

Original Research

Electronic Service Risk Pattern and Ranking by Using Fuzzy TOPSIS Technique

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Abstract

Today, everyone witnesses the influence and expansion of using information technology in delivering various services. Despite the expansion of using the above-mentioned services, there are still some risks to using such services. Thus, identifying such risks and adopting the necessary strategies to them are highly beneficial. As a result, the present study aimed to identify and rank the risks in the field of electronic service with an emphasis on information and communication technology offices. Thus, the research objective was realized using the mixed research method. In the qualitative phase of the study, the library method and semi-structured interviews were used for identifying the electronic service risk pattern and in the quantitative phase, a researcher-made questionnaire was used as a data collection tool and the fuzzy TOPSIS test was used for ranking the risks identified during the first phase. The results indicated that electronic service risks are divided into four main categories such as organizational factors, operational factors, environmental factors, and technological factors. Among the identified risks, environmental factors have the highest risk, followed by operational factors, organizational factors, and technological factors. Using the results of the study, it can be expected that electronic service providers, managers, and government sectors are expected to focus their efforts on reducing the relevant risks through a proper understanding of the types of risks, considering the significance of each risk and making decisions on planning the services. The result is an increase in the quality of electronic service and customer satisfaction.

Keywords: Service model, e-service, risk, theme analysis, fuzzy TOPSIS

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Introduction

The present century is the age of extensive changes and transformations. The emergence of information technology is one of the major changes which could affect almost all areas of human life in the current conditions. Information technology has even led to the change of people's lifestyles. As a result of the using information technology, the use of electronic service was introduced as a new style of service delivery among customers. Electronic service is provided by information technology and mainly on the Internet. Instead of referring to different organizations directly for receiving services, customers receive their desired services through services based on information technology and the Internet. In fact, electronic service is provided as a result of network technologies (Batagam, Pocovnicu, and Capisizu 2009). Electronic government is an extensive field which has been able to serve a wide range of customers. The customers of this field are mostly those who aim to receive a variety of government services through information technology. In order to receive their services, these customers can refer to service provider websites or the information and communication technology offices. In fact, information and communication technology offices provide the electronic service expected by customers. electronic service means delivering services to customers through information technology and network technologies (Batagam et al., 2009). Instead of going to different organizations directly for receiving services, customers take advantage of the services provided via the Internet. Electronic service has two main features such as the availability of services through electronic networks and service providers and also the availability of services by customers through the Internet (Batagam et al., 2009). In the present study, the first form of services was emphasized. Despite all the benefits which electronic service can have for customers and even the government, it cannot be claimed that electronic service can be delivered without any problems. Delivering electronic service can face some risks which can be effective in service delivery process and even put it in danger. Risk is the likelihood of positive and negative returns. In fact, risk is an event with uncertain conditions and if it occurs, it can have positive and negative effects on at least one of the project goals such as time, cost, scope, and quality (Alhawari, Karadsheh, Nehari Talet, and Mansour 2012). Furthermore, risk can be defined as a variable affecting a project and leading to errors and problems in the project (Padayachee 2002). The significant point is that risk cannot be reduced to zero and eliminated, but it can be controlled and its effects can be reduced. As a result, identifying the electronic service risks and prioritizing them can be helpful in this regard. Little research has been conducted in the field of presenting the electronic service risk model and prioritizing the risks. Most of the studies have considered the information technology risks in general or information technology projects, making the present study significant. For example, Smith, McKeen, and Staples (2001) who evaluated the risks of information technology projects. Their findings indicated that the risks such as financial risk, security risk, employee risk, information risk, business process risk, and success risk affect the information technology projects. Viehland (2002) introduced the risks of information technology, especially in information technology projects. The results of his study indicated that competitive risks, system security, and project risk can be identified as the risks affecting the information technology projects. Benaroch (2002) evaluated the risks in the field of information technology. The results of his study indicated that there are financial, project, operational, organizational, competitive, systematic, environmental and technological risks are raised in the field of information technology. Evangelidis

(2003) provided a framework for evaluating electronic government risks. The results of his study showed that risks such as social, economic, technical, political and security risks are effective in delivering electronic government services. Jordan and Silcock (2005) conducted a study to identify information technology risks. The results of their study indicated that project risk, application risk, information technology continuity, information assets, infrastructure suppliers risk, and strategic risks are significant. Matzler et al. (2008) examined the relationship between perceived risks and brand loyalty through the mediation of brand trust and brand value. The results of their study revealed that risk can affect the loyalty of customers of a particular brand. Ramanathan (2011) examined the role of risk in the relationship between corporate performance and customer loyalty in electronic commerce. His study indicated that customer loyalty is affected by the degree and feature of risk-taking in products. Faroughian et al. (2012) showed that the presence of various risks such as financial, psychological, operational risk as well as the quality of services can affect the perceived value of Internet banking customers. Ha and Son (2013) examined the effect of perceived risk on customer satisfaction and loyalty. The results of their study indicated that risks such as operational and financial risk can affect customer satisfaction and their loyalty. Kim and Koo (2016) studied the relationship between perceived risk and trust in electronic markets and indicated that perceived risk and customer trust have a mutual relationship in electronic transactions, so that the risk perceived by customers who did electronic shopping affects their trust and desire to purchase. as a result, can be said, in most studies different aspect of e-service risks have not been considered and an almost complete classification of e-service risks have not been introduced .so identify and ranking e-service risk is so important. Accordingly, this study aimed to identify and prioritize the risks faced by the customers of electronic service provided in information and communication technology offices. As a result, the research questions are:

- What is the electronic service risks model for customers?
- How is the electronic service risk ranking?

In the following sections, the data are reviewed and the results are presented by presenting the research method, data collection, and data analysis.

Theoretical foundations and review of literature

Information technology has taken root in all areas during the recent years. Today's, the widespread use of this technology in various fields of business is obvious. In fact, information technology is the provider of technologies by which data are collected, stored, processed, and transferred. It is currently known as the main platform of customer service in the world. The result is the formation of the concept of electronic service. In fact, electronic service means delivering services to customers through information technology and network technologies (Batagam et al., 2009). Instead of going to different organizations directly for receiving services, customers take advantage of the services provided via the Internet. Electronic service has two main features such as the availability of services through electronic networks and service providers and also the availability of services by customers through the Internet (Batagam et al., 2009). In the present study, the first form of services was emphasized. Delivering electronic service can face some

risks which can be effective in service delivery process and even put it in danger. Risk is the likelihood of positive and negative returns. In other words, the current uncertainty about the future and what is to be realized in the future is equal to risk. In fact, risk is an event with uncertain conditions and if it occurs, it can have positive and negative effects on at least one of the project goals such as time, cost, scope, and quality (Alhawari, Karadsheh, Nehari Talet, and Mansour 2012). Furthermore, risk can be defined as a variable affecting a project and leading to errors and problems in the project (Padayachee 2002). The significant point is that risk cannot be reduced to zero and eliminated, but it can be controlled and its effects can be reduced. As a result, identifying the electronic service risks and prioritizing them can be helpful in this regard. Little research has been conducted in the field of presenting the electronic service risk model and prioritizing the risks. Most of the studies have considered the information technology risks in general or information technology projects, making the present study significant. For example, Smith, McKeen, and Staples (2001) who evaluated the risks of information technology projects. Their findings indicated that the risks such as financial risk, security risk, employee risk, information risk, business process risk, and success risk affect the information technology projects. Viehland (2002) introduced the risks of information technology, especially in information technology projects. The results of his study indicated that competitive risks, system security, and project risk can be identified as the risks affecting the information technology projects. Benaroch (2002) evaluated the risks in the field of information technology. The results of his study indicated that there are financial, project, operational, organizational, competitive, systematic, environmental and technological risks are raised in the field of information technology. Evangelidis (2003) provided a framework for evaluating electronic government risks. The results of his study showed that risks such as social, economic, technical, political and security risks are effective in delivering electronic government services. Jordan and Silcock (2005) conducted a study to identify information technology risks. The results of their study indicated that project risk, application risk, information technology continuity, information assets, infrastructure suppliers risk, and strategic risks are significant. Matzler et al. (2008) examined the relationship between perceived risks and brand loyalty through the mediation of brand trust and brand value. The results of their study revealed that risk can affect the loyalty of customers of a particular brand. Ramanathan (2011) examined the role of risk in the relationship between corporate performance and customer loyalty in electronic commerce. His study indicated that customer loyalty is affected by the degree and feature of risk-taking in products. Faroughian et al. (2012) showed that the presence of various risks such as financial, psychological, operational risk as well as the quality of services can affect the perceived value of Internet banking customers. Ha and Son (2013) examined the effect of perceived risk on customer satisfaction and loyalty. The results of their study indicated that risks such as operational and financial risk can affect customer satisfaction and their loyalty. Kim and Koo (2016) studied the relationship between perceived risk and trust in electronic markets and indicated that perceived risk and customer trust have a mutual relationship in electronic transactions, so that the risk perceived by customers who did electronic shopping affects their trust and desire to purchase.

Methodology

The methodology of this study was mixed. The theme analysis method was used in the qualitative part and the fuzzy TOPSIS analysis process and Excel 2013 software were used in the quantitative part. The present study was applied in terms of the type of research. In addition, this study was considered as descriptive or non-experimental in terms of data collection method. In the qualitative part, the statistical population included the academic and organizational experts in the field of information technology. Furthermore, qualitative sampling methods such as purposeful and convenience were used. At this stage, a number of 12 subjects was considered as sample based on the theoretical saturation. In the quantitative part, a questionnaire including a pairwise comparison matrix was used to rank the identified variables. After collecting the answers, the obtained numbers were converted to the corresponding fuzzy numbers based on [Table 1](#).

Table 1. Verbal phrase and fuzzy number

Verbal phrase	Fuzzy number
Very weak	(0,0,1)
Weak	(0,1,3)
Almost weak	(1,3,5)
Medium	(3,5,7)
Almost good	(5,7,9)
Good	(7,9,10)
Very good	(9,10,10)

Finding

Answering the first question

In order to identify the electronic service risks, the theme analysis method was used based on the method introduced by Braun and Clarke (2006). The theme analysis based on the six steps of Brown and Clark was conducted as follows:

In the first step which aimed at familiarity with the data, first the available resources were reviewed several times. Then, a number of 21 initial themes were identified which seemed attractive to the researcher. After that, 12 codes remained by searching the codes and refining them with the aim of eliminating the incomplete and duplicate codes. Finally, the codes were categorized into four main themes. [Table 2](#) presents the identified main themes and sub-themes of electronic service risks.

Table 2. main themes and sub themes of e-service risks

Main theme	Sub theme	Definition
Technological factors	Security risk	Potential events which make public assets vulnerable
	Technical risk	Due to the lack of information technology infrastructure required for delivering electronic service
Operational factors	Legal risk	Lack of standards, rules and guidelines for delivering electronic service
	Functional risk	Expected returns and outputs from an electronic service provider are not realized
	Process risk	Inefficiency of the processes for delivering electronic service
Environmental factors	Social risk	Non-acceptance of electronic service
	Reputation risk	Spreading negative rumors on the provided electronic service
	Grounded risk	Extensive and unexpected changes such as economic, political and cultural changes and ...
	Competition risk	Presence of competitors to deliver electronic service and attract customers to competitors
Organizational factors	Resource risk	Lack of human resources and required knowledge and skills
	Financial risk	Financial loss for customers because of receiving electronic service from the service provider at a higher cost
	Time risk	Failure to deliver electronic service to customers on time

Based on the result of the theme analysis, the electronic service risk themes tree is drawn in Figure 1.

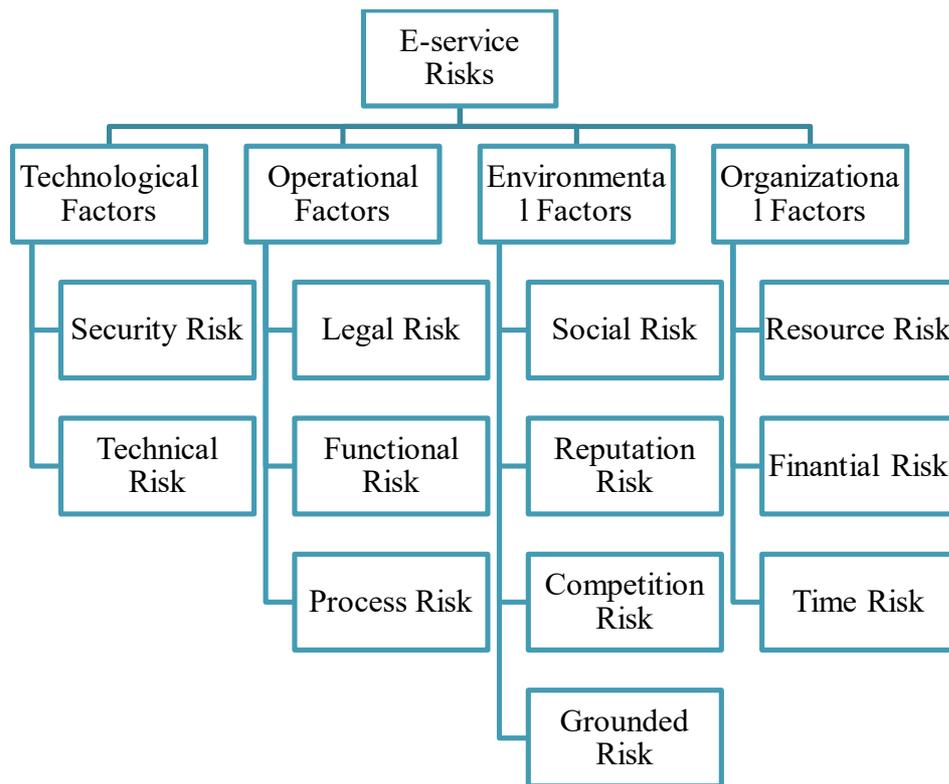


Figure 1. e-service risk themes tree

Answering the second question

Fuzzy TOPSIS test was used for determining the priority of identified risks in electronic services. TOPSIS is one of the multi-criteria decision making methods which ranks m options in accordance with n different criteria. In addition, it is possible to rank some options without any specific criteria. The basis of this method is selecting an option which has the minimum distance from the desirable ideal answer and the maximum distance from the undesirable ideal answer. The steps for performing fuzzy TOPSIS are specified below:

- Step 1: Forming a decision-making matrix for evaluating the options
- Step 2: De-scaling the decision matrix: In this step, we should convert the fuzzy decision-making matrix of evaluating the options into a fuzzy normalization matrix.
- Step 3: Creating a fuzzy weighted normalization matrix.
- Step 4: Identifying the fuzzy positive ideal and the fuzzy negative ideal.
- Step 5: Calculating the sum of distances for each option from the fuzzy positive ideal and the fuzzy negative ideal.
- Step 6: Calculating the relative proximity of the i -th option from the ideal solution.

- Step 7: The options in the problem can be ranked in a descending order. The results are presented in Table 3.

Table 3. e-service risk ranking

Main theme	Sub theme	The distance to the negative ideal	The distance to the positive ideal	CC	Rank
Organizational factors	Financial risk	0.289	19.733	0.014	12
	Time risk	0.693	19.321	0.035	2
	Resource risk	0.669	19.343	0.033	3
Technological factors	Technical risk	0.859	19.147	0.043	1
	Security risk	0.3	19.722	0.015	11
Environmental factors	Reputation risk	0.408	19.612	0.02	9
	Competition risk	0.302	19.719	0.016	10
	Social risk	0.619	19.396	0.031	4
	Grounded risk	0.55	19.467	0.028	7
Operational factors	Functional risk	0.585	19.431	0.029	6
	Legal risk	0.612	19.401	0.032	5
	Process risk	0.541	19.475	0.027	8

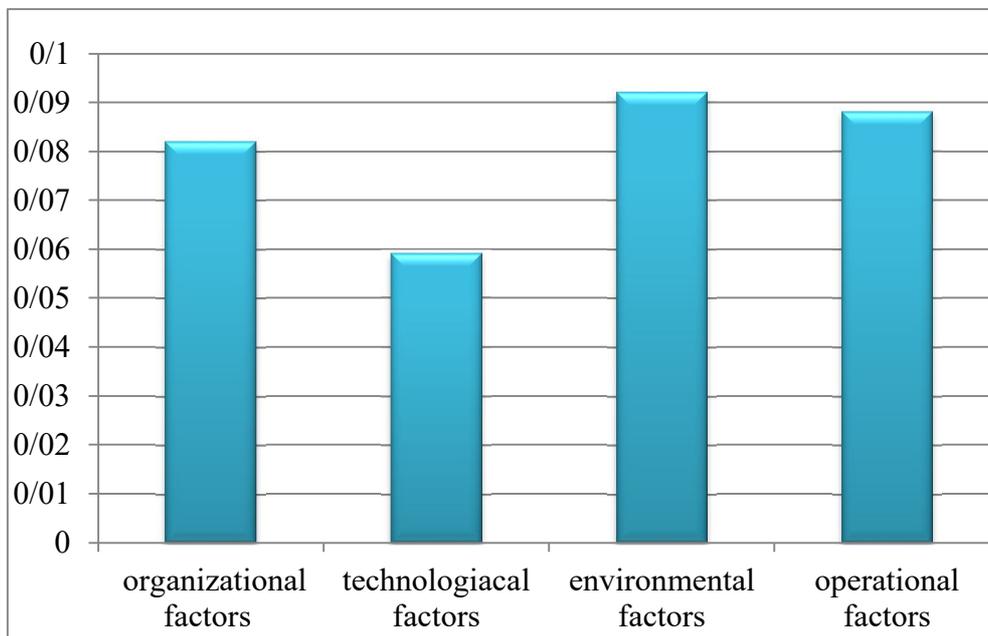


Figure 2. Final weight chart of e-service risk factors

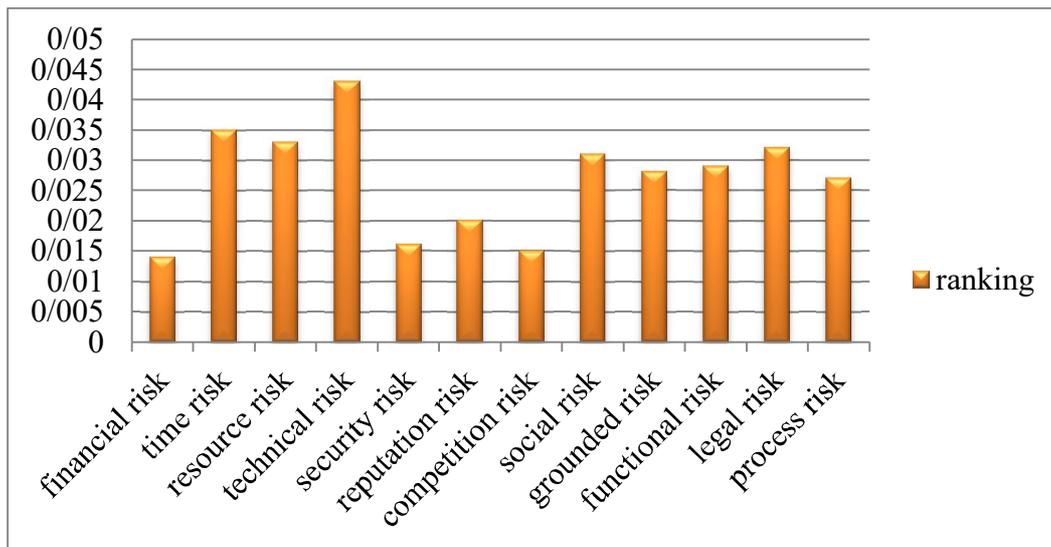


Figure 3. Final Weight Chart of E- Services Risk Sub-Themes

Based on Figs. 2 and 3, the maximum risk is observed in environmental factors. In addition, technical risk has the maximum priority and financial risk has the minimum priority among the sub-factors of risk. In other words, electronic service providers should focus more on reducing the risks with higher priority to deliver higher quality services, leading to higher customer satisfaction.

Discussion and conclusion

The electronic service risk model can be useful for facilitating the delivery of electronic service and increasing the quality of services. Accordingly, this study presented the electronic service model. This model aimed to address most of the risks faced by citizens in using electronic service, especially in developing countries. In this study, first the concepts, definitions, and significances of electronic service were considered. Then, an attempt was made to present the importance considering the present research by reviewing the research background. As a result, it was attempted to achieve a deeper understanding of electronic service risks using qualitative analysis of theme and then the obtained dimensions from the electronic service risk model were prioritized using the fuzzy TOPSIS method. Based on previous studies, electronic service risks were divided into the general categories of organizational factors, operational factors, environmental factors and technological factors and 12 sub-criteria of technical risk, financial risk, time risk, resource risk, legal risk, social risk, operational risk, grounded risk, process risk, reputation risk, security risk, and competitive risk. The findings indicated that technical risk is in the first rank of electronic service risks. In other words, customers often face technical problems due to Internet outage and infrastructure issues in the field of information technology in the services provided in information and communication technology offices which can reduce the quality of delivered services. This issue is consistent with the findings of Evangelidis(2003), Benaroch(2002), Jordan and Silcock(2005). Time risk was introduced as an innovation in the present study as the second risk in electronic service. The reason is that customers expect immediate services from electronic service while there is a certain amount of time waste in information and

communication technology offices due to technical risks. Resource risk was also identified as a risk in electronic service. Resource risk is due to the lack of human, physical and, expert resources to deliver electronic service. Legal risk is a risk in electronic service due to the lack of relevant rules. This issue can be due to the new electronic service in Iran, which can create a gap for delivering electronic service. Social risk as a risk in electronic service due to the effect of social norms and behaviors of others on the use of electronic service by customers, which can lead to the loss of relevant business customers. Operational risk is the sixth risk in delivering electronic service due to not achieving the expected output as a result of delivering electronic services. The customers of the above-mentioned business mainly have expectations which not all of them can be achieved through electronic service. On the other hand, electronic service providers in information and communication technology offices fail to achieve the expected output. grounded risk is a identified risk in delivering electronic service due to the simultaneous and associated changes in the business environment. In other words, if the conditions in the environment require some changes, the above-mentioned business will change accordingly. Based on the obtained rankings, grounded risk is not threatening despite its high status. Process risk is the eighth risk in electronic service due to inappropriate processes and methods of service delivery. In fact, when the delivery of electronic service is prolonged and fails to consider all aspects, it can be because of the use of inappropriate processes for service delivery. In fact, the inappropriate configuration of electronic service delivery processes can lead to process risk. Based on the obtained rank, this risk is not very threatening. The obtained results are consistent with the studies by Smith et al. Reputation risk is because of the adverse effect of the spread of various rumors om electronic service providers, especially information and communication technology offices and has been identified as the ninth risk. Due to the obtained rank, the effect of reputation risk on electronic services is not significant. Competitive risk is the tenth identified risk because of the competition between electronic service providers which can be considered a threat to any electronic service provider. The findings on competitive risk are consistent with the studies by Vilhaland (2002) and Benaroch (2002). Security risk, as the eleventh risk posed in electronic services is due to the customer lack of trust in providing their personal information and the likelihood of misusing personal information. Due to the obtained high rank and the fact that individuals have a lot of trust in information and communication technology offices and on the other hand, such offices work under the supervision of the government, the level of security risk in electronic service is very slight and cannot be considered as a serious threat. Identifying this variable is consistent with the studies by Kim and Koo (2016), Viehland (2002), Smith et al (2001), Financial risk ranked as the last in electronic service. Although it is possible to customers to pay for services more than the legal amount, this amount is very small and can be also neglected. The results obtained from financial risk are consistent with the studies by Smith et al., Benaroch (2002), Ha and Sun (2014), Faroughian et al (2012) The main results of this study were attracting the attention of electronic service providers to reduce the risks with the maximum effect on citizens and providing the possibility of evaluating the current state of risks to identify the weaknesses and plan for eliminating the existing barriers. The presented model covers different dimensions and can provide an appropriate criterion for evaluating the level of risks for electronic service providers. An overview on the current state of information technology and electronic service indicates that if electronic service providers aim to provide services more efficiently with better quality and in this way it is necessary to identify the risks and eliminate them, which

be facilitated by the electronic service risk model. Based on the results obtained from the study, the following suggestions are raised for reducing the risk of electronic service:

- Providing better technical equipment in terms of Internet connections and information technology infrastructures
 - Assuring the electronic service customers about the information security
 - Creating secure equipment for delivering electronic service
 - Improving the service delivery processes to deliver service at a higher speed
 - Considering financial benefits for electronic service providers for more motivation
 - Creating a social culture for accepting electronic service provided in information and communication technology offices
 - Motivating electronic service providers to create a healthy competitive environment
 - Training specialized human resources in the field of information technology
 - Holding classes and training courses for improving the ability of electronic service providers

Developing relevant and new laws based on the changes made in the field of information technology.

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