Analysis of Information Technology Effectiveness on Brand Using System Dynamics: An empirical study in the Pars Refractories Co.

Mostafa Jafari[1], Jamal Hosseini Azabadi[2], Mohammad Dehghani Saryazdi[3]
[1]*Assistant Professor, Department of Industrial Engineering, Iran University of Science and Technology(IUST), Tehran, Iran , Tel: 98-21-7391-3000 E-mail: jafari@iust.ac.ir*
[2]*M.S. Student in Industrial Engineering, Department of Industrial Engineering ,Iran University of Science and Technology(IUST), Tehran, Iran, Tel: 98-913-1594808 E-mail:* hosseini.j@gmail.com
[3]*P.H.D. candidate in Industrial Engineering, Department of Industrial Engineering, Yazd University, Yazd, Iran, Tel: 98-913-1594171 E-mail:* ie.dehghani@gmail.com

Abstract:

In today's competitive environment, organizations need to improve their position in the market. Brand is a tool for elevating the competitiveness of organizations based on the fact that each can find its own way of improvement. Information technology is the usage and knowledge of tools, techniques, crafts, systems or methods of organization in order to solve a problem or create an artistic perspective. Consequently, a dynamic model can be appropriate for analyzing the interrelated behavior of the information technology and brand. Despite the fact that there are plenty of papers and case studies on the brand in organizations but, thus far, a few studies are focused on the dynamics of the systems. In this paper, a dynamic model is presented in which the brand is linked with information technology by causal relationships. In the presented model, as a parameter is changed, one can find how it affects the others by considering the key results. This is the outstanding advantage of our model. Then, it is reasonable to expect that the results of such analysis can somewhat improve the effectiveness of information technology on brand.

Key words: Brand, Information Technology, System Dynamics

1. Introduction

A well-managed brand represents a major asset for many consumer product companies [1]. This is because developing a market entry strategy is a critical activity for any firm [2]. While nonprofit organizations and their brands are growing in importance and stature, these organizations display surprisingly limited brand management activities [3].

Information technology use and effectiveness, although prevalent in developed countries, does not provide the same reliable resource in lesser developed or developing countries [4]. There are many indirect influencers of IT effectiveness [5]. Increasing effectiveness of Information Technology on organization brand is an important prospect. This is because the new structure, speed in accountability and responsibility relationships, and work processes act as serious cases of IT effectiveness.

There are some researches about utilization of system dynamics in Brand. One paper presents a simulation model able to represent brand equity evolution. The model was drawn on brand equity concepts developed by Aaker and Joachimsthaler (2000), using the system dynamics methodology [6]. Another paper, illustrates how the use of System Dynamics and Systems Thinking approaches can support the development of brand strategy delivering superior value [7]. Another paper, examines the effects of IT use, user satisfaction, organizational culture, top management, and IT management on the effectiveness of IT in government organizations in India [5]. Also, there are some researches about utilization of system dynamics in Information Technology (IT). In one article, for improving management of information technology describes a system dynamics model that embodies why and how these controls reduce the problematic behavior of the low-performing IT operation [8]. Another article, studies the growth of enterprise information technology applications by using of an effective system dynamics model. This model reveals the internal laws of the general process experienced by an enterprise integrating the application of modern information technology and management [9].

Although there could be found some researches about utilization of system dynamics in brand and also in IT in the literature, there have been no attention paid to simultaneous investigation of Brand and IT for finding the effects of IT on Brand. In recent years, among various tools for performing brand, information

technologies have excellently smoothed the road of being world-class. In order to reach this goal, interactions should be used to identify the cause and effect relationships between IT and brand.

Hence, the purpose of this study is to explore the importance of the effect of information technology on Brand programs. In this paper, after defining the relationships between variables and formulating a combinational dynamic model for measuring the effectiveness of information technology on Brand programs, different scenarios are designed for developing information technology plans and their results are evaluated. Amongst the various methods for modeling system dynamics, a simple one consisting of problem definition, cause and effect diagram modeling, dynamical model generation, simulation, analysis, and application steps is utilized.

2. Modeling Process

The purpose of dynamic system modeling is to establish the relation between the various variables which make up the system and are used to analyze decision-making policies in the realm under study. [10]

2.1. Cause-and-Effect diagram modeling

The cause-and-effect diagram of this model shows the relation between the information technologies and Brand. The key effectiveness variables in this relation are new information technology, employee's productivity, innovation in processes, customer's satisfaction, financial sources, complexity of industry and Brand. Expanded relations between the information technology and Brand can be described as follows:

- The relationship between the new IT implementation and the innovation in processes.
- The relationship between the new IT implementation and the interaction between employees.
- The relationship between the new IT implementation and the cost to improve information technology.
- The relationship between the new information technology implementation and the Brand.

Due to the expanded relations defined above, in this article the relationships between model's variables are used in designing the model. This is described as follows:

It is believed in the enterprises that reaching lean results regarding customers satisfaction, employees productivity and innovation in processes, requires effective information technology , which itself begins with putting together the new Program needs, and is expanded with the compilation of the Organizational changes for actualizing it. Therefore, the Organizational changes and the new Program needs are effective on all model variables. An organization can attain productivity regarding employees only when it elects suitable approaches in the field of improvement interaction between employees; for this reason, the information technology is related to the employees' productivity. By achieving lean results in the field of customers' satisfaction, the utilization of suitable approaches is possible in the innovation in processes such as design and expansion of products, delivery of products and services and management of communication with customers. Therefore, the customers' satisfaction is related to the processes. Reaching lean results in the field of financial sources requires reaching improvement in customers' satisfaction and employees' productivity. Therefore, the criteria of key operation results are in relation with customers' satisfaction and employee's productivity.

A simplified and stylized version of the qualitative model that was the final result of the first modeling phase is shown in Figure 1. In this causal loop diagram, nine interconnected feedback loops are shown that together determine the dynamic behavior of the model. These are labeled R1 to R4 with the "R" standing for "reinforcing" or positive feedback loop, B1 with the "B" standing for "balancing" or negative feedback loop.

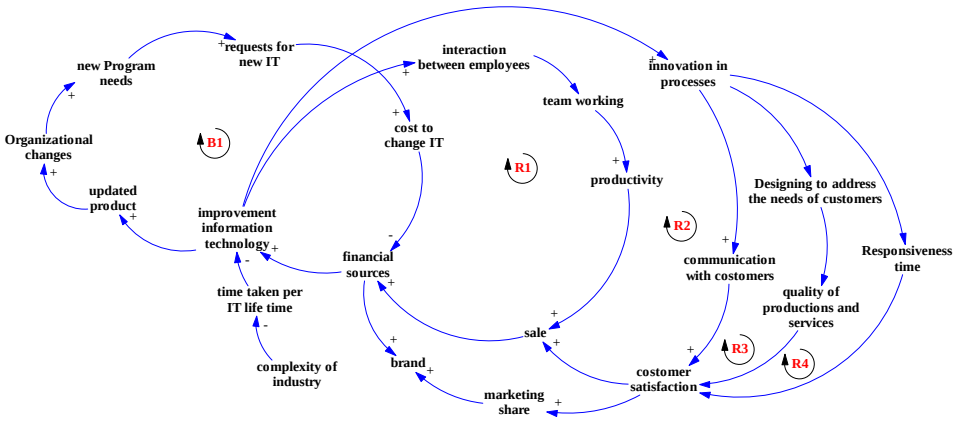


Figure 1. Cause-and-Effect diagram

2.2. Stock and flow diagram modeling

In order to describe the relations between the variables and to investigate the various scenarios, interviews with experts were done. Now the stock and flow diagram based on the relationship between information technology and Brand is presented in figure 2.

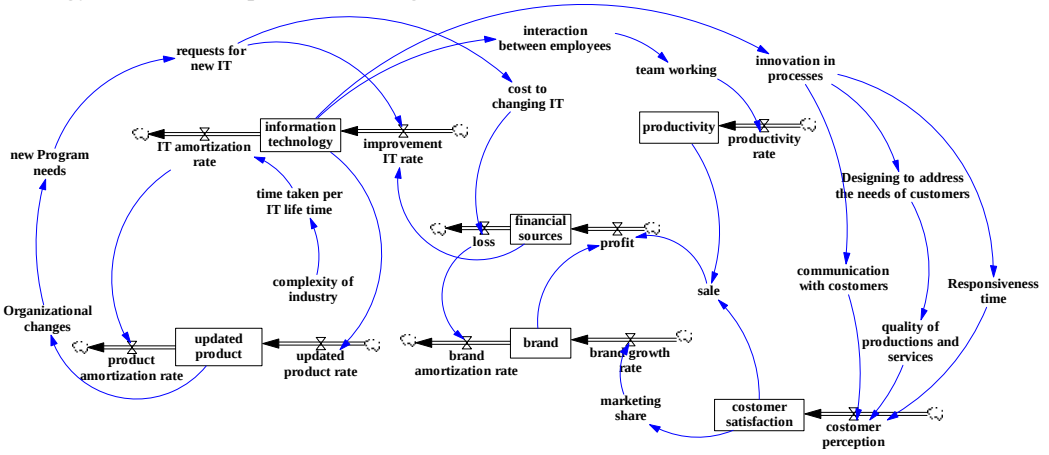
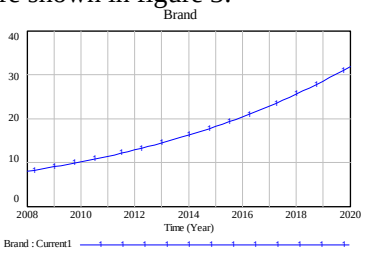


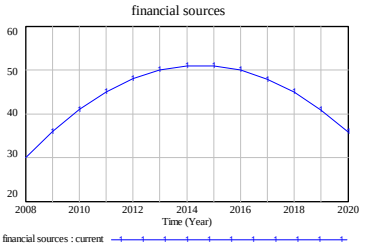
Figure 2. Stock and flow diagram

The developed model is executed by using Vensim PLE software. Time unit is taken a year and the model is run for 13 years beginning from 2008. For studying the trend of organization development, one can define levels during the time that are affected by the new information technologies. In this paper, levels defined are new information technology, updated product, productivity, customer satisfaction, financial sources, and Brand. These levels indicate Organizational changes because of complexity of industry, during the time.

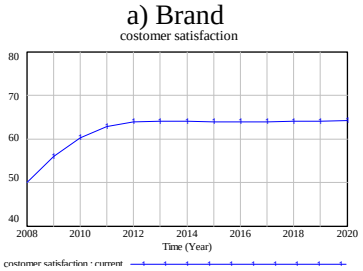
The results of simulation “Brand”, “financial sources”, “customer’s satisfaction” and “productivity” levels are shown in figure 3.



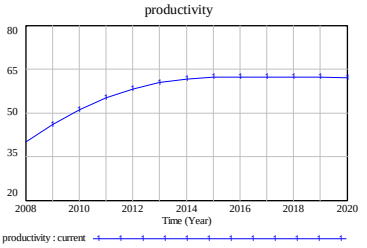
a) Brand



b) financial sources



c) Customer’s satisfaction



d) employee’s productivity

Figure 3. Behaviors of prominent variables obtained through simulation

It is seen that behavior of a, c and d is goal seek. The reason is that the new IT implementation causes the productivity and customer satisfaction to increase. Consequently, Brand improves during the time.

Furthermore, it is seen that the behavior of b in initial stages is increased but afterwards, it is decreased. In short time, the reason is that the new information technology implementation causes expenditures to go up as a result of the increase in new information technology, but in long time, when new information technology

implements productivity and innovation in processes increase, consequently, expenditures go lower as a result of improvement in productivity and processes.

3. Performance tests of the developed model

In order to validate dynamic models, some conventional tests like boundary efficiency, unit's consistency, parameter evaluation, structure evaluation, Cumulative error, and extreme value test are used.

- Boundary efficiency test emphasizes the sufficiency of parameters and causal loops in the model according to the purpose. This problem verified in modeling and after working out the results in interaction with experts and with more consideration on model logic.
- Unit's consistency test emphasizes the equality of units in the model that this problem verified by software.
- Parameter evaluation test emphasizes the correct definition of variable's initial amounts and parameters amounts on the base of objective data or anticipation. For this purpose, all used data in simulation is taken from existing chronological data or has adjusted on the base of anticipation.
- Structure evaluation test considers compatibility of model behavior with its structure. This problem necessitates that variables behavior in negative and positive feedback in the simulated model must be orderly exponential and seeking the object. On this basis as seen in the causal diagram, model variables from negative feedback loops and their behavior in the simulated model must be seeking the object that this problem is crystal clear in Figure 4.

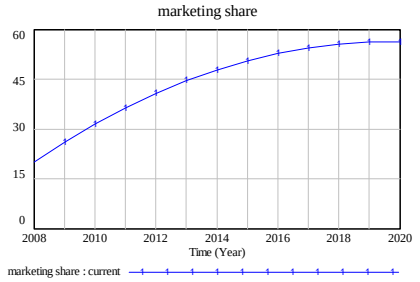


Figure 4. Behaviors of "marketing share" variable

- Cumulative error test questions whether the results of simulation are insensitive to any changes in time unit. For example, if the time unit was taken one year, and we change it to six months the results must be the same as before.
- Extreme value test emphasizes the model's resistance in limited conditions. This means that by changing policies or entries' amounts, model must show its expected behavior under any circumstances. For example, when we increase or decrease initial amounts of external variables greatly, internal variables change in their real ranges. This subject is considered in the model and the model is verified with regard to limited conditions. For example, the amounts of "complexity of industry" variable applied in other two states are 0 and 100 and its effects on "Brand" are tested. "Brand" variable has been shown in Figure 5.

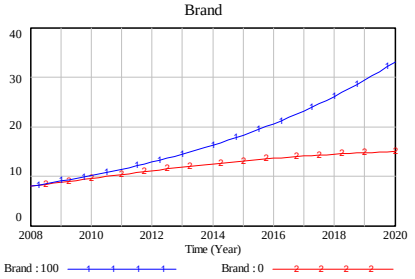


Figure 5. Behaviors of "Brand" variable

It is seen that the behavior of "Brand" variable has not been changed in limited conditions.

Consequently, by model verification, it is possible to make scenarios to analyze the result and subsequently to make decisions that will be discussed later.

4. Policy Making

In this model an "improvement" variable is defined for "Implementing new information technology" variable in order to evaluate different policies (improvement variable is determined based on future goals and policies

of the organization). Now we discuss and compare three different policies and scenarios to find actions by which the firm can achieve its objectives. “Brand” and “financial sources” variables are the main variables to which special attention must be paid. We consider following three scenarios:

- *Policy 1*: We name the first scenario “information technology low improvement approach”. Therefore, we assume the low value of this improvement variable is in its logical value i.e. 10%.
- *Policy 2*: We name the second scenario “information technology middle improvement approach”. Therefore, we assume the low value of this improvement variable is in its logical value i.e. 25%.
- *Policy 3*: We name the third scenario “information technology high improvement approach”. Therefore, we assume the low value of this improvement variable is in it’s in its logical value i.e. 50%.

The results of applying each of above policy for “Brand” and “financial sources” variables are shown in figures 6, 7. As it is obvious from figure 6, 7 “Brand” and “financial sources” variables have a goal seek behavior in the three scenarios.

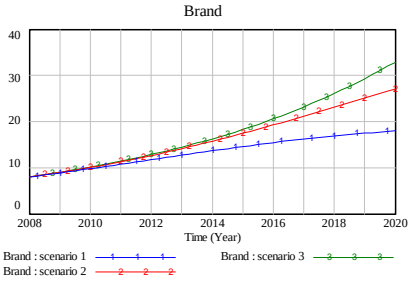


Figure 6. The results of applying three policies for “Brand” variable

In figure 6, “Brand” in all the three scenarios increases faster in the first year of the simulation results than the next years, it grows less in the next year and this behavior continues forever.

In comparison between three scenarios it’s observed that third scenario follows the better trend than the other scenarios. But the trend of second scenario has a nearly similar level to the third scenario.

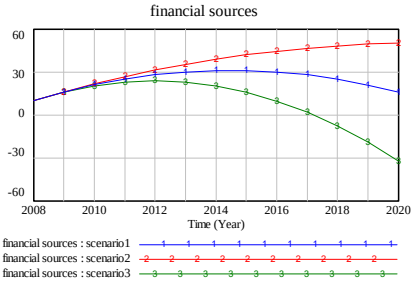


Figure 7. The results of applying four policies for “financial sources” variable

In figure 7, in the first year of the simulation results, “financial sources” in the three scenario increases but in the next years decreases. In comparison between three scenarios it’s observed that second scenario follows the better trend than other scenarios. Since the trend of third scenario in “Brand” variable has nearly the same level as the second scenario, and, in “financial sources” variable, the third scenario follows a better trend than other scenarios, hence it is better than the second scenario.

It means that new information technology implementation must be proportionate to its cost and income. If Brand improvement in proportion to increase in its cost be less, that scenario becomes canceled. Therefore third scenario can’t be chosen.

Consequently, if the second scenario be used in the enterprise, the information technology can be useful and valuable in Brand. Also, this scenario obtains more benefits for enterprise.

5. Concluding remarks

Research provides a model with systemic function in order to analyze the relationship between Information technology and Brand in enterprises. The developed model is very suitable for describing, analyzing, and recovering organizations. In this research, we introduced a new integrated dynamic approach which investigates Information technology effectiveness on Brand in enterprises in order to select the best policy among the enforceable policies.

Therefore, in the proposed model, we indicated the effects of powerful factors on organizational results by using the system dynamics' model, and we obtained and analyzed the trend of changes in terms of different values utilizing software.

Analysis of information technology effectiveness on Brand considering the dynamic behavior of the system provides a group of advantages the most important of which are as follows:

- Simulating the effect of important factors on enterprise results.
- Performing the "what if" analysis for learning from future potential threats and opportunities.
- Capability of visual representation for relations between values of the model.
- Reducing the risk of performing plans through simulating and studying of the results and the conclusions of different policies before using.

Also, generating the dynamic model provides advantages for recovering evaluations, including providing time dimension between cause and effect. With respect to evaluations which were carried base on the developed model, it is indicated that the effects of changing powerful values on the results appear simultaneously. However, these effects appear during the next period not during the same period. We can say obtained dynamic model is a suitable tool for modeling the situation of organizations and for predicting the effect of their existing strategies. Following fields can rise for the next researches:

- More complete performance tests for the developed model.
- Performing of more simulations for different policies with different analysis of their results which leads to more exact conclusions.
- In the developed model, we provided the relationship between information technology, employees, processes and Brand. For improving this model, it is required to complete more relations in the model and add more variables, for example the partnerships, outsources and knowledge management.
- Inviting experts of manufacturing systems and system dynamics for further study on the developed model with the aim of improving the relationships and equations in the model for more use in organizations.
- Modeling and measuring cannot be suitable only for organizations. These techniques must be considered in social-economical systems. If the developed model is combined with organization policies, this can raise its efficiency. Also, discussion about the developed model and implementing it at different positions can be of guidance for researchers in the future investigations.

References

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