Exploring the Boundaries of Formal Specifications of Accounting Language and Understanding of Intelligent Systems

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ABSTRACT With the rapid development of the digital economy and artificial intelligence, the formalization of accounting language has become a crucial factor in promoting intelligent accounting for textile enterprises, enabling more precise financial tracking of raw material costs and textile manufacturing overheads. This paper systematically studies the formalization of accounting language and explores the inherent limitations and practical challenges faced by intelligent systems in understanding accounting language. The inherent ambiguity of accounting language, the complexity of professional judgment, and the differences in cross-cultural contexts hinder intelligent systems from understanding it. Based on the specific characteristics of accounting practices in traditional manufacturing industries such as textiles, this paper proposes establishing a multi-layered formalization system, a rule- and data-driven hybrid intelligent model, and a human-machine collaborative understanding mechanism to improve the understanding of accounting language by intelligent systems, thereby promoting the transformation and upgrading of accounting informatization towards intelligent accounting.

INDEX TERMS accounting language, formal specifications, intelligent systems, boundaries of understanding, textile industry

I. INTRODUCTION

ACCOUNTING language serves as a specialized symbolic system for transmitting economic information, playing a fundamental role in managing textile enterprise operations and making strategic decisions regarding fiber procurement and high-end fabric production costs. With the continuous application of artificial intelligence technology, intelligent accounting systems have evolved from simple data processing to complex semantic understanding. However, accounting language inherently possesses professionalism, flexibility, and context-dependent characteristics, which imposes many limitations on intelligent systems' understanding of accounting semantics. Formal specifications serve as a bridge between natural language and machine language, transforming accounting concepts, rules, and logic into computable formal expressions, providing a foundation for intelligent systems to understand. However, the formalization process itself has its limits of expressive power and cannot fully encompass the complex situations and judgments in accounting practice. Therefore, systematically exploring the value of formal accounting language specifications and the boundaries of intelligent systems has significant theoretical value for developing textile-specific intelligent accounting capable of accurately interpreting the complex cost structures of technical textile engineering and smart garment production.

II. THE THEORETICAL SIGNIFICANCE AND PRACTICAL VALUE OF FORMALIZED ACCOUNTING LANGUAGE SPECIFICATIONS

A. ENHANCING ACCOUNTING INFORMATION VIA SYMBOLIC AND CONNECTIONIST INTEGRATION

Formal accounting language specifications establish a unified accounting language syntax and semantics, transforming traditional textual accounting information into structured data. Important accounting concepts such as accounting elements, accounting subjects, and accounting vouchers have been formalized and defined, providing structural clarity to the ambiguity and uncertainty inherent in natural language expression without oversimplifying the underlying professional nuances. Formal specifications provide a computable basis for machine processing of accounting information, making it feasible to automatically collect, classify, summarize, and analyze large volumes of accounting data [1]. At the same time, standardized forms can promote data exchange and interoperability among different

accounting systems, reduce information silos, improve the flow efficiency and use value of accounting information, and lay a solid foundation for the development of accounting informatization to a higher level [2].

B. FACILITATING SEMANTIC RECOGNITION AND DIGITAL TRANSFORMATION

Formalization makes implicit knowledge explicit, allowing intelligent systems to move beyond simple data processing to understanding economic substance. This transition shifts the accounting function from retrospective recording to proactive strategic support. By providing a technical interface for data integration, formalized specifications foster a complete digital ecosystem, enhancing market competitiveness [3]. Formal specifications make implicit accounting knowledge explicit and systematize scattered accounting rules, so that intelligent systems can process structured accounting data and make progress in understanding the economic substance reflected behind accounting information. The professional level of intelligent accounting systems will be improved, decision support capabilities will be enhanced, and ultimately accounting work will be transformed from accounting type to management type [4].

C. PROMOTING THE INTELLIGENT TRANSFORMATION AND DIGITAL DEVELOPMENT OF ACCOUNTING

Formalized accounting language is the technical foundation of accounting intelligence and a necessary prerequisite for accounting intelligence. After formalization, the core contents such as accounting business processes, accounting processing logic, and accounting supervision rules can be encoded into intelligent algorithms, enabling intelligent systems to automatically complete accounting tasks. This can not only greatly improve the efficiency of accounting work and reduce labor costs, but also free up the time and energy of accounting personnel, allowing them to have enough time to conduct more valuable strategic analysis and decision support work [5]. The formalization requirement shifts the accounting function from past accounting to pre-prediction and in-process control, thereby making accounting and business more closely integrated. Formalized specifications provide a technical interface for the integration of accounting data and other business data, which is conducive to promoting the creation of a complete digital system for enterprises and improving the level of digital management and market competitiveness of enterprises [6].

III. BOUNDARIES AND CHALLENGES OF INTELLIGENT SYSTEMS UNDERSTANDING ACCOUNTING LANGUAGE

A. THE CONTRADICTION BETWEEN LANGUAGE AMBIGUITY AND SYSTEM DETERMINISM

Accounting language is often vague and flexible in practice. Many accounting concepts, accounting policy choices, and accounting estimates have a certain degree of interpretation and flexibility. Accounting practice is complex and diverse, and has a certain degree of ambiguity, which is also the premise for accounting professionals to make a difference. However, the basis for the operation of intelligent systems is deterministic logical rules and precise mathematical models, which require a clear relationship between input and output [7]. The inherent flexibility and semantic richness of accounting language exist in tension with the deterministic nature of intelligent systems. Although formalization mitigates surface-level linguistic confusion, it cannot entirely encompass the 'substantive ambiguity' required for professional judgment. Consequently, the contradiction lies not in the failure of formalization itself, but in the functional gap between rigid formal specifications and the fluid, context-dependent interpretation of accounting standards. For accounting terms with unclear meanings, accounting standard clauses with multiple possible interpretations, and accounting treatment choices that require comprehensive consideration, intelligent systems find it difficult to understand and make reasonable judgments as flexibly as accounting professionals. Therefore, they often fall into a situation where they cannot handle or handle incorrectly. This highlights that formalization should not aim to eradicate the inherent ambiguity that defines professional value, but rather to map its boundaries so that intelligent systems can identify when human intervention is required [8].

TABLE 1. Comparison of the fuzziness of accounting language and the determinism of intelligent systems

Dimension	Accounting language features	Intelligent system requirements
Conceptual definition	There are multiple interpretations, and flexibility and adaptability coexist.	Requires structured mapping of interpretative ranges while preserving the space for professional discretion.
Processing rules	Context-dependent, requiring comprehensive consideration and judgment.	Deterministic logic rules have explicit input-output correspondence.
Application methods	Flexible adjustments based on actual situations; professional judgment is primary.	Based on a fixed algorithm and a mathematical model.
Contradictory manifestations	Intelligent systems struggle with ambiguity and lack professional flexibility.	Requires systems to recognize the limits of formal logic and trigger human-machine collaboration.

B. THE COMPLEXITY OF ACCOUNTING PROFESSIONAL JUDGMENT TRANSCENDS FORMAL EXPRESSION

One of the core values of accounting work is professional judgment ability. Accountants need to comprehensively consider various factors such as the business environment, business substance, accounting standards requirements, industry practices, and regulatory policies to make appropriate accounting decisions on complex economic matters. The judgment process requires qualitative information understanding, uncertainty evaluation, risk-return trade-off, and long-term impact prediction, and is highly context-dependent and subjective. The subjective nature of professional judgment is difficult to express with specific rules and is also difficult to fully capture through formal language, as it requires context-

aware evaluation rather than just resolving linguistic ambiguity [7]. Intelligent systems can process a large amount of structured data and execute pre-set calculation and classification tasks, but when encountering professional judgment scenarios that require in-depth understanding, comprehensive analysis, and creative thinking, their capabilities are inherently limited. Formal specifications cannot encompass all judgment scenarios and decision-making logic, which sets capability boundaries for intelligent systems to deal with complex accounting problems [8].

TABLE 2. Elements of Accounting Professional Judgment and Capability Boundaries of Intelligent Systems

Judgment factors	Complex features	Limitations of intelligent systems
Business environment	Multi-dimensional information integration, dynamic changes, and uncertainties.	Difficulty in processing unstructured qualitative information and weak comprehension ability.
Business substance	Identifying deeper economic implications goes beyond superficial judgments.	Lack of substantive understanding; relies on formal features.
Risk assessment	Risk-return comprehensive trade-off and long-term impact prediction analysis.	Predictive models have significant limitations and cannot cope with unexpected situations.
Criterion application	Creative and flexible application of context-dependent judgment.	Lack of creative thinking makes it difficult to conduct comprehensive analysis and judgment.

C. CONSTRAINTS OF CROSS-CULTURAL ACCOUNTING CONTEXT ON INTELLIGENT UNDERSTANDING

The meaning and application of accounting language are influenced by specific cultural backgrounds, legal systems, and economic environments. There are significant differences in accounting standards, accounting practices, and accounting terminology between different countries and regions. The meaning and extension of the same accounting concept are different in different contexts, and the handling of the same economic event is also different in different accounting systems [9]. This makes it extremely difficult for intelligent systems to understand accounting language. Intelligent systems need to understand the literal meaning of accounting language, as well as the cultural meaning, institutional logic, and social recognition behind it. However, formalized regulations are always formed based on a certain accounting system and cultural background, and it is difficult to fully reflect the characteristics and richness of cross-cultural aspects. When intelligent systems are used in multinational corporations, international transactions, and diversified businesses, their understanding ability will be greatly limited, and they are prone to misunderstandings and misjudgments, thereby affecting the accuracy and reliability of accounting information [10].

TABLE 3. Cross-cultural accounting context differences and constraints on intelligent system understanding

Difference dimensions	Cross-cultural performance	Understanding constraints
Accounting standards	Different accounting systems have different standards and handle the same matter differently.	Specifications are difficult to express uniformly and are difficult to understand across systems.
Accounting terminology	Differences in the connotation and denotation of the same concept and cultural background influence semantic understanding.	Inaccurate semantic mapping can easily lead to misunderstandings and misjudgments.
Industry practice	Regional characteristics lead to diverse approaches, while the underlying institutional logic differs fundamentally.	Lack of situational adaptability and incomplete formal coverage.
Application scenarios	Complex situations of multinational corporations and diversified international transactions.	Severely limited comprehension skills affect the accuracy and reliability of information.

IV. PATHWAYS TO ENHANCE THE ACCOUNTING LANGUAGE COMPREHENSION CAPABILITIES OF INTELLIGENT SYSTEMS

To address the three boundaries faced by intelligent systems in understanding accounting language, this paper proposes a systematic extension path framework. As shown in Figure 1.

A. CONSTRUCTING A MULTI-LEVEL FORMAL SPECIFICATION SYSTEM FOR ACCOUNTING LANGUAGE

To expand the accounting language understanding capabilities of intelligent systems, it is necessary to first establish a more complete hierarchical formal specification system. This system should include three aspects: grammatical layer, semantic layer, and pragmatic layer. From a grammatical perspective, a unified accounting language formal grammar should be established to provide intelligent systems with basic language recognition capabilities. This layer is designed to resolve structural ambiguity, allowing the system to accurately parse information, while leaving the resolution of complex, subjective ambiguity to the higher pragmatic layers and human-machine collaborative mechanisms. From a semantic perspective, an accounting domain ontology library should be created to systematically sort out the classification system, hierarchical relationship, and attribute characteristics of accounting concepts. However, recognizing the "frame problem" in AI, these semantic association networks must be designed as dynamic structures rather than static repositories. While they provide a foundation for understanding the deep meaning of accounting terms, the system must also incorporate mechanisms to identify which contextual frame is active as business environments shift, ensuring that the relationships between accounting elements remain relevant under changing economic conditions [11]. From a pragmatic perspective, the accounting language usage rules of different business scenarios and different industry fields should be formalized. To mitigate

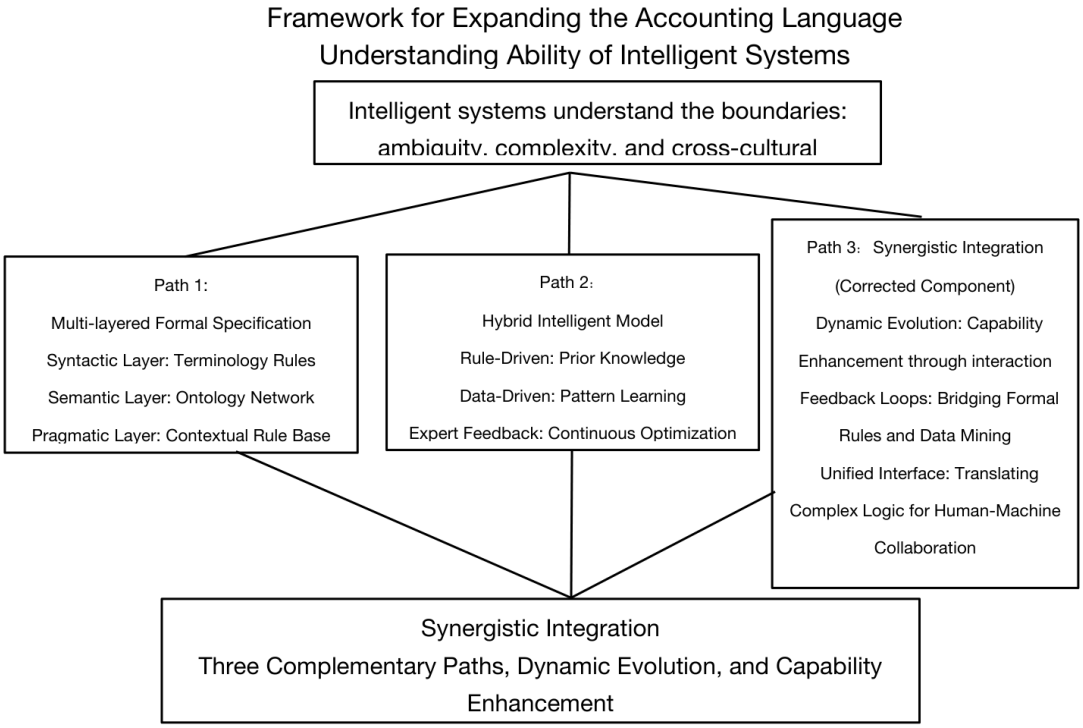

FIGURE 1. Framework diagram of the path to expand the accounting language understanding ability of intelligent systems

the risk of rigid rule-application in shifting environments, this executable rule library must be paired with an environmental monitoring layer. This layer assists the system in determining the boundaries of its current "frame" of knowledge, allowing it to recognize when a novel business shift—such as a sudden change in regulatory policy or market volatility—requires a re-evaluation of which formal rules are applicable. The multi-level specification system should have good scalability and flexibility, and can be dynamically adjusted and improved according to changes in accounting standards and updates in business models. At the same time, attention should be paid to the coordination and consistency between different levels, so that there are no conflicts or contradictions between grammatical rules, semantic definitions and pragmatic norms, so as to provide a unified and comprehensive accounting language understanding foundation for intelligent systems [12].

B. HYBRID INTELLIGENT MODEL INTEGRATING RULE-DRIVEN AND DATA-DRIVEN APPROACHES

The formal methods driven by rules alone cannot cope with the ambiguity and complexity of accounting language, while the purely data-driven methods lack a deep understanding of accounting professional knowledge. Therefore, a hybrid intelligent model that integrates rule-driven and data-driven approaches should be developed. This model treats the accounting professional knowledge contained in the formal specifications as prior knowledge, giving the intelligent system a basic understanding framework and logical constraints, thereby ensuring that the system output meets the requirements of accounting standards and professional standards. Furthermore, it uses machine learning technology to automatically mine implicit accounting patterns. This data-driven approach is critical for addressing the frame problem, as it allows the system to detect shifts in real-world business logic that static ontologies might miss. By identifying emerging patterns in accounting texts, the hybrid model can adjust its contextual understanding in real-time, bridging the gap between rigid formal specifications and the fluid reality of dynamic business environments [13]. To ensure logical consistency, the model employs a hierarchical reconciliation mechanism: if a conflict arises between a mined pattern and 'prior knowledge' (rigid accounting standards), the formal specifications act as a hard constraint to override the data-driven output. The hybrid model can handle situations not covered by formal rules, learn from the patterns of accounting personnel's judgment in historical data, and improve the ability to handle ambiguity by treating data-driven insights as supplementary interpretations within the boundaries of established standards. Traditional manufacturing industries such as textiles fall within the scope of hybrid model applications. By combining the unique accounting practices of the manufacturing industry with the existing accounting practice experience of enterprises, the intelligent system's understanding of the special business of the manufacturing industry can be improved. In addition, the hybrid model should set up a human expert feedback loop, incorporate the correction opinions and evaluation results of accountants into the model's continuous learning process, prompt the model to continuously improve and

enhance its own capabilities, and thus shape an intelligent system architecture in which rules, data and human wisdom complement each other and develop dynamically [14].

C. ESTABLISHING A HUMAN-MACHINE COLLABORATIVE ACCOUNTING LANGUAGE UNDERSTANDING MECHANISM

The boundaries of accounting language understood by intelligent systems should not be insurmountable walls, but rather springboards for establishing human-machine collaboration mechanisms. These mechanisms acknowledge the respective strengths and weaknesses of both intelligent systems and accountants, achieving complementary advantages and integrated capabilities through reasonable division of labor and effective interaction. Intelligent systems handle standardized, repetitive, and large-scale accounting language processing, leveraging their speed, processing power, and tireless nature to complete basic tasks such as data collection, classification, accounting, and reporting. Accountants primarily handle complex decision-making tasks requiring professional judgment and creative thinking. To move beyond a simple burden-shifting model, the intelligent system acts as a "judgment-support engine" rather than a passive reporter. Instead of merely requesting guidance when stuck, the system performs a preliminary "judgment simulation" by identifying conflicting standards, sourcing relevant historical precedents, and calculating the risk-weighting of various accounting treatments. By presenting these structured evidence-based recommendations, the system demonstrates an "augmented understanding" of the professional context, allowing the accountant to act as a high-level validator rather than a primary data processor. This ensures that the interaction is a value-added synthesis where the machine's large-scale analytical capabilities directly reduce the cognitive load of the human's professional judgment. The human-machine collaboration mechanism should also include the interpretability design of the intelligent system to ensure that accountants can understand the reasoning process of the intelligent system, improve their trust and acceptance of the output results of the intelligent system, and ultimately form a new model of accounting work that deeply integrates human and machine intelligence and promotes each other [15]. The task division and interaction process of human-machine collaboration is shown in Figure 2.

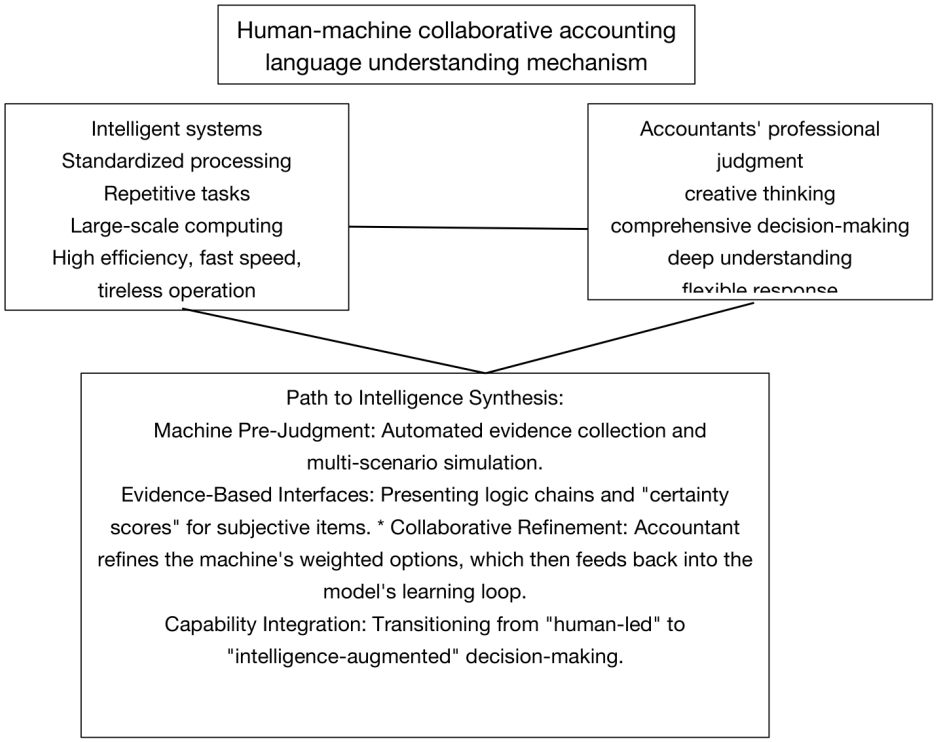

FIGURE 2. Human-machine collaborative accounting language understanding mechanism

V. CONCLUSION

Formalized specifications of accounting language provide the technological conditions for intelligent systems to accurately interpret textile production data and financial information related to advanced weaving and dyeing processes. However, intelligent systems still encounter fundamental challenges in understanding accounting language, such as ambiguity, complex judgments, and cross-cultural differences. Overcoming these limitations requires a comprehensive approach, considering aspects such as building a multi-layered specification system, developing hybrid intelligent models, and creating human-machine collaboration mechanisms. Future research should explore ways to express the deeper meaning of accounting language, develop intelligent learning algorithms that adapt to dynamic environments, and improve the design of human-machine collaborative

interaction mechanisms. This will promote the development of intelligent accounting to a higher stage and provide strong support for the digital transformation of textile enterprises seeking high-quality development through automated weaving management and smart garment manufacturing analytics.

AUTHOR CONTRIBUTIONS

Yuanyuan He designed, collected and analyzed the data, and drafted the manuscript. Yuanyuan He conducted the study, critically revised the manuscript for important intellectual content, and gave final approval of the version to be published. Yuanyuan He participated fully in the work, take public responsibility for appropriate portions of the content, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICTS OF INTEREST

The author declares no conflict of interest.

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REFERENCES

[1] Y. Wang, "Research on the Application of Enterprise Management Accounting in the Age of Intelligent Accounting," 2021 2nd International Conference on Computers, Information Processing and Advanced Education; 25–27 May 2021; ON, Ottawa, Canada. New York, NY, USA: ACM; 2021. pp. 1531–1534, doi: 10.1145/3456887.3459715.

[2] H. Qu, "Design of enterprise intelligent accounting system structure and intelligent accounting algorithm," in Chen E, editor. Proceedings of SPIE, 16-18 December 2022, Wuhan, CN. Bellingham, WA, USA: SPIE, 2023, doi: 10.1117/12.2670299.

[3] Q. Liu, "Enterprise intelligent accounting system structure and intelligent accounting method," 2022; 1(3):141-147, doi: 10.56028/aetr.3.1.141.

[4] S. Marques, R. Gonalves, R. L. D. Costa, L. F. Pereira, and A. L. Dias, "The Impact of Intelligent Systems on Management Accounting," International Journal of Intelligent Information Technologies (IJIIT), vol. 19, no. 19, pp. 1-32, 2023, doi: 10.4018/IJIIT.324601.

[5] H. T. Nguyen and N. T. Nguyen, "The Influence of Regulations of the Ministry of Finance, Requirements from Related Parties, and the Application of IFRS in Teaching on the Quality of Accounting and Auditing Teaching Staff in Vietnam," Education Quarterly Reviews, vol. 5, no. 1, pp. 449-461, 2022, doi: 10.31014/aior.1993.05.01.454.

[6] M. A. Khan, "Contextual Considerations of Audit Technology Acceptance, Accounting Regulations, Administrative Influences, and Organizational Efficiency: A Novel I-TOE Adoption Formulation," Pakistan Journal of Life & Social Sciences, vol. 23, no. 1, pp. 4563-4582, 2025, doi: 10.57239/PJLSS-2025-23.1.00361.

[7] C. M. Boland, D. R. Hermanson, J. L. Higgs, K. W. Prewett, J. S. Pyzoha, and A. C. Tegeler, "Additional Comments of the American Accounting Association Auditing Section Auditing Standards Committee on the PCAOB's Amendments to PCAOB Auditing Standards Related to a Company's Noncompliance with Laws and Regulations and Other Related Amendments," Current Issues in Auditing, vol. 18, no. 2, pp. C4–C10, 2024, doi: 10.2308/CIIA-2024-012.

[8] N. Zdemir and H. Ulusan, "A Study on the Assessment of the Conversion Process of Financial Statements Prepared According to Different Accounting Regulations," Cumhuriyet University Journal of Economics & Administrative Sciences / Cumhuriyet Üniversitesi İktisadi ve İdari Bilimler Dergisi, vol. 23, no. 3, pp. 690-708, 2022, doi: 10.37880/cumuiibf.1088658.

[9] I. Dionisijev and I. Perica, "Legal and Accounting Considerations for Non-Profit Organizations: A Comparative Study of Macedonian and Croatian Regulations," Proceedings of the international conference "Economic and Business Trends Shaping the Future," 9–10 November 2023; Skoplje, Sjeverna Makedonija. Skoplje, Sjeverna Makedonija: Faculty of Economics-Skopje, Ss. Cyril and Methodius University; 2023. pp. 9–23, doi: 10.47063/ebtsf.2023.0001.

[10] A. Al-Hadi and A. Habib, "Consequences of state-level regulations in accounting, finance, and corporate governance: A review," Advances in Accounting, vol. 60, Art. no. 100630, 2023, doi: 10.1016/j.adiac.2022.100630.

[11] A. Pandey, A. Tripathi, and K. Guhathakurta, "The impact of banking regulations and accounting standards on estimating discretionary loan loss provisions," Finance Research Letters, vol. 41, Art. no. 102068, 2021, doi: 10.1016/j.frl.2021.102068.

[12] G. M. Aevoae, "The Influence of Accounting and Auditing Regulations on Decisions Regarding External Growth Strategies in Romanian Industry," Audit Financiar, vol. 20, no. 167, pp. 471-483, 2022, doi: 10.20869/auditf/2022/167/015.

[13] M. A. Ibrahim and A. D. Gbadebo, "ACCOUNTING REGULATIONS AND STANDARDS: THE DEVELOPMENT AND BENEFITS OF IFRS IN NIGERIA," International Journal of Social & Educational Innovation, vol. 11, no. 22, pp. 216-232, 2024, doi: 10.5281/zenodo.14673440.

[14] A. M. Egledi and B. M. Straoanu, "Cryptocurrency (Virtual Coins): Accounting Aspects and Tax Regulations," LUMEN Proceedings, vol. 17, pp. 650-657, 2022, doi: 10.18662/wlc2021/64.

[15] A. Arya, B. Mittendorf, and D. H. Yoon, "The Impact of Uniform Pricing Regulations on Incentives to Generate and Disclose Accounting Information," Management Science, vol. 67, no. 3, pp. 1975-1992, 2021, doi: 10.1287/mnsc.2019.3503.