# Analyzing Factors Affecting the Adoption of Cloud Computing: A Case of Turkey

**Ezgi Akar[1] and Sona Mardikyan[2]**
[1] Management Information Systems Department, Bogazici University
Istanbul, Turkey
[e-mail: ezgi.akar@boun.edu.tr]
[2] Management Information Systems Department, Bogazici University
Istanbul, Turkey
[e-mail: sona.mardikyan@boun.edu.tr]
*Corresponding author: Ezgi Akar

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## Abstract

Cloud computing is an upcoming technology and emerging concept in the field of information technologies. Companies have begun to invest in cloud computing with the expectation that it will improve their business performances, operations, and processes. However, many companies are not so much aware of the cloud computing, so they can hesitate to adopt this new technology. The aims of the study are analyzing factors affecting the adoption of cloud computing and applying structural equation modeling technique to analyze the important dimensions of the adoption. Concordantly, previous studies are examined and expert interviews are arranged. Based on both our literature review and expert interviews, a model is proposed to measure the adoption of cloud computing. It is obvious that there are scarce researches about cloud computing adoption in the literature. Thus, the originality of the paper lies on that it proposes a research model for cloud computing adoption and it investigates various dimensions of cloud computing adoption in detail.

***Keywords:*** Cloud computing, cloud computing adoption, cloud computing characteristics, structural equation modeling

## 1. Introduction

Nowadays, cloud computing has been attracted interests of organizations and academics. It is indicated that cloud computing has been ranked as second top application and technology development in 2011 and third one in 2012 [1]. According to [2], spending on cloud computing services would be more than $180 billion by 2015 and cloud equipment will reach $79.1 billion in the global market by 2018. These statistics show that cloud computing has become a very popular technology among companies operating in different industries. In this manner, companies have begun to invest in cloud computing with the expectation that this new technology will improve their business performances and operations. On the other hand, most companies are not very familiar with cloud computing technologies. It indicates that most companies can hesitate to adopt it or they cannot decide on which criteria that they should consider to adopt it or not.

Cloud computing provides companies with many opportunities. Companies need this new technology to deal with technological changes and to gain a competitive advantage in the global business environment. They want to manage their business processes from anywhere and anytime and they do not want to be bothered with more technical issues anymore. Cloud computing provides them to buy their required technological needs and it enables them to manage their business activities anywhere and anytime, and not to deal with technological issues at the background.

Companies evaluate many dimensions in order to choose and adopt cloud computing. They prefer having more secure and reliable systems, and paying fewer maintenance and up-front costs. In addition, integration of companies' legacy systems with new cloud computing systems is a very important concern for most companies. Furthermore, *legislation and regulations* are concerned by companies as a substantial factor. It is obvious that companies' data are stored on servers of service providers in cloud computing technology. When a disaster or information leakage occurs, it is important to set the responsibilities of both sides. *Supplier availability* is also another important dimension. It is important that cloud *computing services should be delivered on time and companies should get after service support whenever they need.*

In [1], it is stated that cloud computing is still a new field and adoption of cloud computing is still at earlier stage in OECD countries. Concordantly, the aims of the study are the explanation and evaluation of the relationships among factors that affect the adoption of cloud computing services in Turkey. In order to identify factors that determine cloud computing adoption, a literature survey is conducted and expert interviews are arranged. After completing interviews and literature survey, substantial factors are determined. These factors including *security*, *need*, *legislation and regulations*, *on demand service*, *cost*, *supplier availability*, *reliability*, *maintenance*, *virtualization*, *integration*, and *performance*, are analyzed within the scope of the study.

In this respect, a questionnaire is designed to measure the effects of the factors on cloud computing adoption. The questionnaire is sent to people working at a company which takes cloud computing service(s). A model is proposed and structural equation modeling (SEM) approach is used to analyze relationships among the factors. AMOS 18.0 is used as the analyzing tool and maximum likelihood estimation method is applied to measure the dimensions of the proposed model.

The paper is divided into four parts. First part covers the literature review. The second part explains research models and hypotheses. Research methodology and findings are explained in third part and the last part includes conclusion.

## 2. Literature Review

This part of the study is divided into two parts and covers background of cloud computing and its characteristics.

### 2.1 Background of Cloud Computing

The development of Web 2.0 has led to a change in World Wide Web and Internet has entered in our daily lives by providing users with various opportunities [3 and 4]. This development provides the Internet users not only receive information but also share information. From the business perspective, this development stimulates the importance of collaboration among enterprises. Cloud computing is one of the results of these technological developments and it is an emerging technological trend among various industries [5]. Moreover, cluster, grid, and virtualization technologies, peer-to-peer computing, service oriented architecture, and autonomic computing have effects on the emergence of cloud computing [6, 7, 8, and 9].

Predictions show that cloud computing usage and investments for the development of cloud computing services will increase in the following years [10 and 11]. According to estimation of industry leaders, cloud computing businesses will reach $160 billion. In [5], cloud computing is defined as “both the applications delivered as services over the Internet and the hardware and systems software in the data centers that those services”. In addition, National Institute of Standards and Technology defines cloud computing as “a model for enabling ubiquitous, 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” [12]. In [13], It is stated that the architecture of cloud computing involves cloud service providers, cloud services, cloud consumers, and a network infrastructure. Cloud service providers give cloud services to cloud consumers through a network infrastructure.

Meanwhile, cloud computing includes three layers [14]. The first one is Infrastructure of Service (IaaS). This layer provides computation and storage capacity. The second layer is Platform as a Service (PaaS). It provides software development tools and application execution environment. The last layer is Software as a Service (SaaS). It provides cloud computing applications. In addition, Data as a Service (DaaS) and Communication as a Service (CaaS) are added as another layers [8]. The first one provides data storage and the second one supports the communication capability of the companies.

There are three types of clouds: public, private and hybrid [15]. In the public cloud any organization can access any services which reside in that cloud. However, organizations do not have full power and control to manage their operations and data [16]. On the other hand, these organizations can have their own data centers which are called as private clouds. Private clouds are protected by firewalls and they are hosted for a specific organization. Lastly, hybrid clouds are the combination of private and public clouds. Whereas organizations can host their critical data on private clouds, they can prefer using public clouds for other business operations and data. Community cloud is also added as a deployment model [12]. Community clouds are used by a special community of consumers from organizations that share common mission, policy, requirements etc. [12].

According to [5], there are new aspects regarding to cloud computing. The first aspect is that computing resources are limitless. They are available on demand and it enables enterprises to plan for ahead for supplying these computing resources. In addition, these resources can be automatically used and using these resources does not require any organizational interaction [12]. The second aspect is that enterprises do not need to pay for large up-front costs. They can take the advantage of flexibility of cloud computing and increase their computing resources when their needs increase. According to [17], computational resources are stored in a pooled infrastructure. Users can access these "scalable and adjustable" resources virtually.

### 2.2 Characteristics of Cloud Computing

In the literature most of the researchers mainly focus on the similar characteristics of cloud computing. One of these characteristics is on demand service. Organizations are only charged by the amount that they used. This property is on demand service characteristics of cloud computing [13, 18, 19, and 20].

The second characteristic of cloud computing is broad access network. It refers to that computing resources that organizations consume, reside over a network and they can be used with different platforms such as laptops, mobile phones, PDAs, and personal computers at users' site [13, 12, 18, and 20]. Resource pooling is another characteristics of cloud computing. Computing resources are "pooled" at cloud service providers' site. It means that cloud computing permits combination of computing resources such as hardware, software and processing and it supplies multiple users which is known as "multi-tenancy" [13, 18, and 19]. The multi-tenancy is defined as "a single instance of an application software serves multiple clients." In other words, this feature of cloud computing increase the utilization of technological resources [21].

Cloud computing has a rapid elasticity and scalability. It is stated that computing resources can be immediately supplied [19]. In other words, consumers can increase and decrease the usage of computing resources at anytime they want without contract or "up-front commitments" [13 and 18]. It is mentioned that computing resources can be used by multiple consumers. Meanwhile, each consumer is charged by the amount used, so cloud computing has a dynamic system which measures the usage of computing resources for each consumer and gives a clear response to their billing processes and it is known as that cloud computing provides measured services [12, 13, 18, and 19].

In addition to these five important characteristics of cloud computing, further characteristics are added [20]. They declare that cloud computing has a large scale and it is reliable, and it supports diverse applications. Additionally, it is explained that organizations share computing resources and they do not own and manage their own systems. In this manner, cloud computing provides them with various financial benefits [22].

## 3. Research Model and Hypotheses

### 3.1 Research Model

Two stages are adopted in order to develop a well-defined research model for the adoption of cloud computing. The first stage is the literature review. According to literature review fifteen factors including *reliability, maintenance, virtualization, integration, performance, cost, on*

*demand service*, *legislation and regulations*, *security*, *supplier availability*, *adoption*, *need*, *customization*, *user friendliness*, and *managerial suppor*t, are considered. These factors are also investigated as the key dimensions affecting the adoption of cloud computing and described in a proposed model [23].

The second stage includes expert interviews. Semi-structured interviews are arranged with eight cloud computing experts who work at leading cloud computing service providers in Turkey. During interviews, each cloud computing expert has been introduced to the factors that are mined from the literature review. They are asked which of these factors are proper, applicable, and in force within Turkish companies. As a result of these processes, *security*, *need*, *supplier availability*, *on demand service*, *cost*, *legislation and regulations*, *reliability*, *maintenance*, *virtualization*, *integration*, *and performance* are selected as factors having effects on cloud computing adoption and added to the proposed model. In accordance with the interviews, to create a smooth and measurable model that can be analyzed with SEM, *reliability*, *maintenance*, *virtualization*, *integration*, and *performance* which are mostly related with each other are grouped as *other factors*. Finally, the study includes mainly seven factors.

### 3.2 Research Hypotheses

The proposed model and research hypotheses are shown in **Fig. 1**. The first hypothesis is about the *security* dimension. In [24], it is emphasized that one the most significant concern of the organizations is security. Furthermore, it is founded that organizations worry about data security during adoption of cloud computing [25]. In this respect, s*ecurity* is added to the study model as an important dimension for the adoption of cloud computing. How cloud service providers afford security is the one of the most important concerns in cloud computing [26 and 27]. Security is evaluated a cloud computing risk by organizations. In [28], it is also stated clouds can be attractive for hackers and cloud service providers should do the best for secure clouds. Customers or cloud users must be sure that their organizational data are more secure in a cloud [29]. In other words, businesses are reluctant to save their core business values on shared environment. On the other hand, companies can choose private clouds to increase the security. However, it also leads and increase in the cost.

*H1: Security has a positive impact of cloud computing adoption.*

*H2: Security has a positive impact on cost.*

Companies need cloud computing due to changing technological improvements and to satisfy their technological needs [30]. Moreover, competitive pressure and trading partner pressure are *other factors* that increase the need for cloud computing [31]. In this respect, *need* is added as another dimension to the study.

*H3: Need has a positive impact on cloud computing adoption.*

The third determinant is on demand service. It allows organizations to buy services according to their needs and to pay just for the amount that they used. It is like paying for electricity and water [32].

*H4: On demand service has a positive impact on cost.*

*Cost* is one of the most important constructs in the model. It consists of both purchasing cost and long term usage costs. Purchasing cost of cloud computing is very inexpensive compared to traditional computer technologies. Companies can save in the long term costs by preferring cloud computing technologies. In this way, they save in energy, space and staff costs [30 and 20]. Besides, responsibility to update applications and software belongs to cloud

service provider. Therefore, software upgrade costs decreases within the organizations [33]. Physical servers and storages reside in the site of cloud service providers. Companies can not only save in physical hardware costs but also they save in maintenance costs by reducing the number of both actual hardware and maintenance staff.

*H5: Cost saving has a positive impact on cloud computing adoption.*

*Legislation and regulations* is added as another dimension through expert interviews and literature review. It is indicated that from the legal perspective, users have limited control in cloud computing when it is compared with traditional computing [34]. In this manner, security and privacy are one of the most important concerns of the organizations due to legal issues. Additionally, it is stated that legal issues are one of the most critical top 10 risks which are perceived by IT experts [35]. This dimension predicts whether there are enough legal protections to solve conflicts between cloud users and cloud providers when a problem such as a disaster or hacking occurs.

*H6: Legislation and regulations have a positive impact on security.*

*Supplier availability* is also added to the proposed model in accordance with expert interviews. It includes two aspects. The first one is that there must be enough suppliers to purchase cloud services when they are needed any time. Second aspect is that there must be enough suppliers to give after sale support.

*H7: Supplier availability has a positive impact cloud computing adoption.*

According to interviews, to create a smooth and measurable model that can be analyzed with SEM, *reliability*, *maintenance*, *virtualization*, *integration*, and *performance* which are mostly related with each other are grouped under *other factors*. In other words, *other factors* include five sub-factors: integration, maintenance, virtualization, reliability, and performance.

The first sub-factor is the *integration*. Integration of cloud services with existing legacy systems is hard [18]. On the other hand, according to interviews it is said that there are integration operations resulted smoothly. The second sub-factor is *maintenance*. It is very easier in an organization, because updating and other maintenance processes are held on the cloud rather than on each user's computers [33]. The third sub-factor is *virtualization*. Cloud computing allows cloud users to use cloud services anywhere and anytime through various devices such as notebook, personal computers and mobile phones [32 and 20].

*Reliability* is the fourth sub-factor. Cloud computing has a reliable infrastructure serving with minimal downtime and giving rapid response to consumers' requirements and organizations expect minimal downtime and rapid response [32 and 20].

The last sub-factor, performance, is added to the model according to interviews. It is declared that cloud computing technology increases both companies' and users' performances.

*H8: Other factors have a positive impact on cloud computing adoption.*

*H9: Other factors have a positive impact on security.*

*H10: Other factors have a positive impact on cost.*

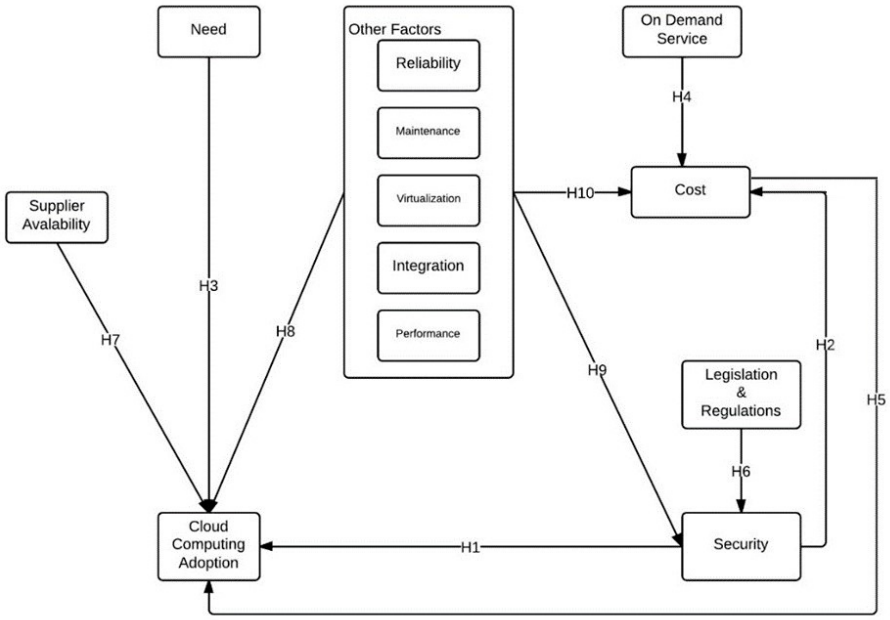


**Fig. 1.** Proposed Model

## 4. Research Methodology and Findings

### 4.1 Research Methodology

In the study, a survey methodology is used to collect data and verify the research hypotheses. Firstly, a literature review is conducted and fifteen factors mentioned in the section 3.1 are obtained from the literature. At the second step, these factors are introduced to experts and they are asked whether these factors are important and testable for the organizations in Turkey or not. Furthermore, they are asked for additional dimensions, which can be also practicable for the organizations in Turkey, and technical details about them. After interviews, the factors are grouped under seven main factors having effects on cloud computing adoption in Turkey. These factors are *security, need, supplier availability, on demand service, cost, legislation and regulations, and other factors (reliability, maintenance, virtualization, integration, and performance).*

After these steps, a questionnaire that includes seven questions is prepared. First questions are descriptive questions that collect data about organizations' sectors, their active years in the related sector, company structure, cloud computing services that they use, and their cloud computing service providers. The last question measures the effects of seven factors on cloud computing adoption. It includes sub items and for each sub item 7-point Likert-Scale is used. Appendix 1 shows main factors, sub factors, and related questions. The questions related to *adoption*, *security*, *need*, and *cost* are adapted from [14].

Data are collected using an online questionnaire service. Targeted sample is the organizations using cloud computing services. For this purpose, the questionnaire is sent to related IT personnel working at these organizations. Online questionnaire is distributed to main cloud service providers to be shared with their customers. In addition, online questionnaire is shared on LinkedIn platform and it is sent as personal message to potential

targeted IT personnel. Totally, online questionnaire is sent and share with 838 IT personnel. As a result, 388 replies are returned. 82 of them are IT personnel who do not fill the questionnaire completely, so they are eliminated. Therefore, the sample of the study includes 306 replies.

### 4.2 Descriptive Statistics

**Table 1** shows descriptive statistics of the study. Companies that are using any cloud computing services are mainly from information and telecommunication sectors. While 60.5% of the companies are in the information sector, 20.6% of the companies are in the telecommunication sector. The companies in trade, food, energy, health, and construction sectors have the least proportion in the list.

According to **Table 1** 48% of the respondents work at a company that operates for more than 21 years in the sector. It is an indication that long-established companies mostly prefer taking cloud computing services. Whereas 58.2% of the respondents work at an international company, 41.8% of them work for a national company. Moreover, 75.8% of the respondents' companies take SaaS and 61.4% take IaaS. Almost half of them make use of PaaS and DaaS of cloud computing.

**Table 1.** Descriptive Statistics

| Characteristic | | Frequency | Percentage |
|---|---|---|---|
| **Company Sector** | Information | 185 | 60.5% |
| | Telecommunication | 63 | 20.6% |
| | Other | 13 | 4.2% |
| | Finance | 11 | 3.6% |
| | Service | 8 | 2.6% |
| | Education | 6 | 2.0% |
| | Trade | 4 | 1.3% |
| | Food | 4 | 1.3% |
| | Energy | 4 | 1.3% |
| | Health | 4 | 1.3% |
| | Construction | 4 | 1.3% |
| **Company Age** | 0-5 | 43 | 14.1% |
| | 6-10 | 39 | 12.7% |
| | 11-15 | 52 | 17.0% |
| | 16-20 | 25 | 8.2% |
| | >= 21 | 147 | 48.0% |
| **Company Structure** | International | 178 | 58.2% |
| | National | 128 | 41.8% |
| **Cloud Computing Services** | SaaS | 232 | 75.8% |
| | PaaS | 163 | 53.3% |
| | IaaS | 188 | 61.4% |
| | DaaS | 153 | 50% |

### 4.3 Structural Equation Modeling

SEM is a statistical model that analyzes and explains the relationships among multiple determinants. In other words, hypotheses about how sets of variables determine factors and how these factors are related to each other are tested with different theoretical models in SEM [28]. SEM which integrates path and confirmatory factor analyses, has been developed by Karl Jöreskog, Ward Keesling and David Wiley [36, 37, 38, and 39 as cited in 40].

SEM analysis consists of two parts: measurement model validity and structural model validity. Results are obtained by using AMOS 18.0 and maximum likelihood estimation method. Maximum likelihood estimation procedure finds the most likely estimates for the coefficients in an iterative manner [41].

### 4.4 Exploratory and Confirmatory Factor Analyses

Measurement model validity includes two analyses: exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). **Table 2** shows EFA results for each latent and indicators that are shown in Appendix 1. According to [41], factor loadings should be at least 0.50 and ideally 0.70 or greater. According to **Table 2**, most of the factor loadings are greater than 0.70 or very close to it and at least 0.50. Additionally, indicators explain their constructs at above 50%. Exceptionally, indicators of *other factors* explain it at 49.98% which is very close to 50% and accepted in the model. In addition, EFA results show that each indicator is gathered under pre-defines factors. In other words, indicators represent the related dimensions of cloud computing adoption.

The second part is the CFA analysis. Factor loadings should be at least 0.50 [41]. In parallel with this purpose, indicators V16 and V13 having 0.32 and 0.25 factor loadings respectively are removed from the measurement model. Because, these loadings are less than 0.50. CFA analysis is reapplied. **Fig.2.** shows the new measurement model and **Table 3** includes the new CFA results. According to **Table 3**, Indicators V20, V5, and V8 have 0.67, 0.68 and 0.62 factor loadings respectively. They do not violate the construct integrity. Furthermore, all values are significant with p value 0.001.

**Table 2.** Exploratory factor analysis results

| Latent Variable | Indicator | Factor Loading | Eigen Value | Total Variance Explained |
|---|---|---|---|---|
| Need | V3 | 0.93 | 1.74 | 87.09% |
| | V4 | 0.93 | | |
| On demand service | V11 | 0.93 | 1.72 | 85.99% |
| | V12 | 0.93 | | |
| Cost | V7 | 0.88 | 1.55 | 77.59% |
| | V6 | 0.88 | | |
| Legislation & regulations | V9 | 0.96 | 1.88 | 91.64% |
| | V10 | 0.96 | | |
| Security | V1 | 0.92 | 1.70 | 84.92% |
| | V2 | 0.92 | | |
| Adoption | V24 | 0.95 | 1.80 | 90.00% |
| | V25 | 0.95 | | |
| Supplier Availability | V22 | 0.94 | 1.78 | 89.19% |
| | V23 | 0.94 | | |
| Other factors | V14 | 0.80 | 4.00 | 49.98% |
| | V15 | 0.74 | | |
| | V16 | 0.61 | | |
| | V19 | 0.79 | | |
| | V20 | 0.75 | | |
| | V5 | 0.73 | | |
| | V8 | 0.66 | | |
| | V13 | 0.54 | | |

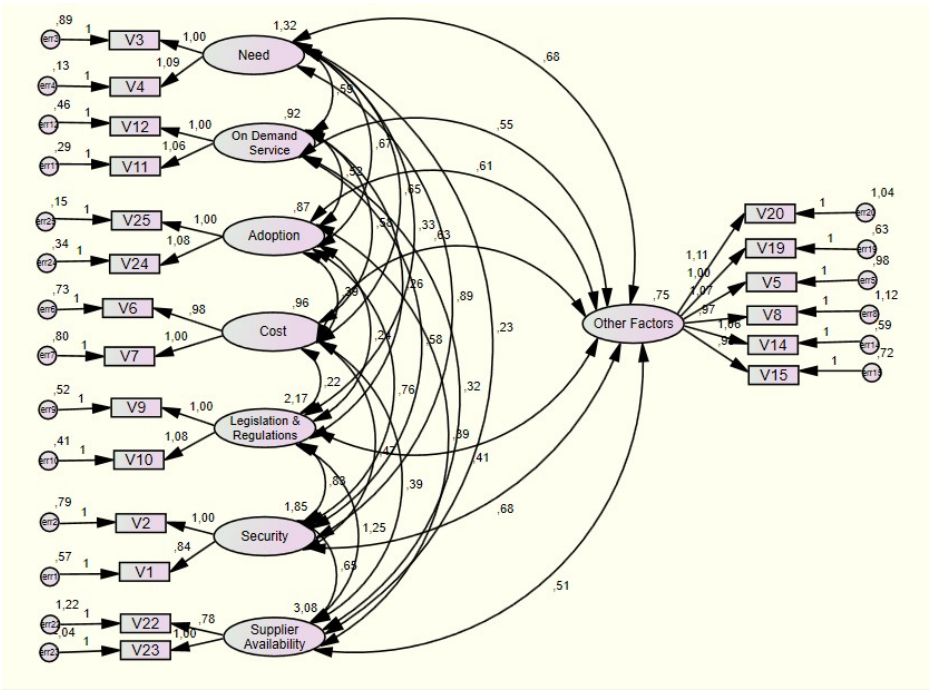


**Fig. 2.** Measurement Model

**Table 3.** Confirmatory factor analysis results

| Latent Variable | Indicator | Factor Loading | Factor Loading Squared | Measurement Error | p- Value |
|---|---|---|---|---|---|
| Need | V3 | 0.77 | 0.60 | 0.40 | -* |
| | V4 | 0.96 | 0.92 | 0.08 | 0.001 |
| On Demand Service | V11 | 0.88 | 0.78 | 0.22 | 0.001 |
| | V12 | 0.82 | 0.66 | 0.34 | -* |
| Cost | V7 | 0.74 | 0.55 | 0.45 | 0.001 |
| | V6 | 0.75 | 0.56 | 0.44 | -* |
| Legislation & Regulations | V9 | 0.90 | 0.81 | 0.19 | -* |
| | V10 | 0.93 | 0.86 | 0.14 | 0.001 |
| Security | V1 | 0.83 | 0.70 | 0.30 | 0.001 |
| | V2 | 0.84 | 0.70 | 0.30 | -* |
| Adoption | V24 | 0.87 | 0.75 | 0.25 | 0.001 |
| | V25 | 0.93 | 0.86 | 0.14 | -* |
| Supplier Availability | V22 | 0.78 | 0.61 | 0.39 | 0.001 |
| | V23 | 1.01 | 1.01 | -0.01 | -* |
| Other Factors | V14 | 0.77 | 0.59 | 0.41 | 0.001 |
| | V15 | 0.71 | 0.50 | 0.50 | 0.001 |
| | V19 | 0.74 | 0.54 | 0.46 | -* |
| | V20 | 0.68 | 0.47 | 0.53 | 0.001 |
| | V5 | 0.68 | 0.47 | 0.53 | 0.001 |
| | V8 | 0.62 | 0.39 | 0.61 | 0.001 |

*not estimated when loading set to fixed value of 1.0

**Table 4** shows the goodness of fit indices for the measurement model and acceptable fit intervals. All goodness of fit indices except CFI are in the acceptable fit intervals. Acceptance of at least three fit indices are enough to say that the model is valid [41]. Results indicate that the measurement model of the study is well designed.

**Table 4.** Goodness of fit indices for the measurement model [40]

| Goodness of Fit Indices | | Acceptable Fits |
|---|---|---|
| Chi-Square | 285.441 | |
| Degrees of Freedom | 142 | |
| Absolute Fit Measures | | |
| GFI | 0.91 | .90⩽GFI⩽.95 |
| RMSEA | 0.058 | .05⩽RMSEA⩽.08 |
| RMR | 0.087 | .05⩽SRMR⩽.10 |
| Normed Chi-Square | 2.010 | 2< X2/df⩽3 |
| Incremental Fit Indices | | |
| NFI | 0.92 | .90⩽NFI⩽.95 |
| CFI | 0.96 | .90⩽CFI⩽.95 |
| Parsimony Fit Indices | | |
| AGFI | 0.87 | .85⩽AGFI⩽.90 |

### 4.5 Construct Validity

In order to assess the construct validity, convergent validity and discriminant validities are investigated in the study. For construct validity, standardized factor loadings should be at least 0.50 and ideally 0.70 or greater [41 and 42]. All the factor loadings in the measurement model are at least 0.50. Additionally, construct reliability should be at least 0.70 and average variance extracted should (AVE) be at least 0.50 as a rule of thumb. **Table 5** shows construct reliability and AVE results. Whole constructs have at least 0.70 or greater construct reliability value. Their AVE values are greater than 0.50. However, *other factors* construct has 0.49 AVE values which are very close to 0.50 and acceptable.

**Table 5.** Construct reliability and average variance extracted

| Latent Variable | Construct Reliability | Average Variance Extracted |
|---|---|---|
| Need | 0.86 | 0.76 |
| On Demand Service | 0.84 | 0.72 |
| Cost | 0.71 | 0.55 |
| Legislation & Regulations | 0.91 | 0.83 |
| Security | 0.82 | 0.70 |
| Adoption | 0.89 | 0.80 |
| Other Factors | 0.85 | 0.49 |
| Service Provider | 0.89 | 0.81 |

Discriminant validity is defined as a measure does not highly correlated with another measure [43]. In order to establish discriminant validity, AVE estimates should be greater than construct squared correlation estimates [44, 41]. When it is compared, all AVE estimates in **Table 5** are greater than the corresponding construct squared correlation estimates in **Table 6**.

While construct squared correlation estimates are shown above the diagonal, correlation estimates are shown below the diagonal in **Table 6**.

**Table 6.** Discriminant validity results

| | **Need** | **On Demand Service** | **Adoption** | **Cost** | **Legislation** | **Security** | **Supplier Availability** | ***Other Factors*** |
|---|---|---|---|---|---|---|---|---|
| Need | 1,00 | **0,289** | **0,398** | **0,335** | **0,038** | **0,324** | **0,013** | **0,468** |
| On Demand Service | 0,538*** | 1,00 | **0,338** | **0,386** | **0,034** | **0,198** | **0,037** | **0,436** |
| Adoption | 0,631*** | 0,581*** | 1,00 | **0,187** | **0,032** | **0,366** | **0,057** | **0,583** |
| Cost | 0,579*** | 0,621*** | 0,432*** | 1,00 | **0,024** | **0,128** | **0,366** | **0,549** |
| Legislation | 0,196** | 0,184** | 0,178** | 0,156* | 1,00 | **0,173** | **0,051** | **0,102** |
| Security | 0,570*** | 0,445*** | 0,605*** | 0,356*** | 0,416*** | 1,00 | **0,233** | **0,339** |
| *Supplier Availability* | 0,112* | 0,190** | 0,239*** | 0,226*** | 0,483*** | 0,271*** | 1,00 | **0,113** |
| *Other Factors* | 0,684*** | 0,660*** | 0,764*** | 0,741*** | 0,320*** | 0,582*** | 0,336*** | 1,00 |

Significance level: *** = 0.001 **= 0.010 *= 0.050

Note: Values below the diagonal are correlation estimates among constructs. Diagonal elements are construct variances. Values above diagonal show the squared correlations.

### 4.6 Structural Model Validity

Structural model validity includes hypotheses testing and model fit. **Fig. 3.** show the first structural model. The results show that hypotheses H2 and H7 are not supported in the first model. P-values of H2 and H7 are 0.133 and 0.467, respectively. These values indicate that the effects of *security* on cost and *supplier availability* on cloud computing adoption are not significant. Moreover, goodness of fit indices indicate a poor structural model. In order to redesign the structural model, hypotheses that are not accepted are removed and modification indices (M.I.) are examined. High modification indices indicate that there is a strong correlational relationship between the related two factors. As a result, correlational relationships between on demand service and *other factors* (102.441 M.I.), need and *other factors* (120.199 M.I.), and need and on demand service (70.550 M.I.) having high modification indices are added to increase the model fit. The new structural model is shown in Fig.4. Table 7 shows the detailed regression and correlational weights of each hypothesis included in the second structural model. Results indicate that all hypotheses and correlations included in the new structural model are significant. According to Table 7, it is concluded that on demand service and *other factors*, need and *other factors*, and need and on demand service are highly correlated with each other [45]. Additionally, *other factors* have the strongest effect on cloud computing adoption.

**Table 8** includes the goodness of fit indices, study results, and acceptable fit intervals. According to [46] normed Chi-Square, GFI, RMSEA, CFI, NFI, and AGFI values are acceptable. Results indicate that the structural model of the study is well designed and acceptable. On the other hand, RMR value is the only value which is not within the acceptable fit intervals. As it mentioned above, acceptance of at least three fit indices are enough to say that the model is valid [41].

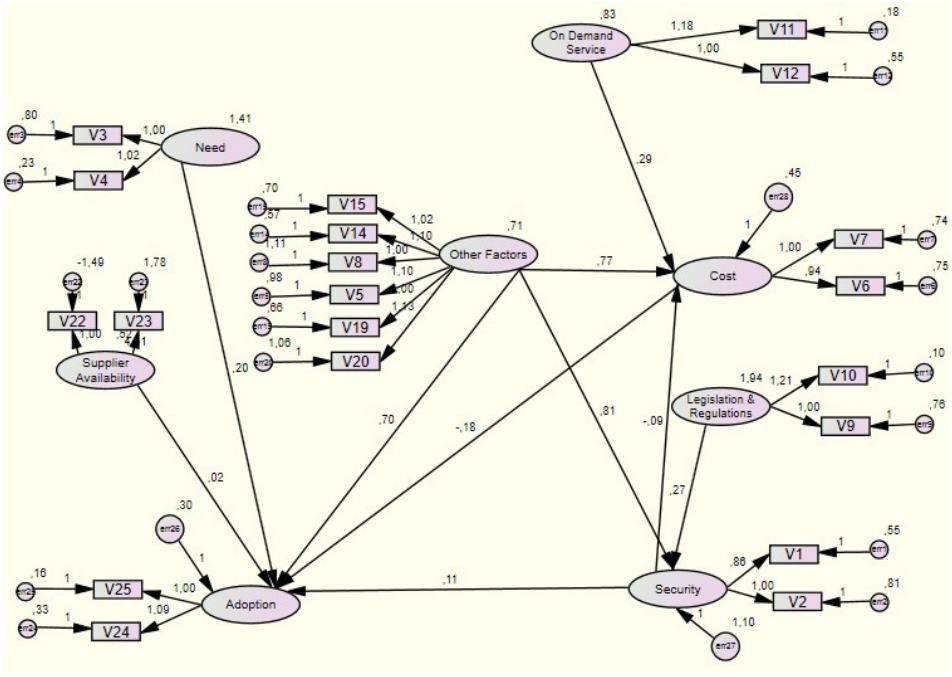


**Fig. 3.** Path diagram of the first structural model

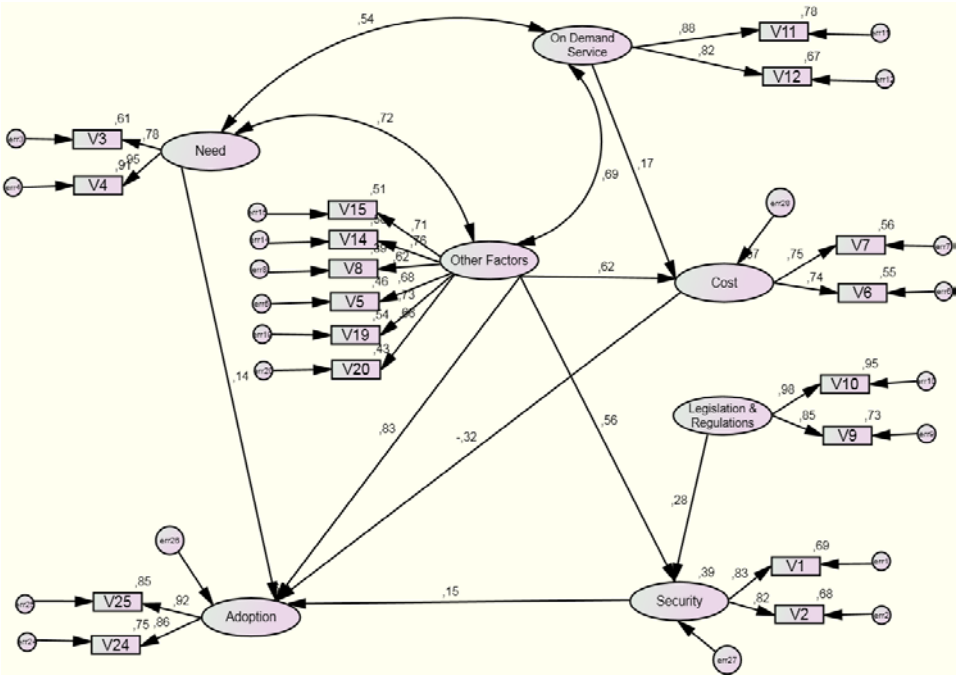


**Fig. 4.** Path diagram of the second structural model

**Table 7.** Regression and correlational weights

| Hypothesis | Regression Weights | P - Value |
|---|---|---|
| 1 | 0.150 | 0.012 |
| 3 | 0.141 | 0.048 |
| 4 | 0.174 | 0.050 |
| 5 | -0.318 | 0.002 |
| 6 | 0.278 | 0.001 |
| 8 | 0.835 | 0.001 |
| 9 | 0.556 | 0.001 |
| 10 | 0.624 | 0.001 |
| **Correlations** | **Correlational Weights** | |
| On Demand Service - *Other Factors* | 0.689 | 0.001 |
| Need - *Other Factors* | 0.715 | 0.001 |
| Need - On Demand Service | 0.545 | 0.001 |

**Table 8.** Goodness of fit indices of the structural model [40]

| Goodness of Fit Indices | | Acceptable Fits |
|---|---|---|
| Chi-Square | 293.468 | |
| Degrees of Freedom | 124 | |
| Absolute Fit Measures | | |
| GFI | 0.91 | .90≤GFI≤.95 |
| RMSEA | 0.067 | .05≤RMSEA≤.08 |
| RMR | 0.18 | .05≤SRMR≤.10 |
| Normed Chi-Square | 2.367 | 2< X2/df≤3 |
| Incremental Fit Indices | | |
| NFI | 0.91 | .90≤NFI≤.95 |
| CFI | 0.94 | .90≤CFI≤.95 |
| Parsimony Fit Indices | | |
| AGFI | 0.87 | .85≤AGFI≤.90 |

**Table 9** shows total effects of exogenous (independent) variables on endogenous (dependent) variables. Total effects include both direct and indirect effects of the factors. According to results, total effects of *other factors* on adoption are 0.72. It includes both positive direct effect and negative indirect effect on cloud computing adoption.

Need has only positive direct effect on cloud computing adoption. Besides, on demand service and *legislation and regulations* factors have only indirect effects on cloud computing adoption. On demand service and *other factors* have only direct effects on cost. They both have positive relationships with cost. Lastly, *other factors* and *legislation and regulations* have also only direct effects on *security*. They have positive relationships with *security*.

**Table 9.** Total effects of exogenous variables on endogenous variables

| Exogenous / Endogenous | Need | On Demand Service | *Other Factors* | Legislation & Regulations |
|---|---|---|---|---|
| **Adoption** | 0.141 | -0.055 | 0.720 | 0.042 |
| **Cost** | - | 0.174 | 0.624 | - |
| **Security** | - | - | 0.556 | 0.278 |

## 5. Conclusions

Cloud computing provides companies with various opportunities and they consider lots of factors in order to adopt it. According to both our literature review and expert interviews, these factors are evaluated delicately. *Security*, *need*, *legislation and regulations*, *on demand service*, *cost*, *supplier availability*, and *other factors* (*reliability*, *maintenance*, *virtualization*, *integration*, and *performance*) are added to the proposed model of the study. Data are collected from 306 respondents.

Before the application of SEM technique, descriptive statistics of the study are revealed. These statistics show that organizations mainly use SaaS. PaaS, IaaS, and DaaS follow it respectively. IDC predictions strengthen this indication that 27.8% of the worldwide organizational applications market will be SaaS-based by 2018 and it will generate $50.8B revenue [47]. Furthermore, usage of cloud computing services will increase and 60% of organizations will run at least half of their infrastructure on cloud computing platforms by 2018 [48].

After that, SEM technique is applied to measure the effects of the seven factors. EFA and CFA are applied to the model to test measurement model validity. EFA results point out that indicators represent the latent variables well and according to CFA results, a new measurement model is proposed and an acceptable measurement model is achieved.

After these analyses, two structural models are constructed. Two hypotheses are not supported and removed from the model. After that, three correlations are added to the model according to modification indices. An acceptable new structural mode is constructed.

As a result of analysis carried out, all variables except cost have positive direct effects on cloud computing adoption. Especially, *other factors* including *virtualization*, *reliability*, *performance*, *maintenance*, and *integration* have the strongest direct impacts on cloud computing adoption. It indicates that adequate technical requirements are important to adopt cloud computing technology. Organizations want to be more business-oriented by lightening their technical burdens. Other indication is that companies are open to adopt cloud computing, if they pay less. Predictions of IDC also indicate that organizations will shift 11% of their budget that allocated for traditional in-house technologies to any cloud computing services [49]. Furthermore, it is stated that 25% of organizations have experienced reduction in their IT costs by preferring cloud computing services [2]. In [50], it is also stated that 82% of organizations have reported that they saved money by preferring cloud computing services. Organizations are open to bear the cost of cloud computing services and they prefer to pay less for their IT needs. It is estimated that the plan of 42% of IT decision makers is increasing the spending of their organizational cloud computing [51].

Another implication of the study is that *need* and *security* increases cloud computing adoption among organizations. Companies' technological needs arise with the emergence of a competitive global environment. In this respect, companies' needs change dynamically. As in mentioned in the study of [2], one of the five reasons that businesses use cloud computing services is that these services can support their various business needs. When viewed from aspect of *security*, if organizations think that their systems are secure in cloud, they do not hesitate to adopt it. According to study of Network World, 36% of IT executives are planning to have their organizations focus on security over the next 12 months [52]. This indication reveals the importance of *security*.

In addition to these findings, study results show that *legislation and regulations* are very important concerns to increase data privacy and security in systems that use cloud computing technologies. Predictions of IDC point out that, organizations will try to comply with data privacy legislation in order to place organizational cloud tasks around the world [53]. It

implies the importance of legislations and regulations.

Lastly, *on demand service* and *other factors* also have effects on *cost*. *Other factors* particularly have the strongest positive direct impact on *cost*. In other words, more reliable systems and more performance, virtualization, and maintenance needs of the companies increase cost.

This study is a primary study for following studies to analyze the factors having effects on cloud computing adoption. It contributes the literature by presenting new factors and a new model. It is the case of Turkey, but the model is developed as parallel to the literature, therefore results of the study can be generalized. It can be extended in a few directions as a future work: increasing the sample size and adding new factors to the study.

## Acknowledgement

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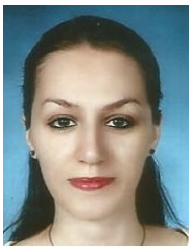
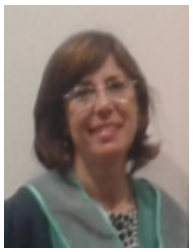
## Appendix 1

| Factor | Sub-Factor | Indicator | Question |
|---|---|---|---|
| Security | | V1 | I feel that cloud computing technology is secure. |
| | | V2 | I feel that cloud computing technology is more secure than traditional computing methods. |
| Need | | V3 | My organization needs cloud computing technology to meet its IT needs. |
| | | V4 | Cloud computing technology provides a significant benefit to my organization. |
| Cost | | V6 | I consider cloud computing technology to have considerable cost savings over traditional computing methods in the long run. |
| | | V7 | I consider cloud computing technology to have considerable low purchasing cost advantage over traditional computing methods. |
| Legislation & Regulations | | V9 | I feel that there are enough legislation and regulations regarded cloud computing technology. |
| | | V10 | I feel comfortable that there are enough legislation and regulations to store organizational date safely regarded cloud computing technology. |
| On Demand Service | | V11 | Cloud computing technology enables my organization to only buy its' needs over traditional computing methods. |
| | | V12 | My organization is only charged by the amount that is used through cloud computing technology over traditional computing methods. |
| Other Factors | Reliability | V5 | Cloud computing technology is more reliable with minimal downtime and rapid responses than traditional computing methods. |
| | Maintenance | V8 | I consider cloud computing technology to have easier maintenance over traditional computing methods. |
| | Virtualization | V14 | I consider that cloud computing technology increases business agility through faster application deployment and updates with no user interruptions. |
| | | V15 | I consider that cloud computing technology enables the personnel to complete their tasks at any time and from anywhere easily. |
| | | V16 | I consider that cloud computing technology reduces the number of physical servers through hardware virtualization. |
| | Performance | V19 | I feel that cloud computing technology increase organizational performance. |
| | | V20 | I think that it is easier to monitor organizational performance with cloud computing technology over traditional computing methods. |
| | Integration | V21 | I consider cloud computing technology to have easy integration with my organization's existing legacy systems. |
| Adoption | | V24 | I feel comfortable recommending cloud computing technology in my organization. |
| | | V25 | I am willing to use cloud computing technology in my organization. |



**Ezgi Akar** is a PhD candidate in the Department of Management Information Systems at Boğazici University. She received her MA in Management Information Systems from Boğazici University in 2013. Her research interests include information systems and technologies, data mining, social networks, cloud computing, and digital marketing.



**Sona Mardikyan** received her BS degree in Control and Computer Engineering from Technical University of Istanbul, Turkey, MS degree in Industrial Engineering from Bogazici University, and PhD in Quantitative Methods from Istanbul University. She is working in Management Information Systems department of Boğazici University as an associate professor. In the meantime, she is the vice director of School of Applied Disciplines. During her 20 years working experience in MIS department, she has taught more than 12 different courses and involved in various research and administrative activities. Her research areas are statistics, quantitative methods, information systems & technologies, and data mining.