Chapter 21
Modelling a Small Firm in Jordan Using System Dynamics

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ABSTRACT

The Jordanian banks and the risk analysts in particularly are seeking to adapt and buy new analytical techniques and information systems that help in identifying, monitoring and analysing the credit risk especially for the small firms that represents the biggest firms' base in the Jordanian markets. This chapter supports that what analysts need is a thinking tool that allow the user to simulate, understand and control different policies or strategies. It will then enable better decision to be made. A simulator based on system dynamics methodology is the thinking tool produced by this chapter. The system dynamics methodology allows the bank to test "What If" scenarios based on a model which captures the behaviour of the real system over time. The objectives of this chapter is to introduce new performance measures using systems thinking paradigm that can be used by the Jordanian banks to assess the credit worthiness of firms applying for credit.

LITERATURE REVIEW

System Dynamics was developed in the second half of the 1950s by Jay W. Forrester at the Alfred P. Sloan School of Management at the Massachusetts Institute of Technology. Forrester's main study was the activities in Operations Research (or Management Science) that aimed to support managerial decision making through mathematical and scientific methods. According to his studies, he found that operations research was not effective in helping to solve many strategic problems inside the organisations. It was too mathematically oriented and focused too much on optimisation and analytical solutions. It neglected non-linear phenomena and relationships between corporate functions.

Forrester (1961) proposed to move towards closed-loop thinking in order to enhance the decision making process where the decision are seen as a means to affect the environment and changes in

the environment also provide input to decisions which aim to influence the connection with this environment. This led Forrester to start studying decision making in social systems from the view point of information feedback control systems, so he made system dynamics more useful and relevant to the study of managerial problems. Forrester developed a method to study and simulate social systems as information feedback systems.

The method was first applied to corporate problems and was called Industrial Dynamics. Forrester (1961) defines Industrial Dynamics as "the study of the information feedback Characteristics of industrial activity to show how organizational structure, amplification (in policies), and time delays (in decision and actions) interact to influence the success of the enterprise. It treats the interactions between the flows of information, money, orders, materials, personnel, and capital equipment in a company, an industry, or a national economy". Lane (1997) summarises Forrester's method to modelling and understanding management problems as "social systems should be modelled as flow rates and accumulations linked by information feedback loops involving delays and non-linear relationships. Computer simulation is then the means of inferring the time evolutionary dynamics endogenously created by such system structures. The purpose is to learn about their modes of behaviour and to design policies which improve performance".

Because social systems contain lots of non-linear relationships, Forrester choose an experimental, or simulation, approach to be utilised in System Dynamics (Vennix 1996). Following Forrester's studies and publications, the method came to be applied to a large variety of problems and its name changed into the more general System Dynamics.

System dynamics is applied currently by both academic researchers and practitioners from all over the world. Applications of system dynamics have reached most of fields such as: health care, commodity production cycle, economic fluctuations, energy and project management and many more fields. Finally, there is an international system dynamics society at MIT, holding a yearly international system dynamics conference. In addition there is the society's journal (System Dynamics Review) and a huge number of chapters and literature on the system dynamics subject published in the conferences and journals around the world.

THE APPROACH OF SYSTEM DYNAMICS

System Dynamics is a systems thinking approach that uses a perspective based on information feedback and delays to understand the dynamic behaviour of complex physical, biological and social systems. It also helps the decision maker untangle the complexity of the connections between various policy variables by providing a new language and set of tools to describe. Then it does this by modelling the cause and effect relationships among these variables. Furthermore, System Dynamics method enables the decision makers or the modeller via its tools in any system to identify the underlying structure of their system or issue and how this structure determines the system's behaviour (see figure 1). The left arrow symbolizes the relationship while the right arrow indicates the deeper understanding that happens from analysing a system structure. System Dynamics can also be used to study the changes in one part of a system in order to observe its affect on the behaviour of the system as a whole (Martin 1997; Anderson and Johnson 1997; Brehmer 1992). Sterman (2000) gives an insight that the real value of an SD model should be to eliminate problems by changing the underlying structure of the system rather than anticipating and reacting to the environment. This allows the model to interact with the environment and gives/alerts feedback for structure changes. This is what the term (Dynamics) refers to: the

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