Internet Banking, Cloud Computing: Opportunities, Threats

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Abstract
With the extension of Internet and its applications, internet banking is introduced as an efficient and cost effective way to provide services to customers. Towards the end of previous decade, cloud computing has been offered as a revolution in Internet application as a service which effect on the way that service is provided. Regarding the service improvement based on customer's needs, cloud computing is a quick move in informational services. This study tried to consider each aspect of internet banking and cloud computing strengths, weaknesses, opportunities and threats and provide SWOT analysis for Internet banking using cloud computing. In the following, the study tried to provide a practical solution for financial agencies and banks to provide better Internet banking services using cloud computing technology. Finally a SWOT analysis of internet banking using cloud computing technology is discussed and approved with expert opinions using fuzzy Delphi method.

Keywords: Cloud Computing, Internet Banking, Strengths, Weaknesses, Opportunities, Threats.

1. Introduction

The advent of internet and its applications caused a revolution in service provision in financial sector. This revolution in financial services caused changes in banking service provision leading to internet banking [1]. Using cost effective and helpful solution, internet banking caused a decrease in the time required for financial activities [2]. This technology resulted in bank customers' cooperation in banking activities such as payments, statements, account information review, money transfer and etc. without having any physical locations [3]. Internet banking lead to a reduction in costs related to other banking situations and provides complete and useful customer information [4]. Internet banking is widely adopted by most countries; the degree of progress in this technology in pioneer countries is more than fifty percent's [5,6]. Business strategies, plans and policies should be reviewed in order to increase the performance and decrease operational costs [7,8,9, and 10]. The power that leads to move toward using internet banking causes a break in adoption barriers, creates new products and services and provides opportunities for internet banking [11].

Based on NIST (National Institute of Standard and Technology) definition, cloud computing is a model to access, to share and to configure computing resources such as networks, servers, storage area, and software and

Services that form the internet [12]. Cloud computing is a new computing method in Information Technology provision [13]. Provided services by cloud computing are focused on two factors of quality and low costs. Customers can increase or decrease their needed services. Customers should pay based on their usage and they are able to increase or decrease the amount of usage rate and shared resources [14]. By workload division on different centers, cloud computing is able to optimize IT infrastructure usage. Also, users are able to access to services from anywhere and anytime [15].

Aim of this paper is to survey and extract cloud computing and internet banking strengths ,weaknesses, opportunities and threats (SWOT) and use these SWOT to provide a SWOT analysis for internet banking using cloud computing technology. Aim of this SWOT analysis is to show which opportunities are created by cloud computing strengths, which strengths will decrease the threats, which opportunities are lost by cloud computing weaknesses and which threat is created by cloud computing weaknesses. In section one, an introduction to cloud computing and internet banking and in section two, paper methodology in order to collect required data is provided. In section three cloud computing features is discussed and cloud computing and internet banking literature is provided. In section four and five a SWOT analysis of internet banking using cloud computing technology is discussed and approved with expert opinions using fuzzy Delphi method.

2. Methodology

In this article, cloud computing subject is considered and is searched for the related articles in Science Direct indexing database. The objective of this search was on

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cloud computing strengths, weaknesses, opportunities and threats (SWOT).

Twenty three articles with cloud computing subject were selected in this database and cloud computing SWOT is extracted with their comparison.

In internet banking issue, twenty one articles were found in Science Direct indexing database. With assessment of these articles, internet banking SWOTs was extracted.

In Internet banking using cloud computing technology issue, two articles are found in Science Direct indexing database. Regarding these articles, internet banking using cloud computing technology SWOTs is discussed and resulted. In addition, some recommendations are proposed, accordingly.

In order to assess results' correctness and to obtain experts opinions, fuzzy Delphi method has been used. Fuzzy Delphi method was developed in the 1980s. The application of this approach is to make decision and consensus on issues that are not explicitly specified goals and parameters, can lead to very significant results. Feature of this method, providing a flexible framework that many of the barriers related to lack of precision and clarity are covered.

3. Literature Review

NIST defined five qualities for cloud computing including "Widely network access", "Resource pooling", "Rapid elasticity" and "Measured services". Also, NIST defined four deployment models for cloud computing including public cloud, private cloud, community cloud and hybrid cloud. In Fig. 1 these deployment models are shown and will be described in table 1.

Based on NIST definition, cloud services can be categorized in three levels which are described in table 2.

From 1990 to now, many works are done about internet banking. Sathye [18] described the main problems of internet banking adoption as security issues, lack of knowledge about internet banking and unreasonable price.

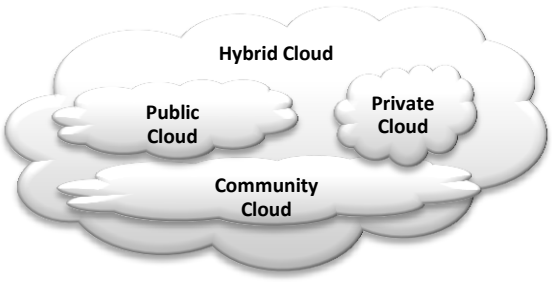

Fig. 1. Cloud computing deployment model

Table 1. Cloud computing deployment models

Public cloud	Public cloud is shared infrastructures among different users and these services are provided for anyone [14].
Private cloud	In private cloud, IT infrastructure is provided and supported for special organizations. In this model, there is no sharing in hardware or software among different users. This service can be inside an organization [16] and customers are responsible for this service management.
Community cloud	In community cloud, Cloud infrastructure is shared among a specific community which has special mission or goals, such as military organizations, banks.
Hybrid cloud	Hybrid cloud is a combination of other models for special purpose.

Table 2. Cloud Computing provided services

Infrastructure as a service	This service includes virtual servers which are run on virtual environments [17]. Customers have full controls on operating systems, storage areas, software and some configurations. Also, customers can provide their needed services based on their required computing power, storage area and required resources. Amazon EC2 service is an example of such service.
Platform as a service	In this service, users can deploy developed software by other users or create their own software using provided programming tools. Microsoft Azure is an example of such service.
Software as a service	This service includes provided software by cloud service providers in order to be used by customers [14]. Google Doc is an example of such service.

Howcraft [19], Liao [20], Akinci [21] described different factors of internet banking which have impacts on internet banking adoption. Some of these factors are, for instance, twenty four hour access, time performance, good quality services, current media support, security issues, and ease of use, transaction speed and user convenient.

Gerrard [22] used questionnaires to analyze customers' opinion about internet banking and described eight factors which prevent customers to adopt internet banking. Risks, lack of comprehensible requirements, service knowledge, and lack of access, face to face interaction and price related issues are some of these factors.

Sayer [23] described internet banking from customers' view and compared internet banking in Turkey and the UK. Focusing on cultural difference between Turkey and the UK in his article, he has done some researches on private financial information methods.

Laakkanen [24] assessed customers' attitude toward internet banking in Finland. Based on this article, resisting customers to internet banking form functional and psychological perspectives were evaluated. Resisting customers to internet banking were only measured from psychological perspectives. Non-resisting customers were more unpleased about information provided for internet banking.

Mirza [25] assessed internet banking adoption by private and public sectors in Iran. Based on this article, private banks were more successful in internet banking adoption by customers.

Subsorn [7] provided a comparative analysis for internet banking security from customers' perspective in Thailand and Sarakolaei [5] described four barriers to internet banking in Iran.

Lee [11] assessed internet banking and private financial information security in South Korea. In this article, he tried to focus on security issues and protection methods for private financial information.

Riffali [26], focuses on the acceptance factor and internet banking usage in Oman and Normalini [27] assessed the biometric technology impacts on the reduction of security problem. Based on this article, researches on biometrics lead to secure the logs process, to eliminate vulnerability problems and to reduce service desk call for password resets.

From 2009, cloud computing is noticed by many researchers because of its different applications. Owing to a wide variety of applications of this technology in all IT related issues, it can be used to accelerate the IT service uses.

Misra [27], worked on companies suitability in cloud adoption and Modeling its return of investments (ROI). This article tried to help companies for cloud adoption based on their specifications. In this article, some factors such as IT resources size, the amount of servers, the amount of user bases, IT annual revenue, the amount of covered countries, the percent of usage, data criticality, sensibility of work done by the company were used and by pointing to these factors, the researchers tried to provide some factors in order to create a suitability index. Finally, it tried to provide some solutions in ROI calculation which include cloud computing annual costs, saved costs, traditional costs, profit and etc.

Mastron [29], in his article tried to assess cloud computing from a business perspective. In his article, the strength, weakness, opportunities and threats of cloud computing for industries were identified. Also, different issues which affect cloud stakeholders were assessed. Some suggestions were provided for cloud service provides and managers.

Trang [30] focused on the role of cloud computing in competitive advantages improvement, and developed a research model for cloud computing form managerial perspective with a focus on small businesses. Also, the impact of cloud related resources in small businesses was assessed in this article.

Paquette [31], assessed security risks related to governmental uses of cloud computing. This article provided these risks as known or tangible risks including access, availability, infrastructure and integration and unknown or intangible risks including reliability, security, privacy and confidentiality, data location and etc.

Zissis [32] focused on cloud related security issues. Trust, security threats identification, confidentiality and privacy, integration, availability were some security factors which were focused in this article. Also, the writer tried to propose some security solutions for cloud computing challenges.

Subashini [33] in his lecture tried to assess security issues for each cloud provided services (SaaS, PaaS, IaaS) and current security solutions for these challenges.

Xunxu [34] worked on manufacturing based cloud computing. This article focused on cloud computing roles in manufacturing industries and its impacts on traditional manufacturing business models changes.

Zissis [35] in his article worked on electronic government and electronic voting security using cloud computing structures. In this article, the increase of complexity and corporation in electronic government services using cloud technology are assessed. In addition, they tried to identify cloud vulnerabilities using structural assessment. Finally, a high level solution for electronic government and electronic voting was presented using cloud computing solutions.

Aposta [36] worked on cloud computing modeling in banking system. In this article, he tried to analyze and assess cloud computing implementation in internet banking. In addition, the key requirements and tools of Cloud implementation are presented. Finally, he tried to identify business challenges in using cloud computing through a case study.

Bose [37] in his article, compared cloud computing and Internet banking form security and confidence perspective. He proposed that customers should have equal confidence about information storage in cloud computing and save money in internet banking. Some recommendations in technological, behavioral and regulatory aspects are presented which include “Critical security thinking”, “Access control and availability”, “confidentiality and privacy” and “long term viability and regulation”. These studies is summarized in table 3.

Table 3. Summary of studies related to Internet Banking and Cloud Computing

Author	Date	Research Fields	Results
Howcraft [19]	2002	Internet banking and customer attitude	• Different factors of internet which have impact on internet banking adoption
Liao [20]			
Akinci [21]	2004		
Gerrard [22]	2006	Internet banking and customer attitude	• Customer opinion about internet banking • Eight factors that prevent customers to adopt internet banking
Sayer [23]	2007	Internet banking adoption and customer attitude	• Internet banking from customer view • Comparison of cloud banking in UK and Turkey • Research on private financial information method
Laakkanen [24]	2009	Internet banking and customer attitude	• Customer attitude toward internet banking in Finland • Evaluation of resisting customers to internet banking from functional and psychological perspective.
Mirza [25]	2009	Internet banking adoption	• Internet banking adoption by private and public sectors in Iran
Subsorn [7]	2012	Internet banking security	• Comparative analysis for internet banking security from customers’ perspective in Thailand

Author	Date	Research Fields	Results
Sarakolaei [5]	2012	Internet banking adoption	• anking in Iran
Lee [11]	2011	Internet banking security	• Security issues for private financial information • Protection method for private financial information
Riffali [26]	2011	Internet banking adoption and customer attitude	• Acceptance factor and internet banking usage in Oman
Normalini [27]	2012	Internet banking security	• Biometric technology impacts on the reduction of security problems
Misra [27]	2010	Cloud computing Adoption	• Suitability index in cloud adoption and modeling its return of investment(ROI)
Mastron [29]	2010	Cloud computing SWOT and adoption	• Cloud computing SWOT • Some suggestion for cloud service providers and managers
Trang [30]	2010	Cloud computing SWOT and adoption	• Research model for cloud computing from managerial perspective • Impact of cloud related resources in small businesses
Paquette [31]	2010	Cloud computing security	• Security risks related to governmental use of cloud computing
Zissis [32]	2010	Cloud computing security	• Cloud related security issues
Subashini [33]			• Security solution for cloud computing challenges
Xunxu [34]	201	Cloud computing SWOT and adoption	• Cloud computing roles in manufacturing industries
Zissis [35]	2011	Cloud computing security	• High level solution for electronic government and electronic voting using cloud computing technology
Aposta [36]	2012	Internet Banking and Cloud Computing	• Key requirements and tools of Cloud implementation • Identify business challenges in using cloud computing
Bose [37]	2013	Internet Banking and Cloud Computing	• recommendations in technological, behavioral and regulatory aspects

4. The SWOT for Internet Banking and Cloud Computing

Cloud computing technology is introduced as a new way to provide services using internet. User convenient, performance, cost reduction and efficiency are the key factors which increased cloud applications and expansion in different services. After four years of cloud service introduction and assessment of every aspect of this technology, there is a good confidence from researchers, industries and customers about the provided services by this technology. Internet banking as a service can use cloud computing strengths and opportunities in order to improve their provided services for customers.

Internet banking can be provided using both public and private cloud. Each of these platforms has some opportunities and threats.

ING direct is one of famous internet banking systems which uses cloud Computing in order to expand its performance and decrease its costs.

Cloud computing has different strengths, weaknesses, opportunities and threats which are summarized in table 4.

Table 4. Cloud Computing SWOT

Strength	Weakness [39]	Opportunities	Threats
• Scalability [38][39] • Cost efficiency [38][40] • Efficiency [39][42] • Agility [40] • Availability [14] • Innovation [14]	• Security • Privacy • Structure • Performance • Financial • Legal • Learning	• Low Costs in IT infrastructure [29] • Cloud based e-education and e-learning [41] • Cloud based e-voting and e-government [35] • Cloud CRM and Cloud ERP [16] • Cloud based Tele-working • Green Cloud [42] • Service innovation	• Threat of Substitution [14] • Change in IT Culture [14] • The Loss of Physical control [14] • Critical Mission applications on Cloud environment [40]

Cloud computing strengths

For either high or low scale of computing demands, cloud computing shows its potential benefits. Traditional IT systems may fail against unpredicted demands. In contrast, cloud computing services can answer these demands quickly [38]. Unlimited capacity makes cloud computing flexible and responsive against changes. Quick responses against demands cause an improvement in IT service for both customers and organizations [39].

Primary benefits of cloud computing are cost saving as the main purpose of cloud computing to decrease purchase, maintenance and update costs of software, tools, and development area and transition of these costs to cloud providers. Because of the shared platform among different users, customers use a pay-as-you-go model that decreases the capital expenditure for each customer. In addition, by using cloud computing, high costs of IT infrastructures and operational costs of maintenance will be decreased [38]. These costs include energy consumption, IT systems maintenance, and support and transition management from old system to newer one [39]. Also, the cost related to servers including hardware and software purchase, annual licenses, technology updates, maintenance management costs and etc. can be saved using cloud computing technology.

Cloud computing efficiency includes an increase of IT infrastructure usage (more than sixty percent) [40], an increase of research and development in software innovation in the way of business and production growth [39], a creation of new ways which are not technically and economically possible without using cloud computing [39], prototyping and surveying on market acceptance for new approach quickly [39].

Cloud computing is agile and responsive for emergency needs because of its capacity to increase or decrease the ability to buy as a service from valid cloud providers [40].

Cloud computing availability can be assessed from some perspectives. From the first perspective, because cloud based software development is based on network performance; high levels of accessibility from this kind of software are excepted [14]. From the second perspective, high flexibility and accessibility of shared information cause an access to these services from anywhere through using internet.

Cloud computing is a motivation in the way of innovation and Creativity [14]. Using cloud computing, new technologies (such as cell phone and tablets) can be used to provide services for customers. For cloud computing implementation and use, vision of managers should change from ownerships of equipment view to service management view. Innovation can be concluded from this view. Also private sectors and organizations can benefit from cloud computing technology in innovation, organizational culture encouragement and relation with new technologies [40].

Cloud computing weaknesses

Security is the most important topic in cloud computing challenges. In cloud computing providers' selection, the care about provided level of security is critical. In this technology, users can have a basic description about their security and can determine security details. Cloud Providers should provide these security parameters. Users are depended for data access to Internet. Any lack of access to internet is a barrier to provide cloud services. So the existence of confident and stable communication platform to internet is critical. Different matters such as sanctions and storage location are important. Cloud's nature is in a way that storage locations can be different. Even data may be stored in different countries or continents. In this case, if service customer in a country is faced with sanctions, data accessibility will be ambiguous. In public platforms, because of neighboring data with other users, different security issues occur. Some security issues like side channels and covert channels are some example of this threat [39].

Privacy may be compromised because of the possibilities of access to stored critical and confidential information. Damage caused by security problems and privacy or inaccessibility to service can also damage reputation of both the customer and the organization [39]. Because of the related risks to cloud computing technology, consideration to priority of provided cloud services is too important.

Cloud computing models (especially SaaS model), for their provided software and type of service, decreased the possibilities of customization [39]. Especially when the organizational process is predefined and organization works based on specific process, implementation and compatibility of cloud services based on current organizational process imposes some complexities. When such compatibility with processes is essential, priority of Business Process Reengineering (BPR) is high. Before moving to this new technology, organizations must check on the effect of this new technology on their business processes and solve any problems or technical obstacles.

Providers must choose their level of service. This level of service should be guaranteed and be mentioned in Service Level Agreement (SLA). Service level should be monitored frequently (by both the providers and users) to ensure that this SLA is based on agreements. Every change in service level causes a disability of full and correct service delivery. So in cloud service provider's selection reputation, background, and service sustainability are critical factors. Because of daily increase in cloud computing service providers, coordination between them is too complex. For example, when a provider wants to finish its services, an organization must have the ability of information, application and processes transition to another compatible cloud provider [39].

Based on cloud pay-as-you-go model, customers will pay based on provided services for them. This model will change organizational IT budget. IT budget for traditional services is in form of capital costs, on the other hand, using pay-as-you-go model, IT budget should change to operational costs. This change may challenge the organization in budget estimation processes [39].

Information may be stored in different locations such as third country, this information is dependent on destination countries and organizations should be aware of destination countries laws to avoid trouble. Problems such as sanctions which may cause obstacle to accessibility of information should be considered by organizations [39]. From educational perspective, organizations should notice that transition to cloud computing technology needs more business analysis, change management and contract managers [39].

Cloud computing opportunities

Sharing IT infrastructures by cloud computing causes a decrease in IT capital costs especially in developing countries which have low capabilities of investment in high costs of IT infrastructures. These countries can use cloud computing to develop their IT services. Software provided by cloud technology creates a decrease in software and infrastructures costs which improve the software usage both for the organizations and users [29].

Software, as a service in electronic learning and electronic education, leads to improve in service quality in these two scopes. Using cloud computing, users can access the educational contents from educational centers or homes cooperatively and geographically which increases both users' and students' cooperation from different locations and educational levels [41].

Cloud computing will provide a secure platform for e-government and e-voting leading to people's cooperation in this subject. With the introduction of new services and provision of monotonic solutions, real time cooperation among agencies, location of free services, new communication and operational channels and elimination of cooperation barriers lead to provide high quality services in e-government and e-voting [35].

Small and medium size industries (SME's) have many problems in ERP and CRM systems implementation.

These problems include high financial power for implementation, managerial risks, business process reengineering (BPR) and etc. using cloud computing technology, SAP and Oracle companies; provide ERP systems under SaaS and IaaS platforms. SME's can use cloud ERP and cloud CRM in order to make benefit from ERP and CRM systems opportunities.

In today's world, tele-working is an important issue. Organizations move toward decreasing the employees' physical presence and increase the working time using tele-working. With data, software, infrastructure availability, cloud computing plays an important role in this way.

Another opportunity of cloud computing is green cloud. Using some mechanisms to save consumption power, cloud computing expands green IT. Some of these mechanisms are energy performance and systems scheduling [42]. Many researches are done in green cloud field in order to decrease energy consumption and increase effective services.

Cloud computing threats

Substitution by other providers is one of the threats which have impacts on cloud computing. Other providers can compete with a provider with higher quality and lower price. Because of the changes in IT culture in organizations, cloud computing may become threatened. These changes include changes in IT budget structure from capital to operational, changes in infrastructure managements and changes in the use of IT in organizations goals. With the elimination and transition of IT infrastructures to cloud computing platform, availability problems can endanger organizations safety. This unavailability may be occurred as a consequence of sanctions, end of provider services or etc. Organizations should be aware of the threat of losing the control on their physical infrastructures and services. Lack of suitable standards to implement cloud Computing shows itself as a threat in cloud computing implementations. In this topic, cloud computing implementation strategies are introduced by the U.S federal government and others [14,38,39,40]. Lack of suitable standards creates some problems in service transition from one provider to another returning from cloud services to traditional IT services.

In table 5 internet banking strength, weakness, opportunity and threat (SWOT) are summarized.

Internet banking strength

Because of twenty four hours services from anywhere and at any time, internet banking provides high level of availability for users. Users can easily go to internet web sites and benefit from internet banking services. This level of availability provides better services to customers and increase customers' convenience in using internet banking. Internet provides a wide platform for banking. Customers can access their requested service from any countries and there is no need for new branches in different countries for service expansion. Because of these, all users which have access to internet can have

Table 5. Internet banking SWOT

Strength	Weakness	Opportunity	Threat
• Better customer service[43] • Wider customer base Availability [1] • Cost reduction [1] • Convenience [43] • Accuracy [43] • Transaction speed [43]	• Security and Privacy [7][11] • Comp ability • Accessibility • Performance • Maintenance • Legal regulation	• Market expand[43] • Building trust on brand name[43] • New product and service[43] • Customer purchase behavior[43] • Profitability [43] • User experience and User involvement [43]	• Loose of market [14] • Information leakage [14] • Continuity of service[44]

access to internet banking service from a specific bank. In addition, lack of physical presence of customers in physical branches will decrease paper work, official process, staff costs and etc. electronic structure of internet banking and service delivery methods such as payment, money transfer, purchase and etc. created more accuracy and transaction speed vs. traditional banking systems which increase service performance. Internet banking opportunities open new ways for banking agencies in providing innovative and new products and services which improve the service level, profit and efficiency [1,48].

Internet banking weakness

Security is one of the main and most important subjects in internet banking. Internet vulnerabilities such as the rejection of services, information leakage, losing customers' confidential information, virus attacks, credit card frauds, stealing account information and etc. are some of these vulnerabilities. In privacy, internet banking has many security challenges. Privacy assurance is one of the challenging issues in this section which endanger expansion of this service.

Customers should be able to transfer their money form an account to another account on internet banks or traditional banks. So these services should be compatible with other banking systems. Trust on internet banking services is hard due to lack of face to face interactions which cause lack of total confidence to internet banking from customers.

Traditional users need extra education and learning activities to learn how to work and trust with internet banking systems and websites. This may cause a decrease in users' attitude to internet banking. Sites and infrastructure maintenance for service provision should be considered. Users and internet banking systems providers should consider regulations and banking and money laws in destination and providers' countries in order to have no problems for both users and business.

Internet banking opportunities

Using internet as a service provision platform by internet banking leads to expand target market and improves bank customers' base. Considering many people's access to internet and provider of internet banking through internet and web sites, a trust on commercial brands is created. Internet banking platform

is a service that can be accessed from anywhere and at any time and changes the social behavior of the people. Service innovations in internet banking will be increased and new and innovative software will be provided by internet banking industries.

All transactions and user visits from bank websites will be stored. Using this stored information, users' behaviors can be underhanded and forecasted easily. Using this understanding, new or changed product or services will be presented in order to improve service quality and convenience. Provided services by internet banking will cause new customer's experience and more customers' cooperation in internet banking services.

Internet banking threats

All of the threats that internet and cloud computing have can be occurred in internet banking service. Information leakage, sanctions, security problems will endanger service accessibility and users' trust which cause the loss of market or even end of an internet banking business.

5. Result and Discussion

Both internet banking and cloud computing are using internet platform to provide services for customers. Cloud computing shares software, platforms and infrastructures through the internet. Using web sites, Internet banking will provide different services for customers. So all SWOT of internet is shared between these two technologies.

In table 6 the strength, weakness, opportunity and threat of internet banking using cloud computing platform is summarized and compared together. In addition, we tried to answer these following questions:

1. Which opportunities are created by cloud computing strengths?
2. Which strengths will decrease the threats?
3. Which opportunities are lost by cloud computing weaknesses?
4. Which threat is created by cloud computing weaknesses?

Table 6. Internet banking using cloud computing technology SWOT

	Opportunities	Threats
Strengths	• More profit for both bank and customers. • Decrease in IT infrastructure costs and result in decrease of organization's IT costs. • Innovation in services and new products. • Service access from anywhere and at any time. • Target market expand and more customer acquisition. • Increase customer satisfaction. • Staff education and training will be more effective and efficient. • Service expansion using mobile cloud. • Increase in small and medium size organization to implement internet banking. • Service management and control form anywhere and at any time. • Service integration using current standards. • Convenience in transactions using current standards.	• Prevention of market loose using innovative and cost effective services. • Security threats prevention using centralized services by provider. • Quick service recovery with low costs. • Better response to change in demand. • High capability for high requests responses.
Weaknesses	• Loose of market and investment because of sanctions. • Loose of customers because of security and access problems. • Loose of physical control on internet banking operations. • Lack of service integration with other internet banking services because of lack of standards.	• Lack of access to data because of sanctions. • Information leakage because of security threats. • Loose of reputation because current weaknesses. • Low service quality and substitution by rivalry.

As a consequence of a decrease in IT costs, cloud computing led to more profit for both banking system and customers. This profit is produced by a decrease in IT infrastructure costs, convenience in service, a decrease in paperwork costs and etc. Innovative specification of cloud computing and application of this technology in internet banking will release innovative and new services and products.

With the expansion of Cloud Computing, every day, new and innovative product and services are provided which can be used in internet banking section. Scalable, cost efficient and available services which are provided by cloud computing technology lead to expand the target market and attract more customers in wider scopes. Low costs services, wider service in geographical scope and availability from anywhere and at any time cause an increase in provided service quality and finally leads to increase in customers' satisfaction which expand target market. The application of cloud computing in internet banking improves mobile banking and staff education activities. On the other hand, some threats will endanger internet banking system based on cloud computing technology. Sanction is the most important threat which endangers these services. Sanctions cause services unavailability, loss of market and money. Information leakage is one of the most important threats to internet banking. This threat may cause a complete destruction of bank. These information leakages can be caused by some vulnerability such as internet threats, information

accessibility to other providers which cause the loss of customers, target market, reputation and whole business.

Because of the provided infrastructure and software by cloud service providers; there is a threat of losing physical controls on internet banking operations from service providers. So organizations should consider providers' reputation, background, commitments and current customers. If provided services have low quality compared with other competitors and customers are not encountered by fast, convenient and accurate services, threat of substitution by competitors is considerable. Due to lack of standards for cloud computing and necessity of internet banking services integration with other internet banking services for transaction and other banking activities, data transaction between different providers may face some problems. Many agencies such as ISO are working on cloud computing standards.

Because of the high priority of security issues for internet banking and investment power in cloud computing technology by these agencies, medium and small size internet banking services can be chosen to migrate on cloud computing technology and take advantage of its unique specifications. In Fig. 2, a method to help internet banking in the way of cloud computing adoption is presented. Fig. 2 shows that whatever banking agencies want to invest more on internet banking based on cloud computing technology and have high security considerations, they can benefit from internet banking on private cloud IaaS.

On the other hand, if they want to invest less on this technology and have lower security considerations, they can choose internet banking on public cloud IaaS.

Cloud Computing provides more profit than traditional internet banking, so each of these two technologies will improve internet bank's efficiency, profit, performance and etc.

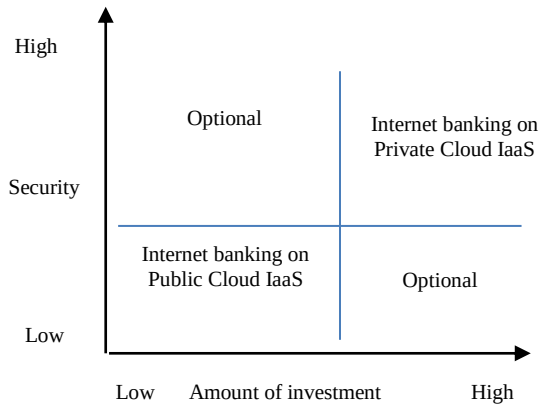

Fig. 2. Cloud computing adoption by internet banking

The Fuzzy Delphi Method is a method based on the Delphi Method and the Fuzzy Theory. Using this model, extracted factors can be evaluated based on expert opinion. Due to the accurate collection and analysis of expert opinions, this model has been used. In order to use fuzzy Delphi method [45], Experts offer their opinion in the form of minimum value and most likely value, then average of expert opinion (number provided) and the degree of disagreement of any expert from the average is calculated.

Fuzzy Delphi steps are as follows:

1. Experts selection
2. Preparation of the questionnaire
3. Getting expert opinion and analysis
4. If there is good consensus fuzzy Delphi process is finished otherwise back to step two

In the first step, ten experts in the field of information technology and banking are selected then a questionnaire based on a literature research in four parts is prepared. These four parts include which Internet banking opportunities can be pursued utilizing the strengths of the cloud computing? (SO), which threats to the Internet banking can be reduced or removed through cloud computing strengths (ST), which opportunities for Internet banking are lost by cloud computing weaknesses (WO) and to which threats Internet banking are exposed due to cloud computing weaknesses (WT).

The result of questionnaire is summarized in table 7.

After experts opinion collection, their opinion is transformed to qualitative variables as a trapezoid-shaped fuzzy numbers low (0,0,2,4), medium (3,4,6,7) High (6,8,10,10) using equation (1). Then the average (mean) A_m of all $A^{(i)}$ is computed using equation (2) [45].

$$A^{(i)} = \left(a_1^i, a_2^i, a_3^i, a_4^i\right), \quad i = 1,2,3,\ldots,n \qquad (1)$$

$$A_m = \left(a_{m1}, a_{m2}, a_{m3}, a_{m4}\right) = \left(\tfrac{1}{n}\Sigma a_1^{(i)}, \tfrac{1}{n}\Sigma a_2^{(i)}, \tfrac{1}{n}\Sigma a_3^{(i)}, \tfrac{1}{n}\Sigma a_4^{(i)}\right) \qquad (2)$$

where: n denotes the number of experts or opinions, m denotes the mean or average

The result of these equations is summarized in table 8.

Using equation (3) [45], for each expert, the difference between expert's opinion and A_m is calculated and sent back to the expert for reexamination. Then each expert sends their revised opinion as a trapezoidal fuzzy number based on this difference. In table 9, the revised expert opinion and the average of expert opinions obtained from the questionnaires are shown.

$$e = \left(a_{m1} - a_1^{(i)}, a_{m2} - a_2^{(i)}, a_{m3} - a_3^{(i)}, a_{m4} - a_4^{(i)}\right) = \left(\tfrac{1}{n}\Sigma a_1^{(i)} - a_1^i, \tfrac{1}{n}\Sigma a_2^{(i)} - a_2^i, \tfrac{1}{n}\Sigma a_3^{(i)} - a_3^i, \tfrac{1}{n}\Sigma a_4^{(i)} - a_4^i\right) \qquad (3)$$

At next step, using equation (4) [45] the distance of two average fuzzy numbers from step one and two is calculated. If calculated difference be less than 2.0, the Delphi process achieved consensus and will be stopped [45]. The process could be repeated again and again until a consensus emerges.

$$S\left(A_{m2}, A_{m1}\right) = \left|\frac{1}{4}\left[\left(a_{m21} + a_{m22} + a_{m23} + a_{m24}\right) - \left(a_{m11} + a_{m12} + a_{m13} + a_{m14}\right)\right]\right| \qquad (4)$$

According to smaller mean difference of 2.0, there is expert consensus on these factors after four rounds (the Results of 3rd and 4th questionnaires was the same). The result of this step is shown in tables 10-12.

Table 7. Result of first questionnaire

	SWOT Statements	The opinion among 10 experts		
		The degree of agreement		
		High	Medium	Low
SO	More profit for both bank and customers.	8	2	0
	Decrease in IT infrastructure costs and result in decrease of organization's IT costs.	9	1	0
	Innovation in services and new products.	7	2	1
	Service access from anywhere and at any time.	10	0	0
	Target market expand and more customer acquisition.	7	3	0
	Increase customer satisfaction.	6	2	2
	Staff education and training will be more effective and efficient.	5	4	1
	Service expansion using mobile cloud.	7	3	0
	Increase in the implementation of Internet banking by small and medium size organizations.	8	2	0
	Service management and control form anywhere and at any time.	8	1	1
	Service integration using current standards.	6	2	2
	Convenience in transactions using current standards.	9	0	1
ST	Prevention of market loose using innovative and cost effective services.	5	3	2
	Security threats prevention using centralized services by provider.	5	4	1
	Quick service recovery with low costs.	8	2	0
	Better response to change in demand.	7	2	1
	High capability for high requests responses.	7	3	0
WO	Loose of market and investment because of sanctions.	9	0	1
	Loose of customers because of security and access problems.	4	5	1
	Loose of physical control on internet banking operations.	3	4	3
	Lack of service integration with other internet banking services because of lack of standards.	5	5	0
WT	Lack of access to data because of sanctions.	4	3	3
	Information leakage because of security threats.	7	2	1
	Loose of reputation because current weaknesses.	3	5	2
	Low service quality and substitution by rivalry.	6	1	3
S: Strengths, W:weaknesses, O: opportunities, T: threats				

Table 8. Average of opinions obtained from the first

	SWOT Statements	Average of experts' opinions (trapezoidal fuzzy number)
SO	More profit for both bank and customers.	[5.4,7.2,9.2,9.4]
	Decrease in IT infrastructure costs and result in decrease of organization's IT costs.	[5.7,7.6,9.6,9.7]
	Innovation in services and new products.	[4.8,6.4,8.4,8.8]
	Service access from anywhere and at any time.	[6,8,10,10]
	Target market expand and more customer acquisition.	[5.1,6.8,8.8,9.1]
	Increase customer satisfaction.	[4.2,5.6,7.6,8.2]
	Staff education and training will be more effective and efficient.	[4.2,5.6,7.6,8.2]
	Service expansion using mobile cloud.	[5.1,6.8,8.8,9.1]
	Increase in the implementation of Internet banking by small and medium size organizations.	[5.4,7.2,9.2,9.4]
	Service management and control form anywhere and at any time.	[5.1,6.8,8.8,9.1]
	Service integration using current standards.	[4.2,5.6,7.6,8.2]
	Convenience in transactions using current standards.	[5.4,7.2,9.2,9.4]
ST	Prevention of market loose using innovative and cost effective services.	[3.9,5.2,7.2,7.9]
	Security threats prevention using centralized services by provider.	[4.2,5.6,7.6,8.2]
	Quick service recovery with low costs.	[5.4,7.2,9.2,9.4]
	Better response to change in demand.	[4.8,6.4,8.4,8.8]
	High capability for high requests responses.	[5.1,6.8,8.8,9.1]
WO	Loose of market and investment because of sanctions.	[5.4,7.2,9.2,9.4]
	Loose of customers because of security and access problems.	[3.9,5.2,7.2,7.9]
	Loose of physical control on internet banking operations.	[3,4,6,7]
	Lack of service integration with other internet banking services because of lack of standards.	[4.5,6,8,8.5]
WT	Lack of access to data because of sanctions.	[3.3,4.4,6.4,7.3]
	Information leakage because of security threats.	[4.8,6.4,8.4,8.8]
	Loose of reputation because current weaknesses.	[3.3,4.4,6.4,7.3]
	Low service quality and substitution by rivalry.	[3.9,5.2,7.2,7.9]
S: Strengths, W:weaknesses, O: opportunities, T: threats		

Table 9. Result of the second questionnaire

	SWOT Statements	The opinion among 10 experts	
		The degree of agreement	
		High, Medium, Low	Average of experts' opinions (trapezoidal fuzzy number)
SO	More profit for both bank and customers.	8,2,0	[5.4,7.2,9.2,9.4]
	Decrease in IT infrastructure costs and result in decrease of organization's IT costs.	9,1,0	[5.7,7.6,9.6,9.7]
	Innovation in services and new products.	8,1,1	[5.1,6.8,8.8,9.1]
	Service access from anywhere and at any time.	10,0,0	[6,8,10,10]
	Target market expand and more customer acquisition.	8,2,0	[5.4,7.2,9.2,9.4]
	Increase customer satisfaction.	7,2,1	[4.8,6.4,8.4,8.8]
	Staff education and training will be more effective and efficient.	6,4,0	[4.8,6.4,8.4,8.8]
	Service expansion using mobile cloud.	8,2,0	[5.4,7.2,9.2,9.4]
	Increase in the implementation of Internet banking by small and medium size organizations.	9,1,0	[5.7,7.6,9.6,9.7]
	Service management and control form anywhere and at any time.	9,0,1	[5.4,7.2,9.2,9.4]
	Service integration using current standards.	7,2,1	[4.8,6.4,8.4,8.8]
	Convenience in transactions using current standards.	10,0,0	[6,8,10,10]
ST	Prevention of market loose using innovative and cost effective services.	6,3,1	[4.5,6,8,8.5]
	Security threats prevention using centralized services by provider.	6,4,0	[4.8,6.4,8.4,8.8]
	Quick service recovery with low costs.	9,1,0	[5.7,7.6,9.6,9.7]
	Better response to change in demand.	8,1,1	[5.1,6.8,8.8,9.1]
	High capability for high requests responses.	9,1,0	[5.7,7.6,9.6,9.7]
WO	Loose of market and investment because of sanctions.	9,0,1	[5.4,7.2,9.2,9.4]
	Loose of customers because of security and access problems.	3,7,0	[3.9,5.2,7.2,7.9]
	Loose of physical control on internet banking operations.	2,6,6	[3,4,6,7]
	Lack of service integration with other internet banking services because of lack of standards.	6,4,0	[4.8,6.4,8.4,8.8]
WT	Lack of access to data because of sanctions.	4,4,2	[3.6,4.8,6.8,7.6]
	Information leakage because of security threats.	7,2,1	[4.8,6.4,8.4,8.8]
	Loose of reputation because current weaknesses.	2,7,1	[3.3,4.4,6.4,7.3]
	Low service quality and substitution by rivalry.	7,0,3	[4.2,5.6,7.6,8.2]
S: Strengths, W:weaknesses, O: opportunities, T: threats			

Table 10. Mean difference of the first and second questionnaires

	SWOT Statements	Difference of experts opinions
SO	More profit for both bank and customers.	0
	Decrease in IT infrastructure costs and result in decrease of organization's IT costs.	0
	Innovation in services and new products.	0.35 > 0.2
	Service access from anywhere and at any time.	0
	Target market expand and more customer acquisition.	0.35 > 0.2
	Increase customer satisfaction.	0.7 > 0.2
	Staff education and training will be more effective and efficient.	0.7 > 0.2
	Service expansion using mobile cloud.	0.35 > 0.2
	Increase in the implementation of Internet banking by small and medium size organizations.	0.35 > 0.2
	Service management and control form anywhere and at any time.	0.35 > 0.2
	Service integration using current standards.	0.7 > 0.2
	Convenience in transactions using current standards.	0.7 > 0.2
ST	Prevention of market loose using innovative and cost effective services.	0.7 > 0.2
	Security threats prevention using centralized services by provider.	0.7 > 0.2
	Quick service recovery with low costs.	0.35 > 0.2
	Better response to change in demand.	0.35 > 0.2
	High capability for high requests responses.	0.7 > 0.2
WO	Loose of market and investment because of sanctions.	0
	Loose of customers because of security and access problems.	0
	Loose of physical control on internet banking operations.	0
	Lack of service integration with other internet banking services because of lack of standards.	0.35 > 0.2
WT	Lack of access to data because of sanctions.	0.35 > 0.2
	Information leakage because of security threats.	0
	Loose of reputation because current weaknesses.	0
	Low service quality and substitution by rivalry.	0.35 > 0.2
S: Strengths, W:weaknesses, O: opportunities, T: threats		

Table 11. Result of the third questionnaire

	SWOT Statements	The opinion among 10 experts		Difference of experts opinions (2nd and 3rd round)
		High, Medium, Low	Average of experts' opinions	
SO	More profit for both bank and customers.	8,2,0	[5.4,7.2,9.2,9.4]	0
	Decrease in IT infrastructure costs and result in decrease of organization's IT costs.	9,1,0	[5.7,7.6,9.6,9.7]	0
	Innovation in services and new products.	8,1,1	[5.1,6.8,8.8,9.1]	0
	Service access from anywhere and at any time.	10,0,0	[6,8,10,10]	0
	Target market expand and more customer acquisition.	8,2,0	[5.4,7.2,9.2,9.4]	0
	Increase customer satisfaction.	7,2,1	[4.8,6.4,8.4,8.8]	0
	Staff education and training will be more effective and efficient.	7,3,0	[5.1,6.8,8.8,9.1]	0.35 > 0.2
	Service expansion using mobile cloud.	8,2,0	[5.4,7.2,9.2,9.4]	0
	Increase in the implementation of Internet banking by small and medium size organizations.	9,1,0	[5.7,7.6,9.6,9.7]	0
	Service management and control form anywhere and at any time.	9,0,1	[5.4,7.2,9.2,9.4]	0
	Service integration using current standards.	8,1,1	[5.1,6.8,8.8,9.1]	0.35 > 0.2
	Convenience in transactions using current standards.	10,0,0	[6,8,10,10]	0
ST	Prevention of market loose using innovative and cost effective services.	7,2,1	[4.8,6.4,8.4,8.8]	0.35 > 0.2
	Security threats prevention using centralized services by provider.	8,1,1	[5.1,6.8,8.8,9.1]	0.35 > 0.2
	Quick service recovery with low costs.	9,1,0	[5.7,7.6,9.6,9.7]	0
	Better response to change in demand.	8,1,1	[5.1,6.8,8.8,9.1]	0
	High capability for high requests responses.	9,1,0	[5.7,7.6,9.6,9.7]	0
WO	Loose of market and investment because of sanctions.	9,0,1	[5.4,7.2,9.2,9.4]	0
	Loose of customers because of security and access problems.	2,8,0	[3.6,4.8,6.8,7.6]	0.35 > 0.2
	Loose of physical control on internet banking operations.	1,8,1	[3,4,6,7]	0
	Lack of service integration with other internet banking services because of lack of standards.	7,3,0	[5.1,6.8,8.8,9.1]	0.35 > 0.2
WT	Lack of access to data because of sanctions.	3,6,1	[3.6,4.8,6.8,7.6]	0
	Information leakage because of security threats.	8,1,1	[5.1,6.8,8.8,9.1]	0.35 > 0.2
	Loose of reputation because current weaknesses.	1,9,0	[3.3,4.4,6.4,7.3]	0
	Low service quality and substitution by rivalry.	7,0,3	[4.2,5.6,7.6,8.2]	0
S: Strengths, W:weaknesses, O: opportunities, T: threats				

Table 12. Result of the fourth questionnaire

	SWOT Statements	The opinion among 10 experts High, Medium, Low	Average of experts' opinions (trapezoidal fuzzy number)	Difference of experts opinions (3nd and 4th round)
SO	More profit for both bank and customers.	8,2,0	[5.4,7.2,9.2,9.4]	0
	Decrease in IT infrastructure costs and result in decrease of organization's IT costs.	9,1,0	[5.7,7.6,9.6,9.7]	0
	Innovation in services and new products.	8,1,1	[5.1,6.8,8.8,9.1]	0
	Service access from anywhere and at any time.	10,0,0	[6,8,10,10]	0
	Target market expand and more customer acquisition.	8,2,0	[5.4,7.2,9.2,9.4]	0
	Increase customer satisfaction.	7,2,1	[4.8,6.4,8.4,8.8]	0
	Staff education and training will be more effective and efficient.	7,3,0	[5.1,6.8,8.8,9.1]	0
	Service expansion using mobile cloud.	8,2,0	[5.4,7.2,9.2,9.4]	0
	Increase in the implementation of Internet banking by small and medium size organizations.	9,1,0	[5.7,7.6,9.6,9.7]	0
	Service management and control form anywhere and at any time.	9,0,1	[5.4,7.2,9.2,9.4]	0
	Service integration using current standards.	8,1,1	[5.1,6.8,8.8,9.1]	0
	Convenience in transactions using current standards.	10,0,0	[6,8,10,10]	0
ST	Prevention of market loose using innovative and cost effective services.	7,2,1	[4.8,6.4,8.4,8.8]	0
	Security threats prevention using centralized services by provider.	8,1,1	[5.1,6.8,8.8,9.1]	0
	Quick service recovery with low costs.	9,1,0	[5.7,7.6,9.6,9.7]	0
	Better response to change in demand.	8,1,1	[5.1,6.8,8.8,9.1]	0
	High capability for high requests responses.	9,1,0	[5.7,7.6,9.6,9.7]	0
WO	Loose of market and investment because of sanctions.	9,0,1	[5.4,7.2,9.2,9.4]	0
	Loose of customers because of security and access problems.	2,8,0	[3.6,4.8,6.8,7.6]	0
	Loose of physical control on internet banking operations.	1,8,1	[3,4,6,7]	0
	Lack of service integration with other internet banking services because of lack of standards.	7,3,0	[5.1,6.8,8.8,9.1]	0
WT	Lack of access to data because of sanctions.	3,6,1	[3.6,4.8,6.8,7.6]	0
	Information leakage because of security threats.	8,1,1	[5.1,6.8,8.8,9.1]	0
	Loose of reputation because current weaknesses.	1,9,0	[3.3,4.4,6.4,7.3]	0
	Low service quality and substitution by rivalry.	7,0,3	[4.2,5.6,7.6,8.2]	0
S: Strengths, W:weaknesses, O: opportunities, T: threats				

6. Conclusions

Cloud computing is a new technology in IT service provision. Using cloud computing as a platform in internet banking service provision creates opportunities and threats. Because of the cost efficiency, availability, scalability, accuracy, innovation and efficiency features of cloud computing, it is proposed for internet banking section. Using this technology leads to more profit for both customers and banking, new products and services, market expansion and etc. nevertheless, some threats such as sanctions, information leakage, change in IT culture and substitution affect this technology.

Banks can use cloud computing as a base for improving their services. Internet banking sectors have low level of security considerations and amount of investment on internet banking on public cloud IaaS. Other internet banking sectors which have high level of security needs and high amount of investment power can choose internet banking on private cloud IaaS. Others can choose between these two kinds of implementation.

This paper has two main limitations. First limitation is the access to experts who have the knowledge and the experience to support researchers. Only limited access to experts in the research areas of cloud computing and internet banking was available in this study. Second limitation of this paper is the restricted number of literature reviews in terms of cloud computing and internet banking which can be expanded using more research on different aspect of these technologies.

In future, we will try to assess internet banking states, opportunities and threats in Iran and opportunities and threat of cloud computing for Iranians' internet banking systems. Finally, we will try to provide some recommendation for Iranians internet banking in order to adopt cloud computing technology.

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