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ORIGINAL RESEARCH ARTICLE

Presenting the Management Accounting Model in the Digital Era with a Data-Oriented Approach in Vensim System

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ABSTRACT

The research aims to provide a management accounting model in the digital age with a data-oriented approach in Vensim system. It was applied research and qualitative with the approach of grounded theory. The methodological approach was followed by using different methods of data collection, such as the method of library study and review of sources and specialized texts, as well as semi-structured interviews. Based on targeted sampling, 20 managers and shareholders of the stock exchange and financial management experts were interviewed in 2023. The conducted interviews were coded in ATLAS.TI software. In order to confirm the results obtained based on three classifications, the data were evaluated and qualitatively analyzed. Based on the system dynamics method, mathematical modeling of the codes obtained from the qualitative analysis has been done. The analysis is based on simulated data and improved model in Vensim software. The findings of the research were identified separately in five categories: causal, background, intervention, strategy and consequences. A model was identified in 6 categories, 16 core codes based on 109 coders. Causal conditions (advancement of science and technology, changes in business conditions and management conditions), strategies (education, infrastructure, targeting of financial reporting and policy making), consequences (optimization of decision making, business prosperity and economic productivity), Background conditions (economic and political environment and accounting situation). and intervening conditions (negligence and neglect, cultural and social conditions, access to resources and environmental conditions) are designed. In the digital era, access to large and high-quality data has enabled more accurate analyses. **©authors**.

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1. Introduction

Management accountants use data analysis to create value, which can be through increased efficiency, improved profitability and cash flow, as well as through customer management, innovation and intellectual property. All this data is not only about focusing on new opportunities that can be targeted, but also about internal drivers of value (Mennati et al., 2022). Examples of activities where management accountants can use data analysis (depending on the size and scope of the organization) can be inventory management, production planning, error rate, quality assurance, procurement, market segmentation, price optimization, resource management, etc. Wadan et al., 2020).

Management accounting is a data-driven method, based on existing data, it analyzes the situation and identifies the knowledge deficiencies of the organization (Salman Zadeh et al., 2022). In recent decades, companies and business units have faced increasing competition in the business environment, which has determined the role of data analysis. In competitive conditions, the importance of information and correct and timely decision-making plays a fundamental role in the success or failure of businesses (Posadzi ´nska et al., 2022). In this situation, management accounting can play an effective role in the decisions made in economic enterprises by creating effective knowledge and providing a wide range of relevant and timely information (Mehrbanpour, Ghorbani and Jandaghiqomi, 2016; Sule et al., 2019). The main goal of management accounting is to play a better role in the management process of the organization through collecting, processing and transferring information and creating practical knowledge (Hilton, 1999).

In the digital age where new information and communication technologies have widely penetrated all aspects of life and business, management accounting as one of the most important tools in the decision-making process and management of financial and operational resources of organizations has faced new challenges. Alao, 2014).

To respond to these challenges, new models and approaches have emerged in the field of management accounting, but due to the rapid development of digital technologies (Baiyere et al., 2020) and the emergence of concepts such as "data-centricity", the requirements for the development of newer models in management accounting Especially in the field of data-driven, it is felt (Huang et al., 2022).

Management accounting professionals, who have advanced data mining skills and the ability to create predictive algorithms, try to create a competitive advantage for the organization based on management accounting techniques (Van Dijck, 2014). This is a very specialized field and it is critical to determine the inputs and outputs required by the organization based on the management accounting process. Management accountants are in an ideal position to determine the data needs to support an organization because they have a comprehensive view of the organization and its existing information systems (Tajvidi et al., 2020). Determining what areas an organization should monitor is determined based on the organization's data analysis from the perspective of management accounting professionals (Bhimani, 2020).

The main goal of this research is to provide a conceptual and practical model for using existing data in organizations in order to improve the decision-making process and provide accurate and timely management information (Collins et al., 2021). To achieve the desired goal, first by reviewing the relevant literature, the concepts of management accounting and data-oriented in the digital age will be analyzed and analyzed (Matt et al., 2015). Then, by examining case studies and interviewing experts in the field, a management accounting model with a data-oriented approach is developed. This model should include methods and processes for extracting, analyzing and using data to provide solid management information (Vărzaru, 2022).

The management accounting model in the digital age is a conceptual and practical model designed for the use of data and

digital technologies in the decision-making process and management of financial and operational resources of organizations. This model is based on the principles of traditional management accounting, but by focusing on the exploitation of data-driven information and data analysis processes, it helps organizations to make better and more accurate decisions about the management of their resources. The management accounting model in the digital era is based on the following concepts and principles:

Data collection: The data-driven management accounting model is based on collecting all the data in the organization and storing it in a common repository. It includes financial and non-financial data collected from internal and external sources of the organization (Chang et al., 2023).

Data analysis: In this model, data analysis techniques and methods are used to identify patterns, relationships and inspirations in the data. Data analysis can include various methods such as information extraction, data mining, predictive analysis and modeling (Mikalef et al., 2022).

Presentation of management information: using data and analysis results, accurate and timely management information is prepared and presented. This information can include financial reports, dashboards, charts, and various analyzes that help managers make strategic and operational decisions (Bao et al., 2023).

Performance improvement: By using the data-driven management accounting model, organizations can improve their performance and make significant improvements in various areas, including financial planning, cost control, process optimization, and communication with customers (Schildt, 2022).

Data security: Due to the importance of maintaining data security, the accounting model uses data-oriented management in order to protect data and prevent unauthorized access. Security methods and technologies used in this model include encryption, protective information systems and access control (Goldstein et al., 2023).

The management accounting model in the digital era enables organizations to take advantage of digital data and technologies and make better and more accurate decisions about managing their resources and operations. This model improves the performance of organizations in the digital age and provides the possibility of providing accurate and timely management information.

This research and presentation of the management accounting model with a data-oriented approach can have significant effects on the performance of organizations in the digital age. By providing a data organization process and using data management technologies, decisions will be more accurate, documented and optimized. Also, providing timely and accurate management information to managers can be effective in the process of strategic and operational decisions of organizations (Skog et al., 2018).

Considering the challenges in management accounting in the digital age and new requirements, providing a management accounting model with a data-oriented approach can help improve the decision-making process and provide more accurate and timely management information.

This model can have significant effects on the performance of organizations in the digital age, considering the use of data in organizations and data management technologies. Therefore, this research seeks answers to the following questions:

What are the causal factors of the evolution of management accounting in the digital era?

What are the underlying factors of the transformation model of management accounting in the digital era?

What are the intervening factors of the model of transformation of management accounting in the digital era?

What is the identification of management accounting transformation model strategies in the digital age?

Identifying the consequences of the transformation model of management accounting in the digital age?

What is the transformation model of management accounting in the digital age?

2. Literature Review

Management Accounting

Management accounting is the process of identifying, measuring, collecting, analyzing, preparing, sharing and communicating with financial information that is used by management in planning, evaluating and controlling internal operations that is used today to guide companies and achieve them. The problem of management accounting is basically the study of a process and is not limited to learning a set of methods. The need for information is often the driving force behind management accounting (Melnyk et al., 2020).

Management accounting information often serves the two main purposes of facilitating decision-making and influencing decision-making, and by providing useful information, it helps decision-makers to choose the best solution among solutions. Most management accounting tasks, such as budgeting, product pricing, performance measurement, and reward system design, require multiple and specific decisions by management accountants. Examining the reasons for the success of large companies shows the importance of having a suitable management accounting system to achieve organizational goals, this system helps managers in producing low-cost and high-quality products by providing the necessary information (Zhen et al., 2024).

The importance of data and its analysis in management accounting

Data and its analysis are very important in management accounting. Below are some of the importance of using data and its analysis in management accounting (Solimanian et al., 2023):

1. *Better decision making*: Using data and analysis in management accounting helps managers to make better decisions. By collecting and analyzing data, managers will be able to identify different patterns and trends and based on them make more successful decisions about budgeting, investment, productivity and organizational strategies (Sun, 2023).

2. *Forecasting and planning*: By analyzing data and using analytical methods, management accounting can provide more accurate and reliable forecasts about the financial and operational performance of the organization. These forecasts help managers to plan better and pay attention to the future state of the organization in their decisions.

3. *Performance control:* management accounting, using data and its analysis, provides the possibility of more accurate control of the organization's performance. By monitoring the organization's financial, operational and functional information, managers can identify defects and weaknesses and apply the necessary improvements. Also, it allows managers to compare and evaluate the performance of different units and departments (Ojra et al., 2021).

4. *Resource efficiency*: By using data and analysis, management accounting can improve resource efficiency. By carefully analyzing the data, managers can identify potential loss and waste patterns and take actions to improve performance and reduce resource wastage. This improves the performance of the organization and increases profitability (Qiu et al., 2023).

5. *Increasing competitive power*: Using data and analysis in management accounting helps the organization to increase its competitive power. By examining and analyzing competitors, the market and industry trends, the organization can develop appropriate strategies to maintain and improve its position in the market (Takhtai et al., 2023).

In the digital era, management accounting is increasingly becoming data-oriented, relying heavily on advanced technologies such as big data, artificial intelligence (AI), and machine learning to enhance decision-making processes. A data-oriented approach in management accounting involves collecting, analyzing, and interpreting vast amounts of data from various business operations to optimize financial performance and strategic planning. The data-oriented management accounting model integrates real-time financial and non-financial data, offering dynamic insights into cost management, performance metrics, and resource allocation. Key elements include predictive analytics for forecasting trends, data visualization for clear communication of

financial insights, and automation of routine accounting tasks, allowing accountants to focus on more strategic activities. The model aligns with business intelligence systems, fostering agile decision-making in response to rapidly changing market conditions.

The Vensim model can be applied to this accounting framework to simulate complex, dynamic relationships among variables. Vensim is a tool used for system dynamics modeling, helping accountants visualize feedback loops, delays, and causal relationships between financial data, resource inputs, and business outcomes. For instance, it can model the impact of changes in pricing, production costs, or capital investment on profitability over time. By simulating different scenarios, management can assess potential risks and make more informed decisions. This combined approach empowers businesses to transform their financial management processes, making them more responsive to data-driven insights. It enhances transparency, accuracy, and strategic alignment within organizations, ultimately improving performance in the competitive landscape of the digital economy. The integration of Vensim modeling also supports long-term planning and optimization in financial strategies, crucial for sustaining success in the fast-evolving digital landscape.

Therefore, data and its analysis are very important in management accounting and help organizations to use accurate and up-to-date information for management decisions and improve their performance.

3. Method

This research was done based on the exploratory model and qualitatively and quantitatively. In this research, the methodological approach was followed by using different methods of data collection, such as the method of library study and review of sources and specialized texts, as well as semi-structured interviews. Data angle, which means controlling the compatibility of different data sources, in the same method, was also noticed by researchers in this research and more than one data source was used. Its potential participants were all managers and shareholders of the stock exchange and financial management experts in 2023.

The sampling method was purposeful and people were selected. This group was selected to conduct the qualitative part of the research and participated in the interview process. To determine the samples of this research and to determine this group of experts, the purposeful sampling method was used.

In this research, the main sources of data were interviews, so that the initial interviews were exploratory and descriptive, and gradually, after each interview, the data obtained from the interviews were coded, and through the method of constant data comparison, theoretical codes emerged through open coding.

In the same way, the coding of 22 interviews was done and concepts and sub- and main classes emerged; It should be noted that the concentration and saturation of the core classes was done based on theoretical sampling, so that by conducting interviews with the statistical population, the research continued until the concepts of that category were condensed and enriched, for example, with the first 8 interviews that were conducted, the category of type of change was condensed.

In other categories such as results and consequences, the data was not enough, so the interviews were continued based on theoretical sampling to saturate the desired category. It should be noted that theoretical sampling for the interviews was not based on the number of interviewees, but based on their role in condensing the categories. Until the 22nd interview, the interviews reached theoretical saturation. The duration of the interview was between 30 and 50 minutes.

Grounded theory was used to analyze qualitative research data in ATLAS TI software. In this plan, the steps of analyzing the collected qualitative data were done in three stages: open coding, central coding, and selective coding. Interviews were conducted based on the following questions from the selected people in the qualitative sample:

1. How are management accounting processes in the digital age different from previous times?

2. What are the challenges in adapting management accounting to the digital environment?

3. How have digital technologies such as artificial intelligence and data analysis brought changes in management accounting?

4. How can the use of numerical data-based tools help to improve strategic decisions in the field of management accounting?

5. How can technology be used to improve efficiency and reduce errors in management accounting processes?

6. What is the impact on the skills and requirements of management accounting managers who are familiar with digital information and related technologies?

7. How can we ensure data security and privacy in the digital environment in management accounting?

8. How can management accounting processes be improved using digital information?

9. How to manage the differences and expectations between different generations of employees regarding technology and digitalization of management accounting processes?

10. What is the role of cooperation between different departments of the organization in the optimal use of digital technologies in management accounting?

Based on the system dynamics method, mathematical modeling of the codes obtained from the qualitative analysis has been done. The analysis is based on simulated data and improved model in Vensim software. System dynamics method has been used to design the model of causal relationships of the dynamic model.

System dynamics is an approach to understand the nonlinear behavior of complex systems over time using feedback loops. This method was introduced in 1961 by Jay Forrester in the book Industrial Dynamics and spread rapidly. To design a dynamic system, first of all, the variables of the model must be identified. A closed boundary refers to a range that clearly separates the variables of a dynamic problem from unrelated variables. Each closed boundary has feedback loops that affect each other. For the effects of the mentioned rings, the behavior is desired. Each feedback loop is actually the cornerstone of the desired system structure. This theory is presented against the traditional view that considered the flow of influence between phenomena to be one-way. The dynamics of systems is caused by feedback loops. Therefore, the modeler should try to make the cause and effect chain into a cause and effect loop. The continuity of system dynamics requires the existence of cause and effect loops. Vensim software has been used to design the system dynamics model.

4. Findings

The statistical description of the characteristics of the field participants is presented in Table 1.

Table 1. *Demographic characteristics of the interviewees*

No.	Education level	field of study	Work experience (years)
1	MA.	Financial management	22
2	MA.	Financial management	16
3	MA.	Financial management	20
4	MA.	Financial management	28
5	MA.	Financial management	25
6	MA.	Financial management	29
7	Ph.D.	Financial management	30
8	Ph.D. Student	Financial management	26
9	MA.	Financial management	12
10	Ph.D.	Accounting	25
11	Ph.D.	Accounting	25
12	Ph.D.	Accounting	27
13	Ph.D.	Accounting	10
14	Ph.D.	Accounting	21
15	Ph.D.	Accounting	23

In order to open coding, all interviews were entered in Atlasti software. Necessary checks were done and desired codes were extracted.

The labeling of the codes has been done based on the interviews and the researcher has tried to adhere to the insight of the respondents as much as necessary in order to avoid any possible and unwanted bias as much as possible. In the entire process of coding, the researcher has adhered to the theoretical sensitivity which is one of the principles of data theory research and has done this to enrich the research as much as possible. Table 2 shows an example of the coding of the conducted interviews.

Table 2. *Coded interviews*

Related interviews	Initial code
Increasing data accumulation in digital environments such as cloud computing increases the sensitivity about cyber security.	Increasing cyber security challenges
The need to provide and maintain the security of data and financial information against cyber-attacks and unwanted intrusions is very important.	Business intelligence
The use of artificial intelligence technologies and data analysis in management accounting creates a significant improvement in the organization's strategic and operational decisions.	Use of cloud computing
These technologies can help recognize patterns, predict events, and improve decision-making processes.	Software development and intelligent accounting

In the following, based on the dimensions of the data model of the Strauss and Corbin

Foundation (1998), the classification of identification codes is specified in Tables 3 to 7.

Table 3. *Coding of qualitative returns (causal conditions)*

Axial code	Secondary Code	Initial Code
Causal Conditions	Advancement of Science and Technology	Increasing Cybersecurity Challenges
		Business Intelligence
		Use of Cloud Computing
		Software Development and Intelligent Accounting
		Developing Technology-Based Accounting Skills
		The Rapid Pace of Technological Change
	Changes in Business Conditions	Diversity of Stakeholder Expectations
		Changing the Balance of Labor
		Business Complexity
		Changing Business Structures and Models
		Globalization of Business
		Customer Orientation
		Convergence of Accounting and Business
	Management Conditions	Management's Attitude Toward the Application of Management Accounting
		Management Knowledge in the Field of Management Accounting
		Management Support for New Management Accounting Procedures
		Flexibility of Managers
		Collaborative Decision-Making Among Managers

Table 4. *Open coding of qualitative data (strategic conditions)*

Axial code	Secondary code	Initial Code
Causal Conditions	Education	The Relationship Between Industry and Universities in the Field of Management Accounting
		Enhancing the Integration of Management Accounting Concepts into Course Topics
		Increasing the Number of Academic Professionals
		Increasing the Number of Professional Associations
	Infrastructure	Easy Access to Resources, Including Hardware, Software, Internet Connectivity, and Knowledge.
		Providing adequate facilities and budget for management accounting.
		Adapting Business Processes to the Management Accounting Structure
		Establishing a Support Unit and Overseeing Management Accounting in Business
		Incentive System to Encourage Greater Participation in Management Accounting
		Creation of Inclusive Databases
		Infrastructure Investment for the Development of Management Accounting Education in Business
		The Importance of a Strong Management Accounting Culture
	Targeting Financial Reporting	Transparency of Information
		Enhancing the Quality of Financial Information
		Enhancing the Speed and Accuracy of Financial Reports
		Reconciliation of Information and Performance (Documentation)
		Timely Provision of Information
		Enhance the Diversity of Reporting.
	Policy Making	Security and Legal Regulations in Management Accounting Systems
		Approval of Short-Term and Long-Term Strategies
		Adapting the Organization's Strategy and Resources.
		Developing a Monitoring and Evaluation System

Table 5. *Open coding of qualitative data (Consequences)*

Axial code	Secondary code	Initial Code
Consequences	Optimizing decision making	Organizational Data Alignment
		The Process of Enhancing Business Performance Through the Benefits of Management Accounting
	Business prosperity	Creating a Competitive Advantage
		Business Innovation
		Synchronization with Global Standards
		The Foundation of the Digital Economy
		Foundations of the Knowledge Economy
		Keeping Up with Global Changes
		Customer Orientation Based on International Standards
		Establishing International Competition
		International Standardization
		International Business Models
	Economic productivity	Economic Growth of the Country
		Reducing the country's costs
		Enhance Sustainable Income
		Combination of Traditional and Modern Systems
		Identification of Global Markets
		Global Customer Focus
		Service Optimization

		Improving Accounting Processes
		Reducing the Unemployment Rate
		Increasing the Growth of the Accounting Profession Based on Sustainable Development Indicators
		Enhance the business environment.
		Empowering Accountants

Table 6. *Coding of qualitative returns (Contextual Conditions)*

Axial code	**Secondary code**	**Initial Code**
Contextual Conditions	Economic and political environment	Economic Recession
		Exercising Control Over the Auditing Profession
		Lack of Economic Transparency
		Iran's Economic Sanctions
		Scattered Efforts in the Knowledge Economy
	Accounting Status	Financial and Accounting Regulations
		Internal Environment of Accountants
		Implementation Conditions for Accounting Techniques
		International Accounting Standards
		Personalization
		Accounting Structure
		Relationships Among Accountants
		Accounting Levels
		Accounting Flexibility
		Accounting
		The Role of Accounting in Society
		Accounting Update
		Hierarchy in Accounting
		The Balance Between Privacy and Publicity
		The Reputation of Accountants

Table 7. *Coding of qualitative returns (Intervening Conditions)*

Axial code	Secondary code	Initial Code
Intervening Conditions	Negligence	Managers' Indifference to the Accounting Situation
		Negligence in the Implementation of Management Accounting Mechanisms
		The Importance of Recognizing the Necessity of Management Accounting
		Indifference to Changes and Developments in Accounting Worldwide
		Not Attempting to Adapt to the Technological World.
		Failure to Pay Attention to Cooperation in Management Accounting Matters
		Not prioritizing the primary responsibilities of management accounting and margining.
	Cultural and social conditions	The Difficult Acceptance of New Technology in the Management Community
		Lack of a Culture in the use of management accounting tools.
		Distrust of Management Accounting Tools
		The Challenge of Embracing Management Accounting Education Rooted in Traditional Thinking
		Quick and essential familiarization of managers with new management accounting tools during and after the COVID-19 pandemic.
		Lack of Proper Cultural Adaptation of Management Accounting for Managers
	Access to resources	Lack of Access to Global Resources
		Insufficient Budget to Establish Effective Management Accounting.
		Insufficient Funding
	Environmental conditions	Rapidly Changing Global Business Environments
		Competitive Pressure
		Economic and Political Sanctions as a Functional Obstacle
		Complex and Rigid Structure
		Strong Structural Focus
		Organizational Directives for Businesses
		Traditional Accounting Structure and Tax Reporting System
		Cumbersome Administrative Procedures and Documentation
		The Failure of Decision-Makers to Recognize the Benefits of Management Accounting.

Based on the system dynamics method, mathematical modeling of the codes obtained from the qualitative analysis has been done. The analysis is based on simulated data and improved model in vensim software.

Vensim, a system dynamics modeling tool, plays a crucial role in visualizing and analyzing the complex interactions between different variables in an organization. In the context of management accounting, Vensim is used to model cause-and-effect relationships, feedback loops, delays, and dynamic behavior over time, which are essential for long-term financial planning and strategic decision-making.

Causal Loop Diagrams (CLD): Vensim enables accountants to create Causal Loop

Diagrams, which illustrate how different variables, such as cost of production, sales volume, and profit margins, are interrelated. This helps organizations understand the full scope of how changes in one area of the business can impact other areas.

Scenario Analysis and Simulation: One of the most valuable aspects of Vensim is its capacity for scenario analysis. Management accountants can simulate different business scenarios—such as changes in product pricing, cost structures, or market demand—to predict their long-term impact on financial performance. This capability enhances decision-making by providing a clear visualization of potential risks and outcomes.

Feedback Loops and Delays: Vensim helps in identifying feedback loops, which are critical for understanding the cyclical nature of business dynamics. Positive feedback loops may highlight growth opportunities, while negative loops might signal issues such as increased operational costs. Delays in feedback can also be modeled, providing insights into lag times between actions taken (e.g., marketing campaigns) and their financial outcomes.

Calculating the effect of internal communication of indicators on the calculated weight

$$W = R_{ij} \times d_i$$

where W is the weight, R is the value considered for the relationship between the requirement and technical engineering requirement, d is the importance of the requirement, i is the corresponding requirement and j is the corresponding requirement.

Finally, by using the following relationship, the new values can be calculated by normalizing the R values, taking into account the internal relationship of the characteristics:

$$R''_{ij} = \frac{(\sum_{k=1}^{n} \gamma_{kj}).R_{ij}}{(\sum_{j=1}^{n}(\sum_{k=1}^{n} \gamma_{kj}).R_{ij})}$$

As a result, taking into account the above relationships, the new weights that will change based on the internal relationship of the model components can be calculated with the following relationship:

$$W''_j = \sum_{i=1}^{m} d''_i . R''_{ij}$$

Modeling

After examining the criteria raised in the qualitative section and evaluating them using experts' opinions, the criteria transferred to the model and the relationships between them are shown in Figure 1.

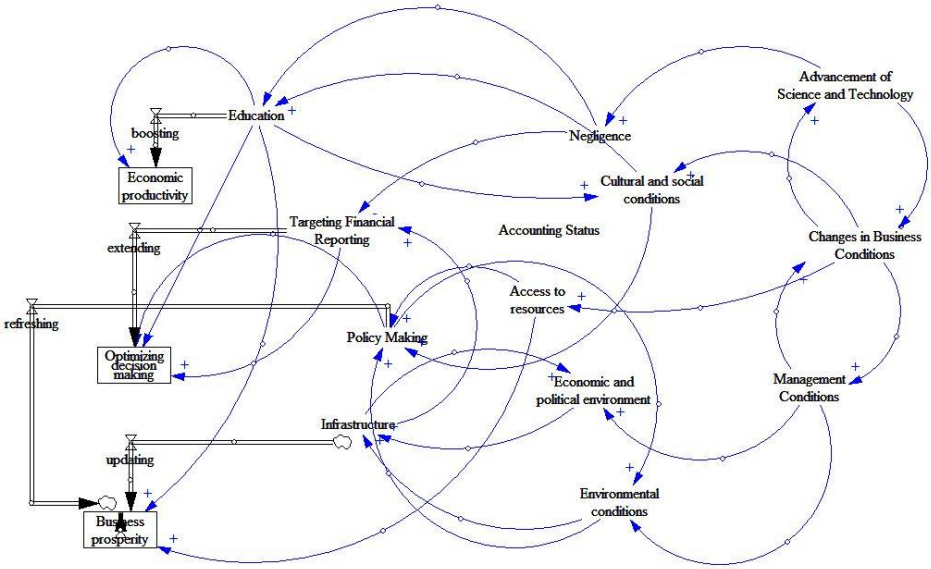

Figure 1. *The data model of the management accounting foundation in the digital era with a data-oriented approach*

Validation of the structure of the boundary adequacy test model

In the boundary adequacy test, the question must be answered whether the important concepts related to the problem within the model have been considered? In this research, the proposed model is based on the literature review and qualitative analysis, and

all the key variables of the model are built, based on the recognition of their importance in the review of the literature related to the design of the new product model based on innovative events and the company's performance.

In addition to this, the necessity and importance of all the variables mentioned in the research literature for related decisions in expert meetings with experts have also been examined, and the variables in the model are the results of the variables confirmed by the research literature and experts. To investigate this question, does the behavior of the model show a significant change after increasing or removing the boundary assumptions? The results of the presented model were examined after removing parts of the model and changing the model boundary.

Increasing the performance of education

In the impact diagram, the increase in training performance is shown. Removing this variable means ignoring it in the simulation (and not the lack of...). This case shows the necessity of considering all the variables and the relationships between them. If this variable is not included, the system shows a virtual performance increase, which is far from the real conditions.

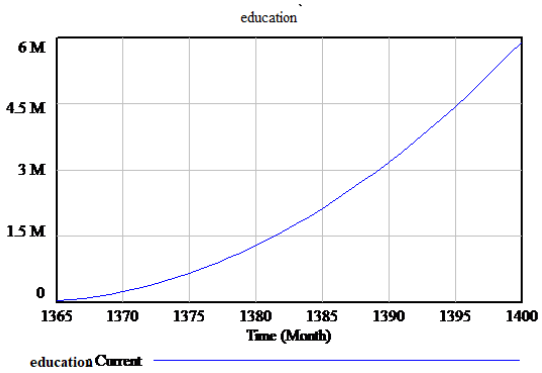

Figure 2. Increasing the performance of the education strategy

- Limit condition test

The limit condition test answers the question, does the model show appropriate behavior when its inputs are placed in limit conditions such as zero or infinity? In other words, the model must be stable even in limiting conditions; There are two ways to perform the limit condition test: firstly, all the equations used in the model are examined in the limit conditions of their variables; Second, he examined the behavior of the model in the scenarios in which the inputs of the model are in limit conditions. In the boundary adequacy test section, the state of variables in the zero state (minimum value) was checked.

Continuation of scenarios

Scenario three

-First situation: In this situation, decision optimization is at its best (blue diagram).

-Second situation: In this situation, decision optimization is at its worst (red color chart).

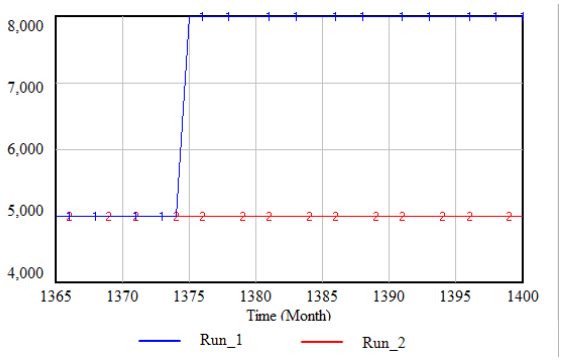

Figure 3. *The behavior of the model in the limit states of decision optimization*

Scenario four

-The third state: In this state, business prosperity is at its maximum (blue graph).

-Fourth state: In this state, business prosperity is at its minimum (red diagram).

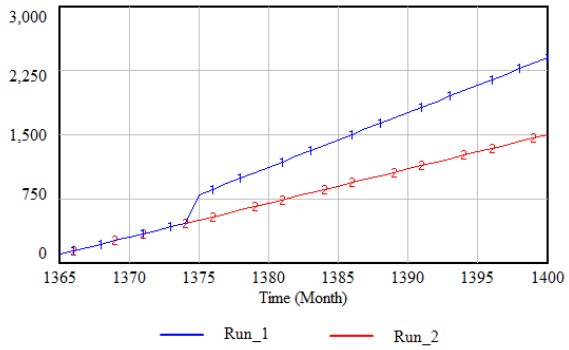

Figure 4. *The behavior of the model in the limit states of business prosperity*

- Integrity error test

This test shows the sensitivity of the results of the model to the choice of time period, which was changed from 36 months to 72 months to perform this test. As it is clear from graph 4-6 and two graphs of 36 and 72 months, no change in the behavior of the model was observed with the change in the time frame of the model, and the factors

affecting the new product model based on digitization events, if controlled, will still improve the model.

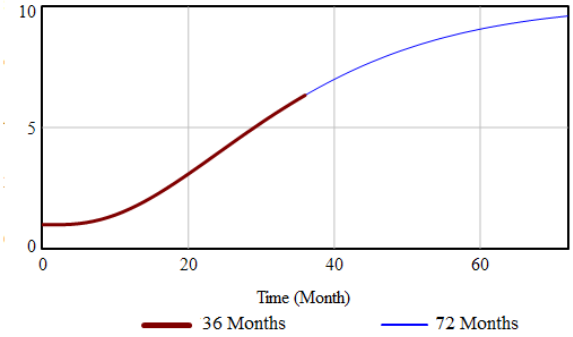

Figure 5. *Model outputs in 36 and 72 months Sensitivity analysis test*

After simulating and observing the behavior of all the components of the model in the desired period of time, changing the various variables of the model and analyzing their effect on the main variable under investigation, which is the company model, is actually tested in the previous sections. And its results were shown in different graphs with changes in boundary and non-boundary values.

5. Discussion

In this research, based on the views of the participants, the category of science and technology progress, changes in business conditions and management conditions. It has been identified and related to another broader category called causal conditions. Education, infrastructure, targeting of financial reporting and policy making were identified as strategies. The results that emerge as a result of strategies.

Consequences are the results of actions and reactions. Consequences cannot always be predicted and they are not necessarily what people intended. Consequences may be incidents and events, take a negative form, be real or implied, and occur in the present or future. It is also possible that what is considered as an outcome at one point in time may become a part of conditions and factors at another time. Optimizing decision making, business prosperity and economic productivity were identified as outcomes.

The background or context is a set of special characteristics that indicate the desired phenomenon; It means the place of events and events belonging to the phenomenon. The context indicates the set of special conditions in which action and reaction strategies take place.

The background conditions identified are: economic and political environment and accounting situation. Structural conditions that belong to a phenomenon and affect action and reaction strategies. They facilitate or constrain strategies within a particular context. The identified intervening conditions are: negligence and neglect, cultural and social conditions, access to resources and environmental conditions.

The integration of a data-oriented approach to management accounting with Vensim system dynamics is not just an enhancement but a necessary evolution in the digital age.

This model equips businesses with the tools they need to process vast amounts of data, make accurate predictions, and optimize financial performance. By utilizing Vensim, businesses can better understand the complexities of their operations, simulate potential outcomes, and navigate through a dynamic business landscape with greater confidence. The results obtained were in line with the research (Mennati et al, 2022; Bhimani, 2020; Vărzaru, 2022; Chang et al, 2023).

Ultimately, the management accounting model in the digital era is about harnessing the power of data and dynamic modeling to foster innovation, drive strategic decision-making, and maintain a competitive edge. It brings together the precision of data analysis with the foresight of system dynamics, offering a comprehensive framework for businesses to thrive in the increasingly complex and fast-paced global market.

Training is one of the most important success factors in data-driven management accounting. With the development of digital technologies and advanced data analysis tools, the need for continuing education for accountants and accounting managers has increased even more. Training related to data analysis, data mining tools, and new technologies can help improve the capabilities of employees so that they can use these tools in decision-making processes.

IT infrastructure plays a key role in the successful implementation of data-driven

management accounting. These infrastructures include advanced information systems, data analysis platforms, and secure and stable communication networks.

Without the right infrastructure, data cannot be properly collected, stored, analyzed, and interpreted, which can lead to incorrect or inadequate decisions.

Targeting in financial reporting using data helps managers determine optimal financial strategies.

Accurate and up-to-date data enables accountants to prepare comprehensive and reliable financial reports that not only show the current state of the company, but also improve financial forecasts. Specific and measurable targeting in financial reporting can help promote transparency and accuracy in financial decisions. In the digital age, policies must be based on real and reliable data. Policies that result from data analysis and accurate forecasts can mitigate risks and identify new opportunities.

Data-driven policies in management accounting allow organizations to quickly react to market changes and implement appropriate strategies. Together, these criteria make management accounting in the digital age not only improved, but also become a powerful tool for strategic and financial decisions.

6. Conclusion

In the digital era, access to large and high-quality data has enabled more accurate analyses. The accounting model of data-oriented management, using data analysis tools and artificial intelligence, has been able to significantly increase the accuracy of financial and strategic decisions. This approach provides managers with more reliable information that helps improve the performance of organizations and achieve long-term goals. The data-oriented approach in management accounting improves the transparency and accountability of organizations. With the use of digital technologies, financial information is available in an accurate and timely manner, and this allows managers to quickly react to environmental changes. Also, this model strengthens the trust of the stakeholders and improves the control and monitoring of financial operations by reducing human errors and financial frauds. The management accounting model in the digital era with a data-oriented approach enables organizations to be more flexible in the face of rapid changes and continuous innovations. With access to advanced analytics and more accurate forecasts, organizations can quickly adapt their strategies and identify new opportunities in competitive markets. This evolution in management accounting allows organizations to maintain their productivity and competitive advantage in complex and dynamic environments. In conclusion, the transformation of management accounting in the digital era, combined with system dynamics modeling using tools like Vensim, represents a significant shift from traditional accounting methods. The evolution of this field is driven by the proliferation of digital technologies, such as big data, AI, machine learning, and advanced analytics.

Management accounting affects the final decisions of business owners more than anything else. This makes this concept highly important and shows why organizations prioritize it in their work. Helping to make decisions, helping to identify and adjusting costs, helping to forecast, helping to create the growth path of the organization, etc. are among the main scientific tasks of management accounting. But on the hidden side of the story, management accounting also gave important hidden aspects that may show over time and the growth of the organization.

Strengthening strategic thinking: By providing data and in-depth analysis, management accounting helps managers to strengthen their strategic thinking and have deeper insights into the market and business opportunities.

Promote a culture of data-driven decision-making: Using management accounting helps create a culture in organizations where decisions are based on clear data and evidence, not just guesswork.

Improving coordination and cooperation within the organization: By providing relevant and useful information to different departments, management accounting helps

coordination and cooperation between departments, which leads to an increase in the overall efficiency of the organization.

Supporting innovation and product development: By providing financial information and market analyses, management accounting can contribute to the development of new products and innovative initiatives.

Effective management of resources: Identifying scarce resources and their optimal allocation is another important aspect of management accounting that indirectly affects the organization's performance.

Strengthening the ability to respond to market changes: By providing up-to-date and relevant information, management accounting helps organizations to respond quickly and effectively to market changes.

Promoting a culture of accountability and transparency: Having a strong management accounting system helps create a culture where accountability and transparency are core values.

These tools have enabled management accountants to become more data-oriented, integrating real-time financial and non-financial information to make more accurate and strategic decisions.

To improve management accounting in the digital age with a data-oriented approach, some practical suggestions can be effective:

Using data analysis software such as Power BI, Tableau, and data mining tools can help accountants analyze financial data in a more comprehensive and accurate way. These tools can identify hidden patterns in data and provide financial reports based on real data.

It is necessary to develop IT infrastructure that can store and transfer financial data securely. This infrastructure should include data management systems, cloud databases, and strong security protocols to prevent unauthorized access to sensitive data.

- Organizations should provide regular and advanced training programs for their accounting and financial staff so that they can familiarize themselves with the latest data analysis techniques and tools. These trainings should include hands-on workshops, online courses, and access to digital learning resources.

- Financial dashboards that are custom designed for the organization's specific needs can provide comprehensive views of the organization's financial performance. These dashboards should be updated real-time and provide the ability to display key performance indicators (KPIs) graphically and interactively.

- Developing and implementing financial forecasting algorithms that use historical data analysis and artificial intelligence can help accountants make more accurate predictions of the organization's financial future. These algorithms can be effective in analyzing scenarios and making strategic decisions.

Accountants should focus on turning raw financial data into information that can help decision makers. This information should be presented in such a way that it can meet management needs and help improve the performance of the organization.

- Coordination and integration of financial data with other organizational data such as operational and marketing data can provide a more comprehensive view of the overall performance of the organization. This data integration can help identify opportunities for improvement and increase efficiency across the organization.

- The implementation of blockchain technology in management accounting can help improve transparency and security in financial transactions. Blockchain can simplify the tracking of transactions and reduce the possibility of fraud.

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