intention (moderated by age and experience)

In TABLE 16 are the ANOVA (two-way) results for Eudaimonic Well-Being over Behavioural Intention when moderated by Age (Q2) or Experience (Q6). The results are: there was a significant interaction for the construct Eudaimonic Well-Being,  $F(6, 32) = 21.548$ ,  $p < 0.005$ ) (see FIGURE 13 bellow); meanwhile there was no significant interaction between the construct Eudaimonic Well-Being and the moderator Age of respondent  $F(6, 32) = 1.271$ ,  $p = 0.298$ ) nor when moderated by Experience of respondent  $F(8, 32) = 0.704$ ,  $p = 0.685$ );

TABLE 16 ANOVA (Two-Way) - Eudaimonic Well-Being effect on Behavioural Intention moderated by Age and Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	177.137 <sup>a</sup>	35	5.061	5.925	.000
Intercept	476.380	1	476.380	557.714	.000
Eudaimonic Well-Being	110.434	6	18.406	21.548	.000
Eudaimonic Well-Being * Q2	6.515	6	1.086	1.271	.298
Eudaimonic Well-Being * Q6	4.813	8	.602	.704	.685
Error	27.333	32	.854		
Total	1636.000	68			
Corrected Total	204.471	67			

a. R Squared = .866 (Adjusted R Squared = .720)

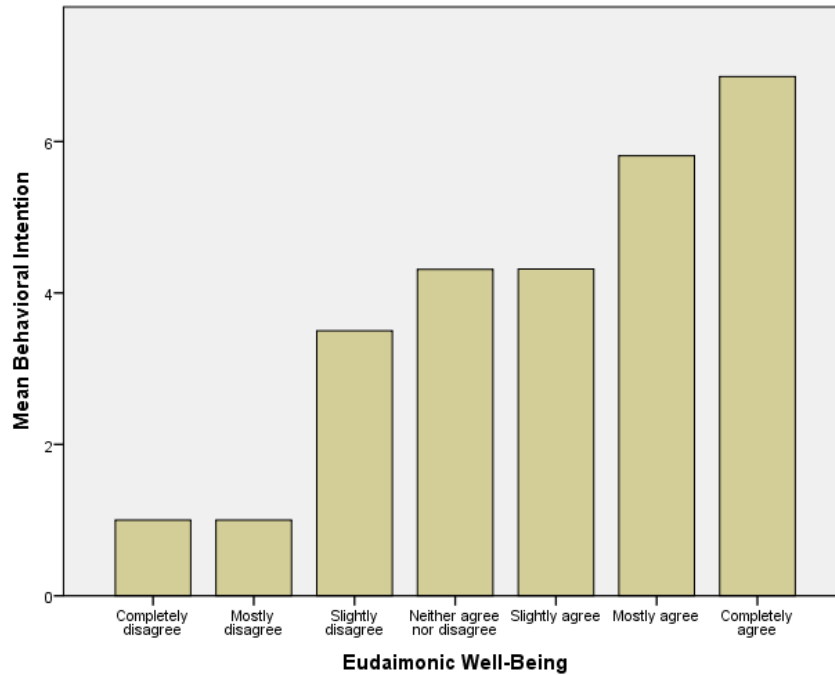


FIGURE 13 Effect of Eudaimonic Well-Being over Behavioural Intention

### 5.6.6 Price Value effect on Behavioural Intention (moderated by age and experience)

In TABLE 17 are the ANOVA (two-way) results for Price Value over Behavioural Intention when moderated by Age (Q2) or Experience (Q6). The results are: there was a significant interaction for the construct Price Value,  $F(6, 34) = 8.752$ ,  $p < 0.005$ ) (see FIGURE 14 below); meanwhile there was no significant interaction between the construct Price Value and the moderator Age of respondent  $F(4, 34) = 0.074$ ,  $p = 0.990$ ) nor when moderated by Experience of respondent  $F(9, 34) = 0.794$ ,  $p = 0.624$ ).

TABLE 17 ANOVA (Two-Way) - Price Value effect on Behavioural Intention moderated by Age and Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	129.037 <sup>a</sup>	33	3.910	1.762	.053
Intercept	476.207	1	476.207	214.640	.000
Price Value	52.514	6	8.752	3.945	.004
Price Value * Q2	.660	4	.165	.074	.990
Price Value * Q6	15.862	9	1.762	.794	.624
Error	75.433	34	2.219		
Total	1636.000	68			
Corrected Total	204.471	67			

a. R Squared = .631 (Adjusted R Squared = .273)

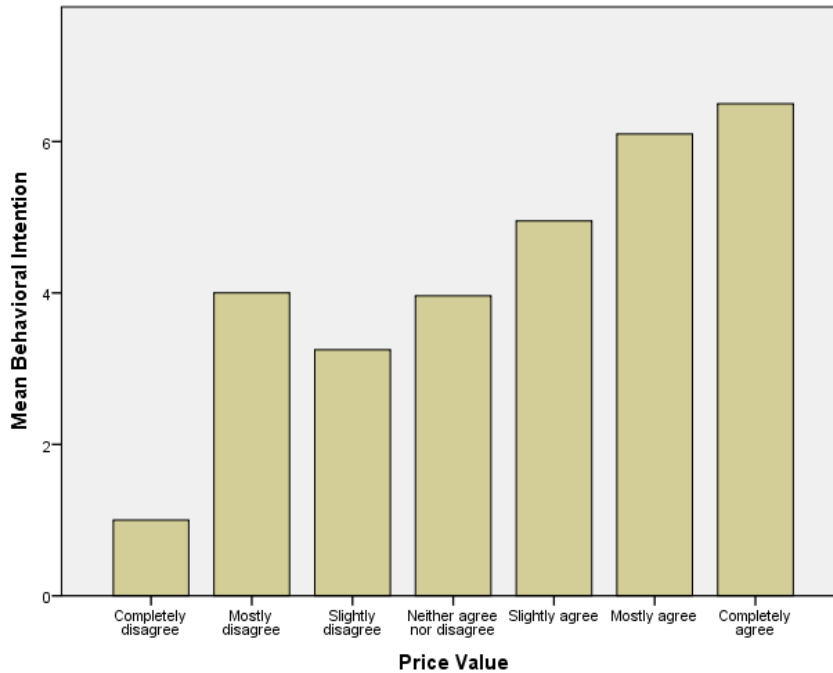


FIGURE 14 Effect of Price Value over Behavioural Intention

### 5.6.7 Habit effect on Behavioural Intention (moderated by age and experience)

In TABLE 18 are the ANOVA (two-way) results for Habit over Behavioural Intention when moderated by Age (Q2) or Experience (Q6). The results are: there was a significant interaction for the construct Habit,  $F(6, 31) = 19.189$ ,  $p < 0.005$  (see FIGURE 15 bellow); meanwhile there was no significant interaction between the construct Habit and the moderator Age of respondent  $F(7, 31) = 1.247$ ,  $p = 0.308$  nor when moderated by Experience of respondent  $F(10, 31) = 1.390$ ,  $p = 0.231$ ).

TABLE 18 ANOVA (Two-Way) - Habit effect on Behavioural Intention moderated by Age and Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	178.453 <sup>a</sup>	35	5.099	6.158	.000
Intercept	569.036	1	569.036	687.278	.000
H	95.327	6	15.888	19.189	.000
H * Q2	7.226	7	1.032	1.247	.308
H * Q6	11.509	10	1.151	1.390	.231
Error	25.667	31	.828		
Total	1620.000	67			
Corrected Total	204.119	66			

a. R Squared = .874 (Adjusted R Squared = .732)

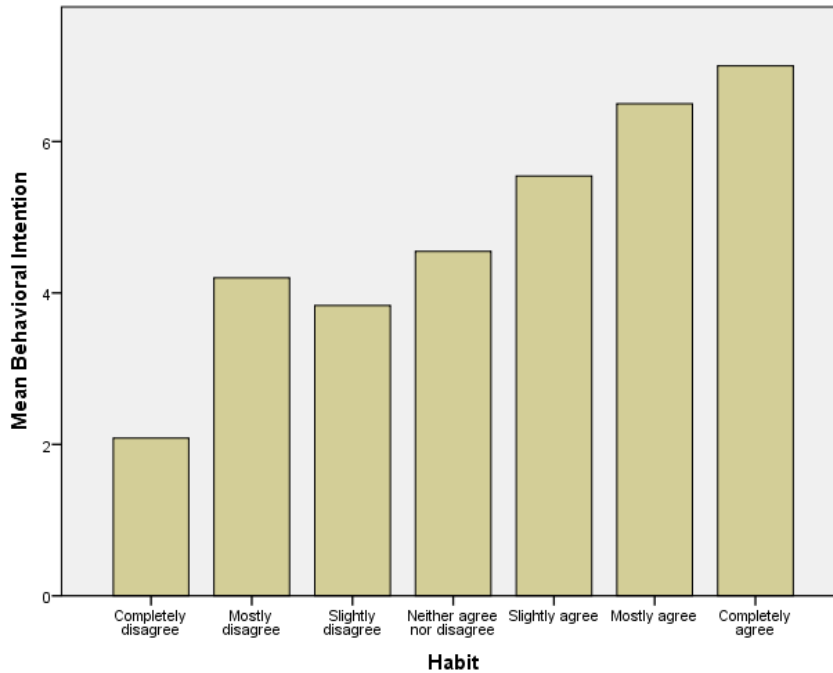


FIGURE 15 Effect of Habit over Behavioural Intention

### 5.6.8 Security effect on Behavioural Intention (moderated by age and experience)

In TABLE 19 are the ANOVA (two-way) results for Security over Behavioural Intention when moderated by Age (Q2) or Experience (Q6). The results are: there was a significant interaction for the construct Security,  $F(6, 36) = 7.854$ ,  $p < 0.005$  (see FIGURE 16 below); meanwhile there was no significant interaction between the construct Security and the moderator Age of respondent  $F(3, 36) = 0.072$ ,  $p = 0.974$  nor when moderated by Experience of respondent  $F(8, 36) = 1.146$ ,  $p = 0.358$ .

TABLE 19 ANOVA (Two-Way) - Security effect on Behavioural Intention moderated by Age and Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	142.104 <sup>a</sup>	31	4.584	2.646	.003
Intercept	452.814	1	452.814	261.378	.000
Sec	81.635	6	13.606	7.854	.000
Sec * Q2	.377	3	.126	.072	.974
Sec * Q6	15.881	8	1.985	1.146	.358
Error	62.367	36	1.732		
Total	1636.000	68			
Corrected Total	204.471	67			

a. R Squared = .695 (Adjusted R Squared = .432)

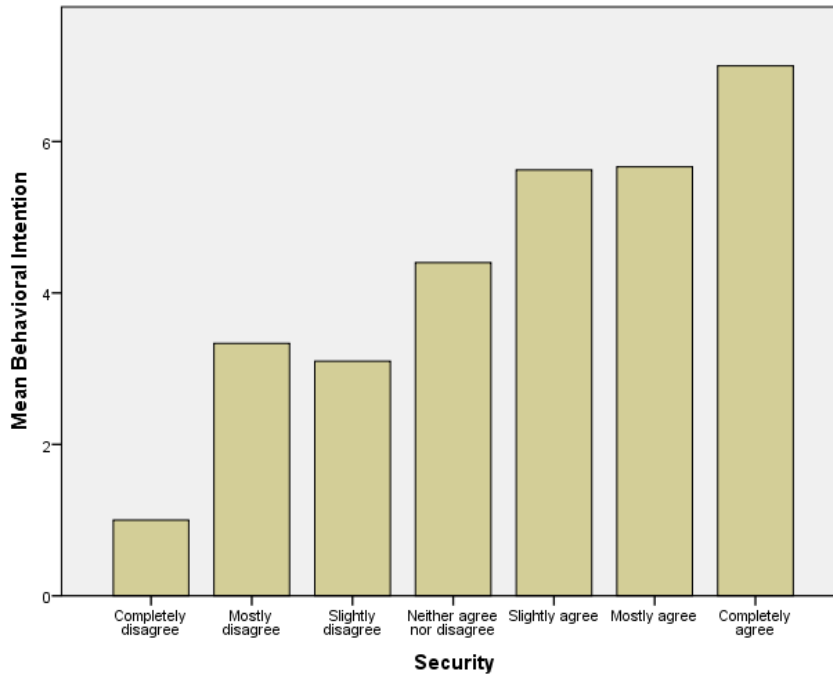


FIGURE 16 Effect of Security over Behavioural Intention

Overall, it can be said that the assumptions from the UTAUT2 extended framework stand confirmed and the independent variables of Performance Expectancy, Effort Expectancy, Facilitating Conditions, Social Influence, Habit and Price Value along with the extensions of Eudaimonic Well-Being and Security do positively have a significant effect on Behavioural Intention. However, the effects of the moderators Age and Experience from the UTAUT2 do not influence the effect size on Behavioural Intention from the above independent variables.

## 5.7 The Chi-Square Test of Independence

The chi-square test of independence is used to determine whether there is a relationship between two categorical variables. In this research the assumption is that two or more variables are independent when analyzing the intention to use or adopting cloud for IOT by organizations. Bellow on TABLE 20, when analyzing the composed variables from each construct group, the outcome of the Chi-Square tests had a significant value for all the constructs, with  $p < 0.05$ , consequently the researcher considers this result to be positive concluding that a good significant relationship exists between the independent variables and the dependent variable, Behavioural Intention to adopt cloud for IOT.

TABLE 20 Chi-Square tests of independence for composed variables

Composed variables	Chi-Square	Df	Asymp. Sig.
Performance Expectancy	143.458	36	.000
Effort Expectancy	79.206	36	.000
Social Influence	137.712	36	.000
Facilitating Conditions	85.446	36	.000
Eudaimonic Well-Being	133.856	36	.000
Price Value	67.975	36	.001
Habit	134.632	36	.006
Security	64.143	36	.003

## 5.8 Multiple Regression Analysis

In order to determine the capability of the independent variables to predict the outcome towards the dependent variable, Behavioural Intention, multiple regression analysis was performed. Complex relations were used, taken from the developed framework and described at each respective point of analysis below.

This study proposes the question of whether the UTAUT2 extended may be used to explain adoption of technology and its behavioural intention; in the case of cloud for IOT, while having the manager as a champion of the technology that represents the organization as an entity that consumes the technology, effectively replacing the role of the consumer/person from the original UTAUT2.

Using the 'Enter' method (in SPSS, all independent variables are entered into the equation, in one step, also called "forced entry"), the models proved significant as described below:

- Performance Expectancy as a predictor of Behavioural Intention when moderated by Age and Experience ( $F(3, 63) = 59.646, p < 0.0005$ ), Adjusted R Square = 0.727;
- Effort Expectancy as a predictor of Behavioural Intention when moderated by Age and Experience ( $F(3, 63) = 10.482, p < 0.0005$ ), Adjusted R Square = 0.301;
- Social Influence as a predictor of Behavioural Intention when moderated by Age and Experience: ( $F(3, 64) = 37.828, p < 0.0005$ ). Adjusted R Square = 0.623;
- Facilitating Conditions as a predictor of Behavioural Intention when moderated by Age and Experience: ( $F(3, 64) = 17.506, p < 0.0005$ ). Adjusted R Square = 0.425;
- Eudaimonic Well-Being as a predictor of Behavioural Intention when moderated by Age and Experience: ( $F(3, 64) = 40.726, p < 0.0005$ ). Adjusted R Square = 0.656;

- Price Value as a predictor of Behavioural Intention when moderated by Age and Experience: ( $F(3, 64) = 16.135, p < 0.0005$ ). Adjusted R Square = 0.404;
- Habit as a predictor of Behavioural Intention when moderated by Age and Experience: ( $F(3, 64) = 47.651, p < 0.0005$ ). Adjusted R Square = 0.680;
- Security as a predictor of Behavioural Intention when moderated by Age and Experience: ( $F(3, 64) = 17.819, p < 0.0005$ ). Adjusted R Square = 0.430.

Experience and Age were not significant predictors in all the models. However the relatively high values of the adjusted R square indicate that the constructs explains the variance in Behavioural Intention to use cloud for IOT to a reasonable extent as presented in TABLE 21. Thus it may be said that the model constructs are significant predictors of Behavioural Intention.

TABLE 21 Model contribution to predicting Behavioural Intention

Predictor Variable	Beta	p	% variance
Performance Expectancy	0.822	$p < 0.0005$	73%
Effort Expectancy	0.461	$p < 0.0005$	30%
Social Influence	0.773	$p < 0.0005$	62%
Facilitating Conditions	0.620	$p < 0.0005$	43%
Eudaimonic Well-Being	0.796	$p < 0.0005$	64%
Price Value	0.555	$p < 0.0005$	40%
Habit	0.857	$p < 0.0005$	68%
Security	0.571	$p < 0.0005$	43%

## 5.9 Summary of the statistical analysis results

For this research data was collected from a questionnaire sent to 1256 managers in ICT companies. Furthermore the data was analyzed utilizing SPSS v21 analysis tool. The respondents filled in data for the framework developed for this research by choosing responses in a Likert scale format, ranging from Totally Disagree to Totally Agree. Later these values were made to correspond to numerical values 0 to 7. The values 0 to 3 meant no adoption and 5 to 7 meant adoption of cloud for IOT, while 4 meant 'Neither Agree Nor Disagree'. The analysis had in consideration the limitations of the scales concerning normality and linearity.

Two research questions were formulated and a hypothesis was presented for further examination. The Pearson rho was used to test the hypothesis, however since correlation is not proof of causality as no variables are controlled, multiple regression was performed to investigate the research question since it allowed to control for other variables.

In the demographic part of the questionnaire, descriptive statistics were performed. Furthermore, a similar treatment was given to the 'Status of Adoption' part, and open questions were analyzed and interpreted qualitatively. To answer the research question, the data taken from the framework related questions was analyzed utilizing descriptive statistics, reliability analysis, analysis of variance (ANOVA) and multiple regression analysis. The return rate for the questionnaire was a low 5% when compared to other online surveys with response rate of about 40%. However the number of responses was almost 10 times the number of factors, which permitted to analyze the data correctly. Included in the analysis was an evaluation of the reliability and the validity for the constructs measured and these were assumed a good fit for the research. To verify the degree of independence of the measured variables a Chi-Square analysis was performed and a significant result was obtained.

ANOVA analysis showed the existence of significant interactions between each independent variable and Behavioural Intention of using cloud for IOT. However, when the moderators of Age and Experience were taken into account, the measured effects on Behavioural Intention were not significant. Finally multiple regressions showed positive correlations between each construct and the dependent variable, i.e., increasing each of the independent variables would in fact produce an increase on the dependent variable, Behavioural Intention, which allowed to refuse the null hypothesis of the research question and to conclude that the UTAUT2 extended as developed in this research is able to explain Behavioral Intention to use of cloud for IOT for an organization, when measuring the variable levels against the organization manager.



## 6 Discussion and conclusions

The objective of this chapter is to summarize the results in relation to the knowledge base elated from the literature review, and to infer conclusions supported with empirical evidence. Parallel to this, an internal review is performed in order to assess the strengths and limitations of the research here presented and suggest directions that may aid future research as well as cloud for IOT vendors.

In detail, data will be summarized; suggestions will be presented on how to utilize the findings towards improving an organization's understanding of the cloud for IOT needs in order to improve adoption. The statistical analysis will be used to explain to coming researchers and to field workers what and how the constructs of the framework may be utilized to influence decision makers on adoption of cloud for IOT.

The chapter includes the discussion of results, limitations, recommendation for future research and conclusion.

### 6.1 Discussion

Survival is a skill that feeds itself on ingenuity, which in turn is catalyzed by innovation. A new discovery or technology may be a revolution or an evolution, i.e. it may be constructed from zero and be totally new or composed by a set of existing technologies that together give credit to the Aristotelian quote: "the all is greater than the sum of the parts". Sometimes the effect of the innovation is a continuous one, where one technology replaces and enhances the outcome of an older one. Sometimes this innovation is disruptive and shakes the structures, technical and social, that are touched by its effect. Cloud computing has had both types of effect as it replaces existing IT structures and enhances them by offering an elastic, on demand and charged per use, model, while challenging the now old paradigm of in-house IT operations. The same effect may be said to exist for IOT because although the vision is a bold one, the

idea of connecting things is not a novel one. However, the notion of having things connected, exchanging and inferring from data they collect in a collaborative manner, without human interference, along with the promise to enhance the quality of human life, is an innovative and disruptive idea that will transform radically the way we interact with and live on planet Earth.

Cloud computing has reached a rate of adoption that hardly will be reversed, at least in the near future. Everyday new companies are defining their systems and businesses as having a primal condition for success the 'no server in premises' resolution. This is not to say that Cloud computing adoption is without hurdles and no major issues exist. Security is for example a major concern for organizations adventuring into the cloud computing area. However, the benefits brought by the usage of cloud computing have been fully understood and accepted as positive by the continuously growing number of adopting organizations. The former circumstance does not seem to have had place in the IOT area. The IOT itself has still to achieve an equal level of adoption maturity relatively to the size of its promised potential of 50 billion things connected in 2020. Fortunately the IOT promise of 'Huge Data' and the needs to process it, makes the IOT a perfect ally to the cloud computing concept. This in turn creates an opportunity for another boost of innovation materialized into cloud for IOT, by adding to the cloud a series of qualities that are specific for the IOT such as communication protocols, compatibility with different hardware and systems, and controlling remotely things connected. Unfortunately, with size comes complexity and the number of communication protocols, multiplied by the different number of devices and within these the different devices capabilities, such as memory, processing power or energy consumption itself, brings to the equation a set of issues that are then added to the ones that cloud computing still has not been able to solve in order to potentiate its adoption level.

Diffusion of innovations theory states that a technology moves through different stages of adoption within each target group and it teaches us that convincing or evangelizing on the technology, is as important as the effects of the innovation itself. The idea of championing a technology is made clear. Accordingly, adoption theories and frameworks have been au-pair of innovation related research for a long time. Social sciences backed by marketing have developed these to attempt to explain the actual adoption and to attempt to predict the adoption of a technological innovation. The UTAUT2, being an evolution of a set of eight different theories, is an innovation in itself. In this research, the UTAUT2 was extended to include the construct of Security, to integrate Eudaimonic Well-Being (replaces Hedonic Behavior) while an empirical study was performed to assess the status of adoption of cloud for IOT by testing the factors that affect that adoption. To achieve this goal, a quantitative research design was utilized to sample 'Chief x Officer' level and managers from companies in ICT area of business located in Finland.

**Research question:** What is the status of adoption for cloud computing platforms which are specific to the internet of things?

Cloud for IOT is yet to become a mainstream technology for the organizations venturing into IOT. The adoption rate for cloud for IOT was found to be around 23%. Despite the fact that the first projects with cloud for IOT have had started at around 2004, the highest period of growth was identified to have had started in 2013 and continued into 2014 with a growth rate of 19% and 31% respectively. This seems to be connected to the fact that cloud adoption in itself had reached a mature level at about the same period. According to the survey, the majority of organizations starts with a share of about 10% of their budget for new projects and slowly increases that amount according to the maturity and success of their enterprise into cloud for IOT.

From the total of cloud for IOT adopters, a share of about 50% are at a high maturity level, taking several projects into cloud for IOT and utilizing up to 100% of budget for the new projects while about 20% is at a stage of assuming adoption and increasing the effort into cloud for IOT. The remainder 30% is considering cloud for IOT actively by implementing projects to help decide on adoption. In average these organizations spend on cloud for IOT about 17.5% of their budget for new IOT projects.

Most projects on cloud for IOT have experienced success at some level with very few organizations were reporting unsuccessful projects on IOT. Overall, 90% of the adopting organizations claim a very good level of success at all modes of delivery: on time, on scope and on budget.

On what concerns the problems faced when dealing with cloud for IOT, for organizations in a status of adoption, the focus was on how to present a case on cloud for IOT to the organization business stakeholders and how to evangelize end customers for the products developed using cloud for IOT. Other important issues nominated were security as a fact, such as authentication and even the awareness on security by customers of the products enabled by cloud for IOT. For organizations venturing into cloud for IOT which are in the early stages of investigation, knowledge at different areas is a major hurdle for reasons such as the span of IOT itself being too wide and difficult to grasp.

According to the survey results, cloud for IOT adoption is increasing exponentially, although half of that increase has been done only on the past few years and there is evidence that this growth is still in its infancy, at about 29%, half of the organizations that have decided to adopt cloud for IOT are at a very mature level of adoption.

Overall the results indicate that adopting cloud for IOT is a complex task and that organizations tend to enter the stages of early adoption with care, moving to a more mature level of adoption in a period of 1-2 years.

**Research question:** Can the adoption of technology by an organization be explained by the UTAUT2 extended framework when applied to a manager, having the manager as the representative of the organization?

The statistical analysis on the results for the framework related questions confirm the framework presented in this research and visible in FIGURE 4.

The results of statistical analysis for each construct in the framework indicated that these constructs would be able to explain and predict the Behavioural

intention to use the cloud for IOT. The results from the multiple regression analysis showed a contribution to the effect by the constructs on Behavioural Intention, ranging from 30% in Effort Expectancy to a high of 73% for Performance Expectancy. The other contributions are: Price Value = 40%; Facilitating Conditions = 43%; Security = 43%; Social Influence = 62%; Eudaimonic Well-Being = 64%; Habit = 68%. The moderator Gender was dropped for the lack of sufficient data and the contribution of the remaining moderators was found to be not significant. However, overall, this is supporting that the developed framework is capable of explaining the behavioral intention to use and adopt cloud for IOT to a very high level, in parallel with the original UTAUT2. Performance Expectancy and Habit had the highest Betas and are consequently the strongest predictors of cloud for IOT adoption. Social Influence and Eudaimonic Well-Being have very close levels as predictors of the adoption behavior intention. These indicators show that usability and knowledge of the properties of the technology, which are part of the perception of the technology, are the main areas to focus on when investigating the adoption intentions towards a technology. The research also shows that the social elements, impacting an individual that is seen in this research as the champion of the technology, also for the most cases the manager of the company, have a similar level of influence in the decision to adopt or reject a technology.

## 6.2 Limitations

Generalizing the results is impaired by the sample selection. Namely, the survey was conducted towards IT professionals and in Finnish companies only. The entire population was obtained from a commercial marketing company and represented by a panel of mid and high level managers. Generalizing the results to other industries, even if located only in Finland might prove to be difficult.

One other factor that may have induced errors in the analysis is that only one individual from each company replied to the survey. That individual might a) not have had full access to the information or b) might not have had been the true influencer or champion of the technology.

Conducting a simple survey may not be the best format to assess the status of adoption of a technology by an organization. A full audit may be more appropriate. However, conducting audits on as many organizations as the amount of respondents (70) would be a nearly impossible task, least for a research in the context of a master degree. Nevertheless, the survey realized is considered a good way to perform an assessment on status of adoption of cloud for IOT as a technology and to analyze the perceptions generated by this technology.

### 6.3 Implications

The research clarifies the relations between the constructs of Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Eudaimonic Well-Being, Price Value, Habit and Security towards the dependent variable of Behavioural Intention, assuring the fit of the UTAUT2 extended in this research, to explain and predict the adoption of a technology, when analyzing the perceptions of this technology that are formed by a manager representing the organization.

The theoretical part of the research discusses on how the social elements of the framework, specifically Eudaimonic Well-Being, have an influence on the individual holding the decision power to adopt or influence the adoption of the technology. It also discusses how the construct of Security is inherited from Cloud technologies and reflects in parallel to the cloud for IOT technology while aggravated by the new security issues coming from the IOT world. These relations were supported by the empirical part of the research which presented evidence on the relationships between Eudaimonic Well-Being towards Behavioural Intention and Security towards Behavioural Intention, along with relations between the remaining constructs towards Behavioural Intention. Accordingly, the relationship suggests that a manager perception of the technology in terms of Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Eudaimonic Well-Being, Price Value, Habit and Security may influence the decision of the organization to adopt the technology.

This research suggests that organizations that are venturing into cloud for IOT could facilitate their entry by affirmatively identifying their champion or developing the perception of the manager on cloud for IOT. Most organizations that ventured into cloud for IOT had a positive view on the technology and consequently appeared to have a higher degree of success and adoption level.

This research also suggests that vendors of cloud for IOT could appear more attractive to an organization whose manager has a better perception on cloud for IOT, i.e., is better informed on the service offerings, their quality levels, such as security certificates and procedures. These vendors could indirectly influence the manager towards adoption by focusing on helping identifying the values created by the products that the organization intends to develop into cloud for IOT and to identify value on using these values as public statements of well-being.

The research found that most organizations venturing into cloud for IOT are IT service providers. This suggests a gap between the other areas of business that may be touched by the cloud for IOT offerings. Hence, the research suggests that more could be done to evangelize cloud for IOT capabilities and potential, near those industries.

The research found indicators that cloud for IOT adoption is increasing. Organizations are fully adopting cloud for IOT as a technology into which they are able to develop their IOT products. The time span for cloud for IOT full

adoption is relatively short which indicates the maturity of the platforms in cloud for IOT.

This research suggests that cloud for IOT providers identify the target organizations decision maker and influence him by demonstrating their offering capabilities in terms of performance and usability and also by making clear to the organization the benefits that their products could provide to the consumers, when potentiated by cloud for IOT.

For an organization to be able to venture into innovation “mind-set” and to create new products based on innovations, it requires support from higher management. This research pointed that lack of awareness of a technology or of its benefits by higher management is a hurdle in the path of the technology adoption.

To be successful, a company needs to place its products near the final consumer. For the consumer to accept the product it is necessary for them to understand the product, its qualities, its usage and its benefits. This research found indication that the products using cloud for IOT are not totally understood by its final consumers, which in turn undermines its market success affecting adoption of cloud for IOT.

This research suggests that in order to increase cloud for IOT adoption, more needs to be done in order to create awareness of the products that cloud for IOT enables. Firstly, near the organization higher management, focusing on the business benefits brought onto the organizations, and secondly near the final consumer of the product, enhancing the novelty as well as other qualities of the cloud for IOT enabled products.

A technology which is still in its early stages of diffusion needs to commit to a strong effort of evangelization of its potential consumers. In this research some indication was found that the cloud for IOT providers need to bring the knowledge closer to the potential products creators, in order to help them develop their skills and competences in the field, especially at early stages of technology discovery, in order to facilitate adoption of cloud for IOT.

## 6.4 Directions for further research

Future research shall mitigate the lack of details, which comes from utilizing a one-time survey method. The research could therefore be enhanced by:

- repeating the same questionnaire after a period of, for example, one year;
- spreading the reach of the questionnaire geographically and in target industry;
- separating the sample into groups corresponding to the adoption stages of the Diffusion of Innovations (DOI) theory and inquiring organizations on their challenges;
- targeting more than one individual at each organization;

- making an initial effort to discover the technology champion and directing the questions to this individual;
- discovering details by querying specifically, for example, on the method of choosing what product to develop, or how the choice of cloud for IOT provider is done in the organization;
- discovering details on the different stakeholders, and their relation to the decision process on the adoption of the technology;

Future research could focus on applying the questionnaire to specific groups, formed from the DOI, i.e., at different levels of adoption. The focus group could also be targeted at a wider geographic area and maybe even further segmented by industry. This would allow grasping more definition and obtain a better view of the adoption levels and intentions towards cloud for IOT or other technology of choice.

## 6.5 Conclusions

The goal of this research was to find out whether technology adoption by an organization can be explained by focusing in the organization manager as the decision maker and to discover the status of adoption for cloud for IOT platforms. The intention was to contribute to the body of knowledge by supplying empirical evidence to support the assumptions and in this process to discover the status of cloud for IOT adoption and also to supply to vendors of cloud for IOT as well as to organizations intending to or developing products enabled by IOT, a tool to strengthen their efforts to increase cloud for IOT adoption.

Some limitations were found in the research, such as the reach of the questionnaire tool, in geographical terms and also in type of target industries.

For this research to achieve its goal a survey methodology was utilized and a questionnaire was created based on a framework developed. For the development of this framework, the UTAUT2 was taken as its base because it presented a set of constructs that would perform a holistic capture of the intentions from the target universe towards adoption of a technology, in this case, cloud for IOT. The UTAUT2 also contained a set of qualities that helped towards the decision of choosing it as a best fit for this research. Although the UTAUT2 was intended initially to study the behavior of individual consumers of a technology, some factors weighted in favor of the UTAUT2 as the chosen theory to support this research own framework. Firstly, the UTAUT2 had been extensively used in cloud computing studies, specifically those studies that focused on organizations as the consumer of the technology, rather than an individual. Secondly, the UTAUT2 had proven to be extensible and allowed to obtain benefits from its usage by being used partially or in modification as well as in totality. This research was the first to justify the usage of the UTAUT2 as a tool to study organizational behavior. In this process, this research was able to not only ex-

tend the UTAUT2 into the specifics needed for the technology under scrutiny, cloud for IOT, via the addition of a Security construct, but to modify its core by replacing the construct of Hedonic Behavior, which was intended to measure individual immediate satisfaction as pleasure from using the technology, with a more appropriate construct to the context of a decision maker or influencer of the decision by an organization, Eudaimonic Well-Being, which measures items of greater reach, of fulfillment and achievement by doing the right thing. This small change has great impact in the understanding of decision making towards technology adoption by organizations and it's the greatest contribution to science by this research. On the other hand, this research has contributed to vendors of cloud for IOT with the tools that will give direction to their efforts to increase adoption near their potential target organizations as users.

The analysis allowed answering the research questions:

*Can the adoption of technology by an organization be explained by the UTAUT2 extended framework when applied to a manager, having the manager as the representative of the organization?*

Answer: the analysis showed a significant positive relationship between each of the factors and the dependent variable, Behavior Intention, allowing inferring that the UTAUT2 extended may in fact be used to explain the adoption of a technology, when those constructs are measured against the perception of an individual, the manager of the organization.

*What is the status of adoption for cloud computing platforms which are specific to the internet of things?*

Answer: The status of adoption for cloud for IOT was shown on the empirical results. A value of 13% adoption has been reached in the first half of 2015, amongst ICT companies in Finland. Since 2013, with a value of adoption on 19%, the adoption rate has increased to 31% in 2014 and if the growth trend continues in 2015, it may reach around 40% level of adoption in ICT companies.

This new found knowledge is indicating that an organization's manager perception of Performance Expectancy, Effort Expectancy, Social Influence, Facilitating conditions, Eudaimonic Well-Being, Price Value, Habit and Security, influences their decision to adopt a technology, specifically, adopting Cloud Computing for IOT.



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## APPENDIX 1: QUESTIONNAIRE

### ADOPTION OF CLOUD PLATFORMS FOR INTERNET OF THINGS

Cloud computing, enables access to shared computing resources.

Internet of things is the vision of versatile and identifiable things connected to the Internet; these things may have the ability to report on a chosen set of qualities that may have values inferred from the surrounding environment, or they may be also capable of receiving commands to act upon...

Cloud for internet of things spans data storage as well as computing resources. The cloud can be the front end to the internet of things.

In this survey we will attempt to gather data that shall help in understanding the status of adoption of Cloud for internet of things and the reasons behind it. We shall also investigate possible future development of the adoption status.

This survey should take 5 to 10 minutes. We thank you in advance for taking the time to reply to this survey and hope to receive your answer until 15/06/2014.

If you wish to receive a copy of the result, send an email to [joribeir@student.jyu.fi](mailto:joribeir@student.jyu.fi), and there will be no connections to your survey answers.

All answers are anonymous.

Your identity will be hidden.

Read more about confidentiality and hidden identity [here](#). (Opens in a new window.)

#### Demographics

##### 2) \* Age

- ( )-30
- 31-50
- 51-60
- 61 and older

##### 3) \* Gender

- Female
- Male

## 4) \* Education

High school Diploma  
Technical Degree  
Bachelor Degree  
Master Degree  
Doctorate Degree  
Other

## 5) \* What best describes your title?

IT/Security/Operation Manager  
Director of IT/Operations  
IT Security/ Assurance Director  
Vice President of IT  
Chief Technology Officer (CTO)  
Chief Information Officer (CIO)  
Chief Security Officer (CSO)  
IT/Cloud/Systems Architect  
Other IT Management Position  
Developer enthusiast  
Developer professional  
Other

## 6) \* How many years of experience do you have implementing solutions using Cloud for IOT technologies?

None  
Less than 2 years  
Two years to less than 5 years  
Five years or more

## 7) \* Your organization type is?

School  
Small business  
Corporation  
Government  
Agency  
Other

8) \* How many users (customers) does your organization support?

- Less than 500
- 501 users to less than 1000
- 1,000 users to less than 10,000
- 10,000 users or more

9) \* What is the primary business or industry of your organization?

- Construction
- Education
- Energy/Utilities
- Financial Services/Banking
- Government
- Health Care
- IT - Manufacturing
- IT - Services
- Cloud Service Providers
- Professional, Technical, and Business Services (non IT)
- Telecommunications
- Travel/Leisure/Hospitality
- Manufacturing (Auto)
- Oil, gas, and petroleum
- Retail
- Transportation & logistics
- Agriculture and forestry
- IOT
- Other

Cloud computing enables access to shared computing resources. Cloud for internet of things expands on it by offering a platform with APIs and dashboards specific to the internet of things (IOT). IOT is the vision of versatile and identifiable things connected to the Internet; these things may have the ability to report on a chosen set of qualities that may have values inferred from the surrounding environment, or they may be also capable of receiving commands to act upon. Cloud for internet of things spans data storage as well as computing resources.

11) \* Which of the following is the best description of your organization's relation to Cloud for IOT? (respondent can choose only one)

- We are not aware of Cloud for IOT
- We are aware of Cloud for IOT, but have not tried to learn more about it.
- We are actively seeking knowledge of Cloud for IOT what is, how it works and why it works



We have learned about Cloud for IOT characteristics and are currently assessing Cloud for IOT's potential benefits for us

We are currently preparing for the decision of either adopting or rejecting Cloud for IOT

We have just decided to adopt Cloud for IOT

We have just decided to reject Cloud for IOT, at least for time being.

We are currently implementing Cloud for IOT with one or more selected pilot projects

We have implemented one or more pilot projects and have decided to expand our adoption of Cloud for IOT

We have implemented one or more pilot projects, but have decided not to expand our adoption of Cloud for IOT.

We are already committed to Cloud for IOT and are widely implementing it

The following criteria must be fulfilled for this question to be shown:

- (
- If "Which of the following is the best description of your organization's relation to Cloud for IOT?" equals "We are aware of Cloud for IOT, but have not tried to learn more about it."
- )

12) Why have you not tried to learn more about Cloud for IOT?

The following criteria must be fulfilled for this question to be shown:

- (
- If "Which of the following is the best description of your organization's relation to Cloud for IOT?" equals "We have just decided to reject Cloud for IOT, at least for time being."
- )

13) Why have you decided to reject Cloud for IOT?

The following criteria must be fulfilled for this question to be shown:

- (
- If "Which of the following is the best description of your organization's relation to Cloud for IOT?" equals "We have implemented one or more pilot projects, but have decided not to expand our adoption of Cloud for IOT."
- )

14) Why have you decided not to expand your adoption of Cloud for IOT?

The following criteria must be fulfilled for this question to be shown:

- (
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We have just decided to adopt Cloud for IOT”
  - or
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We have just decided to reject Cloud for IOT, at least for time being.”
  - or
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We are currently implementing Cloud for IOT with one or more selected pilot projects”
  - or
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We are currently preparing for the decision of either adopting or rejecting Cloud for IOT”
  - or
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We have implemented one or more pilot projects, but have decided not to expand our adoption of Cloud for IOT.”
  - or
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We are already committed to Cloud for IOT and are widely implementing it”
  - or
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We have learned about Cloud for IOT characteristics and are currently assessing Cloud for IOT’s potential benefits for us”
  - or
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We have implemented one or more pilot projects and have decided to expand our adoption of Cloud for IOT”
- )

15) When was the first project using Cloud for IOT started? Please indicate the exact year.

The following criteria must be fulfilled for this question to be shown:

- (
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We are already committed to Cloud for IOT and are widely implementing it”
- )

16) When did you decide of a wide-scale Cloud for IOT adoption? Please indicate the exact year

The following criteria must be fulfilled for this question to be shown:

- (
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We are currently preparing for the decision of either adopting or rejecting Cloud for IOT”
  - or
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We have just decided to adopt Cloud for IOT”
  - or
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We are already committed to Cloud for IOT and are widely implementing it”
  - or
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We have implemented one or more pilot projects and have decided to expand our adoption of Cloud for IOT”
  - or
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We have implemented one or more pilot projects, but have decided not to expand our adoption of Cloud for IOT.”
  - or
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We are currently implementing Cloud for IOT with one or more selected pilot projects”
- )

17) Approximately what percentage of the budget for your new IT implementations is allocated for projects using Cloud for IOT?

The following criteria must be fulfilled for this question to be shown:

- (
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We are currently implementing Cloud for IOT with one or more selected pilot projects”
  - or
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We have just decided to adopt Cloud for IOT”
  - or
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We are already committed to Cloud for IOT and are widely implementing it”
  - or
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We have implemented one or more pilot projects and have decided to expand our adoption of Cloud for IOT”
  - or
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We have implemented one or more pilot projects, but have decided not to expand our adoption of Cloud for IOT.”
  - or
  - If “Which of the following is the best description of your organization's relation to Cloud for IOT?” equals “We have just decided to reject Cloud for IOT, at least for time being.”
- )

18) How successful have your projects which use Cloud for IOT been in the following aspects?

	Com- pletely unsuc- cessful	Mostly unsuc- cessful	Slightly unsuc- cessful	Nei- ther, can't meas- ure	Slightly success- ful	Mostly success- ful	Com- pletely success- ful
Comple- ted on time							
Comple- ted on budget							
Imple- mented with all features and func- tions ini- tially spec- ified							
Delivering the bene- fits and value ex- pected							

19) What has been the most challenging issue in taking into use Cloud for IOT on your projects?

The questions bellow had a 7 point Likert scale:

- Completely disagree
- Mostly disagree
- Slightly disagree
- Neither agree nor disagree
- Slightly disagree
- Mostly agree
- Completely agree

UTAUT2 extended related questions:

Performance Expectancy:

- 20. I find Cloud for IOT useful in the solutions my company creates.
- 21. Using Cloud for IOT helps accomplishing our solutions.
- 22. Using Cloud for IOT increases our productivity

Effort Expectancy:

- 23. Learning how to use Cloud for IOT in our solutions is easy.
- 24. The interaction with Cloud for IOT in our projects is clear and understandable.
- 25. Cloud for IOT easy to integrate in our solutions.
- 26. It is easy to become skilful at using Cloud for IOT in our solutions.

Social Influence:

- 27. People who are important to me think that our projects should use Cloud for IOT.
- 28. People who influence my behaviour think that our projects should use Cloud for IOT.
- 29. People whose opinions that I value prefer that our projects use Cloud for IOT.

Facilitating Conditions:

- 30. I have the resources necessary to implement Cloud for IOT in our solutions.
- 31. I have the knowledge necessary to implement Cloud for IOT in our solutions.
- 32. Cloud for IOT is compatible with other technologies I use for our solutions.
- 33. I can get help from others when I have difficulties using Cloud for IOT in our solutions.

Eudaimonic Well-Being:

- 34. Using Cloud for IOT in our projects is meaningful.
- 35. Using Cloud for IOT in our projects will make life better for others.
- 36. Using Cloud for IOT in our projects feels right.

Price Value:

37. Cloud for IOT is reasonably priced.
38. At the current price, Cloud for IOT provides a good value.
39. The cost of maintenance is lower with Cloud for IOT than with traditional IT methods.
40. I would consider Cloud for IOT to have considerable cost savings over traditional IT methods.

Habit:

41. The use of Cloud for IOT in our solutions has become frequent.
42. We use enthusiastically Cloud for IOT in our solutions.
43. Using Cloud for IOT in our solutions is a must.

Behavioural Intention:

44. We intend to continue using Cloud for IOT in our solutions in the future.
45. We will always try to use Cloud for IOT in all our solutions.
46. We plan to continue to use Cloud for IOT in our solutions frequently.

Security related questions:

Cloud for internet of things is built on Cloud services and expands on it by offering APIs specific to the internet of things

On generic Cloud for IOT implementation:

47. I feel that Cloud for IOT technology is secure.
48. I am concerned about the security of the technology used in Cloud for IOT services such as virtualization, SaaS and PaaS
49. I feel that Cloud for IOT technology is more secure than traditional enterprise networks methods.
50. I am willing to use Cloud for IOT to host sensitive information for my organization