EFFICIENCY ASSESSMENT AND OPTIMIZATION OF ACCOUNTING SYSTEMS: A COMPREHENSIVE INTERVAL ANALYSIS APPROACH

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ABSTRACT

This article delves into the challenges surrounding the efficacy of accounting systems as the cornerstone for generating management information. It establishes that the functionality of management systems hinges on the tools employed for researching, processing, storing, and disseminating information. The enhancement of information utilization gauges the level of effectiveness of an accounting system by streamlining information flows between informing and informed systems. Pertinent information catalyses the efficient functioning of enterprises as production systems. Consequently, the efficacy of the process is contingent upon the efficiency of the accounting system. A fundamental prerequisite for shaping the concept of information within accounting systems for organizational management is its efficiency, wherein productivity is amplified by the value it yields. The article suggests employing interval analysis methods to evaluate an accounting system's efficiency, considering users' perceptions.

INTRODUCTION

Generating pertinent information within accounting systems is crucial in facilitating effective managerial decision-making processes. Relevant information narrows the spectrum of viable solutions and pinpoints significant factors impacting the economic framework. Accounting Information Systems (AIS) are crafted to gather, store, and furnish decision-makers with pertinent and dependable information. Decision-makers across diverse organizational contexts assess this information. AIS data matrices are increasingly expected to encompass nontraditional, nonfinancial, and relatively unfamiliar metrics [1]. The information landscape, tailored to diminish uncertainty, is forged based on insights into the internal and external business environment. Probabilistic uncertainty is interpreted through a widely accepted model known as Shannon entropy. Entropy within the accounting system may stem from neglecting managers' informational needs, diminishing the system's capacity to adapt to environmental shifts. Such entropy curtails the self-organization level of the accounting system and its efficiency in inter-element relationships. However, entropy escalation disrupts the equilibrium of the accounting system, detrimentally impacting the quality of its generated information and potentially leading to system breakdown [2]. Establishing the business information landscape entails creating, processing, and managing extensive financial and non-financial data arrays, entailing significant financial investments and information process management costs. It is necessary to ascertain the relevance of information derived from the accounting system and the efficacy of its utilization. By leveraging

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cost indicators, we can gauge the efficiency of the accounting system and model its optimal parameters. Our study aims to evaluate the cost incurred in generating information within the accounting system and pinpoint factors influencing the information system's costs.

PRESENTATION OF THE CONDUCTED RESEARCH

Quality within the accounting system represents a burgeoning field of inquiry, fostering the advancement of scientific thought and formulating theories and hypotheses regarding the theoretical underpinnings and practical implementation of quality and efficiency concepts within accounting systems. Hegel posited that quality is synonymous with existence, whereby the essence of an object diminishes if its quality is compromised. This implies that the attributes of any object must possess a degree of identification. We conceptualize accounting quality as the capacity to generate pertinent information concerning an enterprise's internal and external environment. Understanding quality within accounting necessitates recognizing that the accounting system of an enterprise exists solely within its economic activities, with accounting serving as a means to acquire information for managing said activities. In essence, accounting furnishes insights into the enterprise's internal (entity activities and outcomes) and external environment, intertwining the concept of accounting quality with information as a product of the accounting system. We view the accounting system as an information system leveraging digital technologies to generate extensive arrays of financial and non-financial information for businesses, shaping an information landscape commensurate with the enterprise's scope. Modelling information field indicators enables the creation of information flows utilized to optimize business processes and ensure their effective organization. Information transmission in generating information is facilitated through channels employing matrix formalism and clear calculation algorithms. Current modelling approaches, quantifying, analyzing information flows, and optimizing them within accounting systems, considering cost factors, are predominantly limited to double-entry methods. Hence, we transcend double-entry methods by interpreting accounting information through interdisciplinary research and information theory lenses. Grounded in the concept of efficiency as the capacity to yield effects relative to the costs incurred in achieving said effects, we posit that the cost of the accounting system should be lower than the costs/losses incurred by the enterprise in its absence. However, such a metric fails to characterize information in terms of its utilization efficiency, necessitating a specific system of metrics. Information efficiency, characterized by the effect derived from its utilization, encompasses economic, technical, social, and other effects. We perceive information efficiency as the cumulative impact of information activities and utilization, considering information activities through managerial decisions. In this context, the effectiveness of the information infrastructure is pivotal in contributing to goal attainment. According to cybernetics theory, control of complex systems hinges on an information unit framework, whereby any complex system comprises a controlled and controlling subsystem. Complex system management relies on a closed information cycle, transforming initial indicators into controlling interactions and receiving feedback. Information possesses quantitative and qualitative characteristics, enabling the determination of measurement units, volume, complexity, and technical means employed in documentation processes. Qualitative features of information dictate requirements for its creation, categorized by accounting objects, structure, activity coverage,

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management system functions, and user requirements. Calculating information value facilitates the determination of accounting action costs, enabling the prioritization of tools and techniques based on information value assessment. Information holds value for management, evidenced by its ability to reduce uncertainty, influence economic behaviour, and, under certain conditions, possess market value. Reducing entropy (uncertainty) facilitates informed and successful managerial decision-making. The positive economic effects of information are reduced to three main components: streamlining information communication, information utilization in management, and enhancing accounting system process efficiency, resulting in resource savings and prevention of economic losses. Economic evaluation of accounting effectiveness depends on users' information needs and functional objectives. The choice of evaluation criteria is dictated by evaluation objectives, with cost-effectiveness assessment prioritized for determining optimal service technological modes and information system implementation tools. The positive role of information creation by users is pivotal in evaluating the priority of different information services. The impact of information utilization in managerial decision-making is crucial for assessing accounting activity outcomes and directly satisfying users' information needs. In a post-industrial society, assessing "new values" entails reevaluating the object's essence and adapting traditional value systems to modern socio-economic conditions. As a form of utility, value differs from cost, representing the ability to obtain information through cognitive processes and human creative capabilities. Ikujiro Nonaka's theory underscores self-organization (information creation), self-renewal, self-learning, and enterprise adaptability. Evaluation and performance criteria vary based on management style. They must account for accounting process efficiency, method and tool feasibility, information flow composition and completeness, and alignment of accounting information with management requests. The General Evaluability Theory (GET) posits those three characteristics—attribute nature, knowledge about the attribute, and attribute presentation mode—should be considered in evaluating attributes' ease of assessment, facilitating effective decision-making. Defining information cost in terms of its impact on economic and enterprise-specific processes, delineating numerical units of information, and determining their value enables the formation of a relevant set of economic information best describing specific economic processes, entities, or phenomena. Approaches to estimating information value can be categorized based on expressing value through the economic effects of information used in business management. However, this interpretation may be outdated, given the ubiquitous integration of IT products in enterprise operations. Economic information value can also be expressed through the economic consequences of information acknowledgement or neglect. Disregarding information exacerbates uncertainty in managerial decisions, resulting in economic losses. The expected value of information (EVI) equals the reduction in uncertainty following accounting and analysis of relevant information:

$$EVI = EOL1 - EOL2, \quad (1)$$

EOL1 – Uncertainty (the probability of making incorrect decisions) without considering the evaluated information, multiplied by the cost of error (equivalent loss); EOL2 – Uncertainty based on information at the price of a mistake. If the classification of methods for evaluating economic information is based on uncertainty, i.e., the impact of disregarding important information, then

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three classes or approaches are defined [9]. In system analysis, the concept of completeness (model) is employed, signifying the degree to which a particular data set about a real object, process, or phenomenon is accurately reproduced (described). It is said that 20% of the information about the object, which can be taken into account, reproduces the object by 80%, whereas the remaining 80% of the data reproduces the object by 20%. Therefore, a crucial consideration when processing economic information is determining the quantity of information that would yield maximum impact on the financial process for effective management.
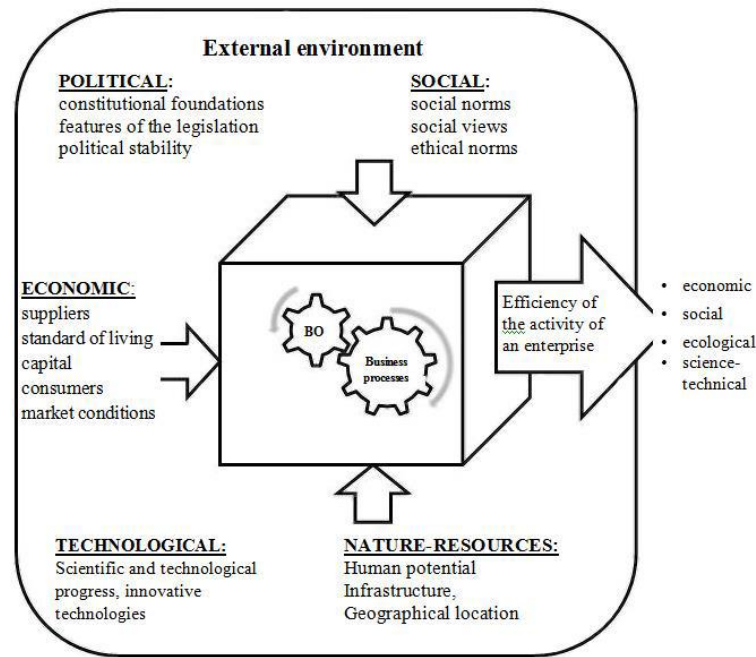

Fig. 1. The influence of environmental factors on information efficiency

Mathematical modelling is one approach to generating crucial data or factors when describing a process or economic entity using mathematical units, where the arguments are quantitative values of financial information, and the resulting indicator reflects the desired effect on the entity. This approach relies on vast amounts of information, necessitating significant costs for measuring and processing such data. Thus, the question arises of using methods to estimate the cost of economic information to ascertain precisely which information needs to be measured and stored to exert the desired impact on the entity or subject of economic activity. Stochastic and statistical methods have various drawbacks; for instance, they require extensive historical data volumes for application, which must be estimated. For example, Fig. 2 illustrates the relationship between the expected cost of information and its volume in an asymptotic estimate that closely approximates the actual price.
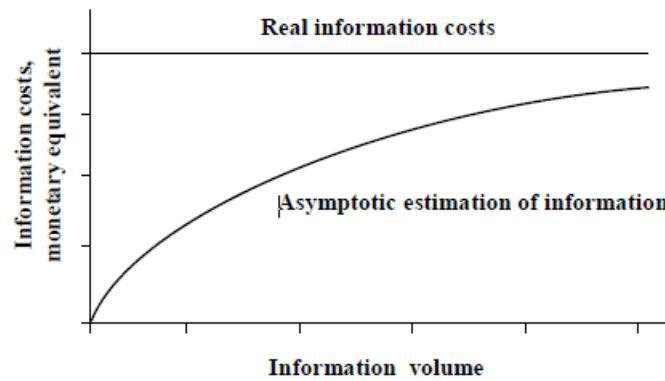
Fig. 2. Dependence of information evaluation on the volume of its processing

As depicted in Figure 2, a substantial volume of information is required to obtain an accurate information assessment (where the degree of uncertainty should be at most 10%). This necessitates reporting on details with a high sampling rate or over a long activity period, which may only sometimes be feasible for rapid decision-making.

Studies indicate that the most valuable information for most projects is only sometimes taken into account, resulting in the reversal of information value (Fig. 3). Consequently, forming a large sample for such indicators becomes time-consuming.

Another drawback of these methods is their reliance on the statistical characteristics of data samples, particularly on the distribution law, which necessitates additional study costs because the asymptotic estimate may depend on the data distribution. Interval analysis methods can be used to circumvent these shortcomings. This approach does not necessitate studying statistical characteristics and can provide an adequate asymptotic estimate of information costs for small data volumes.

Another fundamental advantage of interval data analysis methods is their ability to estimate information with a certain level of uncertainty. We can specify the desired estimate when we can ascertain the information costs within a value interval. These advantages facilitate the widespread use of interval data analysis methods for information assessment. The results and application methods of the interval approach are described in articles [11,13].

Since the cost of information is equivalent to the cost of measurement, calculating the cost of measuring information about the business's external environment and strategic information, which cannot be continuously monitored, becomes a crucial issue in organizing such information systems. Identifying parameters unique to each enterprise (business) and developing indicators that furnish relevant information for decision-making are necessary. Based on accounting and analysis of these indicators, conclusions can be drawn regarding the business's state or potential effects.
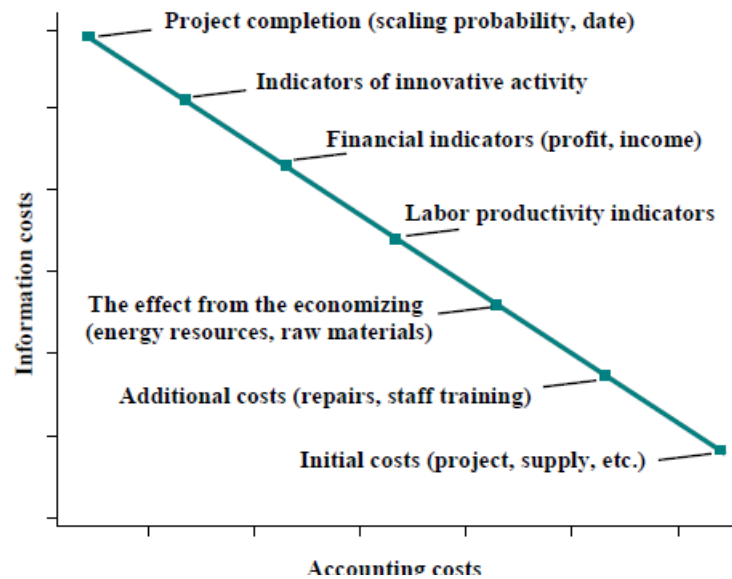
Fig. 3. Inversion of the information costs and its accounting

Significant variations in information creation costs concerning these indicators necessitate capturing the required information sets through measurement costs. Traditional methods of information assessment, aimed at reducing uncertainty, utilize all available information, incurring substantial expenses for monitoring, recording, accounting, and storage. The quality assessment system encompasses monitoring the accounting system, determining its effectiveness based on specific company characteristics, providing different information and analytical blocks for analysis, and developing quality assessment methods, among others. The outcome of monitoring is identifying the system's strengths and weaknesses and offering recommendations for optimization and quality improvement.

CONCLUSIONS

All economic processes exist objectively, yet their perception is subjective. Even high-quality information cannot guarantee the formation of an accurate business perception in the subject's mind. Considering its value for management, the use of accounting information must be constrained by users' perception of this information. The information domain of the organizational management system can only be flawless if certain parts are perfect, and users are entirely proficient. Assessing the functional components of the information system (management, financial, and strategic accounting sub-systems) determines its information capabilities level for management needs. Business leaders can decide to enhance existing information systems or create a fundamentally new information management concept based on the assessment results.

The proposed information estimation method determined that the most valuable indicators in terms of information are those that reduce uncertainty on average over accounting periods. The proposed approach yields a maximum error reflecting a 9.4% uncertainty degree, while the standard method based on regression analysis results in a 12.8% uncertainty. Thus, the proposed approach allows

for determining the value of economic information and forming relevant data series to ensure decision-making with minimal uncertainty. Consequently, the amount of information to be accounted for and stored is reduced without significantly losing value. Hence, the cost of information creation and information resource formation should be meticulously studied in accounting theory, given the importance of such resources, their strategic nature, and their pivotal role in today's business environment, focusing on long-term perspectives. Information resources are innovative in content and function, comprising intangible assets that constitute the company's value and competitiveness. Their versatility enables efficient utilization of all other enterprise resources to enhance management, conserve and boost resource productivity, and achieve optimal production levels.

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