

THE USAGE OF SYSTEM DYNAMICS IN STRATEGIC AND OPERATIONAL DECISIONS IN THE FINANCIAL SECTOR

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Abstract

This paper proposes an additional technique in the decision-making process in the financial sector – the application of the system dynamics method in strategic and operational decisions. The applicability of this method is substantiated by an analysis of its relevance for the financial sector, the analysis of opinions of 35 experts (primary research through direct interviews and surveys), and by exploring its usage through two case studies, and the evaluation of the insight obtained and its benefits for an organization in the financial sector. Decision-making is a fundamental component of strategic and operational management; it requires the ability to interpret and act on feedback quickly. System dynamics is a way of studying complex systems to understand their behavior and decisions outcomes.

Keywords: Analytical method, Simulation, Interpretation, Decision making, Feedback systems, Systemic correlations, Managerial methodology.

1. INTRODUCTION

Strategic and operational management is an essential component in achieving the strategic objectives of the organization. Over the past decades, numerous techniques and management analyses methods have been developed and evolved continuously (Corbos, 2005, 2011; Corbos et al., 2013; Plumb and Zamfir, 2008, 2009, 2011; Verboncu 2011, 2013; Zamfir 2010, 2011, 2013).

Today's managers have access to a broad set of support methods in decision making. Initially, management methods were focused on improvement of operational processes and scientific management, which involved developing methods to analyze and solve production problems. The early assembly line principles developed by Henry Ford were built upon in the 1950s by Toyota with the implementation of the Quality Circles, aimed at efficient production systems and elimination of waste. Starting with the 1960s several new methods and frameworks have been developed, either at prestigious universities or by management consultants (Gardner, 2004; Quadrat-Ullah et al., 2007; Senge, 1990; Smith, 2007). Later on, the focus on operational efficiency has been furthered through

extensive focus on lean manufacturing, eliminating everything that does not add value to a process, and increasing adaptability of an organization through elimination of waste.

Initially these methods were focused on the production sector, but in the past couple of decades their application has expanded to the financial sector. The recent financial crisis and its huge impact on bank's financial results triggered an increased concern for banks to reduce their costs. The largest banks in the world have successfully implemented Six Sigma methods and reengineering processes, achieving significant cost reductions, with the engineering efforts being attributed cost saves of hundreds of millions of US dollars (Khanna, 2008).

Moreover, the financial crisis demonstrated the inter-connectivity and vulnerability of the financial system resulting from this interdependence, complexity and intensity of ties between participants. Also, each organization is a complex system in itself, with many components and interactions which often cannot be anticipated by simply analyzing isolated factors of influence. The complex nature of organizations and the environment in which they operate bring to the fore the need for a different analysis method, with focus on fundamental understanding of all components of the organization and the environment in which it operates. The analysis of the components of a system and their inter-relations is fundamental to understanding the system. Only when the systemic aspects are deeply understood one can determine what must be done to achieve long-lasting improvements.

2. THE APPLICATION OF MANAGEMENT METHODS IN THE FINANCIAL SERVICES SECTOR AND THE OPPORTUNITY FOR AN ALTERNATIVE METHOD FROM CURRENT PRACTICES

Case studies of several large financial institutions which operate globally and/ or in Romania - such as Citibank, Bank of America, American Express, AIG, BCR, BRD, Societe Générale and Raiffeisen Bank – reveal significant interest from these organizations in improving quality of service and efficiency through simplifying and streamlining their organizations. Through a comparative analysis of the application of methods of managerial analysis in Romania and abroad it can be observed that the vast majority of these organizations apply process re-engineering methods extensively, mainly to increase efficiency and reduce costs. Some US organizations have hundreds of employees dedicated to the application of analytics in order to increase an organization's financial performance. Institutions which adopted the modern methods of analysis and process management-for example, Bank of America, Citibank, American Express, or who adopted Six Sigma, were able to obtain benefits of hundreds of millions of US dollars (according to their annual financial reports). These successes have generated

particular interest among smaller or regional banks, both in the US and in Europe and Asia.

While financial institutions have historically employed modeling as a key source of gaining market advantage, modeling and simulations are not broadly used in operational and strategic management. Recently, regulator pressure in developed markets have put significant emphasis on stress testing and simulations to determine capital adequacy and drive appropriate capitalization. While institutions which are deemed to be "systemically important" have started to implement processes to support stress testing requirements, the feedback loops to operational and strategic decisions are just nascent.

The system dynamics method should be considered as an alternative and/ or supplemental method in decision-making. The method of study of system dynamics is part of systems theory discipliners. At the foundation of this method is the assumption that the structure of a system, with multitude of relationships between components, it is just as important in the understanding of the system as well as an understanding of the individual components. (Often, a system is considered complex because of its large number of components, or the number of possible combinations that must be taken into account in making a decision.) This method also is studying the behavior of complex systems over time, analyzing feedback loops and using the concepts of "stocks" (accumulations) and "flows" (movements). These elements are used to demonstrate that even the simplest systems most often behave non-linearly. Recognition of feedback systems within an organization, although it is a simple concept, represents a major shift from the linear approach.

The system dynamics approach provides the ability to predict possible outcomes of decisions (Sterman, 2000). A traditional analysis process, such as the linear-type approach, enables us to identify simple loops; however, as the distance between cause and effect is greater in time and space, the consequences of previous decisions become more difficult to identify, as they are directly correlated with the accumulation of experience and refining future decisions (Morecroft, 2010).

A systemic approach includes the analysis of feedback systems and is focused on finding solutions that suit the environment in which the organization operates and identifying interdependencies between different parameters and their interaction with the environment. The ability to recognize feedback systems within an organization - although simple in concept - represents a major departure from the linear approach and gives us a different way to interpret the economic and social environment (Forrester, 1993).

Systemic dynamics is not a new approach, but its use in financial services, in the context of understanding systemic impact is limited, although the recent financial crisis demonstrates the need to better understand how organizations are connected to the environment they operate in. According to

Deming (1993), only when systemic issues are deeply understood, one can determine what needs to be done to achieve lasting improvements in quality and efficiency. Organizations run by people who are guided by "profound knowledge system" are much more likely to succeed and be effective. Deming is among the most recent world-renowned experts who support the introduction of a systemic approach in answering management questions.

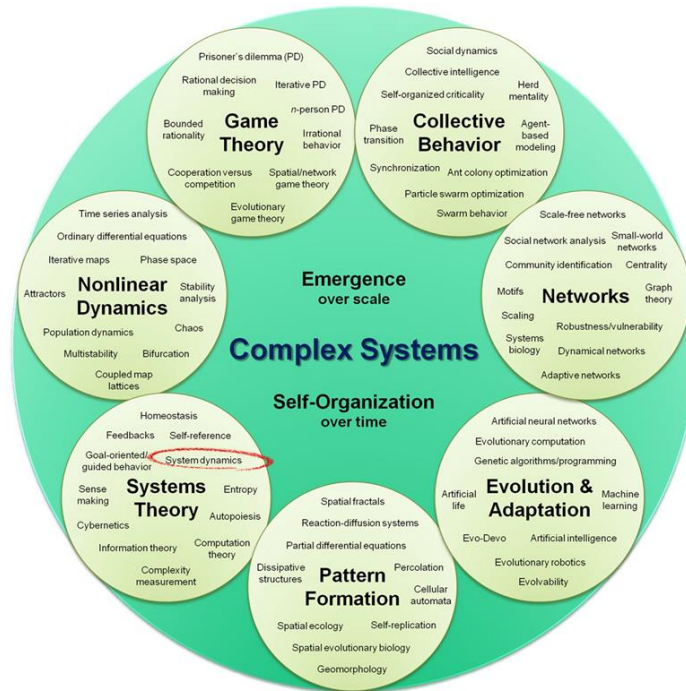


FIGURE 1 – DIAGRAM OF COMPLEX SYSTEMS SCIENCES
Source: Hirani Sayama, State University of New York

But surprisingly, system dynamics is studied and applied in a limited fashion. Since being developed at the Massachusetts Institute of Technology ("MIT") in Cambridge, Massachusetts by the renowned professor Jay Forrester, the method has been mostly applied to understand public policy issues and predict possible outcomes and unintended consequences; it also has been applied to operational problems, such as production management (Forrester, 1961, 1989). Currently, in the US system dynamics as a field of study is included in the curricula of very few universities (however, the method continues to hold a prominent place in the curriculum at MIT).

This method has particular relevance for the financial sector. Due to the complexity of the financial system and its predominantly silo-ed approach, and due to the risks involved, a systems dynamics approach can fulfill a key role in strategic, organizational, and operational management.

This topic is particularly relevant in the current context, in which financial services firms were shaken by

the economic and financial crisis, and are faced with increasing pressure on costs, but also with increasingly sophisticated client requirements, clients who do not accept any compromise in quality of service. In addition, the degree of innovation in this sector has increased significantly in recent years, propelled by numerous advances in technology and an increased sense of entrepreneurship of the new generation, adding new complexities through the introduction of new competitors, often outside the financial system.

However, the system dynamics method is not much used in the financial sector. Interestingly, the System Dynamics Society, which maintains a repository of case studies of its application across different domains, only has one existing case study, which is focused mostly on policy (System Dynamics Society, n.d.).

3. THE APPLICABILITY AND OPPORTUNITY OF USING THE SYSTEM DYNAMICS METHOD

The complexity of the financial system drives the need for a superior understanding of the ecosystem and of the role played by the organization, as well as its growth opportunities in the new market context. In order to explore the degree of relevance, current application, and opportunities and barriers for the usage of this method, a primary research was undertaken, including interviews and surveys with 35 international specialists with experience in the financial services sector, some of which had specific experience with the application of system dynamics. In order to obtain the perspectives of experts, research activity has included extensive data collection and analysis (interviews and surveys conducted with experts). The objective of this research was to obtain different perspectives on the applicability and use of this method in finance and the opportunities and limitations of these methods.

Among the experts interviewed, 90.4% had experience in financial services. We included specialists with different levels of experience to provide different perspectives. Over 70% of interviewed specialists have direct experience in strategy and operations; 66% of specialists have direct experience in management. We provided an overview of system dynamics to all specialists, which included definitions of the method and key components, discussion of objectives and features, and illustrative examples.

Interview results

Interviews with specialists in the field identified the high applicability of this method, especially as support for operational decisions. Identified key benefits of using this method included: further understanding of system behavior, identifying the necessary corrective actions, and contributing to the

strategic alignment of various decision makers. In particular, specialists anticipate significant growth in the use of system dynamics as method of study. An increased degree of adoption, according to experts, is influenced primarily by the fact that organizations are becoming increasingly complex and we need specific tools to understand them; also, the degree of adoption is also dependent on the availability of data and an increased interest in the use of new modeling methods.

A key observation was the unanimous appreciation of specialists who have used this method that its use has brought the answer to the question/ problem addressed. However, a significant subset of respondents noted that this method has identified new areas for exploration. This is a typical feature of management analysis methods that identify new questions and directions of exploration, without giving false confidence in achieving "absolute truth". Interestingly, of the experts interviewed, the vast majority (92%) consider that this method is beneficial and recommended its usage. The most commonly identified benefit was the method's contribution to the strategic alignment of various decision factors enabling a deeper understanding of the system in study.

Subsequently, the experts were asked to provide insight on *decision makers that could benefit most from the usage of this analysis method*. The overwhelming response was in favor of the Chief Operating Officer – chosen by 89% of respondents as the main beneficiary of this method. This is a logical correlation with specialists' perspective that this method has significant benefits in the operations management space. The next beneficiaries identified are the regulators (identified by 60% of respondents), followed by the "Chief Executive Officer" and the "Chief Financial Officer" (both identified by 57% of respondents). Another benefit identified is the *ability to demonstrate innovative thinking*, which is becoming an increasingly important focus in the financial sector in today's environment, faced with significant competition, including competition from non-traditional players, such as the "fin-tech" companies; the word comes from the combination of „financial" and „technology" and refers to new companies which leverage new available technologies and apply them in the financial services sector (e.g. mobile to mobile payments with no bank accounts required).

Experts were also asked what types of problems can benefit most from the application of this method. Risk management, operational and strategic issues, and consumer analysis were most selected. These selections are in line with the traditional use this method – mainly for management to identify possible future scenarios and therefore determine measures to reduce the risk in various unfavorable scenarios.

The specialists have been invited to provide insights on the importance of six factors considered in our research, as well as to provide additional options on other factors of influence. One of the key factors identified was that organizations are becoming increasingly complex, and managers need new

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methodologies targeted to specific levels of complexity in order to understand them.

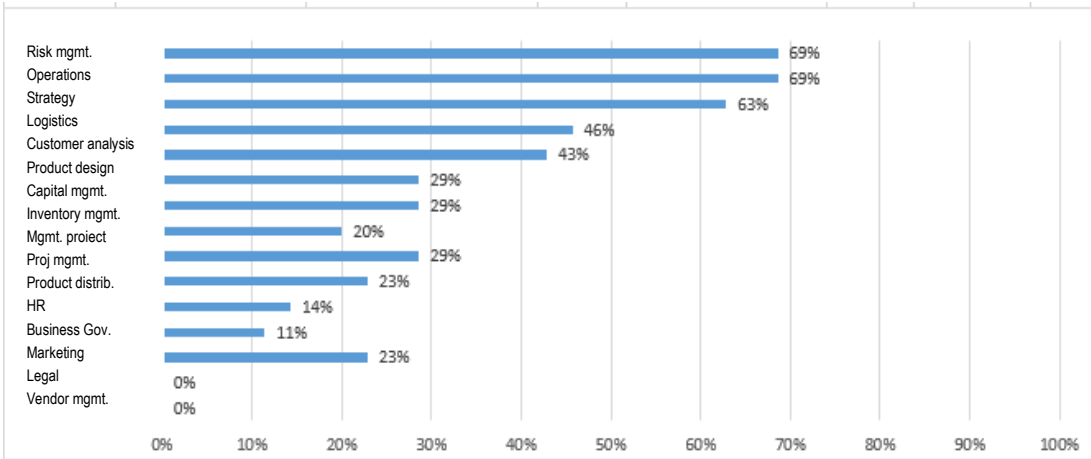


FIGURE 2 – AREAS/TYPES OF PROBLEMS THAT MOSTLY BENEFIT FROM USING THE SYSTEM DYNAMICS METHOD IN THE FINANCIAL SECTOR

Legend:

Mgmt. = Management

Distrib. = Distribution

Gov. = Governance

Additional factors mentioned included the fact that data availability is much higher nowadays, that there is growing interest in the marketplace in using new methods of modeling, and that there are now more innovative ways of finding answers to current problems.

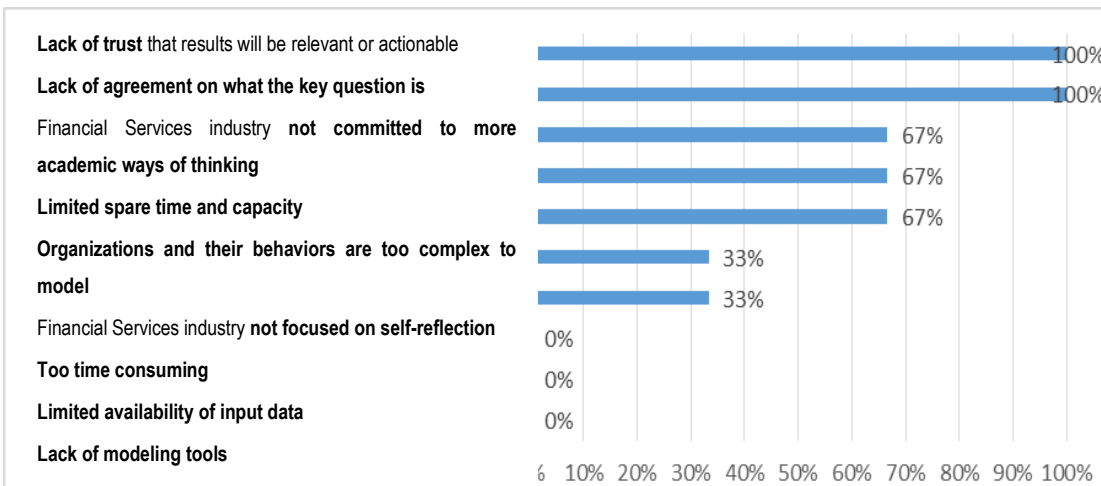


FIGURE 3 – PERSPECTIVES ON BARRIERS THAT LIMIT WILL INCREASE THE USE OF THIS METHOD IN THE FINANCIAL SECTOR

Also, the experts were asked to provide their perspective on potential barriers to increasing the adoption of this method. 100% of respondents identified lack of trust that the results obtained may be used for

decision-making, and lack of information about this method as the main barriers. Very interesting is the large number of experts who believe that often, it is difficult to come to consensus on what the problem is to be solved. Indeed, this is one of the barriers often mentioned by those who are experienced in applying this methodology, often identifying a lack of common understanding of the problem as a major factor in delays in the planning phase. It is also interesting to note that none of the experts identified as barriers the lack of modeling tools or the availability of input data.

In addition to the perspectives on the applicability and the relevance, a subset of the specialists has been consulted specifically on the applicability of the method in a case study, the analysis of emerging disruption in the investment management space - respectively, the emergence of new companies that radically change the traditional business model. Through the usage of the system dynamics method and the Bass Diffusion Model (Frank Bass, "A new product growth for model consumer durables", 1969) a model can be developed to determine how new products get adopted in a population. The model presents a rationale and the feedback loops on how current adopters and potential adopters of a new product interact. By including in the systems dynamics model the specifics of the investment management market, the adoption curves can be developed and forecasts can be developed on the adoption of new products. When consulted about the applicability of systems dynamics and using existing models (such as Bass) to enrich modeling conclusions, 100% of the specialists responded that 1) the systems dynamics method is extremely informative in understanding the behavior of the individuals in the marketplace and 2) that models such as Bass can support the mathematical modeling of potential outcomes based on the feedback loops outlined in the system dynamics model developed. Also, in absence of applying a mathematics model, even a conceptual, partial analysis, offers a new perspective on the influence of key factors within a system.

4. CONCLUSIONS

As organizations and the environment in which they operate become more complex, increasing regulatory requirements, customer needs and expectations of shareholders to obtain increased financial performance put significant pressure on management. The system dynamics method, focusing on the fundamental understanding of the main components of a system, provides particularly relevant instruments for the current problems of the financial system. The method also facilitates the identification of correlations and interdependencies between the organization and the environment in which they operate, facilitating management analysis and identification of optimal decisions and trade-offs, in the context of a specific macroeconomic environment. For example, in the absence of a systemic approach, process analysis remains an isolated (Becker et al., 2011), linear exercise that often

ignores critical systemic elements that are essential in decision making. Even a conceptual system dynamics analysis, without the development of a model, offers a new perspective on the critical factors of influence in a system. The application of the system dynamics method enables a deep understanding of the behavior of an organization and the ecosystem in which it operates.

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