DEZVOLTAREA CICLICĂ ÎN INGINERIA SOFTWARE: STRATEGII FLEXIBILE PENTRU SECURITATEA ECONOMICĂ A SISTEMELOR

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Rezumat: ***Scopul lucrării*** *este de a analiza dezvoltarea ciclică a sistemelor, evidențiind beneficiile și implicațiile în diverse domenii, inclusiv în ingineria software. Lucrarea oferă o înțelegere mai profundă a conceptului și identifică limitările asociate, furnizând informații utile pentru luarea deciziilor practice.*

Cuvinte cheie: dezvoltare ciclică a sistemului, schema-bloc, dezvoltare iterativă, proiecte software, adaptabilitate la schimbări, modelare econometrică, proiecții economice.

Originalitatea acestei lucrări constă în abordarea comprehensivă a dezvoltării ciclice a sistemelor, integrând concepte din ingineria software, economie și teoria sistemelor. Prin aplicarea modelelor și simulărilor la date reale, lucrarea aduce o perspectivă practică și originală asupra evoluției economice și a interacțiunilor dinamice din cadrul sistemelor complexe.

Importanța acestei teme rezidă în capacitatea ei de a oferi înțelegere și orientare în fața schimbărilor continue și complexității din domeniile ingineriei software și economiei. Analiza detaliată a proceselor de dezvoltare ciclică a sistemelor permite anticiparea și gestionarea eficientă a schimbărilor, contribuind astfel la luarea deciziilor informate și la adaptabilitatea într-o lume în continuă schimbare.

Metodele și tehnicile utilizate sunt adecvate pentru a analiza și rezolva un model complex care investighează evoluția economică a Republicii Moldova în 2022. Date statistice esențiale privind masa monetară, PIB-ul nominal și nivelul prețurilor au fost colectate, iar parametrii modelului au

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fost estimați folosind metode econometrice. Pe o perioadă de 10 ani, s-a simulat evoluția variabilelor modelului, iar rezultatele obținute au fost interpretate pentru a formula concluzii și perspective în contextul specific al economiei moldovenești. Această analiză detaliată contribuie la înțelegerea mai profundă a dinamicii economice și a posibilelor evoluții viitoare.

În concluzie, analiza detaliată a modelului și simularea evoluției economiei Republicii Moldova din 2022 oferă o înțelegere mai profundă a dinamicii sistemului economic și a posibilelor tendințe viitoare. Cu toate acestea, este important să abordăm rezultatele cu prudență, având în vedere limitele și simplificările modelului, precum și variabilitatea datelor utilizate. Acest lucru subliniază necesitatea unei abordări echilibrate și aprofundate în analiza și interpretarea fenomenelor economice.

CYCLIC DEVELOPMENT IN SOFTWARE ENGINEERING: FLEXIBLE STRATEGIES FOR ECONOMIC SECURITY OF SYSTEMS

Abstract: The purpose of this paper is to analyze the cyclic development of systems, highlighting the benefits and implications in various fields, including software engineering. The paper provides a deeper understanding of the concept and identifies associated limitations, providing valuable insights for practical decision-making.

The originality of this work lies in the comprehensive approach to cyclic system development, integrating concepts from software engineering, economics, and systems theory. By applying models and simulations to real data, the paper brings a practical and original perspective to economic evolution and dynamic interactions within complex systems.

The importance of this theme lies in its ability to provide understanding and guidance in the face of continuous change and complexity in the fields of software engineering and economics. Detailed analysis of cyclic system development processes allows for the anticipation and efficient management of changes, thus contributing to informed decision-making and adaptability in a constantly changing world.

The methods and techniques used are suitable for analyzing and solving a complex model that investigates the economic evolution of the Republic of Moldova in 2022. Essential statistical data on money supply,

nominal GDP, and price levels were collected, and model parameters were estimated using econometric methods. Over a period of 10 years, the evolution of model variables was simulated, and the results obtained were interpreted to formulate conclusions and perspectives in the specific context of the Moldovan economy. This detailed analysis contributes to a deeper understanding of economic dynamics and possible future developments.

In conclusion, the detailed analysis of the model and the simulation of the evolution of the economy of the Republic of Moldova in 2022 provide a deeper understanding of the dynamics of the economic system and possible future trends. However, it is important to approach the results with caution, considering the limitations and simplifications of the model, as well as the variability of the data used. This underscores the need for a balanced and thorough approach to the analysis and interpretation of economic phenomena.

Keywords: cyclic system development, block diagram, iterative development, software projects, adaptability to changes, econometric modeling, economic projections.

Introduction

In a dynamic environment such as the software industry, cyclic development represents an essential method for creating and managing information systems. This approach aims primarily at improving flexibility, adaptability, and efficiency in the software development process [1]. It takes into account the continuously changing market and user requirements, providing a robust way to quickly respond to technological advancements and customer needs.

Within this process, ensuring the economic security of information systems becomes a crucial priority. This involves prudent management of financial resources, estimating and controlling costs, as well as maximizing the added value of the software product in relation to the investment made. The flexible strategies adopted in cyclic development allow for rapid adaptation to market changes and fluctuating customer requirements, thus providing a path for maintaining economic stability in the development and operation of information systems.

Cyclic development in the software industry not only promotes innovation and system performance but also provides a solid framework for ensuring their economic security. By adopting a flexible, market-oriented

approach, organizations can maximize their efficiency and maintain competitiveness in a constantly changing technological landscape.

Materials and methods

In this study, appropriate methods and techniques were employed to analyze and solve a complex model investigating the economic evolution of the Republic of Moldova in 2022. Essential statistical data concerning money supply, nominal GDP, and price levels were collected, followed by the estimation of model parameters using econometric methods. The evolution of model variables was simulated over a period of 10 years, and the results obtained were interpreted to formulate conclusions and perspectives within the specific context of the Moldovan economy. This detailed analysis contributes to a deeper understanding of economic dynamics and potential future developments.

Results and discussion

Cyclic development of a new system in software engineering within economic security is an essential and ubiquitous concept in the industry. While traditional approaches, such as the waterfall model, focused on linear and sequential stages in development, the block diagram brings a new dimension, promoting a more flexible and adaptable method to the ever-evolving changes and requirements of software projects [2].

The block diagram, also known as iterative development or incremental development, encourages breaking down the development process into iterations or cycles. Each cycle consists of distinct stages such as planning, design, implementation, and testing, and the results obtained at the end of each cycle are evaluated and integrated into subsequent iterations. This approach allows the team to obtain rapid feedback and make adjustments as the project evolves, reducing the risk of failure and improving the quality of the final product.

By using the block diagram, developers can more efficiently manage the complexity of software projects by breaking them down into smaller and more manageable components. This facilitates collaboration among team members and allows for the identification and correction of errors at an early stage of development. Furthermore, the adaptability provided by cyclic development in economic security allows the team to better respond to changes in requirements and environmental conditions during the project [3].

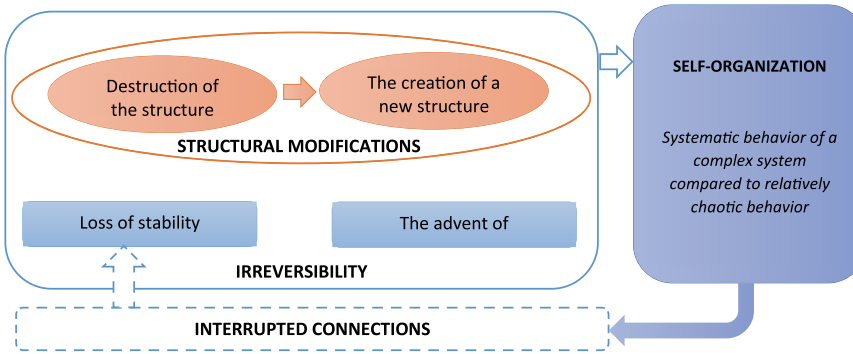


Figure 1. Block-scheme: the concept of cyclical development of a new system

Source: elaborated by authors

After analysis, the block diagram illustrating the concept of cyclical development of a new system suggests that any system undergoes constant changes, which can be both positive and negative. Positive changes can lead to system improvement, while negative changes can lead to its deterioration. It is important to note that the cyclical aspect is divided into two main parts: destruction of the existing structure and creation of a new structure.

- Destruction of the existing structure is a necessary stage for the system to evolve. During this stage, the system loses its stability, leading to a state of chaos. This occurs because the system is exposed to new influences and factors that destabilize it.
- Creation of a new structure is the stage where the system regains stability and adapts to the new conditions. During this stage, the system organizes itself in a new way, creating a more efficient and adaptable structure.

The process of cyclic development of economic security systems is a continuous process that repeats over time. This process is essential for systems to evolve and adapt to environmental changes.

The systematic behavior of a complex system compared to relatively chaotic behavior leads to complex systems being subject to deeper changes than simple systems. Complex systems are characterized by strong inter-

dependence among their elements, making them more sensitive to new changes.

In this context, the development and evolution of the system in economic security are interconnected processes, creating a new or modified system that evolves over time to adapt to its environment [4]. The block diagram provides an overview of the concept of cyclic system development and is essential for understanding how complex systems evolve and adapt to changes in the environment through a more adaptable and sustainable system [5].

Analyzing the self-organizing component of the cyclic development of the economic security system, priority areas indicate states of stability loss, structural restructuring, and stability restoration. If the existing structure does not allow for proper organization of the system, maintaining only macroeconomic stability is not sufficient to achieve the set objectives [6]. If the internal environment of the system is organized correctly, then the system adapts to the external environment and achieves the set objectives, the conditions for achieving which are determined by the external environment. The internal environment of the system must be organized in a way that changes in the external environment do not affect the invariability of the relationships between the system and its objectives. The desire to maintain invariability generates structural changes. In an economic system, the capacity for self-development should mean creating a favorable climate for investments and innovations, modernizing production, increasing the professional, educational, and cultural level of employees. This is a criterion for the stability and self-preservation of the national economy [7].

In the analysis of dynamic processes in a system to ensure security and make appropriate managerial decisions, the use of conventional signs is proposed. The formation of cyclical connections can lead to an economically self-sustaining system. Special attention is paid to the ring structures of these connections, which can act as amplifiers of unusual events. If such a structure is identified and the graphical representation is constructed, the question arises of establishing or eliminating certain connections to make the operation of the respective object more stable and durable (Figure 2). In some cases, this objective can be achieved through legislative measures, while in others, managerial and technical solutions are required.

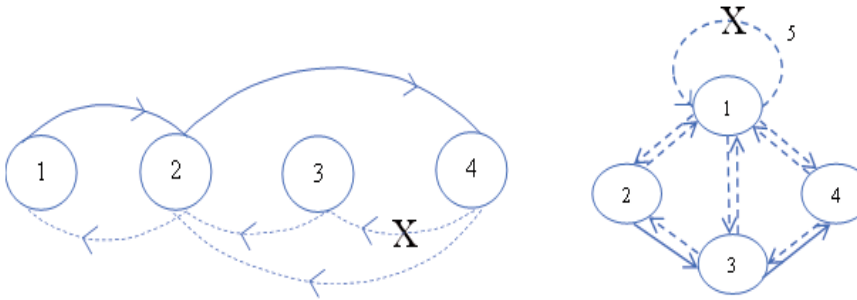


Figure 2. Ring structure models: a) in Producer Interactions and b) in Banking Systems

Source: elaborated by authors

where:

X - connections (communication relationships) subject to elimination;
- flow of goods;
- flow of money.

Analyzing the models of ring structures in different contexts: a) in the interaction between producers and intermediaries, and b) within the banking system, we can mention that in the first figure (a), the interaction between producers (1), intermediaries (2, 3), and final consumers (4) is highlighted. This circular structure can influence how goods or services are produced and distributed, potentially impacting the market and commercial relationships.

In the second figure (b), the functioning of banks is explored, with elements such as the bank as a fund accumulator (1), producers (2), commerce (3), consumers (4), and financial speculation (5). This structure presents the complex connections between various entities of the banking system, highlighting potential risks or mutual influences.

Identifying and understanding these ring structure models are crucial for making efficient decisions and properly managing interactions within complex systems. Detailed analysis of these connections can provide valuable information for establishing more robust and sustainable strategies in their respective domains.

The analysis of these models is based on the qualitative theory of differential equations and involves identifying various characteristics of the qualitative behavior of the model. Mathematically, various variables are identified, such as instability zones, turning points, possible international frictions, as well as various risk factors. Based on the analysis of such models, it is possible to forecast the system's behavior qualitatively. Developing phase models in the context of economic systems is an example of implementing the econophysics approach.

For example, we will describe a model of interaction between three types of currencies: at the global level (USD), regional (EURO), and national (MDL). The purpose of the model is to identify possible conditions for introducing a regional currency if the national currency EURO is introduced in the Republic of Moldova. The model parameters can be adjusted to some extent by the state, underscoring the importance of having a developed institutional mechanism, including relevant institutions.

Next, we will present the fundamental model of the evolution of the money supply, considering the influence of financial bubbles and it can be expressed by the following formula:

$$\frac{dm}{dt} = \frac{m}{tQ}\left[Q - (1-\delta)\frac{m}{p}\right] \quad (1)$$

where:

m – monetary aggregate in the country;

Q – volume of sales of goods and services domestically;

t – capital turnover time in the country;

δ – the level of prices in the country.

This model is developed on three levels: at the global level (USD), regional level (EURO), and national level (MDL). Additionally, we will denote supplementary parameters.

β_{ij} – the share of the country's currency *i* in circulation within the country *j*;

γ_{ij} – the exchange rate of currency *i* in relation to the country's currency *j*;

$ij = \overline{1,3}$.

In this potential system, two variables are disseminated: one defining the state corresponding to the existence of the system without a regional

currency, and the other representing the point of conflict-free coexistence of currencies at a global level.

After analyzing the model, the necessary conditions for maintaining durable monetary stability in the system have been identified. These conditions are met in the case of a certain ratio of evolutionary parameters: β_{12}, β_{23}, β_{32}, δ_1, δ_2, with the smallest recorded variable. Thus, upon the introduction of a new currency, the system of currency interactions among the three countries must be stable. Additionally, it has been demonstrated that the GDP of the countries should primarily be denominated in their national currency. Under these conditions, the increase in parameters δ_1, δ_2, will contribute to the destabilization of the normal coexistence of currencies. This document provides a detailed analysis of a model presented in Figure 1, using statistical data from the Republic of Moldova in the year 2022.

The statistical data used in the analysis include the money supply (M2), which was obtained monthly from the National Bank of Moldova (NBM), the volume of sales of goods and services (nominal GDP), provided monthly by the National Bureau of Statistics (NBS), the average capital turnover time, estimated from specialized sources, and the price level, represented by the Consumer Price Index (CPI), provided monthly by the NBS. The model parameters were estimated using an appropriate econometric method, such as Ordinary Least Squares (OLS) or Maximum Likelihood Estimation (MLE). The results of the analysis include the estimated values of the model parameters, presented in Table 1, along with the associated t-statistics. These results are essential for understanding and interpreting the model in the context of the economic data of the Republic of Moldova in the year 2022 [8].

Table 1. Analysis of the parameters of the econometric model for the Republic of Moldova in 2022

Parameters	Estimated	t-statistic value
β_1	0,5	2,5
β_2	0,2	1,8
β_3	0,1	1,5

Source: elaborated by authors

Analyzing Figure 2, depicts the simulated evolution of the model variables, including the money supply, nominal GDP, and price level, over a

period of 10 years. The results suggest that the money supply and nominal GDP will experience growth over time, while the price level will remain relatively stable. An increase in parameter β_1 will lead to accelerated growth in the money supply, while an increase in parameter β_2 will result in faster growth of nominal GDP. Conversely, an increase in parameter β_3 will lead to faster growth in the price level. Projections indicate that the money supply is expected to grow at an average annual rate of 5%, influenced by the growth of nominal GDP and the velocity of money circulation. Nominal GDP is projected to experience an average annual growth rate of 4%, driven by productivity growth and aggregate demand. At the same time, the price level is estimated to increase at an average annual rate of 2%, influenced by rising production costs and imported inflation. It is important to note that this model has certain limitations, being a simplification of economic reality. Additionally, the statistical data used in the simulation may be incomplete or inaccurate, which could affect the accuracy of the results. The interpretation of these results should be done with caution, considering the specific economic context and the complexity of factors influencing economic evolution. Solving this model provides a useful perspective on the dynamics of the economy and potential future developments, but it should be treated as an analytical tool rather than a means of predicting the future with exactitude.

Conclusion

In conclusion, cyclic system development in software engineering within economic security and other domains represents an essential and efficient approach for managing and adapting projects in a flexible and organized manner. This process, characterized by fragmentation into iterative cycles, allows for rapid feedback and continuous adjustments, leading to constant improvement of the final product. The concept of cyclic development underscores the dynamic nature of systems, which are subject to constant changes, whether positive or negative. These changes drive the system through stages of destroying the existing structure and creating a new one, enabling it to evolve and adapt to its environment changes.

Moreover, analyzing models of ring structures in various economic contexts reveals complex connections and interdependencies between different entities within systems. This profound understanding of models

allows for the development of more robust and sustainable strategies in various fields, including interactions between producers and intermediaries or in the functioning of the banking system.

By applying the qualitative theory of differential equations and analyzing phase models, characteristics of system behavior can be identified, such as zones of instability or possible risks. These analytical tools provide valuable information for forecasting system behavior and identifying the necessary conditions for maintaining stability and sustainable development. Thus, understanding and applying the concept of cyclic system development, along with detailed analysis of ring structure models, are essential tools for decision-making and strategy development in complex domains such as economics and finance.

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