Available Online at ESci Journals
Journal of Business and Finance
ISSN: 2305-1825 (Online), 2308-7714 (Print)
http://www.escijournals.net/JBF

UTILIZING SYSTEM DYNAMICS APPROACH TO ANALYZE TRADE-OFF AMONG POSSIBLE STRATEGIC RESPONSES OF KARAZIN HOLDING COMPANY WHILE FACING MARKET RISKS

[a]Morteza Sardari*, [b]Mohamad E. Molaei, [b]Mahdi Z. Mazdeh
[a] *Ivanekey University, Iran.*
[b] *Educational institute of Iran industries, Iran.*

A B S T R A C T

Presence of risks and uncertainties in organizations' markets plays significant role in organizations' performance. Thus, there is a considerable need to have an effective risk analysis approach in order to assess the impact of different risks on the organization's success and the outcomes that potential responses may have. A powerful risk analysis approach may consider dynamic nature of risks, as well as accounting for feedback loops affecting the overall risk impacts. This paper presents a new approach to construction risk analysis in which these major influences are considered explicitly. The proposed methodology is a system dynamics based approach in which different risks may efficiently be modeled. To make the concepts more clear, one model is introduced at the final section merely to show one strategic response framework.

Keywords: Risk management, System dynamics, Market risks, Strategic response framework.

INTRODUCTION

Daily, we are exposed to information from a multitude of sources: the news media, newspapers, radio, TV, and the Internet. Generally this kind of information reports events what happened, where, when, how, who was involved, etc. This is a snapshot view of the world because this level of information is very shallow; the reports only touch the surface of what actually happened. For example, the stock market information that is reported daily gives a snapshot of the day's activities. It tells us whether stocks, on average, won average, went up or down (often the index goes both up and down within one day) and by how much. We also get information on the volume of shares traded, the dollar value of stocks traded (capital turnover) and much more. All of this information is at event level.

Sometimes there is commentary about a news item or an issue, and this allows one to look back and examine the trends and patterns of events and data. This provides a richer picture of reality and gives more insight into the 'story'. In the stock market example, this means looking at the trends over past months or years, observing the the fluctuations and trying to explain what caused 'pulses' in the system - for example, news of a merger, a quarterly economic report or a political scandal.

However, it is rare to see a study of how such trends and patterns relate to and affect one another. This represents a much deeper level of thinking that can show how the interplay of different factors brings about the outcomes that we observe. In the stock market example, this would mean trying to relate a host of factors that systemically cause the fluctuating patterns. These factors could be economic, social, political or structural. The critical thing at this level of thinking is to understand how these factors interact.

If a risk analyzer recognizes a fluctuation in a special product price in a period, he uses the first level information to find a risk. If he studies this price fluctuation in a longer period and recognizes its pattern and its main causes, he uses the second level information to determine a risk. But if he compares this issue with other sources of risk and causes of price fluctuations, and furthermore, determines their relationships and connections, he makes deepest analysis to recognize the risk.

In this paper this kind of analysis will be discussed through system dynamics approach.

* Corresponding Author:
Email: mort.sardari@gmail.com

RISK MANAGEMENT

Managing risk is one of the primary objectives of firms (Ghoshal, 1987). Risk management is an area with conflicting terms, and there is a widely acknowledged need for a critical reflection of its definitions, core contents, principles and regulation (Aven. T, 2011). The primary purpose of risk management is gaining opportunities and obviating harmful outcomes in risky situations. The processes to manage risks, opportunities, and action items are in some ways interrelated. Managing risks and opportunities often requires certain actions to be performed and tracked. Timely and effective management of program action items supports the reduction of risks and enhances exposure to opportunities.

Figure 1: Interactions among Risks, Opportunities, and Action Items.

Failure to manage action items may lead to risks and the necessity to deal with mitigation actions or corrective actions. Effective management of action items in other cases may lead to opportunities and associated pursuit actions. Some opportunities have risks associated with them and the treatment of risks may uncover opportunities. Figure 1 illustrates the overlaps in these processes.

The term "unpredictability" can be used as a synonym of the term "risk" in management sciences. This usage of risk is consistent with strategy researchers' use of variance (or standard deviation) of accounting-based performance variables such as return on equity and return on assets, stock returns volatility measures (beta and unsystematic risk), and measures of deviations from stock analysts' earnings forecasts as measures of corporate risk. The term "uncertainty" as used in strategic management and organization theory refers to the unpredictability of environmental or organizational variables that impact corporate performance (Miles , 1978) or the inadequacy of information about these variables (Duncan , 1972). Uncertainty about environmental and organizational variables reduces the predictability of corporate performance, that is, increases risk. Uncertainty can arise from exogenous shocks, unforeseeable behavioral choices, or combinations of the two.

Managers take some measures to alleviate the external risk influences. In the other hand, Corporate performance is composed of the separate performances of its business units and how they fluctuate and interact together to shape corporate financial outcome. Then corporations can take external or internal measures to respond to risks. Moreover, since all the measures and their outcomes are interconnected, analyzing the outcome of some measures is not the easy task. Until now, no integrated model has been developed to help managers analyze multilateral dynamic connections between risk sources and outcomes of measures which are taken to respond to those risks. So developing these two dynamic models will be the main purpose of this proposed research.

LITERATURE REVIEW

In the finance and strategic management literatures, business risk has been analyzed from various perspectives, including income stream risk, stock returns risk, and strategic risk (Miller, 1990). Business risk has been captured by different variables, such as the standard deviations of ROA or ROE, the coefficient of variation of stock analysts' earnings forecasts, and the debt-to-equity ratio (a measure of corporate financial leverage reflecting a company's risk of bankruptcy) (Shapiro, 1986).

Although there are a lot of models about corporation risks and their sources and influences, there are few models that are developed to introduce organizing framework for categorizing the range of risks relevant to managerial decision making. As Miller .D, the developer of one of those few models, says, managers may perceive as uncertain (1) general environmental, (2) industry, and (3) firm specific variables (Miller, 1990). Each of these categories encompasses a number of uncertain components. Review of a wide range of literature on uncertainty and risk management (shown in table1) served to identify the specific uncertain components included in this typology.

Table 1: range of corporate risks.

General Environmental Risks	Industry Risks	Firm Risks
Political risks • War • Revolution • Democratic changes • Other political turmoil **Government policy risks** • Fiscal and monetary reforms • Price controls • Trade restrictions • Nationalization • Government regulation • Barriers to earnings repatriation • Inadequate provision of public services **Macroeconomic risks** • Inflation • Changes in relative prices • Foreign exchange rates • Interest rates • Terms of trade **Social risks** • Changing social concerns • Social unrest • Riots • Demonstrations • Small-scale terrorist movements **Natural risks** • Variations in rainfall • Hurricanes • Earthquakes • Other natural disasters	**Input market risks** • Quality uncertainty • Shifts in market supply • Changes in the quantity used by other buyers **Product market risks** • Changes in consumer tastes • Availability of substitute goods • Scarcity of complementary goods **Competitive risks** • Rivalry among existing competitors • New entrants • Technological uncertainty	**Operating risks** • Labor uncertainties • Input supply uncertainties • Production uncertainties **Liability risks** • Product liability • Emission of pollutants **R&D risks** • Uncertain results from research and development activities **Credit risks** • Problems with collectibles **Behavioral risks** • Managerial or employee self-interested behavior

To challenge corporation risks, which introduced above, there are two main measures that will be discussed in following part

Financial Risk Management: The principal financial risk-reduction techniques are purchasing insurance and buying and selling financial instruments (forward contracts, futures contracts, swaps, and options). The nonexistence of markets for hedging exposures to many uncertain environmental contingencies is itself a result of uncertainty (March, 1987).

Strategic Risk Management: While the risk-reduction properties of forward contracts and insurance have been rigorously explored in the finance and insurance literature, the risk management implications of many corporate strategies have received relatively little attention. There are, nevertheless, a number of strategic moves that can potentially mitigate the risks associated with the uncertainties outlined earlier. The five "generic" responses to environmental uncertainties are avoidance, control, cooperation, imitation, and flexibility (Table 2). As mentioned in the title, these kinds of responses (strategic measures) will be considered as a solution in the model of this study.

SYSTEM METHODOLOGY

Systems methodology or the systems approach refers to a set of conceptual and analytical methods used for

systems thinking and modeling. The general methodological approach towards systems thinking and modeling used in this paper is based on the system dynamics method. The field of system dynamics was developed by Jay Forrester:

- the theory of information feedback systems;
- the understanding of decision-making processes;
- the use of mathematical models to simulate complex systems; and
- the development of high-speed electronic digital computers as a means of simulating
- Mathematical models.

Table 2: five generic responses to corporation risks.

Avoidance	• Divestment Delay
	• new market entry
	• Low uncertainty niches
Control	• Political activities
	• Gain market power
	• Exchange of threats
	• Vertical integration
	• Horizontal mergers and acquisitions
Cooperation	• Long-term contractual agreements with suppliers or buyers
	• Voluntary restraint of competition
	• Alliances or joint ventures
	• Franchising agreements
	• Licensing and subcontracting arrangements
	• Participation in consortia
	• Interlocking directorates
	• Interfirm personnel flow
Imitation	• Imitation of product and process technologies
	• Follow other firms in moving into new market
Flexibility	• Diversification
	Product diversification
	Geographic diversification
	• Operational flexibility
	Flexible input sourcing
	Flexible work force size
	Flexible work force skills
	Flexible plants and equipment
	Multinational production

Many other people have contributed to the development of systems thinking and system dynamics including Coyle (1977, 1996), Randers (1980), Richardson and Pugh (1981), Roberts et al. (1983), Senge (1990), Wolstenholme (1990), Richardson (1991), Mohapatra et al. (1994), Morecroft and Sterman (1994), Vennix (1996), Richmond and Petersen (1997), Sterman (2000), and many others! However, several authors have provided definitions of the system dynamics methodology, but we consider the one provided by Eric Wolstenholme (1997) as most appropriate. Wolstenholme's description of the scope of system dynamics is set out below.

What: A rigorous way to help thinking, visualizing, sharing, and communication of the future evolution of complex organizations and issues over time;

Why: for the purpose of solving problems and creating more robust designs, which minimize the likelihood of unpleasant surprises and unintended consequences;

How: by creating operational maps and simulation models which externalize mental models and capture the interrelationships of physical and behavioral processes, organizational boundaries, policies, information feedback and time delays; and by using these architectures to test the holistic outcomes of alternative plans and ideas;

Within: a framework which respects and fosters the needs and values of awareness, openness, responsibility and equality of individuals and teams.

The development of a systems thinking and modeling (Maani & Cavana, 2000) intervention involves five major phases:

1. problem structuring;
2. causal loop modeling;
3. dynamic modeling;
4. scenario planning and modeling;
5. Implementation and organizational learning (learning lab).

These phases follow a process, each involving a number of steps, as outlined in Table 1. However, it must be emphasized that a ST&M intervention does not require all phases to be undertaken, nor does each phase require all the steps listed in Table 1. Rather, these phases and steps are presented as guidelines, and which phases and steps are included in a particular ST&M intervention depends on the issues or problems that have generated the systems enquiry and the degree of effort that the organization is prepared to commit to the intervention. Figure 2 shows the progression of the phases. As mentioned earlier, although these phases can be used individually, their cumulative use adds more value and power to the investigation.

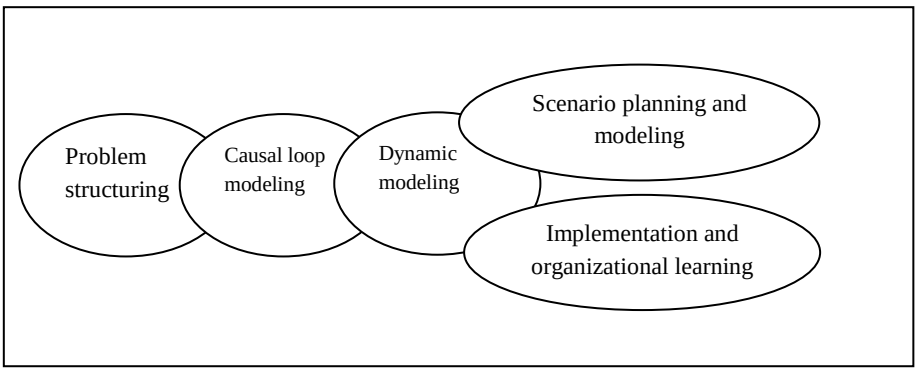


Figure 2: Phases of the systems thinking and modeling methodology.

Table 3: Systems Thinking & Modeling Process.

1. Problem structuring	1. Identify problems or issues of concern to management
	2. Collect preliminary information & data
2. Causal Loop modeling	1. Identify main variables
	2. Prepare behavior over time graphs (reference mode)
	3. Develop causal loop diagrams (influence diagrams)
	4. Analyze loop behavior over time
	5. Identify system archetypes
	6. Identify key leverage points
	7. Develop intervention strategies
3. Dynamic modeling	1. Develop a systems map or rich picture
	2. Define variable types and construct stock-flow diagrams
	3. Collect detailed information and data
	4. Develop a simulation model
	5. Simulate steady-state / stability conditions
	6. Reproduce reference mode behavior (base case)
	7. Validate the model
	8. Perform sensitivity analysis
	9. Design & analyze policies
	10. Develop & test strategies
4. Scenario planning and modeling	1. Plan general scope of scenarios
	2. Identify key drivers of change & keynote uncertainties
	3. Construct forced & learning scenarios
	4. Simulate scenarios with the model
	5. Evaluate the robustness of the policies and strategies
5. Implementation and organizational learning	1. Prepare a report and presentation to management
	2. Communicate results and insights of proposed intervention to stakeholders
	3. Develop a micro world and learning lab based on the simulation model
	4. Use learning lab to examine mental models and facilitate learning in the organization

Problem structuring: In this phase, the situation or issue at hand is defined and the scope and boundaries of the study are identified. This is the common first step in most problem-solving approaches. The problem structuring phase consists of the following steps:

(1) Identification of the problem area or policy issues of concern to management. This step requires that we clearly establish the objectives, taking into account multiple stakeholders and perspectives.

(2) Collection of preliminary information and data including media reports, historical and statistical records, policy documents, previous studies, and stakeholder interviews.

Causal loop modeling : During this phase, conceptual models of the problem, known as causal loop diagrams (CLDs) will be created. This is a major component and the most commonly used part of the systems thinking approach. The following steps are used in causal loop modeling:

(1) Identify main (key) variables.

(2) Draw behavior over time charts (or reference modes) for the main variables.

(3) Develop causal loop diagrams (influence diagrams) to illustrate the relationships among the variables.

(4) Discuss behavior over time of the dynamics implied by the causal loop diagrams.

(5) Identify system archetypes that would describe high-level causal patterns.

(6) Identify key leverage points.

(7) Develop intervention strategies.

Dynamic modeling: This phase follows the causal loop modeling phase. Although it is possible to go into this phase directly after problem structuring, performing the causal loop modeling phase first will enhance the conceptual rigour and learning power of the systems approach. The completeness and wider insights of systems thinking is generally absent from other simulation modeling approaches, where causal loop modeling does not play a part. The following steps are generally followed in the dynamic modeling phase:

(1) Develop a high-level map or systems diagram showing the main sectors of a potential simulation model, or a 'rich picture' of the main variables and issues involved in the system of interest.

(2) Define variable types (e.g. stocks, flows, converters, etc.) and construct stock flow diagrams for different sectors of the model.

(3) Collect detailed, relevant data including media reports, historical and statistical records, policy documents, previous studies, and stakeholder interviews.

(4) Construct a computer simulation model based on the causal loop diagrams or stock flow diagrams. Identify the initial values for the stocks (levels), parameter values for the relationships, and the structural relationships between the variables using constants, graphical relationships and mathematical functions where appropriate. This stage involves using specialized computer packages like STELLA, ithink, POWERSIM, DYNAMO, DYSMAP, COSMIC or VENSIM.

(5) Simulate the model over time. Select the initial value for the beginning of t he simulation run, specify the unit of time for the simulation (e.g. hour, day, week, month, year, etc.). Select the simulation interval (DT) (e.g. 0.25, 0.5, 1.0) and the time horizon for the simulation run (i.e. the length of the simulation). Simulate model stability by generating steady state conditions.

(6) Produce graphical and tabular output for the base case of the model. This can be produced using any of the computer packages mentioned above. Compare model behavior with historical trends or hypothesized reference modes (behavior over time charts).

(7) Verify model equations, parameters and boundaries, and validate the model's behavior over time. Carefully inspect the graphical and tabular output generated by the model.

(8) Perform sensitivity tests to gauge the sensitivity of model parameters and initial values. Identify areas of greatest improvement (key leverage points) in the system.

(9) Design and test policies with the model, to address the issues of concern to management and to look for system improvement.

(10) Develop and test strategies (i.e. combinations of functional policies, for example operations, marketing, finance, human resources, etc.).

Scenario planning and modeling: In this phase, various policies and strategies are postulated and tested. Detail of this phase will be discussed in section5.

Implementation and organizational learning: One of the most beneficial and enduring outcomes of systems thinking and modeling is organizational and team learning. Once simulation models have been developed, they can be enhanced by extending them into a microworld. Microworlds (also known as management flight simulators) provide an interactive and user-friendly interface for managers to experiment with the model. The learning laboratory uses microworlds in a structured process, akin to a scientific environment, to test hypotheses and mental models designed to create individual and group learning. The following steps summarize this phase:

(1) Prepare a report and presentation to the management team and other stakeholders .This should document the background and development of the systems thinking project, the challenges faced and lessons learned.

(2) Communicate results and insights of the study and the reasons for the proposed intervention to all stakeholders.
(3) Develop a microworld and design a learning lab for the simulation model. This involves adding necessary features (i.e. from computer software) to convert the simulation model into an interactive and user-friendly microworld. Then design a learning lab process for the microworld.
(4) Use the learning lab process to diffuse and facilitate learning in the organization.

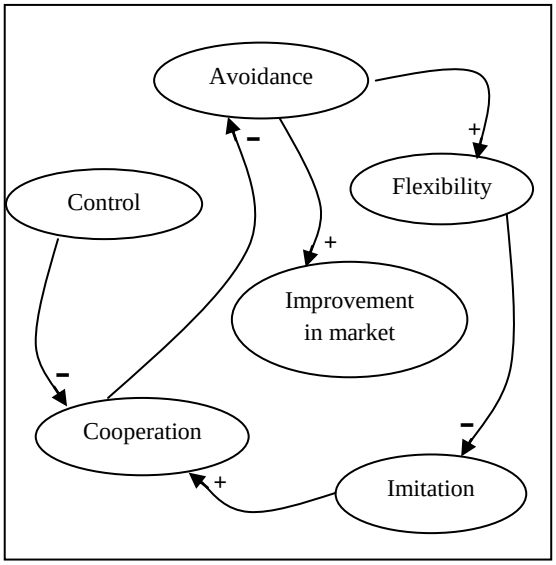
MODELING

As it was mentioned before, while modeling, various policies and strategies are postulated and tested. Here 'policy' refers to changes to a single internal variable such as hiring, quality, or price. Strategy is the combination of a set of polices and as such deals with internal or controllable changes. When these strategies are tested under varying external conditions, this is referred to as scenario modeling:

1. Develop general scope, time frame and boundaries of external environment for scenarios. Prepare stories of possible futures or theme scenarios.
2. Identify key drivers of change, uncertainties and factors that could have a significant impact on the decisions, policies and strategies being evaluated. Determine ranges for external parameters and graphs.
3. Construct forced scenarios by placing all the positive outcomes in an optimistic scenario and all the negative scenarios in a pessimistic scenario. Check the forced scenarios for internal consistency. Modify these scenarios as learning scenarios (based on Schoemaker, 1995).
4. Simulate the scenarios (either the individual scenarios varying the key uncertainties or the learning scenarios) with the model. Redesign scenarios if necessary.
5. Evaluate the performance of the policies and strategies with the model for each scenario. Assess the performance against a range of relevant performance measures for overall robustness. Select the policies or strategies that meet management's objectives for the investigation.

According to literature review and methodology, model for analyze trade-off among possible responses of Karazin holding company, is depicted in figure3 to merely one example of implementation of discussed concepts and illustrations be shown.

Figure 3: Trade off among Karazin Potential response to its market risks.



REFERENCES

Aven T. (2011). On some recent definitions and analysis frameworks for risk, vulnerability, and resilience. Risk Analysis 2011;31(4):515–22.

Duncan, Robert B. (1972). Characteristics of organizational environments and perceived environmental uncertainty. Admiinistrative Science Quarterly, 17: 313-27.

Ghoshal,Sumantra.(1987). Global strategy: An organizing framework .Strategic Management Journal,8: 425-40.

Maani, K.E and Cavana, R.Y. (2000). Systems Thinking and Modeling: understanding Change and Complexity, Prentice Hall, Auckland.

March, James G. & Zur Shapira. (1987). Managerial perspectives on risk and risk taking. Management science 33: 1404-18.

Miles, Raymond E. & Charles C. Snow. (1978). organizational strategy, structure, and process. New York: McGraw-Hil.

Miller, Kent D. & Philip Bromiley. (1990). Strategic risk and corporate performance: An analysis of alternative risk measures. Academy of Management Journal, 33: 756-79.

Schoemaker, Paul J H (1995). Scenario Planning: A Tool for Strategic Thinking, Sloan Management Review; 36, 2; ABI/INFORM Global.

Shapiro, Alan C. & Sheridan Titman. (1986). An integrated approach to corporate risk management. In Joel M. Stern & Donald H. Chew, editors, the revolution in corporate finance. Boston: Blackwell.