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Marketing Strategy Evaluation by Integrating Dynamic Systems Modeling and Network Data Envelopment Analysis

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Abstract. Nowadays, the service industries play an essential role in the economic development of countries, and among the various fields of insurance, life insurance is of particular importance because it covers its cover directly to humans. Increased competition in the insurance industry has led managers to seek marketing strategies that, in addition to increasing insurance sales, reduce costs and gain competitive advantage. Therefore, the purpose of this study was to develop appropriate marketing strategies in the form of scenario-based strategic planning in the life insurance market of Mellat Insurance Company. For this purpose, system dynamics and network data envelopment analysis tools have been used. In order to formulate marketing strategies, the causal-loop diagram and then the flow-stock diagram were simulated for scenario-based strategic planning. Then the operation

was performed for different scenarios and the simulated results were put as input to the data envelopment analysis model and based on the obtained results, the best and most efficient scenario was selected. It should be noted that in this study, different scenarios play the role of marketing models and strategies, and their performance has been analyzed.

Keywords: Marketing Strategy, Scenario-Based Strategic Planning, Systems Dynamics Model, Network Data Envelopment Analysis Model

1. Introduction

The development of the insurance industry in Iran, despite its expansion capabilities in the country, faces many obstacles. Most of all, lacking the necessary infrastructure to implement technology. In addition, another obstacle is the vacuum, which is related to life insurance. Therefore, today, more than ever before, an appropriate marketing strategy is needed to provide the resources and meet the diverse needs and needs of everyone with access to life insurance benefit. In fact, given the evolving environment of the insurance industry, having the right marketing strategy can help the company survive and gain competitive advantage. Because the chosen strategy, in addition to satisfying the needs of the target market, also corresponds to the marketing and organizational goals. Each company, depending on the business and its responsibilities, develops and selects its appropriate marketing strategy (Pishbahar and et al., 2017). Formulating a marketing strategy is an important part of strategic management and planning. Formulating a marketing strategy also has potential benefits and rules that will ultimately lead to improved business performance (Arasa and kobonyo, 2012). On the other hand, one of the most important strategic planning needs in a competitive and turbulent world is the uncertainty. Conventional strategic planning approaches, based on definitive forecasts of the future, attempt to formulate strategies, but the more turbulent the environment and the faster the rate of change, the greater the likelihood that these forecasts will fail. Therefore, conventional approaches to strategic planning lose their effectiveness in the face of uncertainty and environmental change. This has led to approaches that allow planners to

deal with uncertainty. There are tools such as scenario planning for such approaches. Scenario planning (scenario planning) as a strategic tool is a systematic way to create or test strategies and programs with their possible futures. This makes sense especially when faced with uncertainties (Yazdani and Nohpishe, 2016).Therefore, the approach proposed in the present study is a combination of the general model of strategic planning and scenario planning, and the system dynamics methodology (simulation) has been used to evaluate and formulate the strategy and predict the inputs and outputs for scenario-based strategic planning. Also, since each simulation model yields a number of inputs and a number of outputs after the model is run, the analysis of the performance of these inputs and nonparametric outputs requires the use of a technique for performance evaluation. Therefore, in this study, network data envelopment analysis technique was used. Using the network data analysis model, different scenarios can be compared in different simulation implementations, and considering the different inputs and outputs, the performance of each scenario is evaluated and the best one is selected. The purpose of this study is to identify the best scenario and formulate appropriate marketing strategy for better performance of Mellat life insurance market by integrating "system dynamics" methodology and sequential two-stage network envelopment analysis model for scenario-based strategic planning.

2. Literature review

Marketing strategies mean researching and finding the right markets in various dimensions, both economically and socially, as well as culturally and legally, and continuously laying the groundwork for announcing the existence and preservation of the resulting situation (Roosta *et al.*, 2019). Strategic planning involves determining the important and vital goals of the organization and strategies to achieve them according to environmental factors (mosedeghrad, 2015). Scenario planning as a strategic tool is a systematic way to create or test strategies and programs by creating possible futures to test them (Yazdani and Nohpishe, 2016). In fact, this methodology can be considered as the application of "principles of feedback control systems" and techniques for modeling, analyzing and understanding the behavior of complex systems

(Forrester, 1961). Data envelopment analysis is a mathematical planning technique that measures the relative efficiency of a group of decision-making units (Fukuyama, 2017).

In Table (1) the most important research that directly relates to identifying are presented.

Table 1. Research background

Schwenkr and Wulf, 2013	They used a six-step model in a study on "scenario-based strategic planning": project definition, cognitive analysis, identifying trends and uncertainties, scenario building, strategy definition and monitoring, and controlling strategies
Franco, 2005	He has looked at the dynamics of insurance companies from the perspective of information flows and has attempted to present a model for the management of loss factor in insurance companies
Reshnevdi et al.,2017	They concluded that the current growing trend in sales of life insurance and insurance premiums is possible for the next 10 years. And the most important factors affecting the future of the insurance industry are: the extent of agents 'network expansion and sales and sales representatives' returns
Mashayekhi et al.,2014	They conclude that two main factors in increasing the average payment of insurance are: increasing the administrative bureaucracy and increasing the number of customers of insurance companies. And improving staff performance and efficient use of information technology are two key factors in reducing payback time
Jalalinayini et al., 2012	They reviewed the concepts of institutionalism by devising a two-step method by combining mathematical programming with statistical methods. And by using data envelopment analysis with nonlinear output (robust optimization), they measured the performance of the insurance company during 2003-2009.

3. Method

The research method used is applied type and its method is case-based. The purpose of applied research is to obtain the understanding or knowledge necessary to identify the means by which a specific need is identified. Since the system dynamics model and the theoretical findings obtained from the network data envelopment analysis model have been

practically applied in real life conditions of the life insurance market of Mellat Insurance Company, this research is a case-study type. The statistical population of this study includes the life insurance market of Mellat Insurance Company and since all statistical population have been evaluated in this study, therefore no sampling has been done in this research. In order to gather information in this study, firstly, through the study of recent articles and research, the field of research was identified by scenario dynamics modeling based on scenario planning and scenario formulation. It also found how marketing scenarios and strategies were ranked by the network data analytics model. And after reviewing the articles, in order to fully understand all the indicators, a guided interview was conducted with the relevant insurance authorities. Finally, the final indicators of performance evaluation and formulation of life insurance marketing strategies were identified in the form of causal-loop diagram and network data envelopment analysis models, which are described below. In order to model and simulate the model of marketing strategies formulation in scenario-based strategic planning in this study, it is first necessary to draw a causal-loop diagram and then to implement a simulation, to transform a causal-diagram into a stock-flow diagram. And then run it on "Vensim" software. The causal-loop diagram of the research is shown in Fig. 1.

As can be seen from Fig. 1, the causal diagram of the study has 7 marketing strategies (7 loops), which are listed below. By following the loops, the positive and negative effects of the variables of each loop are determined:

- First Dynamic Marketing Strategy (Advertising Through Marketing Ring):
- Second Dynamic Marketing Strategy (Research Engagement Ring).
- third dynamic marketing strategy (word-of-mouth advertising ring)
- Fourth dynamic strategy (trust-based advertising ring).
- Fifth Dynamic Marketing Strategy.
- Sixth Dynamic Marketing Strategy (Loop Cost Reduction).
- Seventh Dynamic Marketing Strategy (Price Impact Loop).
- Eighth Dynamic Marketing Strategy (Loop Investment Loop).

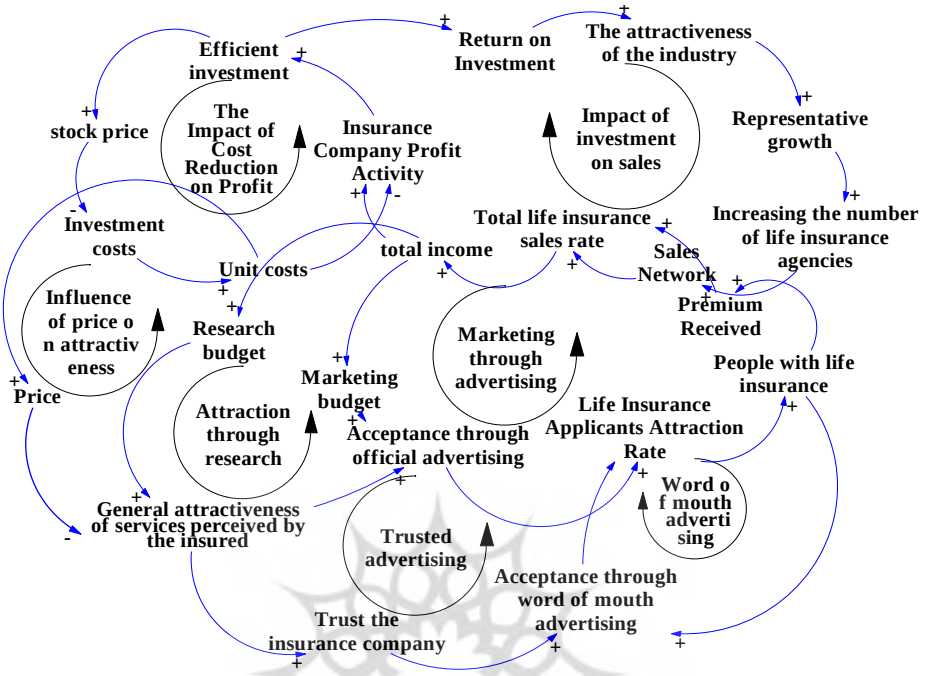

Fig. 1. Formulation of marketing strategies

Also the stock-flow diagram is the translation of the variables used in the causal-loop diagram diagrams into the cumulative (inventory or state) and rate (flow) variables. Inventory variables are variables that become slower over time and can be traced over time. This model has two state variables and 2 flow variables and 50 auxiliary variables (intermediary and tabular). State variables include the number of potential life insurance applicants and the number of active applicants with life insurance, and the flow variables are the total insured rate of attraction and the rate of loss of the client. The rest of the variables in the model are auxiliary variables. Figure 2 illustrates the stock-flow diagram. The important formulas used in the flow-stock diagram are:

Number of Potential Life Insurance Applicants = INTEG (Customer loss rate + Total absorption rate), Number of active life insurance applicants = INTEG (Total absorption rate - Customer loss rate), Total absorption rate = Also other features used table functions and auxiliary variables and mathematical functions to express more clearly real-world

concepts and facilitate equations. And some other variables are also given a number.

Fig. 2. Develop marketing strategies in the form of stock-flow diagram

After running the flow-stock diagram in "Vensim" software, model validation is required. Validation in system dynamics models is divided into two types: structural validity and behavioral validity. There will be no behavioral validity unless the model has good structural validity. In this study, due to the lack of access to real data about customers, marketing budget and research budget in insurance company, two methods of model structure validation were used by expert opinions and structural test of model boundary conditions. For the first accreditation, the opinions of experts who have had insurance business experience have been used. And the causal-loop diagrams of the model, the table functions used in the model, as well as the model simulation behavior, were confirmed. To perform the second validation, several simulations were performed with sudden and severe changes in some parameters of the model to verify the accuracy of the model response to these changes.

For example, if the price of the product drops sharply in the base case, the model should show the higher attractiveness of the service. For this purpose the price was reduced from 50 to 20 and the result is shown in Fig. 3. The blue color chart confirms the correctness of the model

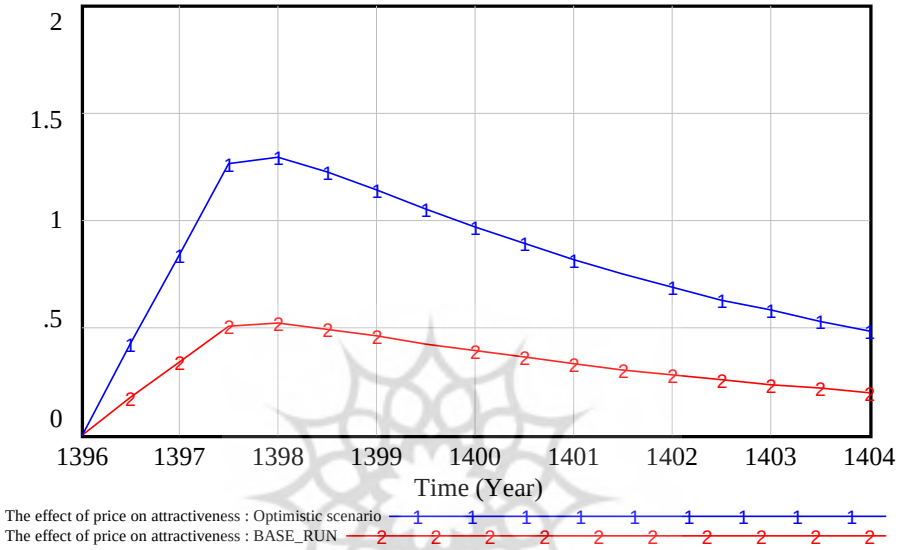

Fig. 3. The effect of falling price

4. Findings

Once a robust model with improved policy structure is obtained through sensitivity analysis, it can be used to formulate different scenarios for the future. To this end, two optimistic and pessimistic scenarios are presented by varying the parameters in the justified range using the results of the sensitivity analysis and compare the two new scenarios with the baseline scenario. The values of the parameters in the three scenarios are presented in Table 2. As can be seen, for the optimistic scenario formulation assuming the most favorable conditions, the parameters are changed at best and at worst. The system parameters are set to the worst possible values. Then, the parameters of each scenario are included in the model and the impact of the change on key variables (preferably accumulation) is presented, which are presented in Figures 4.

Table 2. Different scenarios for scenario-based strategic planning

Scenario parameter	Optimistic	Basis	Pessimistic
Innovation	0.95	0.50	0.30
Desirable quality	0.95	0.50	0.30
Reduce the payment of damages	1month	3month	6month
Price of service	20	50	70
Call rates	110	100	80
Create a positive image in the mind of the customer with appropriate staff behavior	0.90	0.50	0.30
Reduce bureaucracy	0.90	0.50	0.30
Reduce customer time spent on work	15min	30min	60min

The effect of the three scenarios on the accumulation variables is also shown in Fig. 4.

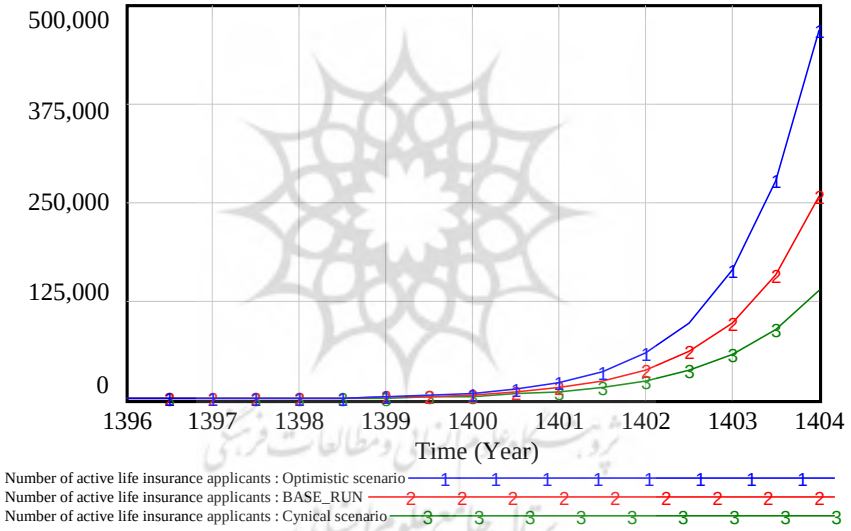

Fig. 4. The effect of scenarios on active applicants

Given that for simulating a model, a series of input data is collected and a set of outputs is obtained after the model is executed, the data envelopment analysis model enables the different strategic scenarios obtained in different simulation implementations, Compared and considering the different inputs and outputs, evaluated the performance of each scenario and selected the best one. In this study, in order to identify the best-case scenario, a sequential two-stage network envelopment analysis model is considered for insurance company according to the article by Momeni and his colleagues (2017). In the first

stage, the insurance company uses the number of dealers and unit costs (administrative, personnel, etc.) as inputs and obtains the total sales rate and total customer attraction rate as output. In the second stage, the total sales rate and the total customer attraction rate and the total number of life insured persons (the second stage input itself) are used and the percentage of premium received from the customer and the profit of the insurance company activity as output. The model structure is as follows:

$$\max\left(\frac{1}{\theta_1}+\frac{1}{\theta_n}\right)$$

$s.t$:

$$\sum_{j=1}^{n}\lambda_j\, X_{ij} \leq X_{i0} \qquad i = 1 \dots \dots \dots n$$

$$\sum_{j=1}^{n}\lambda_j\, Z_{hj} \geq \Theta_1 Z_{i0} \quad h = 1 \dots \dots H$$

$$\sum_{j=1}^{n}\lambda_{nj}\, Z_{hj} \leq \Theta_1 Z_{i0} \quad h = 1 \dots \dots H$$

$$\sum_{j=1}^{n}\lambda_{nj}\, p_j \leq P_0 \qquad p = 1 \dots \dots P$$

$$\sum_{j=1}^{n}\lambda_j\, Y_{rj} \geq \Theta_n Y_{r0} \quad r = 1 \dots \dots R$$

$$\lambda_{1j} \geq 0\,, \lambda_{nj} \geq 0, \qquad \Theta_1, \Theta_n \text{ free}$$

As mentioned earlier, the two optimistic and pessimistic scenarios were generally implemented in the simulation model and their changes are presented in the graphs above. Therefore, in order to rank the mentioned scenarios, they are presented below and implemented in the data envelopment analysis model of the mentioned data and their results are reviewed. Scenario One: The effect of quality on the attractiveness of customer-perceived services in which the quality scenario is increased by forty-five percent. Scenario Two: Price effect on customer perceived service attractiveness in which price scenario is reduced by 30%. Scenario Three: The effect of reducing the time of payment to the customer on the attractiveness of the customer perceived service, which in this scenario reduces the time of payment to two months compared to the baseline. Scenario Four: The effect of good customer behavior on customer attraction on the attractiveness of customer perceived services and creating a positive image in the customer's mind, in which scenario 40% better employee behavior than the baseline. Scenario Five: The

effect of customer time spent on referral to an insurance company on the attractiveness of services perceived by the customer in this scenario is reduced to 15 minutes of work time. Scenario Six: The effect of reducing bureaucracy on the attractiveness of customer-perceived services in which scenario has reduced the amount of administrative bureaucracy by 30%. Scenario Seven: The effect of the call rate on the marketing mechanism and the increase in adsorption rate by advertising and word of mouth, which in this scenario increases the ten percent call rate. Scenario Eight: The impact of innovation on customer service compared to competitors in which scenario has increased forty-five percent of base case innovation.

After entering the data into the WIN.QSB model, the following results are presented in Tables 3, 4 and 5.

Table 3. Evaluation results of units of year 2019

Scenario	Performance Stage 1	Performance Stage 2	Network Performance	Rank
Basis	0.54	0.79	0.75	....
1	0.70	1	0.58	8
2	0.37	1	0.72	4
3	1	0.13	0.88	1
4	1	0.36	0.73	3
5	0.64	0.49	0.75	2
6	1	0.55	0.64	6
7	1	0.42	0.69	5
8	0.80	0.82	0.61	7

Table 4. Evaluation results of units of year 2020

Scenario	Performance Stage 1	Performance Stage 2	Network Performance	Rank
Basis	1	1	0.50	....
1	1	1	0.50	8
2	1	1	0.50	4
3	0.96	0.50	0.93	1
4	1	0.97	0.51	3
5	1	0.10	0.90	2
6	1	1	0.50	6
7	1	1	0.50	5
8	1	1	0.50	7

Table 5. Evaluation results of units of year 2021

Scenario	Performance Stage 1	Performance Stage 2	Network Performance	Rank
Basis	1	1	0.50	....
1	1	1	0.50	8
2	0.96	0.98	0.52	4
3	0.80	0.42	0.82	1
4	0.59	0.86	0.68	3
5	0.60	0.61	0.81	2
6	1	0.92	0.52	6
7	1	0.97	0.50	5
8	1	1	0.50	7

5. Discussion and Conclusions

Since insurance companies have an environment in which internal and external variables are constantly changing, it is difficult to predict. Therefore, formulating and implementing marketing strategies to achieve the long-term goals and growing prospects of insurance companies, especially life insurance markets, is very important. Formulating a marketing strategy is an important part of strategic planning. In today's world, too, the rapid pace of economic, social, and technological change in insurance companies has made the strategic planning based on conventional methods of forecasting and the trend image from the moment of discredit invalidated because it is based on the assumption of uncertain elements. Investigating and identifying uncertainties using scenario planning is therefore an essential prerequisite for establishing a sustainable and long-term plan in the current business world, insurance companies and especially the life insurance market. Insurance companies are unpredictably facing new technologies, new products and new markets, so strategies formulated do not meet their needs in many dynamic and changing environments. These pressures will continue to increase in the future as technological, economic and social changes continue to spread. Obviously, the future is not predictable, but the important thing is that insurance companies can prepare themselves to face it, and that readiness creates a competitive advantage for them. As uncertainties intensify, so will the competitive advantage of insurance companies that have developed sustainable and resilient strategies for change. Scenario planning helps managers and strategic planners of insurance companies to gain insight into formulating insurance strategy

by assessing their future environment, maintain the competitive advantage of the company in a turbulent and changing future environment. Therefore, according to the above, scenario-based strategic planning, using system dynamics tools and network data envelopment analysis, was used to predict the marketing strategy of Mellat Insurance Company and its life insurance market. After simulating the model, it was applied to run different scenarios. Then the performance of the life insurance market of the company was examined in three optimistic, basic and pessimistic scenarios, and in order to plan future by scenario-based strategic planning for the performance, profitability and satisfaction of the insured, eight independent scenarios were defined by data envelopment analysis model and ranked these scenarios, during 2019 to 2021. Predictive results for all three years indicate that the best scenario is to reduce the time of payment of damage, which ranks first. After that, reducing the time spent by the customer to visit the company and do the job is second. After that, the appropriate behavior of employees with the client is ranked third. Therefore, it is necessary to pay attention to customer's rights and fulfill the obligations mentioned in the contract and to reduce the time of payment of damages to the client in order to attract the customer as well as promote the income and growth of the insurance company. In fact, customer-centricity is one of the critical factors of the company. Good behavior with the customer leads to a positive image in the customer's mind and through word-of-mouth advertising to attract the company. The use of information technology to reduce bureaucracy and reduce error, as well as reduce time spent by the customer, are other important determinants of a company's survival. In the end, innovation and quality of service also leads to customer satisfaction and competitiveness. Therefore, executives at the top level of the company should know their marketing strategies in the form of strategic planning based on the above mentioned scenarios, in order to both satisfy the customer and increase the profit of the company.

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