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A Simulation Based of Setting Policy in Project Acceptance Based on Experiences in Project-Driven SME's

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ABSTRACT:
The acceptance of the right project which leads to the realization of the set objectives is one of the most important issues in project-oriented companies. Therefore, corporate managers prefer to work on those projects which ensures the achievement of goals such as increasing financial profits or being the top brands in their rivals market. The present research aimed at introducing a systematic approach to the project acceptance modeling in order to ensure that effective decision-making can be seen and analysis them with appropriate model. This paper provides a system dynamics model of project accepting which examines the effective factors in decision-making process. This data used in the present research included number of staffs assigned to the projects as well as the identified of delay in project execution. The identified factors have been used to indicate the cause and effect relationships in graphs and calculating the related equations before being integrated into the model. Finally, sensitivity analysis was done by running model and validating it to determine suitable strategies which improve the decision-making of managers when dealing with the process of accepting or rejecting available market's projects. Therefore, the results can be used in decision –making process.

Keywords: *System dynamics, Simulation, Project acceptance, Simulation variables*

INTRODUCTION

Modern organizations undertake a huge volume project-based activities as their routine market performance. In addition managers should consider their resource constraints and cost to select the appropriate project to be implemented . The major concern of senior executives is how to select the best projects among the ones which are under review and how to apply their practical knowledge in order to predict the possibility of any given project breakdown or failure; in other word, their task is to choose those projects that prevent substance and resources abuse. To sum up project selection is the process of evaluation and analysis of independent projects which lead to the realization of the organizational goals.

In many small and medium project-driven organizations only the projects that make the greatest value for company and ensure stability through being aligned with organization's strategy are selected . This decision making criteria is determined by the organizations. Therefore, the organizational survival and successful projects execution are the issues at stake in the process of selecting the future projects. Therefore, there should be a model to

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identify the result of system performance based on effective factors in steps of implementation to investigate the acceptance or rejection of projects through simulation models. In the present paper dynamic simulation methods had been used to model the project acceptance process to meet strategic goals.

Given the importance of this issue, the purpose of this research is the optimization of implementing the projects that fit with project-driven organization's performance to enhance the function and executing the profitable projects in accordance with operation. As well as responding to this question that how can model the process of project selection throughout the last experiences in company. The research hypothesis is that selection of organizational policy in resource allocation leads to different behaviors in projects performance.

Literature Review

System Dynamic

System dynamic is the science which attempts to model social phenomena; it is a simulation technique based on system thinking rules used as a tool to investigate complex systems feedback (Forrester, 1968). The theories of control and modern nonlinear dynamic are system dynamics basic assumptions. It means that there is an accurate mathematic base for the theory and models (Gregoriades et al., 2000). According to Sterman, basic principles in dynamics will form the structure of system behavior. The complex behavior is the outcome of the interactions between single components; therefore, in order to analysis these interactions and connections between components in system the feedback structures should be identified via cause and effect examination during the time (Sterman, 2002). This method provides the companies with an opportunity to perceive the complex dynamic problems of the internal system (Snabe, 2007). In other words, this method is for recognizing, understanding and analyzing the behavior of system components; it can be said that this method is an approach to analysis a complex system behavior in order to get a strong perception of events involved in the process.

Anderson and Parker (2000) applied system dynamic in analyzing the relation between different levels of supply chain. Chinda (2011) used this system to create and expand the culture of safety in organizations. According to Marko and Dieter (2010) a dynamic model could be used to manage the customer complaints based on positive and negative oral values. As said by Briano and others (2010) a dynamic model can be applied in order to simulate and design product supply chains with short life cycles. In another survey system dynamic modeling is applied as a tool to consider performance of project and to implicate risk management (Worapong et al., 2013)

In the area of domestic industries in Iran, Bararpour and Araghi (2006) analyzed the infrastructures of the competitive automotive industry through system dynamics. Hashemi Olia (2008) applied a dynamics method to analyze and improve components supply chain in automation companies of Irankhodro. System dynamic modeling was used in the survey with the objective of evaluating the complex dynamics involved in implementing electronic health information exchange (HIE) for public health reporting at a State Health Department, and to identify policy implications to inform similar implementations (Merill et al., 2013)

There is another concept, system thinking that many of people use instead of system dynamic, but these concepts main focus is to explore interrelationship, including creating casual loop diagrams and behavior over times without the need for computer software. System dynamics employs system thinking outputs such as casual loop diagram to focus on building and analyzing stock and flow models-aided by user friendly computer software such as Vensim and stella (Heffron, 2013).

Project Selection and the Role of System Dynamic

Project-driven companies mostly look at the projects as a strategic option for organizational planning, so project selection is critical in these organizations. There are many different techniques for project selection. One of the most important points in selecting and making an appropriate framework which is being align with company's strategies (Archer and Ghasemzade, 1999). The project selection issue is a critical process for each related business (Melano and Wharton, 1984). Therefore selecting the most suitable project between other projects is a determined resource allocation decisions that can

enhance the competitive advantage of business. Since there are many quantitative and qualitative factors in this field, project selection is a difficult process (Lee and kim, 2001). Hence, Productivity and profitability of company can be immediately affected by effective evaluation of projects and selection strategy. The traditional method of project selection mostly failed to identify the uncertainty and interaction in the projects. Besides, old techniques had focused on quantitative tools such as cash flow, net current value, payback and payback period (Liberatore, 1987).

Decision makers in company usually estimate the best project based on results. However, these approaches ignore multiple factors that affect project so they do not suggest an effective conversion formula that combines all related criteria in a unique decision making model (Brewer et al., 1993). As the problem of project selection is an important and iterative activity in many companies, there are a lot of techniques to help in this process. Today, one of the essential tools in many organizations is project portfolio management and its main goal is making sure that a set of projects selected meet the organizational objectives (Kendal, 2003).

The conceptual model of this research shown in figure 1.

RESEARCH METHOD

The methodology present research was practical; it was done based on sampling and case study between research's variables. In fact, the methodology of the research was a cause study to identify the factors which were discussed in project selection and project management in order to investigate quality. Finally a suggested simulation template with a system dynamic method which applied Vensim software for quantitative survey was presented.

The Process of Research

The process of this study was modeling of project effect on organizational performance dynamically and simulating the project behavior by applying management policies with respect to capability of organization. This process can be summarized in the following steps:

1. Reviewing the literature through studying related texts and valid papers.
2. Conducting field studies and extracting data from interviewing with project managers and decision makers of company. Also, considering the projects that had been done and surveying of effective variables.
3. Simulating the process and the project performance by using the dynamic modeling techniques and presenting the simulation model of project in company.
4. Examining accuracy of model by testing the simulated model with using the project data.
5. Determining the ability of company in running the variety of projects, making decision and participating intenders for projects which bring greatest profits aligned with company's strategy relied on simulated models.

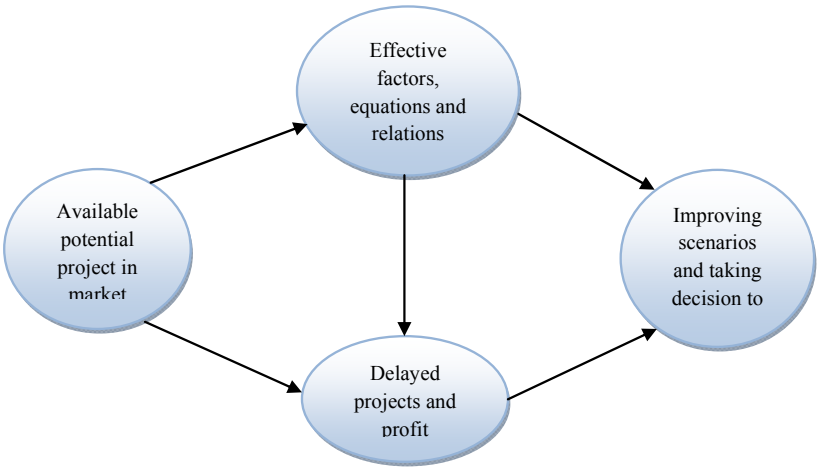


Figure 1: The conceptual model of project acceptation

The Value and Variables of Simulation

State Variables

1. Available staff: It indicates the number of staff available in company.
2. Employee Assigned on Running Projects: The number of staff working in project at present time.
3. Total Remained Projects on hand: The total projects that company holding them.
4. Profit: The amount of profit that company obtain from project.
5. Potential Projects (Jobs): The number of project that are taken into consideration in the process of project selection.

Flow Variables

1. Rate of Human Resource Change in Availability: It causes of the variable accumulation of available staff. In fact, it indicates the rate and flow of hiring and firing in company.
2. Rate of Assignment: It shows the rate of allocated workers in projects and the number of staff distributed to the projects.
3. Rate of Release: It displays the release of staff when projects are finished
4. Income Rate: It shows the rate of company's income and inputs
5. Expense Rate: It represents the rate of costs during the projects from start to finish
6. Rate of Project Taken: It indicates the ability of taking project according to effective variables such as the successful conversation rate with customer, so the rest of project at hand will be shown via affecting on state variable.
7. Finishing Rate of Projects: It shows the completion rate of projects
8. Rate of New Projects in Market: It indicates new projects flow in the company intended market. This variable is the input of state variable of potential projects which can calculate the number of projects that are under consideration and negotiation with customers according to the variables of input flow.
9. Rate of Success: It shows the state variable success rate of potential projects.
10. Rate of conversation failure: It indicates the state variable failure rate of potential projects.

Experts of Survey

To identify all research variables like stock and flow many interviews were performed with some managers and experts of company. These managers and experts were experts in project management, marketing, research and develop, programming and designing. After interviewing with them many important factors were identified to determine stock, flow and constant variables.

Case Study

To implement of this survey, the information of an IT-based Samix Company which acts in IT scope. This Company has many contract, which need to be performed within set deadlines, with many public and private organizations.

General Cause and Effect Chart

After determining effective factors, the cause and effect diagram of factors connections was obtained by Vensim software which is shown in figure 2:

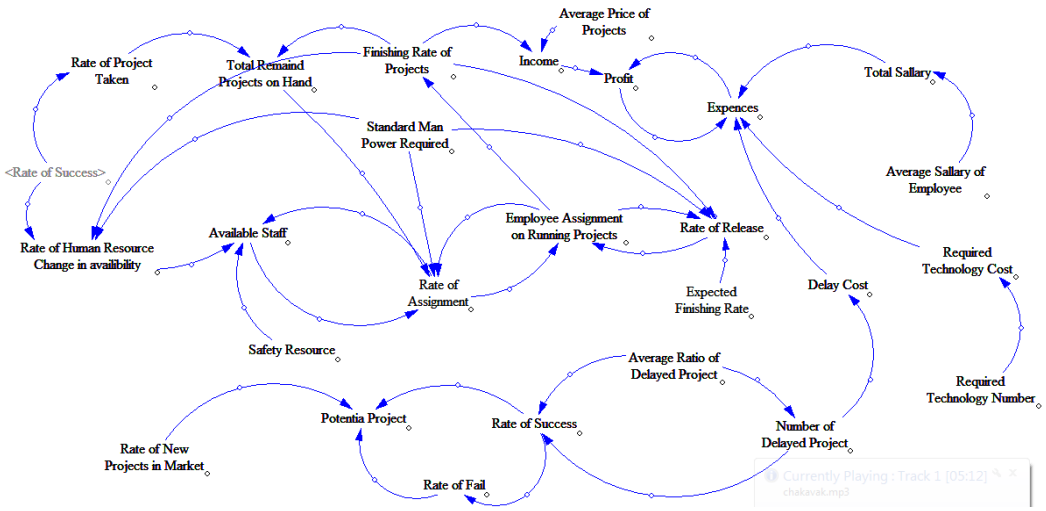


Figure 2: Cause and effect graph of model

The Relations and Function of Model

At this point, some of the equations between some of the model variables are listed:

A Equation 1 available Staff = ∫ (rate of human resource change in availability-rate of assignment)

The initial value of this variable is equal with a constant value of ensure personnel which is fixed.

Equation 2 Employee Assigned on Running Projects = ∫(rate of assignment-rate of release)

Equation 3Total remained projects on hand = ∫(rate of projects taken-finishing rate of projects)

Equation 4 Profit=∫ (income rate-expense rate)

Equation 5potential projects (jobs)=∫(rate of new projects in market-rate of fail-rate of success)

Equation 6 Rate of Human Resource Change in Availability =Rate of Success*Standard Man Power Required-Finishing Rate of Projects* Standard Man Power Required

The rate of hiring and firing is determined according to success rate of projects under negotiation and by multiplying the number of hypothetical personnel for running the projects then subtracting the multiplication rate of completion of projects and the hypothetical personnel.

Equation 7 Rate of Assignment=Available Staff*min (1,max(0,(Total Remained Projects on hand*Standard Man Power Required-Employee assigned on Running Projects)/Available Staff+1))

This formula is obtained by multiplying the number of available projects in the number of needed worker then is subtracted the total staff which remained from calculating the allocation and release them. Finally, it is made by dividing the total forces that are currently available. The cause of using max function and comparing with zero is that algebraic operations not be adversely. After that first part is gotten with using min function which the lowest level is between 1 and algebraic operation of previous step that obtained and multiple in the number of available forces.

Equation 8 Rate of Release = MAX (0,(standard man power required/ employee assigned on running projects)*(finishing rate of projects/ expected finishing rate))

In Equation above, to calculate the rate of staff release, the highest value between 0 and obtained value which got from dividing hypothetical needed forces on allocated forces to current projects then multiplying in the result of completion rate divided by the expecting completion rate.

Equation 9 Finishing Rate of Projects = (employee assigned on running projects-standard man power required*Total remained projects on hand)/(standard man power required*Total remained projects on hand)

This equation came from multiplying the hypothetical needed forces in total available forces then with subtracting from applied forces among running projects and finally, dividing on multiplied hypothetical needed forces in total available projects in company.

Equation 10 Income Rate = average price of a project*MAX (0, finishing rate of projects)

Taken projects have incomes for company at the end of them. In Equation 10, the average price of project will multiply in maximum rate of completion and zero to determine the rate of income flow of company. Using max function here means that the lowest value of income can be zero.

Equation 11 Rate of Success = IF THEN ELSE (Number of Delayed Projects>n,0," Potential Projects(Jobs)"*((1-Average Ratio of Delayed Projects)/2))

In this equation, if the number of delayed projects is more than the specific number, the value of function will be zero; therefore, all projects will reject. Otherwise, it will use the

condition third part formula. The cause of diving on 2 in this equation is that we hypothetic the chance of taking project is 50-50.

Graph of Accumulation-Flow Model

After writing the equation of variables relationship, the graph of accumulation – flow model is done by Vensim software which figure 3.

RESULTS AND DISCUSSION

After numbering in model with Vensim software and writing the equations and functions, model can be run correctly. Figure 4 shows some of the accumulation and flow of model.

Figure 4 represented the comparison charts of three variables which are the completion rate, the number of delayed projects and projects profits. As can be seen, with a certain amount of constant and auxiliary variables up to eight months the number of delayed projects is continuing in range of zero which means there are no delayed projects. However, from eighth month the number of delayed project enhanced.

Meanwhile, it can be observed that the rate of completion declined with enhancing the number of delayed projects and nearly in eighth month it took negative value. It is notable that being negative of completion rate did not mean any project would not be done, but it means the project would be done with a lower rate. Besides it was shown that the number of delayed project is more than the number of completed ones.

The profit variable grew until eighth month which it did not have any delayed project but after that the amount of profit decreased because of increasing the number of delayed projects, declining the completion rate, paying for delayed projects penalty and also due to complete project with lower rate, the amount of income decreasing.

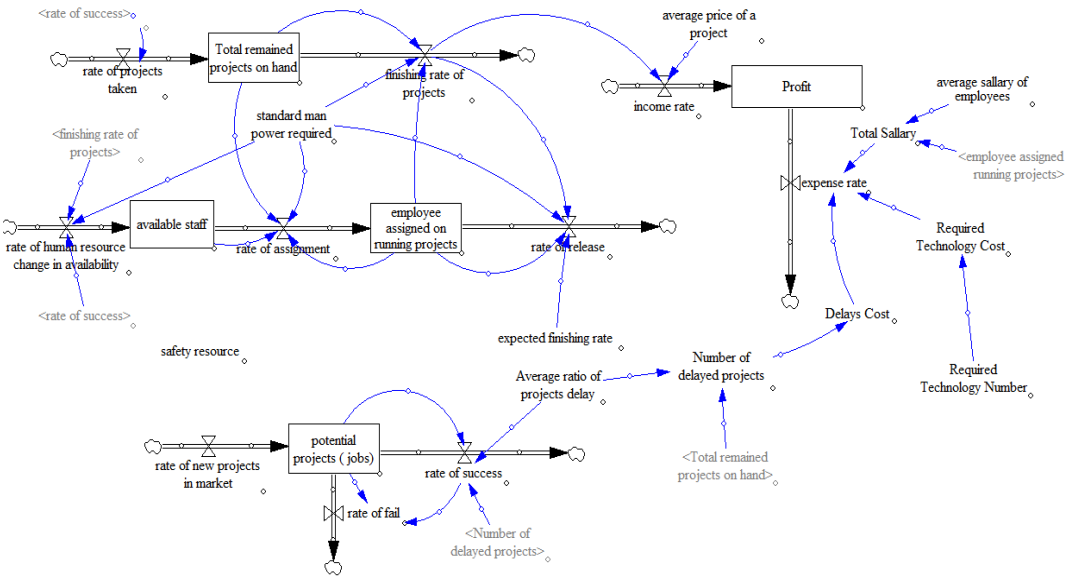
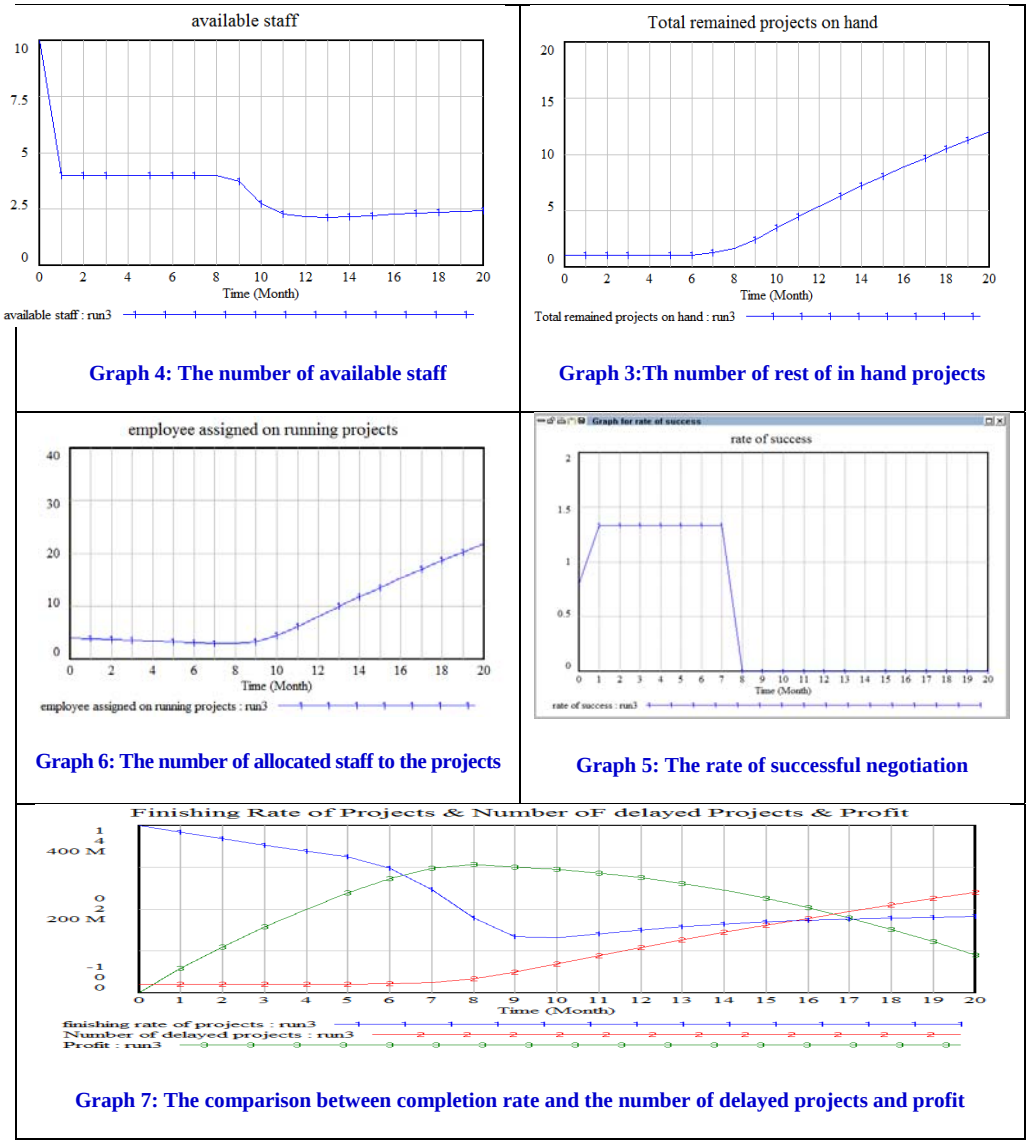


Figure 3: Graph of accumulation- flow model



Graph 4: The number of available staff

Graph 3:Th number of rest of in hand projects

Graph 6: The number of allocated staff to the projects

Graph 5: The rate of successful negotiation

Graph 7: The comparison between completion rate and the number of delayed projects and profit

Figure 4: The results of some model variables

Sensitivity Analysis

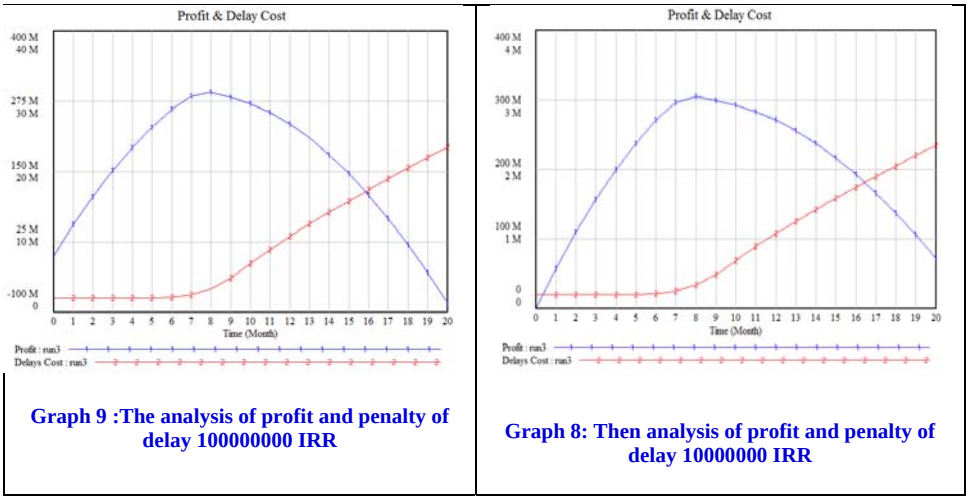
According to experts of the desired company and with focusing on that the projects' aim is gaining higher income and lowest delay in running project, for categorizing them and making decision about under negotiation projects in markets, two state variables such as profit and number of delayed project considered as a base for making decision in align with policy of project acceptation and successful negotiation about accepting certain available project in market. Also they took into for sensitivity analysis and observed model behavior of these variables.

Sensitivity Analysis on Delay Cost Variable

In this condition, in the first step delay cost variable selected and two limit values for this variable is considered and the result are shown in figure 5.

In the first chart, the lowest fine for delayed project is about 1000000 IRR and in the second chart, the highest value for fine is around 100000000IRR. It can be observed that in the first chart, enhancing of delayed projects affected on the amount of delay fine in positive way so it decreased the profit. Therefore, with this amount of delay cost, the volume profit at the end of twentieth month reached lower than 100 million Rial.

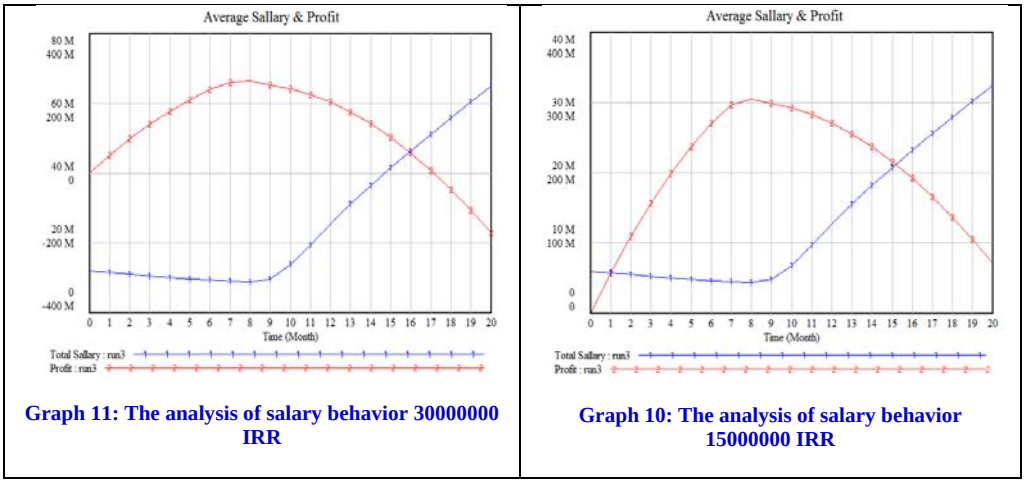
In the second chart, it is given that in highest level of delay cost, the amount of profit declined considerably so at the end of twentieth month there is no profit and company will have defeat. It is clear that numbered values can be different according to company's policy.



Graph 9 :The analysis of profit and penalty of delay 100000000 IRR

Graph 8: Then analysis of profit and penalty of delay 10000000 IRR

Figure 5: The analysis of the delay cost variable



Graph 11: The analysis of salary behavior 30000000 IRR

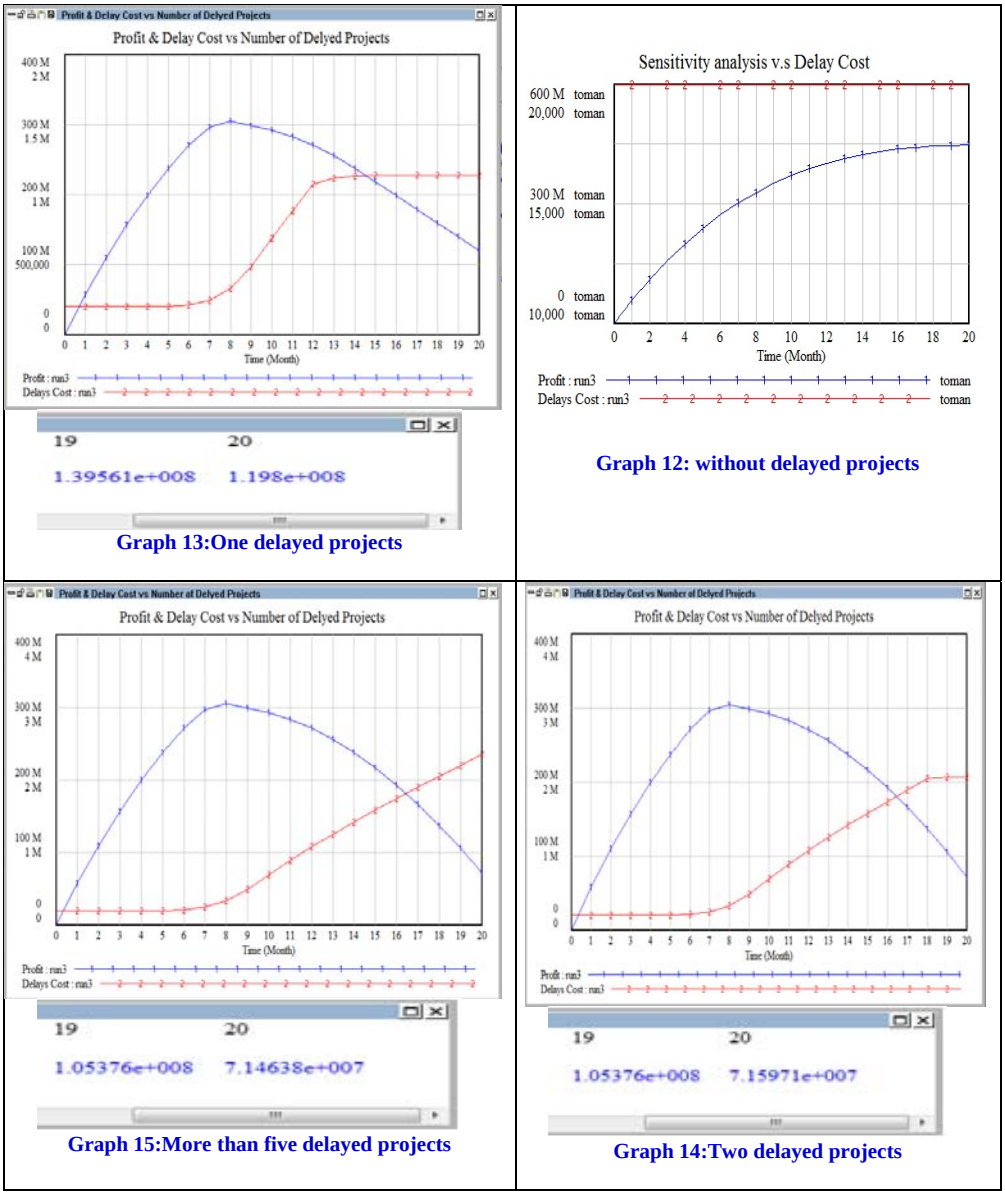
Graph 10: The analysis of salary behavior 15000000 IRR

Figure 6: The analysis of salary variable

Sensitivity Analysis on Workers Salary Variable

In next step, the salary of forces which company allocated into projects was selected for analysis to indicate how it made change in profit and how effect on final decision. It is shown in figure 6.

Clearly, in this graph by putting the value of 30 million IRR for each worker's salary, profit in compared with declined significantly to15000000 IRR. Even it is shows that the company near to twentieth month not only has no profit but also is affected.



Graph 12: without delayed projects

Graph 13:One delayed projects

Graph 15:More than five delayed projects

Graph 14:Two delayed projects

Figure 7: The scenario of improvement

Improve the Policy

Final purpose of modeling and learning process is designing improved policies which can make advance in system behavior. The new policies designed intuitively and tested for being suitable and challenging. The main goal of modeling the policies should make an improvement insight of quantitative model not just definite number for each certain scenario. Therefore, in this research the number of delayed projects considered as a critical factors which is a base for decision-making about accepting project in scenarios. These scenarios are shown in figure 7.

The final decision about accept or reject project can be taken by observing the effect of changes on factors such as profit, so the best policy can be selected which has effect on profit variable in accepting project. To determine the best policy from scenario, it should be noticed which one of them has optimal effect on desired variable that is profit. So in next step when new project entered into market, the company can take a suitable decision for these conditions. We choose the profit as a desired variable because it is critical for our target company. The graphs related to scenarios had shown in table above.

The Comparison of Different Scenario

With comparison of the graphs of scenarios and numbered value of them it could be said that even in a state with one delayed project, company will not accept new project, and in this situation profit increase during time. In other three states it can be seen that profit grew up to the certain time (eighth month); however, it will decline because of delayed project and the fine of it can effect on the cost of companies running projects. Graphs show that decline of profit in state 2, 3 and 4 are different and in a state which there is one delayed project the profit decreased less than the others states.

Finally, to determine which policy has best condition for accepting project till it can be considered as the best policy in the acceptance process, company observes the condition of variables like profit that is one of the determining variable in decision making and the effects which it accepts in different situation, can make decision for useful policy.

CONCLUSION

This research attempted to present a dynamic model in order to response to the results of different managers policies about resource allocation and help to improve managers decisions in accepting project for reaching desired goals in a better and optimum way.

Firstly, important and related factors identified from point of view of experts and managers in field of related projects accepting and marketing them has enough experience. In next step, it was explained the relation between these factors and variables and was recognized the way of effecting on together to understand problem carefully. With Knowing the relationship it can represent the cause circles and then the graph of relationship in form of cause and effect chart was drawn in Vensim software. After that, relation equations with considering the policy of company were determined. And in next step, after presenting the dynamic model of cause and effect for accepting project, factors were divided into three groups which were state, auxiliary and fixed variables and the graph of accumulation- flow of model has been shown according to relations and equations also with considering different situation of company's policy then it was entered to the model. After completing the relations between factors, model simulating has been done in Vensim software and result was obtained. In purpose of model validation, structural and behavioral test such as sensitivity parametric and validation test has been used according to expert opinion. With considering the sensitivity parametric test, sensitivity analysis has been done by changing some of the model parameters like amount of fine for delayed projects and amount of workers salary until the range of model sensitivity can be observed in different variables then the result of it was determined according to company's aim.

At the end, with presenting scenarios which include different policies such as taking decision for accepting or rejecting the projects when the number of delayed project effects on decisions, represent some solution to improve situation of project accepting which after that company can faced more professionally with market potential available projects and can take suitable policies and decisions to making better condition by accepting or rejecting the projects.

The main limitation of the present research is the lack of mature information. This research used information of past company projects and because of the importance and criticality of some projects. It is obvious that with all information of projects, more factors could be used. The other limitation that can be considered is the lack of time during the research. This research has many loops and is obvious that during developing more loops can be found and finally the model can be more explained.

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