

E-Accounting System as a Service (E-ASaaS): A Conceptual Overview

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Abstract - In this paper we present an innovative concept of a public information system based on several digital technologies and approaches for outsourcing accounting as a public service. Accounting is one of the fundamental business functions of any business entity, that is highly regulated in all the economic systems. Over the recent decades accounting function in business organizations has evolved due to dramatic changes and advancements in information and communication technologies. These technologies-initiated changes in form of digital documentation, online or cloud accounting and similar alternatives to traditional organization of accounting. The goal of this paper is to draw attention to available technologies that may provide even more drastic innovation in organizing accounting function of business entities in a common administrative space such as counties, or entire countries and nation-wide economics. Here we propose a model of a public access E-accounting system that employs the functionality of cloud-based services, data pod concepts and blockchain technologies in order to automate processes of bookkeeping but also reporting on the side of business entities, while at the same time provide autonomous control and audit as defined by law and competent institutions in various segments of supervision (i.e. tax supervision, statistics reporting, etc).

Keywords - Accounting Information Systems (AIS), Accounting, Public Electronic Services, Blockchain, Data pods, Cloud Computing

I. INTRODUCTION

Accounting as the basic of financial reporting is the key element of any economic system in contemporary societies. It is the first business function that was supported through the means of electronic computers, and the gateway to the rise of information and communication technologies (ICT). Over the past decades overall process of digitalization has changed many aspects within the accounting function as well as various related aspects in the business environment. In order to cater for these changes Accounting Information systems (AIS) have evolved and transformed into crucial part of the overall business information systems (BIS) used by both small and medium companies as well as large domestic and international corporations. Yet, beside the initial innovation functions of the average AIS remain the same in their core. At the same time new technologies have been developed that enable new capabilities that core function of the AIS may transform further to achieve new goals and functions that were not attainable before the raise of digitalization and digital economy.

The intention of this paper is to analyze, select and present several key technologies that hold the potential for transformation of AIS. Using the electronic services as the fundamental building block for AIS instead of traditional software, transition from software solutions to service-oriented AIS is available. Electronic services can also provide additional functionalities and capabilities for more effective, efficient, and more comprehensive outlook on accounting and business transactions that take place in the digital economy.

The goal of this paper is to present a conceptual model of a public service that is inspired by currently available electronic services provided through the concept of electronic government. The concept of electronic accounting system-as-a-service (i.e. e-ASaaS) is based on the principle of regarding transactions in digital economy based on digital documents, digital payments, and digital exchange not only of information and finances but in certain situations of goods and services. The system itself relies on digitalization of public sector records that are the legislative basis for any economic activity in any economy. Only by taking the nature of digitalization into account a system with additional information controls and automation capabilities that provide higher level of trust in financial reporting, contracting, investment and business partnerships can evolve.

The main contribution of this paper is to outline three most important technologies that may enable service-based AIS provided by the public sector based on public data records and existing infrastructure. Additional contribution is in the definition of key structural elements of the proposed conceptual model and the SWOT analysis of the proposed system.

The structure of the remainder of the paper is as follows: In Section II current state of financial accounting and financial reporting is discussed as well as fundamental principles and standards that shape the current implementations of AIS. In the following Section key information and communication technologies are described, outlining the most important aspects for the e-ASaaS model. In Section IV description of the conceptual model e-Accounting System-as-a-Service is given. In Section V a discussion of the described concept is given, while examining the feasibility and potential of the system through the SWOT analysis. Finally, in the last Section conclusions on potential benefits and possible challenges are given as well as remarks for the future work.

II. DIGITALISATION AND FINANCIAL ACCOUNTING AS BUSINESS FUNCTION

Financial accounting is an essential part of business reporting in enterprises. The accounting function is a structured layered system that is dedicated to providing information relevant to decision makers and more specifically, to equity investors, lenders and other creditors in their capacity as capital providers. For this purpose, key elements that are described with accounting information are (1) Assets, (2) Liabilities, (3) Equity, (4) Income and (5) Expenses. In order to preserve high quality of accounting information a rigid set of assumptions, principles and constraints need to be followed. For additional assurance various standards exist either on a national level or international level (such as International Financial Reporting Standards – IFRS).

With the development of Information and Communication Technologies (ICT), first digitalized systems of keeping accounts were introduced. Over the years, they have evolved into a comprehensible integrated information systems where the core of these business information systems (BIS) is the accounting information system (AIS). The impact of AIS on accounting functions is undeniable and comprehensive as they in turn shaped the organizational aspects of the accounting profession [9, 10].

Further digitalization of business entities and governmental bodies have also allowed for digitalization of business transaction elements beyond the boundaries of one business entity. This was made possible by establishing, prescribing and regulating standards in electronic document interchange (EDI) usually using XML schemes and other standardized formats, protocols of interaction and various security elements. One such example in Croatia is the introduction of digitalized infrastructure for electronic business that is used for creation of digital documents such as e-Invoices.

In turn this means that AIS had to adapt to these changes not only to accommodate for new types of business documentation but also to take advantage of digitalization and improve their own effectiveness and performance [5, 8].

Certain aspects of AIS or various subsidiary ledgers have been created so that they allow for automatized entry of transactions as the documentation arrives in real time or as business processes are being executed. The efficiency of this type of systems has also influenced the quality of financial information processes by these systems, but also introduced additional controls to detect mistakes and even fraudulent activities [6].

The increased functionality of AIS that improves quality of financial information also comes at a cost in terms of changes to organizational support to accommodate these new functionalities and also, requirements for the accounting professionals in terms of required knowledge and skills [7].

In order to accommodate for convenience of using such complex systems an alternative to traditional integrative software solutions (such as SAP S/4 HANA, or MS Dynamics NAV), service-based solutions (such as

Oracle ERP cloud) are becoming increasingly popular ultimately replacing native application approach.

Based on this trend and the fact that regulators (being a part of the public sector) already record important regulatory, statistical, and financial data, a new approach to organization of the overall accounting function lends itself to the idea of public electronic service. In order to take advantage of existing infrastructure service-based solution should define standards and protocols that will certify adequate security and efficiency levels that are currently available in commercial cloud-based solutions. In the following Section we will present several key technologies that can be used to achieve this requirement.

III. OVERVIEW OF RELEVANT KEY INFORMATION AND COMMUNICATION TECHNOLOGIES

There are several ICT solutions that hold a great potential for innovation of existing AIS. Some of these include blockchain technology, cloud computing and data pods. All of these technologies resolve a specific requirement for using existing Internet infrastructure and available public resources to support businesses in meeting their legal obligation for establishing Accounting and Financial reporting function.

In the rest of this Section, for each relevant key technology that e-ASaaS concept is based on, a brief description is given, underlining their advantages and disadvantages.

A. Cloud computing

Over the past decade cloud computing has emerged and established itself as one of the most prominent architectures for providing electronic services [11, 12]. Its influence has been so significant that cloud computing challenged software developers by disrupting the traditional business models both their own and those of businesses running their software. Software industry accepted this transformation shift from local and native software solutions to cloud solutions and e-services. Today, electronic services and cloud-based software solutions are one of the most important segments in software industry.

Unlike Grid computing, cloud computing enabled service-based business models for a whole new range of services that were not traditionally deliverable in digital form. Today dependency on cloud solutions is high enough so that cloud computing faces new challenges in sustaining its security solution, privacy of information, continuity managements etc.

Main benefits of cloud computing such as resource sharing, flexibility, scalability and security as well as current trends in software industry favor the solutions based on cloud computing platforms. These solutions generally perform better in terms of cost efficiency and recovery flexibility in comparison to traditional software solutions.

Cloud computing is defined as a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers,

storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [13]. As such, Cloud computing established a layered architecture that also defines the level of service provided. Each tier can be controlled cumulatively either by the service provider or the service user depending on the scope of control and disposition of resources required by the service user.

e-ASaaS model upgrades the organization of the top two tiers of cloud computing (i.e. data tier and application tier), upgrading them using additional solutions based on technologies described in the remainder of this Section.

B. Blockchain technologies

Blockchain technology has been popularized through the rise of cryptocurrencies since 2009 when first Bitcoin was established. Technology behind the Bitcoin was based on peer-to-peer transaction system where intermediary was removed by recording transactions in a distributed data system with built in cryptographic verification used to establish encryption and digital signatures [1]. The data records, organized as blocks with separate timestamps, are chronologically linked into a chain where additional blocks prevent changes of data along the chain [3]. Soon after the initial cryptocurrency many others were founded using the same technology. The intrinsic permanent and secure record of transactions than can be easily verified using the blockchain soon gain popularity as a secure and trustworthy alternative payment method without intermediaries which led to the popularization of benefits and advantages of blockchain model.

Blockchain can be described as a distributed data ledger that is used to permanently store digital transaction data, that cannot be modified or removed from the records, and where high level of security and privacy of the data is achieved using public key cryptography and unmediated access to data. As a distributed record system a network of participating nodes is established where each node maintains a version of the blockchain, either full or partial. There are different consensus mechanisms used to maintain agreement on the true state of the blockchain content. These mechanisms provide incentive through rewards for nodes that maintain genuine record and prevent fraudulent transactions.

Public data records can benefit from using blockchain technology as founding technology for various transaction ledgers or master records and has been proposed as feasible solution in a number of incentives in e-government projects [2, 4].

Possible drawbacks usually pertain to establishing more efficient and environmentally friendly consensus mechanism as mechanisms implemented for cryptocurrencies require high energy consumption and are time consuming. There are suitable alternatives that can be used in e-government implementations [14].

C. Data pods

Data pods, are secured dedicated data storage locations for private data in distributed web networks [15]. They pertain to reorganization of the commercial logic in contemporary Web solutions where private data is treated simply as the result of data processing and service delivery that commercial exploiter and other third-parties use to generate profit. The intent of the private data pods is the reversal of the traditional digital commerce business model and economic value chain, by putting an asset value on the individual's personal data that is of direct financial and other benefit to that individual [15].

Main idea of data pods is that the owner of data contained in the pod can grant access to third parties to a selection of data contained within the data pod in a flexible manner with the option to withdraw at any time. In this way privacy and confidentiality is preserved while empowering the owner of private data to negotiate the use of their information even on commercial terms. Pods can be defined as decentralized data stores that function as secure personal web servers of data [16].

Currently, the idea of data pods and the implementations of data pods are being explored under the more general project Solid which is envisioned as an alternative view of Web 3.0 with redefined commercial roles [16].

For the purpose of providing public electronic services, data pods can be used to store private and confidential data on the public sector infrastructure, where each data pod is associated with a particular user (person or business) using national identification and authentication system (NIAS). Each user can have multiple data pods which is one of the assumptions of the conceptual model of e-ASaaS that will be explained in detail in the following Section.

IV. CONCEPTUAL MODEL OF E-ACCOUNTING SYSTEM AS A SERVICE (E-ASAAS)

The proposed model takes advantage of existing standards and technologies described in the previous sections of the paper so that it further refines the SaaS tier of cloud computing, improving the value of visibility to the end user with additional automatization options that heavily rely on secure and permanent data records and access to constituting electronic services (Figure 1)

The concept further expands elements in the Data and Application level of SaaS cloud architecture. Data level is organized using data pods for various types of data that may contain private and confidential entity information. A part of this data involves public data records that government bodies already have on record and can be accessed on their origin using data pod permissions. The accounting transactions are stored as a portion of the data layer as they contain blockchain ledger of transactions that were used in recording financial transactions of the entity. This blockchain ledger is distributed across the cloud that contains full nodes and master nodes.

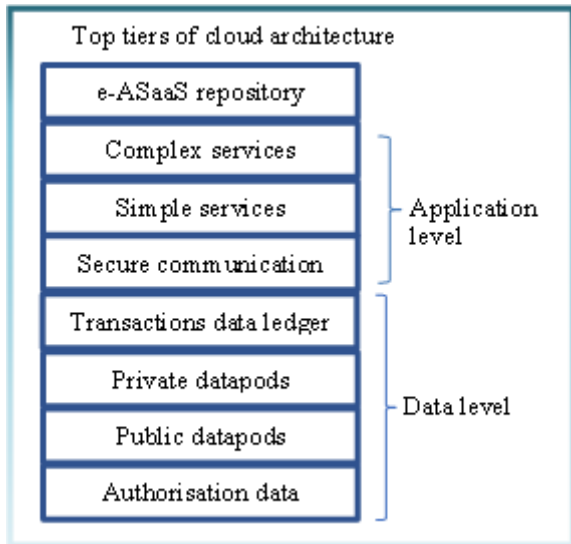


Figure 1. Elements of the e-ASaaS concept model within the cloud architecture

In the transaction data ledger layer, a separate blockchain ledger is kept recording access to the financial information in the general ledger of the entity. A separate blockchain logs data on access to the financial reports of the entity where various regulators and agencies have usually temporary or limited legal authorization for access. Here majority of blockchain consists of partial nodes containing only hash values with references to data that is kept usually by the entity in their separate data record systems or e-archive of the entity.

Finally, application level of the architecture contains several elements that pertain to establishing secure communication between entities, and permission for accessing simple and complex services that are available as basic building blocks of the accounting information system in the form of business logic. In Figure 2, we can see fundamental elements that this business logic contains.

The organization of data and functions is coupled from various data pods and existing services within the public sector cloud. While majority of the e-ASaaS system is contained in the public sector cloud, some services originate in connected information systems such as e-Archive systems, civil registries etc.

Each user entity is granted permanent access to the system where they can access and manage their access policies that regulate access of their employees to General ledger data on one hand, and access to their financial reporting data that can be granted to various agencies.

The general ledger is based on the blockchain and covers five basic elements of the financial reporting framework. Each blockchain transaction contains complete posting information from the journal that are validated for correct credit and debit balance before they are recorded in the general ledger. The chart of accounts and posting models for various typical business transactions are available in the form of business logic within the e-ASaaS system. They are aligned with updated and current legal regulation as it becomes available. Posting procedure itself can be semi-automated (requiring verification by person responsible) or manual using the

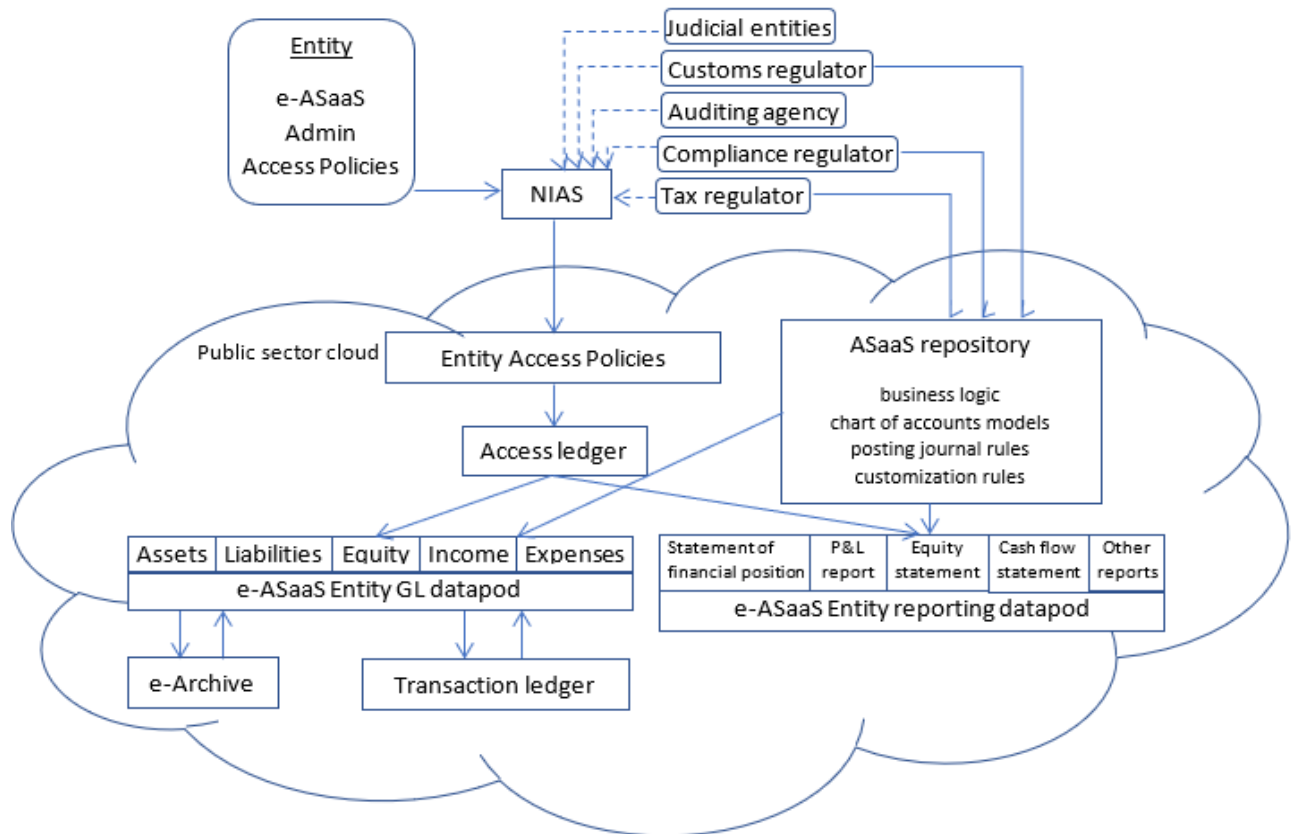


Figure 2. Overview of the e-ASaaS concept model structure

services for creating record provided by the systems business logic.

One example is the use of e-Invoices where the procedure for incoming invoices can be automated when the trading partner is recorded by the system.

Basic financial reports can be generated based on the information contained in the General Ledger and transferred to the reporting data pod of the entity. Each authorized regulator or agency can access data in this data pod and reassemble the data in the form that they prescribe for their intended purpose.

V. DISCUSSION

Public sector in most developed and developing countries has established a level of information infrastructure that can provide higher level of e-services. These e-services can cater for more complex and comprehensive needs of citizens and businesses. There is an opportunity to offer new e-services that are not traditionally offered through this platform. One such service is the proposed conceptual model of electronic accounting information system as a digital service, e-ASaaS. A more detailed overview of proposed concept characteristics is provided through the SWOT analysis (Figure 3).

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|---|--|
| <p style="text-align: center;"><u>STRENGTHS</u></p> <ul style="list-style-type: none"> • Proactive e-government • Compliance with legislation • Real time governance reports • Encourage business activity | <p style="text-align: center;"><u>WEAKNESSES</u></p> <ul style="list-style-type: none"> • System outages backup • Supplementary records issues • Limit accounting practices |
| <p style="text-align: center;"><u>OPPORTUNITIES</u></p> <ul style="list-style-type: none"> • integration of digital economy stakeholders • international trade integrator | <p style="text-align: center;"><u>THREATS</u></p> <ul style="list-style-type: none"> • Advancement of quantum computing • Environmental impact • Lack of standards • Changes in demand for accounting professionals |

Figure 3. SWOT analysis matrix for the e-ASaaS conceptual model

A. Strengths of the e-ASaaS concept

Keeping financial books and records is obligation of business entities prescribed by law, and as such proactive approach of e-government can support businesses by providing a public service to fulfil their obligation.

Business entities that would use e-ASaaS system will always use the updated most recent legislative solutions that prescribe various changes in regulations of any aspects of bookkeeping and accounting as they are available with the business logic of the system itself.

There is a potential of instant access to current insight into statistical results of national industry and GDP by government agencies, tax collection, customs, and import and export indicators by government agencies.

If public-private partnership is established, a new service market can be initiated potentially creating additional impulse to business activity as it was the case of previous infrastructural digitalization projects (such as NIAS, e-Invoicing, etc...)

B. Weaknesses of the e-ASaaS concept

In case of technical failure or failure of the system there would be a temporary delay in providing this service which may disrupt regular business especially in some crucial moments (i.e., payroll accounting for example). In order to overcome this issue contingency plans, need to be established.

Various supplementary records have a high variety and dependencies on organization circumstances of each entity. It is expected that standardization to provide various requirements and needs of different business entities may prove to be very hard or even unattainable. These records however need to be included in the general ledger at some point and if they are not included or connected to the e-ASaaS system they would have to be included manually or imported from external source.

A rule-based system that assures the compliance with current regulation may have the effect of limiting the options of accounting practices that would otherwise take advantage of loopholes in standards and regulation. This can be considered a weakness of the system because the “creative accounting” practices are indicators for the regulator of the quality of accounting standards and laws, and more generally tax regulation and other governmental policies, driving political and governmental agencies to improve the legal framework.

C. Opportunities provided by the e-ASaaS concept

The e-ASaaS provides valuable functionalities that can be further connected with other relevant entities such as commercial banks that have high level of digitalization. Better overall integration of the nationwide economy can be promoted.

There are several factors that could impact higher volume in international trade. Better competitiveness of the domestic businesses, readily available business information, incentive for international entrepreneurs to invest in national business incentive are just a few to name. All of these incentives can eventually further promote business activities.

D. Threats that may diminish benefits of the e-ASaaS concept

As continuity of business entities is one of the most important assumptions for accounting, there are several possible threats that could jeopardize confidentiality of entity data. One such development is the advancements in the field of quantum computer where current cryptographical solutions for secured communication would become obsolete and privacy of data would be disrupted.

The distributed architecture of the system may provide high level of privacy and security but may also increase the effects of the system on ecology in terms of power

consumption and similar cost inefficient effects on public spending.

There is still a lack of standards for particular elements of the underlying technologies that need to be established before implementation of all of the system elements. Further investment on behalf of academic and commercial sector is required in order to overcome these challenges and establish a viable, sustainable and effective organization of overall system.

In the long run, automation in accounting practices may result in changes in demand for experts in the field of accounting. Demand for less specialized and traditional positions may significantly decrease, forcing employees to seek specialization for more complex accounting roles. There is also possibility of increased demand for higher expertise in the field of accounting and related areas that offer better job conditions but also higher responsibilities (such as managerial accounting positions, consultant positions, audit positions etc.). In each case, accounting profession will require updated and more comprehensive IT skills.

VI. CONCLUSION

In this paper we presented an innovative concept of a public information system for outsourcing accounting as a public service. The model is based on available public sector infrastructure and takes advantage of a few rising digital technologies. The main premise is that the existing public data, resources, infrastructure, and other public assets can be used to provide novel, high complexity, comprehensive services.

The goal of the paper was to present a conceptual model of the proposed system that may improve cost effectiveness to business entities while achieving additional goals of public interest for all social stakeholders. We presented key characteristics of cloud computing, blockchain and data pods that make the fundamental elements of proposed concept.

The model incorporates new technologies in current cloud computing layered model that enable system to automate various accounting tasks while maintaining secure, private, confidential, and permanent record of business transactions. At the same time the system can provide means of autonomous control and audit as defined by law and competent institutions in various segments of supervision (i.e. tax supervision, statistics reporting, etc).

In order to consider and analyze potential of the proposed model and functionalities blockchain technology and data pod specification bring to the public sector a SWOT analysis is performed. There are significant strengths of the proposed model such as the potential to redefine and re-establish entrepreneurial environment and provide competitive advantage to businesses on a national level. Yet, there is a number of challenges that need to be addressed before implementation of this system to minimize potential security and downtime risks.

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