

# A systematic literature review of electronic invoicing, platforms and notification systems

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**Abstract**— In the XXI century, electronic commerce is considered as an alternative to reduce costs, increase the productivity, among other benefits, all of them perceived through the digitalization of billing. Although there is a large amount of literature on this field, such literature is not focused on electronic invoicing platforms with notification delivery. Thus, the present systematic literature review has been performed, it is based on a reliable, auditable and rigorous methodology in order to know and clarify the state of the art in the subject associated to electronic invoicing, technological aspects related and notification systems. The analysis of the 39 selected papers from a total of 1202, shows the absence of studies that relate the use of notifications into e-invoicing systems.

**Keywords**—*e-invoicing, electronic billing, notification, security, sms, mail, platform, review.*

## I. INTRODUCTION

The electronic invoicing concept emerges as a modern, reliable and efficient method for handling and processing invoices of products, services, taxes and other types of merchandise, without the need of paper [1]. Electronic invoicing is given as an information system service that collects information from a business transaction and transmits it over a network [2].

Nowadays, with the development of smartphones, people interact actively with those devices. Therefore, users seek to have all personal and work information synchronized and at their fingertips, turning the use of emails, instant messaging applications, and SMS as a regular way to be informed. These are key channels for the delivery of business information, from Business to Consumers (B2C).

On the other hand, extensible markup language, XML, is a format used widely to interchange information about invoices in a digital manner [3], [4], [5], [6], [7]. Through the use of XML, there are many implementations that use web services for receiving, storing, processing and sending information to tax collectors [4], [6]. Said invoices can be sent to the customer e-mail like in [4], which includes the invoice in XML and a version of the document in PDF format.

Also, the security represents an important non-functional characteristic to be considered in e-invoicing solutions, because they usually handle sensitive information of clients. Firstly, this characteristic should be based on rules and laws of each country in terms of electronic invoicing. Also, it is important to

take into account certain measures for a correct handling of information. These essential requirements allow authentication, content integrity, non-repudiation of origin and receiver, confidentiality and privacy, sequence integrity and corresponding policies [3], [7]. As it is shown in [8], the use of the electronic invoicing allows: (i) to save time and money, (ii) control over payments, (iii) the generation of universal payment mechanisms, (iv) privacy and security, (v) reliability and (vi) dispute resolution. Implementing electronic invoicing in a company or business has a significant impact on the exchange of information and operational links between B2C, creating a more lasting and committed relationship [9].

On the other hand, exploring the benefits of electronic invoicing versus traditional paper invoicing show the reduction of costs by the reduction of transportation costs and saving time by reducing workflow [10]. Even the environmental impacts of electronic invoicing are much lower than traditional invoicing, mainly due to energy consumption [11]. At an organizational or business level, electronic invoicing improves control of billing processes by increasing productivity in invoice handling units, reducing processing time, reducing paper consumption, among others [12].

In any case, as far as it is known, there have not been found secondary studies about e-invoicing systems with notifications. It is important to know how the existing solutions of e-invoicing systems, associated technologies, security considerations and notifications delivery mechanisms have been proposed. Therefore, in this paper we present a systematic review of literature, which addresses the state of the art in terms of e-invoicing systems along with the delivery of notifications by digital means. The results obtained with this research show that the relationship between e-invoicing systems and the use of digital notifications has not been addressed yet.

To carry out this research it has been used the methodology proposed by Kitchenham [13], which consists on three stages: planning, execution and documentation. This paper is structured as follows: firstly, section 2 addresses the works related to the research topic. Next, in Section 3, the systematic literature review is presented, including the protocol, execution and results; and finally, Section 4 presents the conclusions and further work.

## II. RELATED WORK

It has not been found any secondary studies related to e-invoicing and its related activities. However, this section presents approaches that consider important topics such as technologies, security, benefits, methods and implementations. Thus in [10], it has been considered a reduction of costs in the transition from paper billing to electronics. It approaches the manual and electronic invoicing process in the Department of Housing in Finland as a case study. Resulting in a billing processing cost (per invoice) of 8.60€ (paper invoice), 2.11€ (invoice on scanned paper) and 1.89€ (electronic invoice). As a result, there is a real reduction in transport and storage costs, and an additional reduction in the advantages of advance payments.

On the other hand, the authors of [14] examines the way in which service quality of service providers affect customers satisfaction in an environment of extent SMS usage, including their behavioral intention to continue using SMS. The results have revealed that aspects of perceived value, empathy, assurance and tangible interaction plays an important role in the client's satisfaction in the electronic commerce ambit.

Additionally, in [15] a unifying metamodel of factors has been developed, which influences the adoption of electronic invoicing at the governmental level, making an analysis of the literature. It includes several factors such as institutional and ecological pressure, political committee, technological preparation, economic benefits, among others.

Regarding to characteristics of electronic invoicing, the study [7] mentions the importance and way of sending, receiving and processing invoices without manual intervention. In this way companies benefit from shorter payment delays, less errors, as well as lower printing and shipping costs. However, the study mentions that the introduction of such systems is often complex and costly, particularly for small and medium-sized enterprises. In addition, it presents functional and non-functional requirements, logical structure of the system, technologies to be used and finally its security.

Finally, [4] gives an overview of electronic invoicing development, where the results show that despite demonstrable savings, elimination of errors, accelerated cash flow, enhanced competitiveness and efficient supply chains, it still becomes a marginal issue with a wide space for further investigation. Therefore, as far as it has been investigated, no secondary studies have been reported that approach the notifications to customers in an electronic invoice environment.

## III. SYSTEMATIC LITERATURE REVIEW

A systematic review of the literature consists on identifying, evaluating and interpreting all available information on a research topic or phenomenon of interest by using a reliable, auditable and rigorous methodology [13]. This systematic review consists of three phases: (i) planning the review, (ii) conducting the review, and (iii) reporting the review.

### A. Planning the review

This phase consists of establishing the steps that will be

performed during the review, for which research questions and strategies of search are determined. This phase consists of two steps: (i) establishing the research questions and (ii) defining data sources and search strategy.

#### 1) Establishing the research questions

The research question that has been stated defines the scope of the systematic review and it is as follows: "What is the state of the art regarding electronic invoicing and information systems or platforms that use notifications?"

##### a) Research sub-questions

To address the research question the following sub-questions have been proposed:

RQ1: How is the e-invoicing process handled in other countries?

RQ2: How is the technical aspect of e-invoicing implementations addressed?

RQ3: Which security attributes are considered into the e-invoicing process?

RQ4: How are e-invoicing studies being addressed and how are they validated?

#### 2) Defining data sources and search strategy

The following digital libraries have been selected for automatic search: IEEEExplore, ACM Digital Library, Springer Link, Science Direct, and Google Scholar. For the manual search the best conferences and magazines related to the topic of electronic commerce have been chosen. Table I shows the conferences and selected journals where papers have been found that could not be retrieved by the automatic search and whose content is representative for the research.

TABLE I. MANUAL SEARCH SOURCES

Conferences	
IEEE International Conference on Enterprise Computing, E-Commerce and E-Services	
International Conference on Electronic Commerce	
International Symposium on Data, privacy and E-Commerce	
Journals	
International Journal of Electronic Commerce	
Journal of Organizational Computing and Electronic Commerce	

#### a) Search string

In order to perform the automatic search a string was defined based on keywords related to the subject of the investigation. This string was chosen at investigators' criteria, after a process of multiple attempts with different combinations of possible keywords. These combinations and the final search string are shown in Table II.

TABLE II. SEARCH STRING

Concept	Substring	Conector	Alternative terms
Electronic Invoicing	e?invoic*	OR	includes e-invoice, e-invoicing
Electronic Invoicing	electronic invoic*	OR	includes electronic invoice, electronic invoicing

Electronic Invoicing	electronic billing	AND	
Platform	platform	OR	
Information System	information system	OR	
System	system	OR	
Web	web	OR	
Cloud computing	cloud	AND	
Notifications	notification	OR	
Alerts	alert	OR	
Messages	message	OR	
Messages	SMS	OR	
Mail	mail		
Search string	("e-invoice" OR "electronic invoice" OR "electronic billing") AND ("platform" OR "information system" OR "web" OR "cloud") AND ("notification" OR "alert" OR "message" OR "SMS" OR "mail")		

### b) Search period

Electronic invoicing concept starts in the 1970 decade when organizations began to exchange invoice files. At that time, there were no standards for exchange and business systems did not meet the requirements that were required for that purpose. Technological solutions and standards like XML made this process possible [16].

### c) Extraction criteria

In order to answer the research questions raised, criteria for extracting information have been defined, which are shown in Table III. The importance of defining criteria of extraction lies in avoiding bias on the researchers' side, in order that their expectations do not influence the analysis of the studies.

TABLE III. EXTRACTION CRITERIA

<b>RQ1: How is the e-invoicing process handled in other countries?</b>		
EC1	Service Model	IaaS,PaaS,SaaS
EC2	Deployment Model	Community, Private, Public
EC3	Institution types	Commercial, Government, Industrial, Education, Other
EC4	Included parts	Notifications, Electronic billing, Cloud computing, technologies
EC5	Uses	Merchandise payment, Services payment, Taxes payment
<b>RQ2: How is the technical aspect of e-invoicing implementations addressed?</b>		
EC6	Types of architecture	Monolithic, Service oriented, Microservices
EC7	Used development methodology	Scrum, Waterfall
EC8	Programming language (Back End)	Java, PHP, .NET
EC9	Programming language (Front End)	Javascript,HTML,Angular, Bootstrap
EC10	Databases	Relational, Non-Relational
<b>RQ3: Which security attributes are considered into the e-invoicing process?</b>		
EC12	Security attributes	Integrity, Confidentiality, Non-repudiation, Authenticity

<b>RQ4: How are e-invoicing studies being addressed and how do they validate them?</b>		
EC13	How the studies are approached	Industry, Academy, Case study
EC14	Validation methods	Controlled experiment, Concept tests
EC15	Kind of study	New, extension

## B. Conducting the review.

### 1) Selection of primary studies

After performing the automatic and manual search, each study has been evaluated in order to determine whether or not it should be included. Any discrepancy in this process is resolved in consensus by thoroughly examination of the conflicting study. Studies that meet at least one of the following inclusion criteria will be used:

- Studies containing information about e-invoicing
- Studies involving e-invoicing and cloud computing.
- Studies containing information on electronic notices
- Studies containing information related to the quality and technologies used by these platforms.

Studies that meet any of the following exclusion criteria will be excluded:

- Introductory papers on special topics.
- Duplicate studies of the same subject in different sources.
- Short papers of less than five pages.
- Papers written in languages other than Spanish and English.

This stage describes the results of the tasks performed in this study. The automatic search of the aforementioned search chain allowed the retrieval of studies from different sources or digital libraries, considering included and excluded studies.

After applying the inclusion and exclusion criteria on the studies retrieved from the searches, 39 articles were considered, as shown in Table IV. On the other hand, 9 articles were considered for this study that were found in the manual search.

TABLE IV. NUMBER OF INCLUDED PAPERS

	Included	Not included	Percentage
ACM	3	71	7.69 %
IEEE XPLOR	11	162	28.21 %
SCHOLAR GOOGLE	20	598	51.28 %
SPRINGER LINK	2	50	5.13 %
SCIENCE DIRECT	3	282	7.69 %
TOTAL	39	1163	100.00 %

### 2) Quality assesment

In addition to the inclusion and exclusion criteria, it is important to carry out a quality assessment. For this purpose, a three-point Likert scale is used, based on the number of citations from each study. Table V show the results of the evaluation according to the criteria of qualification: (-1) the

study has no citations, (0) the study has one to three citations, (+1) the study has more of three citations.

TABLE V. QUALITY ASSESSMENT

Score	Quantity	Percentage
0	6	12.50 %
+1	34	70.83 %
-1	8	16.67 %
TOTAL	48	100 %

### 3) Analysis and synthesis

In this section, it is presented the final results of the systematic review, the histograms show the individual results of each criterion. The most relevant criteria obtained is shown on the bubble graphs.

Fig. 1 shows the percentage of studies according to the type of institution to which they are focused, showing that there is great interest in the commercial and governmental sector. On the other hand, Fig. 2 shows the distribution percentage of studies according to the subject treated, finding the majority in subjects of e-invoicing and the absence of studies that refer to notifications.

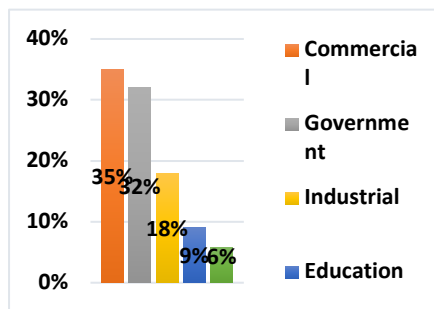


Fig. 1. Percentage of studies corresponding to EC3: Institution types.

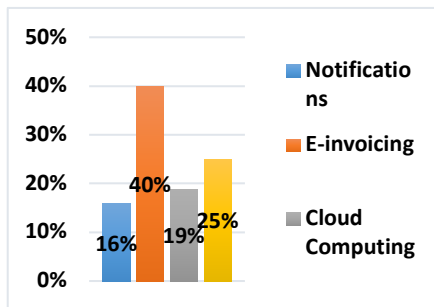


Fig. 2. Percentage of studies corresponding to EC4: Included parts.

Fig. 3 shows the percentage of studies according to the security aspect they address, presenting as the main interest in authenticity, followed by close values between integrity, confidentiality and non-repudiation.

From another perspective, Fig. 4 contains the axis of the represented ordinates by EC 3: types of institution, in the axis of the abscissa is shown EC 4: included parts. In this way it is observed that the majority of studies are taking place on issues of e-invoicing focused on commercial institutions, followed by government. Also cloud computing is a point of interest in government institutions, while the aspect of notifications is barely being addressed.

Similarly, Fig. 5 shows in the abscissa axis the EC 11: security attributes, the ordinate axis represents the EC 3: institution types and included parts. It is observed that in many studies related to e-invoicing the security attributes are addressed, while in studies on notifications the security issue is not addressed. Also the security attributes are a point of interest mostly in studies that have a commercial focus.

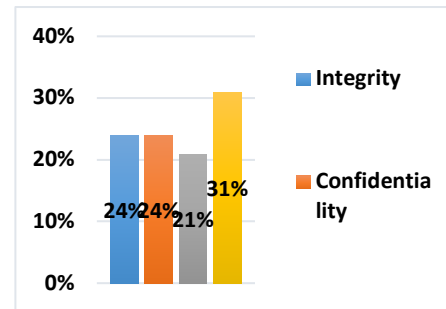


Fig. 3. Percentage of studies corresponding to EC11: Security attributes.

### C. Reporting the review

Below is a brief discussion according to the extraction criteria that have been considered:

#### EC3: Institution types

E-invoicing has been considered as one of the most important sources of profitability in Europe [17]. Some countries have been more active in the transition to e-invoicing. In some cases, this has been promoted by the government at the level of legislation, making it compulsory, such as the case of Denmark [17] and of Italy with public institutions.

The inclusion of e-invoicing in the institutions results in a decrease in billing costs and therefore, an increase in available resources, which could be used for other purposes to increase value to the organization [18]. There are several factors that influence the adoption of e-invoicing in the institutions. The study [18] analyzes these factors with a case study of four private companies and two public organizations. At follow there are the factors along with the results after the implementation of e-invoicing:

(i) Relative benefit: degree to which an innovation is better than the preceding one. The number of errors in paper invoices was reduced. The circulation time for invoices was reduced from one week to two days.

(ii) Compatibility: degree to which an innovation is consistent with what already exists. The usability of e-invoicing systems is important, as their graphical interfaces should be easy and be similar to paper invoices.

(iii) Complexity: degree to which an innovation is perceived as difficult to understand and use. The transition to e-invoicing should be simple and have the ability to centralize invoices from multiple departments within the organization.

(iv) Testing capabilities: the degree to which an innovation can be tested. It is useful to test the operation of e-invoicing by taking a pilot company to perform the tests and obtain feedback.

(v) Observability: degree to which the results of an innovation are visible. A public organization seeks to project a positive and modern image of the public service, in addition to monitoring the internal flow of information among its employees.

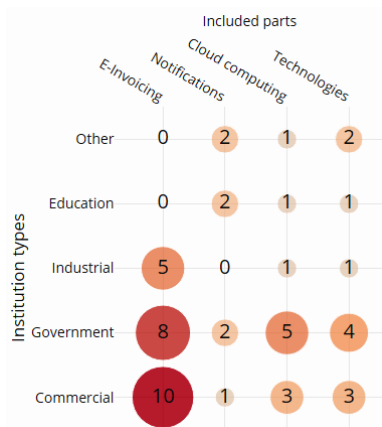


Fig. 4. Comparison between EC 3: Institution types and EC 4: Included parts

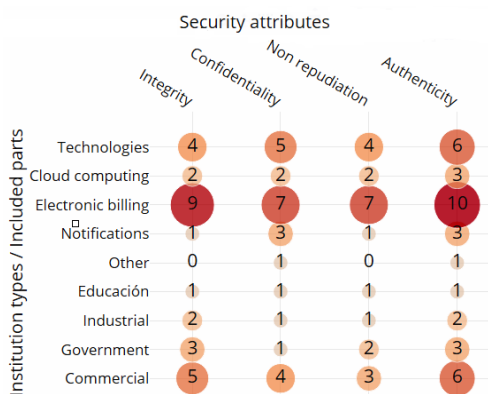


Fig. 5. Comparison between EC 11: Security attributes, EC 3: Institution types and EC4: Included parts

On the other hand, studies [4], [6], [19] address the relationship of e-invoicing with tax collection, given the legal validity that this mechanism provides. In [6] an e-invoicing solution is proposed that allows the integration of the taxpayers with electronic government platforms that have public access. The results show that the need of the taxpayers is solved and a more efficient control of the tax collection agency is allowed.

#### EC4: Included parts

This criterion is one of the most important for the papers classification, since it segments the problem (i.e., notifications, electronic invoicing, cloud computing, technologies). In terms of notification, 12 papers were found, which approach this issue. The studies [20]–[22] can be used to make a notification system for real-time emergencies. These developments propose a system in which notifications can be made and alert from a mobile application, smart watch, as well as SMS and the use of Extensible Messaging and Presence Protocol (XMPP). On the other hand, in [23], it is proposed a notification module for a school, where it facilitates student-

teacher interaction for files exchange and sending of SMS, which also includes the technologies used for such implementation.

Moreover, it has been proposed the use of Instant Messenger (IM) for real-time notifications, as is the case of [24] and [25]; where, an architecture is stated, which uses notifications for companies with web services. This uses XML format and a system of management of content for e-commerce, which has been developed with HTML, CSS, PHP and Ajax respectively.

Finally, the authors of [26] explore the possibilities of implementing a messaging framework that can be used as a free notification mechanism running on the cloud. The framework is based on Extensible Messaging and Presence Protocol (XMPP). This study is complemented with several mechanisms offered by cloud providers in order to deliver messages to mobile applications, these mechanisms are considered to be a black box service (e.g., GCM, APNS, MPNS, etc.).

Also, 27 papers were found, which deal with electronic invoicing. On one hand, these papers mention the benefits and; on the other hand, the implementation of such a system. In [2], it is performed a study about the factors involved in e-government that enable the use of cloud computing. It concludes that e-government is a trend that should be adopted in companies to obtain greater benefits. In the same way [1], [8], [10], [11], [15], [17], [18], [27]–[30] address the benefits and impacts of the adoption of systems or platforms for electronic invoicing, electronic commerce and e-government.

Furthermore, [3], [19], [30], [31] propose mature frameworks and models for the electronic invoicing process and tax system in order to have efficiency for that process and improve tax collection. On the other hand, [4], [6], [7], [32], [33] propose electronic invoicing systems with different functionalities (e.g., sending, receiving and processing invoices). Those systems require manual intervention, elaboration of security standards for the electronic invoicing system, and electronic invoicing system for tax collection by using web services. In addition, the contribution [4] proposes an e-invoicing platform for tax collection based on cloud computing with Software as a Service (SaaS). It shows the technologies used for the development in order to receive, store, process and send invoices to tax collectors and customers through e-mail.

#### EC11: Security attributes

Security is very important in notification systems for aspects of authenticity, authorization, and accounting. In the notification system proposed in [20], the Public Protocol Extensible Messaging and Presence Protocol (XMPP) is used to provide communications security between enterprises and instant message (IM) service providers. In addition, the information transmitted over the Internet maintains confidentiality when using encrypted communications with the Hypertext Transfer Protocol Secure (HTTPS) protocol and the use of digital signature with a Public Key Infrastructure (PKI).

As a measure of protection against a database that has been compromised, the system proposed in [24] uses MD5 hash algorithm to encrypt users' passwords on their system before saving them to the database, in this way if an attacker gains access to the database, this sensitive information will be unreadable.

Given the nature of e-commerce between clients and banks, the study [1] uses the Virtual Private Network (VPN) protocol to verify the origin of communications, to ensure the integrity and confidentiality of transmitted messages.

The study [3] proposes an e-invoicing system based on web services, which complies with the requirements of European directive 2001/115/EC. The system provides source authentication with the application of digital signatures in combination with smart cards. The integrity of the information is achieved by using cryptographic hash functions, either next to the signature or separately. Non-repudiation of origin and destination is achieved with digital signatures of XML Advanced Electronic Signature (XAdES) and timestamps. The XML Encryption Syntax is reached following the W3C Recommendation.

Studies [7], [19], [33]–[35] consider the same mechanisms for authentication, non-repudiation, integrity and confidentiality.

*EC12: How is the study being addressed and EC13: Validation method.*

In the studies it was found 14 papers that execute case studies such as [2], [10], [12], [21], [23], [36]. Among the most outstanding it can be determined that is [17] which execute 6 case studies focusing on companies in Europe and two Finnish cities, including textile companies, kitchen and bathroom accessories manufacturer, IT service provider and recycling service. Also [30] presents the case of a textile industry in Hong Kong; [6] the Thai Income Department and finally [28] presents an electricity company in Iran. While for the academy it was have found 15 papers, in which [4], [14], [15], [18], [26], [31], [35], [37]–[44] are located on European countries. Additionally, in the industry were obtained 12 papers with implementation of notifications and alerts, e-inclusive and e-commerce. Finally, controlled experiments were performed on [2], [4], [10], [11], [24], [28], [30], [36], [45]–[47].

The use of cloud computing to provide electronic government services provides several benefits such as the reduction of the total cost, distributed data storage, scalability, responsibility, modification capacity and security administration [50]. However, these electronic government services, based on cloud computing, assume certain tangible risks (access, availability, infrastructure and integrity) and intangibles (reliability, security, confidentiality and data privacy, among others.) [51].

Countries with more resources are at the forefront of this development, since the adoption of e-government by a certain group of people is influenced by several factors, such as economic prosperity, levels of education, political stability and cultural acceptance [52].

Following this, [53] mentions one of the biggest challenges

for e-government, where it indicates that large-scale information technology implementations are risky projects, multiplying the challenges and risks by having the participation of several organizations, as is often the case in the electronic government initiatives. This author also mentions that some of the risks can be addressed by carefully aligning the motivations of the partners. So, [54] proposes a framework of strategic alignment, the same one that was used to examine the motivations of a group of government agencies and companies in order to minimize risks.

Benefits that organizations can expect to obtain when switching to electronic invoicing are capturing digital invoices (that is, less manual labor), automated validation of invoices (that is, fewer errors), cost reduction, improved cash management (ie, quick work), lower carbon footprint, optimization of the IT system, better relationship with suppliers, security, acceptance of multiple formats [55].

#### 1) Threats of validity

Due to the large number of renowned digital libraries, only the five most significant in the field of computer science have been considered. Additionally, for better results, a manual search was conducted in conferences and magazines in the area of electronic commerce. However, the search string has been defined according to the criteria of the investigators, which may require the inclusion of bibliography in terms related to e-invoicing.

#### IV. CONCLUSIONS AND FURTHER WORK

In this study the methodology proposed by Kitchenham [13] has been used in order to perform a systematic review that allowed readers to know about the state of the art in issues related to e-invoicing. For this purpose, it has been analyzed studies dating from 2001 onwards, which help in answering the research questions initially raised. Electronic invoicing has been implemented in several countries over the years. In some cases, through the introduction of mandatory bills for the issuance of electronic invoices. Benefits have been reported in the adoption of e-invoicing in public and private institutions. Due to the sensitive nature of the information handled in an electronic exchange, it is important to take into account the security criteria: confidentiality, integrity, authenticity, trust and non-repudiation. In this way, secondary studies like [1], [33] give an overview of the security aspects to consider and apply in future implementations.

Some studies that address the use of notifications by different means (SMS, e-mail, IM, mobile applications) were analyzed, however these solutions are aimed at a different field than e-invoicing. Finally, a Key Performance Indicators (KPIs) analysis is proposed as a future work in applying the use of notifications to final customers in e-invoicing systems.

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