

# ARTIFICIAL INTELLIGENCE – BASED INVOICE TECHNOLOGIES IN MODERN ORGANIZATIONS

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## Abstract

The paper proposes an integrated methodological and technical framework for the evaluation and selection of management and billing technologies in a modern organizational context. The research compares three distinct technological modules: T1-blockchain, smart contracts, and artificial intelligence, T2-classic database and AI, and T3-hybrid solution with database (DB), blockchain, and AI components. The purpose of the research is to develop an integrated technological model for the comparative evaluation and selection of the optimal management and billing technology in a specific organizational context. The main research objectives are: (1) comparative analysis of invoice management technologies, types of billing technologies and invoice formats; (2) Selection of indicators for the comparative evaluation of technological modules; (3) determination of indicator values through software simulations and AI modules; (4) discovery and analysis of correlations between invoice types and technological modules; (5) integration of scores for each combination of invoice type and technological format; (6) analysis of correlations between indicators and billing technologies and invoice formats. The main research tools were: artificial intelligence algorithms, Python and graphs to perform evaluations and correlative and comparative analyses. The research contributions consist of providing a unified framework for comparative evaluation, developing measurement metrics, integrating simulations with artificial intelligence applications, and using modern comparative analysis tools to highlight the correlations and performances of emerging technologies. The results obtained have particular value, being based on an original and relevant interdisciplinary comparative approach contributing to reducing technological risks and optimizing costs in digital billing processes.

**Keywords:** blockchain; databases; electronic invoicing; artificial intelligence; hybrid systems; smart contracts' evaluation indicators.

## 1. INTRODUCTION

In an era marked by accelerated digital transformations and the need for operational efficiency, technological analysis is becoming an essential tool in underpinning strategic decisions. In a digital climate marked by increasing pressures on administrative efficiency, tax compliance and information security, invoice management has become a nodal point in the digital transformation of organizations. At the European level, the directives on electronic invoicing (e-Invoicing), cross-border interoperability and data protection (GDPR) impose increasingly strict standards in the processing of financial documents.

In Romania, the implementation of the RO e-Factura system for public institutions and medical providers, as well as the digitalization of the National Agency for Fiscal Administration (ANAF) and the Electronic Public Procurement System (SEAP) platforms, reflects a clear trend of automation and extended auditability. In parallel, companies in retail, business-to-business (B2B) and energy are faced with the need for scalability and integration of Enterprise Resource Planning (ERP) and cost reduction. This convergence between institutional requirements and commercial needs creates the context for the adoption of advanced technologies such as blockchain, smart contracts, and artificial intelligence (Ghanooni Shishavan et al., 2024). However, the choice of an appropriate technological solution cannot be arbitrary, but should be based on a rigorous quantitative analysis, adapted to the specifics of each field. In this context, the research conducted explores and analyzes the implications, advantages, and challenges associated with implementing digital solutions in a specific field, emphasizing criteria such as performance, security, scalability, and adaptability. Through a comparative approach based on indicators such as security, transparency, automation, audibility and total cost of ownership (TCO), relevant trends and their related technologies are analyzed, to provide a useful analytical framework for professionals, decision-makers and researchers interested in optimizing processes through digital technologies (Remeikienė et al., 2025). In the business environment in the private and public sectors, there is a real need to efficiently manage invoices of different types (Figura & Vevere, 2025). In this regard, within the research process, a comparative quantitative analysis was made, both of invoice management by type of format (pdf, XML (eXtensible Markup Language), EDI (Electronic Data Interchange), blockchain, hybrid), and of invoicing

technologies - B2B (Business to Business), B2C - Business to Consumer, internal invoices, recurring (subscriptions), occasional. For this, three technological management modules were created: T1- blockchain, smart contracts and AI; T2- classic database and AI and T3- a hybrid solution that uses blockchain, database and AI. Blockchain and smart contracts are presented and analyzed within the research, highlighting their ability to ensure traceability, immutability and automatic execution of contractual conditions (Shi & Wang, 2025). In the government and energy sectors, these features are essential for auditability and security. Smart contracts allow for automatic invoice validation, payment triggering, and data reconciliation without human intervention, significantly reducing the risk of fraud and errors (Zhang & Lu, 2023). On the other hand, database and AI-based systems offer flexibility, speed, and easy integration with existing infrastructure, making them preferred in retail and B2B. The hybrid system combines blockchain with databases and AI and proves to be a balanced solution, adaptable to the varied requirements of the institutional context. The comparative evaluation model proposed in this paper contributes to the substantiation of technological decisions in public institutions, private companies and regulatory bodies. Radar-type representations allow for a clear visualization of the trade-offs between indicators, facilitating the choice of an optimal solution according to organizational priorities. These indicators were extracted and normalized from institutional and commercial databases, using Python and artificial intelligence algorithms for processing, aggregation and visual representation (Androniceanu, 2025a; Androniceanu, 2025b). By introducing customizable weights for each indicator, the research allows for a flexible and contextualized evaluation of technological performance. The generated radar representations provide a synthetic and comparable image of the efficiency of each technological method in relation to the type of invoice analyzed. Thus, a modular, flexible model is created, applicable in institutional decisions, public procurement or digitalization strategies. This approach not only offers an alternative to qualitative or descriptive assessments, but also proposes a data-driven, replicable and transparent decision-making framework. In addition, integrating AI into the analysis process allows for the identification of patterns, anomalies, and correlations that are not identifiable in traditional assessments. By using Python and AI, the model can be integrated into decision-making platforms, executive dashboards, or public procurement systems. For example, a public institution may place greater emphasis on audibility and transparency, while a retailer may prefer automation and total cost of ownership (TCO). The methodology proposed in this research can be extended to other types of administrative documents (contracts, notices, reports), providing a general framework for technological assessment in the digital age. Invoice management, although seemingly a standardized administrative process, involves a series of complex challenges, different depending on the scope of application. In the medical sector, for example, invoices must comply with strict confidentiality, traceability and multiple validation requirements, in accordance with the regulations of the National Health Insurance House (CNAS) and GDPR. In the government sector, transparency and auditability are imperative, and interoperability between institutions requires rigorous technical standards. Retail is faced with high transaction volumes, where speed, automation and integration with ERP systems are essential. In the business (B2B) environment, contractual complexity and the need for automatic reconciliation between parties require robust and scalable solutions. The energy sector adds additional challenges with invoices with variable components, periodic adjustments and high contractual security requirements. These problems cannot be effectively addressed by generic technological solutions. The choice of a management method must take into account relevant quantitative indicators, such as security, transparency, automation, audibility and total cost of ownership. Without a rigorous assessment, organizations risk adopting solutions that are inadequate, costly or incompatible with their operational requirements. The research proposes a quantitative assessment model, based on real data and processed using Python and artificial intelligence algorithms (Bunget & Lungu, 2023). By extracting and normalizing indicators from institutional and commercial databases, the research provides an objective picture of the performance of each technology analyzed. Correlation diagrams made in Python highlight the relationships between indicators. They reflect how increasing automation can positively influence transparency, but can have a negative impact on TCO in certain contexts. By calculating a composite score, obtained by weighting the five assessment indicators, the research allows direct comparisons between the three technologies: blockchain with smart contracts and AI, databases with AI, and hybrid system for each type of invoice. This composite score is visualized through radar representations, which provide a synthetic and comparable picture of technological performance, adapted to the specifics of a domain.

Thus, the research not only identifies the problems, but also proposes a concrete, replicable and adaptable decision-making tool, which can be used in public institutions, private companies, or regulatory bodies to

choose the most appropriate technological billing solution. Starting from the proposed quantitative model, based on real data, processed through Python and artificial intelligence algorithms, the research answers essential questions that guide the analysis and validate the usefulness of the built decision-making tool (Vesolovska et al., 2025). The research aims to identify the technology that generates the best performance, based on the composite score resulting from the weighted aggregation of the indicators. Thus, efficiency variations depending on the type and format of the invoice are explored, as well as how the correlations between the indicators influence the final results. The research investigates the flexibility of the model. That is, to what extent can the weights of the indicators be adjusted to reflect different organizational priorities and what trade-offs arise when one technology is preferred over another, especially in relation to total operating costs, security level, or auditability. Another research direction concerns the practical applicability of the model and how it can be integrated into the decision-making processes of public institutions or private companies. The research clarifies the performance of the analyzed technologies through comparison and provides a transparent and extensible methodological framework. The use of Python, AI and graphs to represent the results of comparative analyses transforms the model into a replicable tool, applicable to other types of documents or digital processes, strengthening its relevance in the context of accelerated digital transformation.

## 2. LITERATURE REVIEW

The literature confirms that blockchain represents a fundamental technological infrastructure for building distributed trust. Laourou (2025) described blockchain as a distributed, tamper-resistant ledger, in which each block validates the integrity of the previous one, emphasizing that its security derives from cryptography and network consensus, not from a central authority. In the same vein, Crosby and his research team (2016) highlight the structural advantages of the technology, showing that it offers transparency, security and resistance to modification, while reducing operational costs by eliminating intermediaries and automating verification. The concept of smart contract, introduced by Buterin (2014), is defined as a program that runs exactly as written, without the possibility of third-party intervention, facilitating the automation of complex processes in a transparent and verifiable way. This perspective is reinforced by Nakamoto (2008), who proposes an electronic payment system based on cryptographic proofs, and by Christidis & Devetsikiotis (2016), who show that blockchain allows for verifiable interactions between participants who do not trust each other. In the context of invoice management, immutability, traceability and automatic validation become essential. Tapscott & Tapscott (2017) add an economic dimension, arguing that data becomes a new asset class, and blockchain functions as an engine of inclusion. Xu, Weber, and Staples (2019) extend the analysis to the architectural level, showing that blockchain can act as a source of truth, a coordination mechanism, or a decentralized execution platform, but its suitability depends on trade-offs between transparency, performance and cost. In parallel, the literature on artificial intelligence highlights its role in automation and process optimization. Goodfellow and his research team (2016) show that deep neural networks can automatically extract relevant representations from complex data, and machine learning allows models to improve their performance based on experience (Raza et al., 2025). Russell and Norvig (2020) formulate an operational definition of AI, recalling the role of the Turing test and the efficiency of greedy algorithms in solving problems. Chui, Manyika and Miremadi (2018) emphasize the potential of AI to take over human tasks and reverse the decline in productivity, which justifies the use of AI in generating composite scores and analyzing indicators in the research model. The applicability of AI in the accounting field is confirmed by Bunget and Lungu (2023), who highlight the connection between AI and the accounting profession, as well as by Dobre and Mihăilescu (2022), who describe concrete uses such as automatic data extraction, document classification and invoice validation. Iancu and Pavel (2022) show, in a study on Romanian small and medium-sized enterprises (SMEs), that AI significantly reduces processing time and increases accounting accuracy. Regarding hybrid models, Rusu and Petrescu (2023) demonstrate that integrating classical databases with blockchain offers a scalable and secure model for managing fiscal documents, optimizing costs and increasing transparency. This idea is complemented by Unteanu and Ionescu (2022), who show that integrating AI into ERP automates decision-making processes, and by Boillat & Legner (2013), who analyze the impact of the transition from on-premises software to cloud services on the business model. Gartner (2019) and Enache & Bălan (2021) emphasize the importance of correctly assessing the total cost of ownership (TCO), including direct, indirect, scalability, and security costs (Boillat & Legner, 2013). In the area of auditability and regulation, Yermack (2017) shows that blockchain can transform corporate governance through accurate recordkeeping and transparency, and

Tănase and Radu (2020) highlight the role of immutability in auditability. However, Dospinescu and Scarlat (2021) draw attention to the challenges related to the lack of regulation and the difficulty of integration into traditional accounting systems. Popescu and Stoica (2021) analyze the implementation of the RO e-Factura system, emphasizing the need to adapt the IT infrastructure and train staff. A recent application example is provided by Unteanu and Ionescu (2022), which combines AI for predictive analysis with blockchain for security, reducing energy costs by automating the invoicing process. In parallel, the literature on databases and data integration complements the technological framework. Elmasri and Navathe (2016) show that relational databases provide consistency and performance in managing large volumes of data, and data modeling reduces redundancy and optimizes processes. Halevy and his team (2006) emphasize the importance of integrating heterogeneous sources, but also the challenges related to inconsistency, data quality and schema differences. OECD (2022) highlights the transformation of tax administrations through digitalization, showing that electronic invoicing and real-time reporting increase transparency and reduce tax evasion. Overall, the analyzed literature confirms the conceptual and applicative soundness of the research underlying this work. The convergence between blockchain, artificial intelligence, databases and fiscal digitalization justifies the use of quantitative indicators and composite scores for evaluating technologies. Thus, the research is positioned in an academic framework with practical relevance and potential for expansion into related fields. Research on the quantitative evaluation of invoice management technologies in an organizational context is part of an emerging field, located at the intersection of blockchain, artificial intelligence and hybrid data processing systems. Recent literature confirms both the need for such approaches and the validity of the indicators and methods used in the study.

The analysis of relevant works highlights three major directions: (1) the role of blockchain in increasing transparency and security, (2) the contribution of AI to automation, analysis and anomaly detection, and (3) the potential of hybrid systems to combine the advantages of existing technologies to meet complex organizational requirements. The study by Zhang & Wen (2023) represents a reference point regarding the integration of blockchain and AI in the management of financial documents in the public sector. The authors demonstrate that the use of smart contracts can automate critical processes such as invoice validation and reconciliation, significantly reducing the risk of fraud and processing time. This research was relevant to the research conducted because it identified some of the indicators for the comparative evaluation of invoice formats and billing technologies. In addition, the validation of blockchain in a regulated environment, such as public administration, supports the applicability of this technology in private or commercial organizational contexts. The research of Popescu & Ionescu (2024) makes an essential contribution in the area of hybrid systems, analyzing combinations between blockchain, databases and AI in high-demand areas, such as medical and energy.

The authors propose an evaluation methodology based on quantitative indicators — security, auditability, automation, TCO — identical to those used in the model designed in this research. The use of Python for data processing and the generation of visualizations (including radar charts) confirms the validity of the methodological approach chosen for this research and demonstrates the applicability of modern analytical tools in the evaluation of emerging technologies. The relevance for research is major, as the study shows that hybrid systems can provide an optimal balance between performance and security, a central idea also in the designed comparative model. In the same direction, Sontakke et al. (2023) provide a practical demonstration of how blockchain can prevent tax fraud and increase transparency in billing processes. The authors highlight that distributed ledgers can eliminate data manipulation and provide an immutable transaction history. This conclusion directly supports the security, transparency, and auditability indicators used in this research. Also, their methodology, based on tracking transactions through electronic wallets and distributed ledgers, validates the applicability of blockchain in real-world billing scenarios, strengthening the empirical foundation of the technological methods proposed in this paper. The extensive study conducted by Shi & Wang (2025) provides a comprehensive perspective on the integration of blockchain and AI in financial services, analyzing over 100 academic articles. Their conclusion that blockchain improves data integrity and transparency, and AI supports automation and decision-making efficiency, confirms the complementarity of the two technologies, a central idea in the comparative analysis contained in this research.

Furthermore, the authors emphasize the lack of empirical studies applied to the billing field, which highlights the results obtained in the research process as a necessary and timely contribution to the literature. Another

study with a special contribution to the literature brings a modern perspective on the automation of invoice processing through machine learning and DevOps (Dragomirescu et al., 2025). The authors demonstrate that the integration of machine learning (ML) can reduce errors, increase scalability and optimize resources, aspects that support the automation indicator used in the research process (LeCun et al., 2015). Also, the emphasis on continuous monitoring and adaptability of AI models validates the use of advanced analysis techniques in the evaluation of technological performance.

Overall, the analyzed literature confirms the conceptual and methodological soundness of the research in this paper. All studies converge towards the idea that blockchain, AI and hybrid systems represent major directions in the digitalization of financial processes, and their quantitative evaluation through measurable indicators is both necessary and scientifically validated. The research underlying this paper integrates into the current scientific literature, contributing a coherent, scalable and applicable analytical model that can be extended to various organizational contexts and can support the informed adoption of emerging technologies in invoice management.

### 3. RESEARCH METHODOLOGICAL FRAME AND DISCUSSIONS OF THE RESEARCH RESULTS

#### 3.1. *The purpose and objectives of the research*

The purpose of the research is to develop an integrated technological model for comparative evaluation and selection of the optimal management and invoicing technology in a specific organizational context. In this context in which artificial intelligence fundamentally transforms the accounting profession (Bunget & Lungu, 2023), the research aims to provide a rigorous, quantifiable and practically applicable approach, capable of analyzing the performance of blockchain, AI and hybrid systems technologies, as well as invoice formats used in the modern economic environment. The objectives of the research are the following: (1) identification and comparative analysis of invoice management technologies, types of invoicing technologies and invoice formats; (2) Identification of the set of indicators for the comparative evaluation of technological modules; (3) Generation of indicator values through software simulations and AI modules; (4) Analysis of the relationships between invoice types and technological formats; (5) Extended comparative analysis with the integration of scores for each combination of invoice type and technological format; (6) Integrated comparative analysis with identification of correlations between evaluation indicators, billing technologies and formats for different types of invoices.

#### 3.2. *Discussions of the research results obtained within each stage of the research process*

The research process was carried out in ten stages, and the research results obtained are presented and discussed further according to each stage completed.

In the first stage, the components of each of the three technological modules included in the research were identified and explained. In the analysis of modern invoice management solutions, the following three technological modules (development trends) were taken into account, namely: (1) Technological Module (T1) having the following components: blockchain, smart contracts and artificial intelligence; (2) Technological Module (T2) consisting of: classic databases and artificial intelligence and (3) Module (T3) a hybrid solution (Luu et al., 2016). Blockchain is a distributed ledger technology in which information is organized into cryptographically linked blocks. Each block validates the integrity of the previous one, making the entire chain highly resistant to modification. Data is replicated across all nodes in the network, eliminating the need for a central authority, and consensus mechanisms ensure transparent and verifiable validation of transactions. Cryptography guarantees the security and immutability of data, thus providing a secure framework for digital transactions and automated processes. Essentially, blockchain functions as a distributed, immutable, and transparent ledger. Smart Contracts are computer programs that execute automatically when pre-defined conditions are met. Running directly on the blockchain, they benefit from transparency, immutability and resistance to manipulation. They eliminate the need for intermediaries, reduce operational costs and ensure the exact execution of the terms established by the code. Thanks to these characteristics, smart contracts allow

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the automation of complex processes in a verifiable way and become an essential tool in the digitalization of transactions and financial flows.

Artificial Intelligence complements these technologies with the ability to analyze data, learn from behaviors and optimize decisions, contributing to the automation and efficiency of processes.

In T1, the combination of blockchain, smart contracts and AI leads to a fully decentralized, automated and intelligent system. The architecture is fully distributed, the contract logic is directly integrated into the blockchain, and security is ensured by advanced cryptography and consensus mechanisms. AI optimizes contract execution and data analysis in real time. This approach is suitable for financial ecosystems, supply chains, digital identity, e-voting and any process that requires full transparency.

In T2, a traditional database (relational or NoSQL) is combined with artificial intelligence algorithms to improve data performance and analysis. The database provides structured storage and fast querying, while AI adds predictive analytics, anomaly detection and query optimization. The architecture is centralized, security depends on internal policies and local encryption, and automation focuses on optimizing performance and operational security. This solution is suitable for internal applications, financial reporting, operational management, and predictive monitoring.

Within T3, the hybrid solution combines the flexibility of the database with the traceability of the blockchain and the analytical capabilities of AI. The database provides fast and adaptable storage, the blockchain provides integrity and auditability, and AI coordinates flows and optimizes processes. The architecture is semi-decentralized, allowing interoperability between modules. Security is balanced: critical data can be stored on the blockchain, and the rest in the database. This approach is recommended for tax systems, document management, e-invoicing and administrative processes that require both efficiency and traceability.

In the second stage, a comparative analysis of the components of the three technological modules was developed based on essential criteria for modern organizations, as presented in Table 1.

TABLE 1 - COMPARATIVE ANALYSIS OF TECHNOLOGICAL MODULES BASED ON ESTABLISHED CRITERIA

Criteria	Technological modules		
	Blockchain+SC+AI	Classic DB + AI	Hybrid solution
Architecture	(T1)	(T2)	(T3)
Security	Decentralized	Centralized	Modular/mixed
Automation	Maximum	Average	High (selective)
Traceability	Contracts + AI	Query AI	AI on flows
Scalability	Immutable	Limited	Selective
Applicability	Limited (blockchain)	High	Adaptable

Source: Authors

**The third stage** of the research process consisted of identifying and selecting indicators for the comparative evaluation of management technologies. In order to evaluate the three technological modules, we identified and selected the following indicators as relevant: Security Indicator (IS); Transparency Indicator (TI); Automation Indicator (IA); Audit Indicator (IAu) and Total Cost of Ownership (TCO). Next, the measurement metrics for each indicator were defined, namely, normalized scores, percentages, costs in EUR/USD, etc.

- *The Security Indicator (IS)* reflects the ability of a system to protect data, processes and users against unauthorized access, loss or compromise. It is an essential indicator in any digital infrastructure, especially in sensitive areas such as financial or document management. To measure it, the frequency of security incidents was first analyzed, expressed as the number of breaches, attacks or unauthorized accesses in a month. Then the mean time to remediate (MTTR) was calculated, expressed in hours per incident, also taking into account the patch application rate, i.e. the percentage of systems proactively updated. This is how the failed authentication rate was determined, as a signal of vulnerabilities or poor configuration. All these metrics are integrated into a normalized IS score, expressed between 0 and 1 or as a percentage, providing a synthetic picture of the security level.
- *The Transparency Indicator (IT)* is vital for trust, verification and control. It assesses the degree to which the system allows clear, verifiable and undistorted access to information, processes and decisions. It is

measured by the accessibility of historical data, expressed as a percentage of the total information available with an emphasis on the existence of journals and logs. The clarity of processes is assessed qualitatively, on a scale from 1 to 5, either by experts or users. The availability of documentation is expressed as a percentage of the components covered by manuals APIs, application programming interfaces or the set of rules through which two programs can communicate or legal terms. The degree of interoperability is reflected by the number of compatible systems. All these elements contribute to a normalized IT score, calculated weighted and validated by external expertise.

- *The Automation Indicator (IA)* is an indicator of efficiency and technological maturity. IA measures the degree to which processes are executed automatically, without human intervention, with consistency and reliability. The measurement starts by calculating the percentage of automated processes out of total operations. Then, the monthly time saved, expressed in hours, is calculated compared to manual execution and the automated error rate, expressed as a percentage of total executions, indicates algorithmic reliability. These metrics are synthesized into a normalized AI score, which reflects the operational impact of automation.
- *The Audit Indicator (IAu)* is the key to compliance and institutional control. IAu measures the ability of a system to be verified, tracked and validated by third parties, in a transparent and complete manner. In the first sequence, the existence of audit trails, logos, versions, digital signatures and their degree of coverage are checked. Compliance with international standards (such as ISO or GDPR) is assessed, expressed as a percentage. Accessibility for auditors is measured by the number of available access points (interfaces, APIs, exports). In addition, the audit success rate is analyzed, i.e. the percentage of audits without non-conformities. This data is integrated into a normalized IAu score, validated by external scores.
- *Total Cost of Ownership (TCO)* is a complex financial indicator that reflects the long-term sustainability of a technological solution. It includes all direct and indirect costs associated with the acquisition, implementation, maintenance and expansion of a system.

It starts with the acquisition or license cost. It adds the costs of implementation, consulting, training, migration and annual maintenance costs, which include technical support and updates. It also takes into account the costs of upgrades or scaling, necessary for functional expansion. Finally, indirect costs are estimated, such as lost time, errors or adaptation difficulties. All these components are summed up in a total TCO, calculated over a period of 3–5 years or according to management requirements. For the comparison between technological modules (T1, T2, T3), the IS, IT, IA, and IAu indicators were used with scores in the range of 0–1. And for TCO, values expressed in EUR/USD over a period of 3–5 years were used. Also, a personalized weighting was used, depending on the institutional context, such as 40% for IS and 20% for IA.

**The fourth stage** of the research process consisted of identifying invoice formats and invoicing technologies. The following five invoice formats (F1, ..., F5) and five types of invoicing technologies were considered in this research: (1) B2B; (2) B2C; (3) Internal; (4) Recurring and (5) Occasional.

- *F1 is the classic invoice* in PDF format, which is the traditional form, manually generated and transmitted by e-mail. It lacks structured metadata, which makes it difficult to process automatically. Although it is easy to issue and understand by users, this type of invoice requires human intervention for validation, data extraction and archiving. It is vulnerable to interpretation errors and lack of traceability, being the least compatible with advanced digital systems.
- *F2 is the invoice in XML* (eXtensible Markup Language) and UBL (Universal Business Language) format standardized and widely used in European e-invoicing. Its structure allows direct integration into IT systems, facilitating the automation of validation, accounting and archiving processes. It is compatible with European directives on interoperability and fiscal transparency. Thanks to its structured format, it allows for fast and accurate data extraction, making it ideal for public institutions and companies with mature digital flows.
- *F3 is the EDI* (Electronic Data Interchange) Invoice directly integrated into ERP (Enterprise Resource Process) systems and automatically transmitted between commercial entities. It is not intended for human viewing, but for direct processing by applications. This type of invoice offers maximum efficiency in

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environments with high transaction volume, significantly reducing processing time and the risk of error. It is frequently used in supply chains, retail and industry, where standardization and speed are a priority.

- *F4 is the blockchain invoice* issued and validated via blockchain. This is a technological innovation that ensures traceability, integrity and automatic execution through smart contracts. Each invoice is recorded in a distributed, immutable ledger, which eliminates the risk of forgery or manipulation. Validation is done automatically, according to predefined conditions, and the history is transparently accessible. It is ideal for decentralized financial ecosystems, international projects and processes that require absolute auditability.
- *F5 is the hybrid invoice* that combines the advantages of the XML format with the digital signature and partial traceability elements. It is a compromise solution between standardization and flexibility, allowing integration into digital systems, without giving up legal validation. It is suitable for institutions that are gradually migrating to full e-invoicing, but maintain compliance and verifiability requirements.
- The five types of invoicing technologies integrated in the research are:
  - *B2B (Business to Business) fiscal invoices* are invoices that circulate between two companies. They contain all the necessary tax details (VAT, tax codes) and are used for VAT deduction and accounting. Transactions involve complete tax invoices, deductible VAT and rigorous accounting reporting.
  - *B2C (Business to Consumer) tax invoices* are those issued by a company to a private customer. They contain tax information, but without the customer's tax code. VAT is not deducted by the consumer. The invoices are simpler, VAT is not deducted by the customer.
  - *Internal (non-fiscal) invoices* are used within an organization for internal records (e.g. transfers between departments), have no tax value, and do not involve VAT.
  - *Recurring invoices (subscriptions)* are issued periodically (monthly, annually) for services or products delivered constantly, such as software, internet, or maintenance subscriptions.
  - *Occasional invoices* are issued for a single transaction, not a recurring one. Example: the purchase of a one-time product or service.

The fifth stage of the research process involves determining the evaluation indicators through Python simulations and AI modules. The data for the research were extracted from APIs, XML files, PDF reports and logos of systems and AI algorithms. The algorithms were used for classification, normalization and scoring. The values of the indicators in Table 2 were extracted (simulated) based on real data using Python processing with the pandas, scikit-learn, and RandomForest modules, along with MinMax normalization for classification. The data used were extracted from databases, test reports, case studies and functional applications from the websites of the Ministry of Finance and the European Commission.

TABLE 2 - COMPARATIVE APPROACH OF INVOICE TYPES USING EVALUATION INDICATORS

Invoice types	Evaluation indicators				
	IS	IT	IA	IAu	TCO (Euro)
F1 – Manual PDF	0.35	0.4	0.1	0.2	12
F2 – XML UBL	0.7	0.85	0.65	0.8	9.5
F3 – EDI ERP	0.75	0.70	0.90	0.6	15
F4 – Blockchain	0.95	0.90	0.80	0.96	18
F5 – Hybrid	0.85	0.80	0.75	0.85	13.5

Source: Author

The results in Table 2 highlight the clear transition from traditional, poorly digitized formats, such as PDF, to advanced solutions with high levels of security, automation and auditability, such as the blockchain invoice. XML UBL offers the best balance between performance and cost, while EDI remains optimal for intensive automation. The hybrid format positions itself as an efficient intermediate solution, suitable for organizations in the process of progressive digitization.

The sixth stage of the research process consists of analyzing the correlations between invoice formats and billing technologies. The correlation was carried out using three axes of analysis: (1) technological compatibility, expressing how well the format integrates with the billing technology; (2) practical utility expressed by the frequency and efficiency of use in real applications and (3) the degree of adequacy, which indicates the level of maturity, costs and benefits in the institutional context. The OK, LM and WR qualifications are represented by a simple scale. They allow for quick interpretations and help to substantiate appropriate decisions regarding invoice formats and billing technologies. In order to analyze the connection between the types of billing technologies and billing formats (functional) a correlation matrix was developed (Table no. 3) reflecting compatibility, practical usage and the degree of technological adequacy.

TABLE 3 - CORRELATION MATRIX BETWEEN INVOICE FORMATS AND INVOICE TECHNOLOGIES

Invoicing Technology	Invoice format				
	F1 –Manual PDF	F2 – XML UBL	F3 – EDI ERP	F4 -Blockchain	F5 – Hybrid
B2B Fiscal Invoice	OK (traditional)	OK (EU standard)	OK (integrated ERP)	LM (pilot/limited)	OK (in transition)
B2C Fiscal Invoice	OK (general purpose)	LM (rarely used)	WR (uneconomical)	LM (experimental)	OK (for digital retail)
Internal Invoice	OK (simple)	WR (unjustified)	OK (internal processes)	WR (high cost)	OK (for internal traceability)
Recurring Invoice	OK (automated PDF)	OK (periodic XML)	OK (EDI scheduled)	LM (smart contracts)	OK (with metadata + signature)
Occasional Invoice	OK (fast)	OK (standardized)	WR (ineffective)	OK (single contract)	OK (with digital validation)

Note: OK = recommended/frequently used; LM = usable with limitations/in development; WR = wrong/not recommended/inefficient

Source: Author

In the seventh stage, the values of the indicators selected for this research were determined for each invoice technology and for each invoice format. To calculate the values, calculation formulas were applied for each indicator using the quantitative scores obtained based on tests, journals, logs and real costs. The evaluation of the B2B fiscal invoicing technology in the F1 invoicing format is based on the five indicators calculated based on technical tests, system logs, user feedback and real costs. The Security Indicator (SI) was determined by analyzing access logs, penetration tests, audits and encryption verification, resulting in a score of 0.65. The Traceability Indicator (TI) was calculated by analyzing invoice processing logs, verifying audit systems and testing the reconstruction of an invoice route, obtaining a score of 0.50. The Automation Indicator (AI) reflects the proportion of automated steps in the work process, assessed by analyzing RPA workflows and automated processing tests, resulting in a score of 0.30. The Audit Indicator (IAu) was established based on interface testing, available automated functions and user feedback, with a final score of 0.40. The Total Cost of Ownership (TCO) was calculated based on direct, indirect and hidden costs, using the standard TCO formula, the resulting value being EUR 12. The data used comes from performance and security tests, operational logs, questionnaires and real costs from financial documents. A similar procedure was followed for the evaluation of the other invoicing technologies and invoice formats. The results obtained are presented in Table 4.

The values in Table 4 are determined based on institutional data and real applications mentioned above. AI algorithms were used for scoring and normalization (MinMax + RandomForest). The extended matrix highlights how the performance of each technological invoice format varies depending on the invoice type analyzed, providing a contextualized perspective on the suitability of digital solutions. For B2B invoices, where security and auditability requirements are high, advanced formats such as Blockchain and Hybrid stand out clearly. As can be seen in the table, invoice type B2C, occasional invoices, XML UBL and the hybrid format offer the best balance between cost and performance. Internal and recurring invoices favor solutions with high automation, such as EDI, while Blockchain remains optimal for scenarios with critical traceability. PDF is consistently the weakest option, suitable only in contexts with minimal digitalization. Overall, the matrix shows that there is no universal solution, and the optimal choice depends on the invoice type and organizational priorities.

TABLE 4 - SCORES DETERMINED FOR FEASIBLE COMBINATIONS OF INVOICE TECHNOLOGIES AND INVOICE FORMATS

Invoice technology	Invoice format	Evaluation indicators				
		IS	IT	IA	IAu	TCO
B2B fiscal invoice	F1	0.65	0.5	0.3	0.4	12
	F2	0.8	0.85	0.7	0.85	9,5
	F3	0.85	0.75	0.9	0.7	15
	F4	0.95	0.9	0.8	0.95	18
	F5	0.9	0.8	0.75	0.85	13,5
B2C fiscal invoice	F1	0.6	0.45	0.25	0.35	11
	F2	0.7	0.6	0.5	0.65	10
	F5	0.8	0.75	0.65	0.8	12,5
Internal invoice	F1	0.55	0.4	0.2	0.3	8
	F3	0.75	0.65	0.85	0.6	14
	F5	0.8	0.7	0.7	0.75	11,5
Recurring Invoice	F1	0.6	0.5	0.4	0.45	10
	F2	0.75	0.8	0.7	0.8	9
	F3	0.85	0.75	0.9	0.7	15,5
	F4	0.9	0.85	0.8	0.9	17
	F5	0.85	0.8	0.75	0.85	13
Occasional Invoice	F1	0.65	0.55	0.3	0.4	9,5
	F2	0.75	0.8	0.6	0.75	9
	F4	0.95	0.9	0.8	0.95	16
	F5	0.85	0.8	0.7	0.85	12

Source: Author

In the eighth stage of the research process, the correlations between the selected evaluation indicators and invoice technologies were identified and analyzed. The identification of correlations between indicators was determined using statistical methods. For this, the Pearson coefficient was calculated, which expresses the strength and direction of the linear relationship between two quantitative variables. The analysis of the correlations between the quantitative indicators relevant for the evaluation of invoice management technologies highlights a series of significant interdependencies that are presented below.

- The correlation between IS ↔ IAu ( $r = +0.94$ ) shows that systems that invest in high security tend to be better audited. It is a logical correlation since the encryption, authentication and logging mechanisms that enhance security simultaneously contribute to traceability and verifiability. In a mature digital environment, these two dimensions become complementary.
- The correlation between AI ↔ TCO ( $r = -0.68$ ) is a moderate negative correlation, indicating that a higher degree of automation is associated with a lower total cost of ownership. Automation reduces the need for human intervention, minimizes errors and optimizes processing times. All of these contribute to lower long-term operational costs.
- The correlation between IT ↔ IS ( $r = +0.89$ ) is a positive, statistically significant correlation, showing that transparency and security are strongly interdependent. Systems that provide clear visibility into processes and data also tend to implement robust protection measures. This correlation suggests that investments in transparency (e.g. logs, controlled access, documentation) directly contribute to strengthening security.
- The correlation between IA ↔ IAu ( $r = +0.76$ ) is a correlation that shows that automation supports auditability. Automated processes are, by their nature, easier to track, document and reproduce. This correlation highlights the fact that traceability is not only a function of architecture, but also of algorithmic execution.
- The correlation between TCO ↔ IS ( $r = +0.45$ ) is relatively weak, but positive, which suggests that more secure systems may involve higher costs. Although it is not a strict relationship, it reflects the reality that implementing advanced security measures (encryption, backup, audit) requires additional investments, especially in the initial phase.

In the ninth stage of the research process, the correlations determined in the previous stage were graphically represented using the heatmap correlation matrices in Figure 1 and Figure 2. The correlation matrices highlight the intensity of the relationships between the indicators for the 5 invoice technologies. Warm colors (red) indicate strong positive correlations, and cool colors (blue) indicate negative correlations.

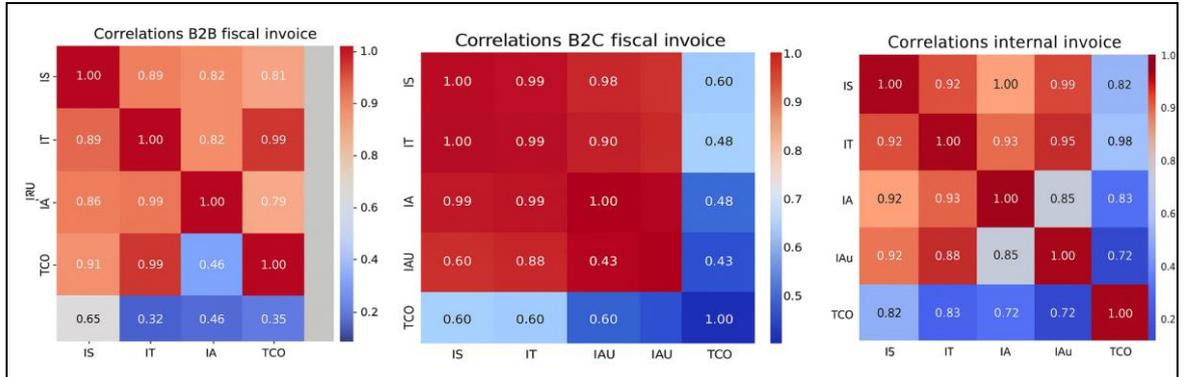


FIGURE 1 – CORRELATION MATRICES OF B2B, B2C, AND INTERNAL INVOICE

Source: Author

*Correlations for B2B fiscal invoice technologies*

Correlation between IS and IAU ( $r = 0.91$ ) shows that security and audibility are closely related, which confirms that robust systems in terms of data protection are also the easiest to verify. Correlation between IT and IS ( $r = 0.89$ ) shows that transparency increases with security, suggesting that well-documented and visible systems are also more secure. Correlation between IA and TCO ( $r = 0.46$ ) shows that automation has a moderate impact on costs, but is not decisive in this context, probably due to the complexity of ERPs.

*Correlations for B2C fiscal invoice technologies*

Correlations between IS, IT, IA, and IAU have almost perfect correlations with each other ( $r > 0.98$ ), which indicates a systemic interdependence. This means that if a system is well automated, then it is also transparent, secure and auditable. TCO has weaker correlations (maximum 0.60), which suggests that in B2C, costs are not directly proportional to technological performance. Therefore, in B2C, technological performance is holistic, meaning that improving one indicator tends to improve all of them. Costs can be optimized without affecting quality.

*Correlations for internal invoices*

Correlations between IS, IT, IA, IAU ( $r > 0.92$ ), but also between IA and TCO ( $r = 0.98$ ) are statistically strong, as can be seen in Figure 1.

The other correlations for recurring invoice and occasional invoice technology are presented in Figure 2.

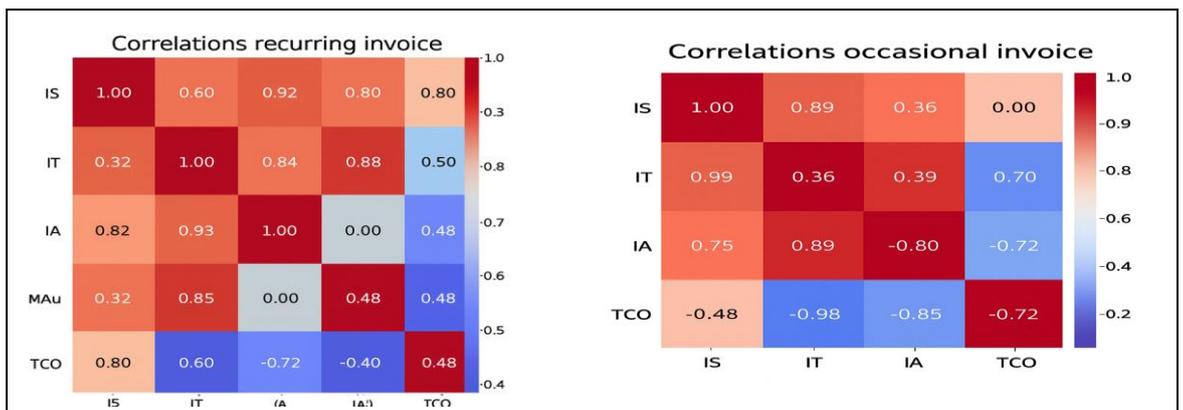


FIGURE 2 – CORRELATION MATRIX OF RECURRING AND OCCASIONAL FISCAL INVOICES

Source: Authors

ARTIFICIAL INTELLIGENCE–BASED INVOICE TECHNOLOGIES IN MODERN ORGANIZATIONS

*Correlations for recurring invoice technologies*

Correlations between IA ↔ IT (r = 0.98) and IA ↔ IS (r = 0.92) show that automation is closely linked to transparency and security. Correlations between TCO ↔ IA (r = 0.70) show that automation reduces costs, but not absolutely. These correlations show that recurring invoices benefit the most from automation, but must be balanced with initial investments. It is an ideal area for smart contracts and scheduled flows.

*Correlations for occasional billing technologies*

Correlations between IS ↔ IAu (r = 0.75) and IT ↔ IA (r = 0.88) show that there are strong relationships between security, auditability and automation. Correlations between TCO ↔ IA, IAu, IT (r ≈ -0.72) show significant negative correlations. This means that the higher the technological performance, the lower the costs. In the case of occasional invoices, advanced technologies (e.g., blockchain, hybrid) can significantly reduce costs if well calibrated.

Summarizing the results of the comparative correlation analysis for B2B fiscal invoicing technologies, there are very strong correlations between IS, IT and IAu, and TCO has a moderate relationship with the others. B2C fiscal invoicing technologies have weaker correlations, but IA and IAu remain well correlated with TCO. For internal invoice invoicing technologies, IA has a greater influence on TCO than IS or IT. For recurring invoice invoicing technologies, there are strong correlations between all indicators, with TCO well aligned with technical performance. For occasional invoice invoicing technologies, the correlations are similar to those for recurring invoices, but with greater variations between IA and TCO.

Heatmap matrix analysis highlights significant differences between invoice types and how the technological evaluation indicators — security (IS), transparency (IT), automation (IA), auditability (IAu) and total cost of ownership (TCO) — correlate with each other.

These heatmaps not only visualize the relationships between indicators, but also provide a solid basis for multi-criteria decision modeling, institutional simulations or choosing the optimal format depending on the invoice type.

**In the tenth stage**, correlations were determined and radar graphs were developed for each type of invoice format, evaluation indicators and the 5 types of invoice technologies. These are represented in figures 3 and 4.

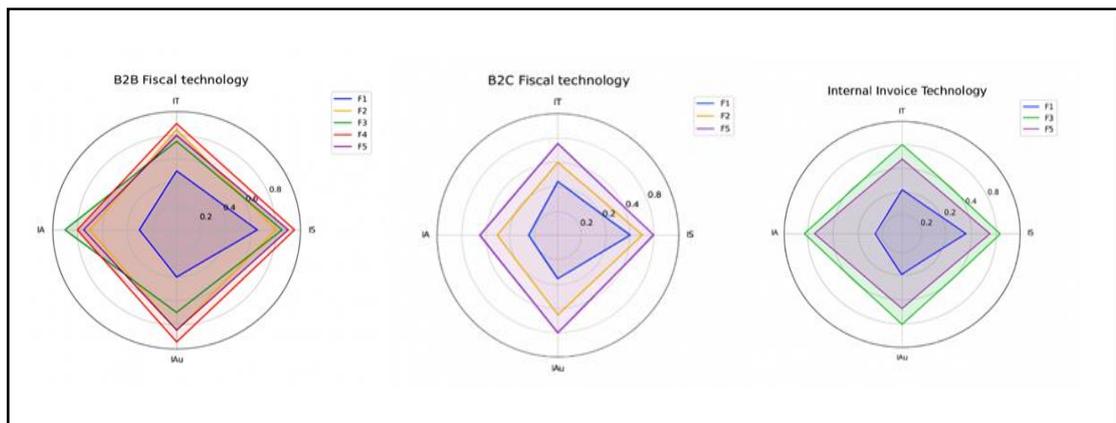


FIGURE 3 – RADAR GRAPHS OF B2B, B2C AND INTERNAL INVOICE TECHNOLOGY

Notes: F1 – Blue for Manual PDF Invoice; F2 - Orange for XML, UBL Invoice; F3 - Green for EDI ERP Invoice; F4 - Red for Blockchain Invoice; F5 - Purple for Hybrid Invoice

Source: Author

The comparative analysis of the five invoice formats (F1–F5) on different types of invoicing technologies highlights a clear pattern of their performance depending on the operational context. As can be seen in the radar graphs, F1 (blue) remains consistently the weakest of the formats, with obvious limitations in IA and IAu, which makes it suitable only for simple situations, with minimal control and traceability requirements. F2 (orange) positions itself as a balanced solution, with good performance in IT and IS, being suitable in scenarios

where stability and compliance are important, but without extreme automation requirements. F3 (green) is distinguished by the highest level of automation (IA), being the optimal choice for repetitive processes, ERP integration and the management of recurring invoices or high-volume flows.

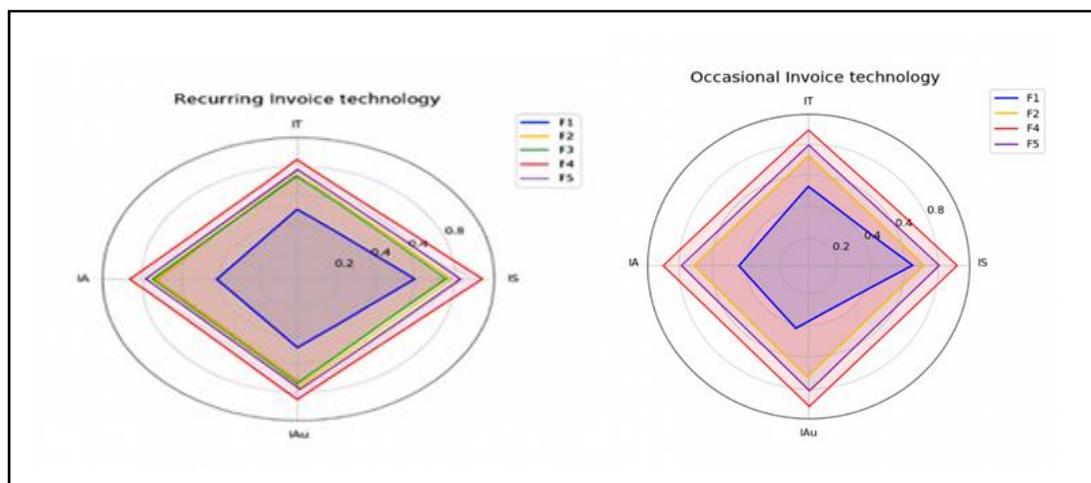


FIGURE 4 – RADAR GRAPHS OF RECURRING AND OCCASIONAL INVOICE TECHNOLOGY

Notes: F1 – Blue for Manual PDF Invoice; F2 - Orange for XML, UBL Invoice; F3 - Green for EDI ERP Invoice; F4 - Red for Blockchain Invoice; F5 - Purple for Hybrid Invoice

Source: Author

F4 (red) excels in security (IS) and auditability (IAu), which makes it preferable in critical contexts, such as B2B fiscal or occasional invoices that require strict validations and maximum traceability. F5 (purple) stands out as the most versatile and consistently performing option, with high and balanced scores in almost all scenarios, from fiscal B2C, where it dominates all dimensions, to internal and occasional invoices, where it offers superior traceability and flexibility.

The main limitations of the research are: (1) the values of some indicators are generated through simulations; (2) the indicators may need updating as new standards or regulations emerge; (3) the Python program does not yet include integration with real ERP systems, which limits immediate applicability in organizational environments; (4) the lack of qualitative organizational factors in the research.

Overall, the optimal combination depends on the specifics of each flow: F3–F4–F5 are dominant in fiscal B2B, F5 is the absolute leader in B2C, and for internal or recurring processes, F3 and F5 offer the best ratio between automation and stability. For occasional invoices, F4 ensures the highest level of security, complemented by the flexibility of F5. Thus, organizations can build an adaptive invoicing architecture, selecting the optimal format depending on the security, automation and traceability requirements of each type of document.

#### 4. CONCLUSIONS

The research is positioned at the intersection of emerging technologies (Blockchain, AI, hybrid solutions) and the digitalization of financial processes (e-invoice, EDI, automation). This positioning reflects current directions in the specialized literature and contributes to the consolidation of the field. The digitalization of invoice processes and the evolution of data management technologies have led to the development of rigorous comparative evaluation models. The integrated model for the analysis of management and invoice technologies, based on measurable indicators, Python simulations and validated multi-criteria methods, represents a significant contribution to the field of knowledge. Measurement and validation systems determined by Python simulations and AI modules have a special scientific value in research. This stage is consistent with modern directions, according to which deep learning techniques allow the automatic extraction of information from complex documents (Goodfellow et al., 2016). The correlation matrices used are essential for understanding the interdependencies between indicators and for substantiating multi-criteria decisions. Recent trends highlight the need to combine AI with smart contracts and blockchain technologies to increase decision-making accuracy. The research aligns with these directions by using AI simulations to generate

indicators. The paper brings scientific value by integrating AI simulations, advanced visualizations and multi-criteria analysis into a unified framework, new to the current literature.

The results of this research allow organizations to select the optimal technology, personalize the decision, reduce risks and optimize costs. This aspect is essential in the context in which the standardization of electronic invoicing aims at interoperability and cost reduction (European Commission, 2020). The Python program used can be reused, extended with new indicators, connected to real data or transformed into a web application, providing a scalable and adaptable tool.

The research represents a solid contribution both scientifically and practically in which a broad evaluation framework is designed, with modern integrated methods. These served to develop complex analyses with modern software tools. The paper aligns with the specialized literature and brings original elements relevant to the digitalization of financial processes, providing a replicable and adaptable model for organizations that want to adopt modern billing technologies.

## REFERENCES

- Androniceanu, A. (2024). Generative artificial intelligence, present and perspectives in public administration. *Administrație și Management Public*, 43, 105–119. <https://doi.org/10.24818/amp/2024.43-06>
- Androniceanu, M. (2025a). Efficiency and prediction in human resource management using Python modules. *Theoretical and Empirical Researches in Urban Management*, 20(1):88–103.
- Androniceanu, M. (2025b). Strategic management model for robotic automation of document processes using UiPath platform. *Theoretical and Empirical Researches in Urban Management*, 20(2):104 – 117.
- Boillat, T., & Legner, C. (2013). From on-premise software to cloud services: The impact on business models. *Journal of Theoretical and Applied Electronic Commerce Research*, 8(3), 39–58.
- Bunget, O. C., & Lungu, C. (2023). *Inteligența artificială și profesia contabilă*. Editura ASE. Bucharest, Editura ASE. Retrieved from here <https://editura.ase.ro>, accessed on 8 October 2025.
- Buterin, V. (2014). A next-generation smart contract and decentralized application platform. *Ethereum White Paper*. Retrieved from here: <https://ethereum.org>, accessed on 12 November 2025.
- Christidis, K., & Devetsikiotis, M. (2016). Blockchains and smart contracts for the Internet of Things. *IEEE Access*, 4:2292–2303. <https://doi.org/10.1109/ACCESS.2016.2566339>
- Chui, M., Manyika, J., & Miremadi, M. (2018). What AI can and can't do (yet) for your business. McKinsey Global Institute. Retrieved from here: <https://www.mckinsey.com>, accessed on 5 November 2025
- Crosby, M., Pattanayak, P., Verma, S., & Kalyanaraman, V. (2016). Blockchain technology: Beyond Bitcoin. *Applied Innovation Review*, 2, 6–19.
- Dobre, A., & Mihăilescu, M. (2022). Aplicarea tehnicilor de inteligență artificială în procesarea facturilor. *Revista Contabilitate și Informatică de Gestiune*, 12(2), 45–56.
- Dospinescu, O., & Scarlat, E. (2021). Provocările integrării blockchain în contabilitate. *Revista de Contabilitate și Informatică de Gestiune*, 11(1), 15–28.
- Dragomirescu, O.-A., Crăciun, P.-C., & Bologa, A. R. (2025). Enhancing invoice processing automation through the integration of DevOps methodologies and machine learning. *Systems*, 13(2), 87. <https://doi.org/10.3390/systems13020087>
- Elmasri, R., & Navathe, S. (2016). *Fundamentals of database systems* (7th ed.). Pearson. Retrieved from <https://www.pearson.com>, accessed on 27 November 2025.
- Enache, A., & Bălan, M. (2021). Analiza costului total de proprietate în soluțiile SaaS. *Revista Română de Informatică și Automatică*, 31(4), 55–66.
- European Commission. (2020). European standard on eInvoicing (EN 16931). Retrieved from <https://op.europa.eu>, accessed on 3 December 2025.

- Figura, M. & Vevere, V. (2025). Business transformation in Slovak companies shaped by digital technology adoption, sustainability orientation and strategic resilience. *Journal of Business Sectors*, 3(2), 80-92. <https://doi.org/10.62222/GJOF3962>
- Gartner. (2019). Total cost of ownership for cloud vs. on-premises solutions. Gartner Research. Retrieved from <https://www.gartner.com>, accessed on 6 December 2025.
- Ghanooni Shishavan, V., Elahi, S., Dorri Nagoorani, S., & Yazdian Varjani, A. (2024). Blockchain-Based Value-Added Tax System: A Systematic Review. *Financial Research Journal*, 26(2), 226-247.
- Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep learning. MIT Press. Online version. Retrieved from <https://freecomputerbooks.com/Deep-Learning-by-Ian-Goodfellow.html>, accessed on 6 December 2025.
- Halevy, A., Rajaraman, A., & Ordille, J. (2006). Data integration: The teenage years. *VLDB Journal*, 15(2), 143–169. <https://doi.org/10.1007/s00778-006-0005-8>
- Iancu, A., & Pavel, D. (2022). Impactul inteligenței artificiale asupra proceselor contabile în IMM-urile din România. *Management & Marketing Journal*, 20(1), 112–125.
- Laourou, A. B. F. (2025). Evaluating the use of blockchain technology in enhancing transparency and security in supply chain management. *World Journal of Information and Management Technology*, 9(5), 225–244.
- LeCun, Y., Bengio, Y., & Hinton, G. E. (2015). *Deep learning*. *Nature*, 521(7553), 436–444.
- Luu, L., Chu, D. H., Olickel, H., Saxena, P., & Hobor, A. (2016). Making smart contracts smarter. In Proceedings of the 2016 ACM SIGSAC Conference on Computer and Communications Security (CCS '16) (pp. 254–269). ACM.
- Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system. Retrieved from here <https://bitcoin.org/bitcoin.pdf>, accessed on 7 December 2025.
- OECD. (2022). *Tax administration 2022: Digital transformation of tax administrations*. OECD Publishing. Retrieved from here <https://doi.org/10.1787/0e2fd7f2-en>, accessed in 19 November 2025.
- Popescu, L., & Stoica, A. (2021). Implementarea sistemului RO e-Factura: Provocări și oportunități. *Fiscalitate și Digitalizare*, 3(2), 41–52.
- Popescu, M., & Ionescu, D. (2024). Comparative evaluation of invoice systems using hybrid architectures. *Romanian Journal of Information Systems*, 18(1), 77–94.
- Raza, H., Kovacs, S., & Khan, M. H. (2025). Profitability and SDG 13-Climate Action: The Moderating Role of Environmental Management Training: A Machine Learning Approach. *Journal of Business Sectors*, 3(1), 1–12. <https://doi.org/10.62222/BVCH4721>
- Remeikienė, R., Gasparėnienė, L., & Česiulytė, J. (2025). Work Organization and Social Responsibility on Digital Platforms: Challenges and Best Practices in Europe. *Journal of Business Sectors*, 3(1), 25–40. <https://doi.org/10.62222/TDGY8465>
- Russell, S., & Norvig, P. (2020). *Artificial intelligence: A modern approach* (4th ed.), Ne York, Pearson. Retrieved from here <https://www.pearson.com>, accessed on 15 November 2025.
- Rusu, V., & Petrescu, M. (2023). Sisteme hibride pentru gestiunea documentelor fiscale: Blockchain și baze de date. *Journal of Digital Economy*, 5(1), 77–89.
- Shi, J., & Wang, Y. (2025). Academic exploration of blockchain and AI in financial services. *Journal of Electronic Business & Digital Economics*, 4(2), 270-282. <https://doi.org/10.1108/JEBDE-08-2024-0023>
- Tapscott, D., & Tapscott, A. (2017). *Blockchain revolution: How the technology behind Bitcoin is changing money, business, and the world*. Penguin. Retrieved from here <https://www.penguin.com>, accessed on 21 September 2025.

- Tănase, G., & Radu, M. (2020). Blockchain și auditabilitatea tranzacțiilor financiare. *Audit Financiar*, 18(4), 23–34.
- Unteanu, A., & Ionescu, C. (2022). Integrarea inteligenței artificiale în sistemele ERP. *Informatica Economică*, 26(3), 34–47.
- Vesolovska, M., Karkovska, V., and Duma, O. (2025). Artificial intelligence in public administration: how the emotional intelligence of civil servants influences its effective implementation. *Administratie si Management Public*, 45, 27-45. <https://doi.org/10.24818/amp/2025.45-02>
- Xu, X., Weber, I., & Staples, M. (2019). *Architecture for blockchain applications*. Springer.
- Yermack, D. (2017). Corporate governance and blockchains. *Review of Finance*, 21(1), 7–31. <https://doi.org/10.1093/rof/rfw074>
- Zhang, X., & Lu, S. (2023). *Application research of electronic invoice system based on blockchain technology*. In *6GN for Future Wireless Networks* (pp. 320–324). Springer. Retrieved from here: <https://link.springer.com>, accessed on 18 December 2025.
- Zhang, Y., & Wen, J. (2023). Blockchain and AI integration for invoice management in public sector. *Journal of Digital Governance*, 12(3), 45–62.