*Interdisciplinary Description of Complex Systems* 16(1), 40-59, 2018

# A MODEL TO INVESTIGATE THE EFFECT OF WORK ETHIC CULTURE ON DYNAMICS OF REWORK IN MANAGEMENT OF PROJECTS

**Hossein Kiani[1], Seyed Hossein Hosseini[2,] * and Farshid Abdi[1]**

[1]Islamic Azad University (South Tehran Branch), School of Industrial Engineering
Tehran, Iran

[2]Model-based Management Systems Engineering Institute (SAMAM)
Tehran, Iran

DOI: 10.7906/indecs.16.1.3
Regular article

*Received:* 6 February 2018.
*Accepted:* 28 March 2018.

## ABSTRACT

The present study aims to investigate the effect of work ethic culture on rework in construction projects through a review of literature, surveys, and interviews with project managers. The main research question is what mechanisms can project manager use to balance the costs of personnel training, financial and language incentives, and implementation costs to finish the project with more profit and less rework. In this regard, modelling and data analysis is done using System Dynamics methodology. The results show that by considering work ethic, rework in the project is reduced from 46 % to 39 %. However, the project has been completed with 10 % lower cost and 26 % lower variance. Integrating the issue of rework with the culture of work ethic in the field of project management by at least one exogenous parameter has been studied, while in this study qualitative parameters have been converted to quantitative parameters using fuzzy inference system. The change in management approach to the issue of work ethics and the formulation of human resource strategies of large projects by human resource managers is one of the applications of this study.

## KEYWORDS

work ethic, system dynamics, rework, project management, construction

## CLASSIFICATION

JEL: C61, M12, M54, O22

*Corresponding author, $\eta$: s.h.hosseini@samamsystem.com; +98 912 6002275;
#7, No.2, End of the impasse of Qadir, after Habibollah st., Azadi st., Tehran, Iran

## INTRODUCTION

Project management is undoubtedly one of the most important and most used branches of management over the past decades [1]. Project management is a combination of "the art of collecting facilities and doing work by individuals in the formal and special organization" as well as "the science of producing and processing vast amounts of information for project planning and control" [2]. The first issue in project management is to ensure that the project is defined with specific constraints. The second issue, is to optimize the allocation of resources and to align the data needed to achieve the project's predetermined goals [3].

Project management is skills, tools and management processes required to successfully complete a project [4]. According to Figure 1, project management combines processes, tools, and skills, as described below.

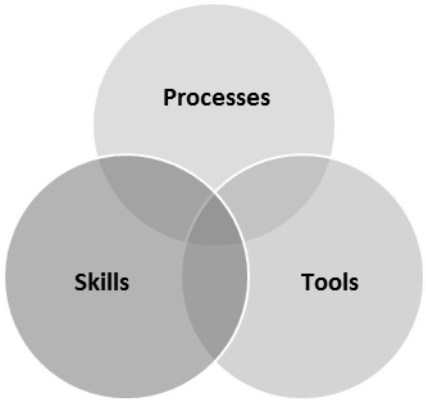


**Figure 1.** Project management components [4].

A set of skills: knowledge, skills and experience of specialists are needed to reduce the risk level of the project to increase the probability of success of the project.

A set of tools: various types of tools are used by project managers to improve their chances of success. Examples include templates, registers, planning software, modeling software, audit checklist and revision forms.

A set of processes: various processes and techniques are needed to monitor and control time, cost, quality and scope of the project. Examples include time management, cost management, quality management, change management, risk management and problem management.

Therefore, project management helps us ensure the achievement of project goals and plans, organizes, monitors and controls the necessary resources and tasks for project implementation, such as people, money, equipment, operations, and time of project implementation [5].

Given the role of human resources in all of the above three groups, when it comes to the principles of project management, it is usually the human resource management (HRM) [6]. Approach and perspective of the HRM is regarding the development of human resources to use this force to improve team performance of projects and build the competitive advantage of the organization. Therefore, planning and developing human resources (HRs) of projects is an essential part of HRM in the construction industry. HR planning has been recognized as an important method that focuses precisely on project performance. HR planning generally involves setting formal goals, appropriate strategies and searching for the use of creative HR [7].

An organization's HRs include everyone employed in a job, regardless of the role they play in the organization [8]. The role of HR in the progress of companies active in the construction and urbanization industry is a central role [9]. Nowadays, changes in the construction and urbanization industry increase, which requires more attention to targeted planning for HRM [10].

Human resource management is directly related to the organization's human resources. These forces contribute to the goals of the organization. If this relationship is a healthy and effective relationship, then this organization will definitely achieve its goals. And if this relationship is based on unethical behavior, then its effects and consequences will prevent the organization from achieving its goals. Therefore, HRM should combine ethics with today's laws to develop work ethic culture in the organization so that it does not encounter any problems in its movement and production and achieves strategic goals by establishing an effective relationship between HR managers and employees of the organization [11].

Managers must ethically create an atmosphere or a healthy environment for employees so that they can increase their production and do not get into trouble in terms of good behavior [12].

Today, many countries in the industrialized world have grown mature, disregarding ethical issues and fleeing social responsibilities and obligations, leading to the disappearance of the firm [13].

Such attention might be attributed to the fact that work ethic, in particular, is believed to reflect an individual's attitudes towards various aspects of work, including preference for activity and involvement, attitudes toward monetary and non-monetary rewards, and the desire for upward career mobility [14].

The importance of this research can be considered from a number of perspectives:

- first, from the point of view of the literature of the subject, on which no specific study has been done so far,
- the next perspective that is examined is construction industry,
- from another perspective, the importance of this research is considering the upstream documents of the country.

Love et al. conducted a study titled "determining the causal structure of rework influences in construction" and examined the effect of rework in construction projects with a simple system dynamics model [15].

By studying the research on the subject of rework in project management using the system dynamics methodology, it is found that combining these topics with the culture of work ethic that is related to the humanities and social sciences is examined in a superficial way with just an exogenous parameter. In other words, the issue of making the qualitative issues of project control quantitative has not been addressed so far, for which fuzzy methods can be used. In this research, it is tried to do this with the present research gap.

Since the problem occurs in the context of a complex system, while different cultural and social, economic, and technical factors are influencing, in this research, system dynamics methodology is utilized to model different dynamics affecting the problem. System dynamics has the ability to include quantitative and qualitative factors in form of causal loops and it simulates the behavior of model varibles during the sinulation time. The methodology has been used to investigate complex problems in various field like unconventional oil technology development [16], wind power development [17], oil production [18], production systems [19], climate [20], project management [21], agriculture [22], brian drain [23], social networks [24], etc.

According to the above, the subject of this research is to present a model for the study of the culture of work ethic in the management of Iranian rework in construction projects (because the culture of different nations is different in terms of work ethics and self-control), in which the problem of rework is addressed using a System Dynamics on the basis of discussion of responsibilities and social obligations, i.e. the standard ISO 26000 and SA 8000 (social responsibility) workspace [25]. Research results may also apply to any other construction project, such as a refinery, but the scope of the present work is a building construction project.

External factors such as changes in the scope of the project make it difficult to achieve the project's goals, but the internal dynamics of the project also reduce the ability of project managers to control the project and can defeat a project. A typical example of the internal threats of the success of the project is described as "rework" [26]. Rework is one of the main causes of excessive cost and scheduling [27], which can indicate increasing percentage of progress by a continuous increase in unfinished tasks of the project, while a decrease in the percentage of progress has been achieved that leads to a final failure [28].

Many complex projects, including nuclear power plants, fail due to their delivery time and budget. For example, the construction of the first generation of nuclear power plants in the United States had an average of 239 % variance from its program and experienced an average of 338 % cost increase [29], which is shown in Figure 2.

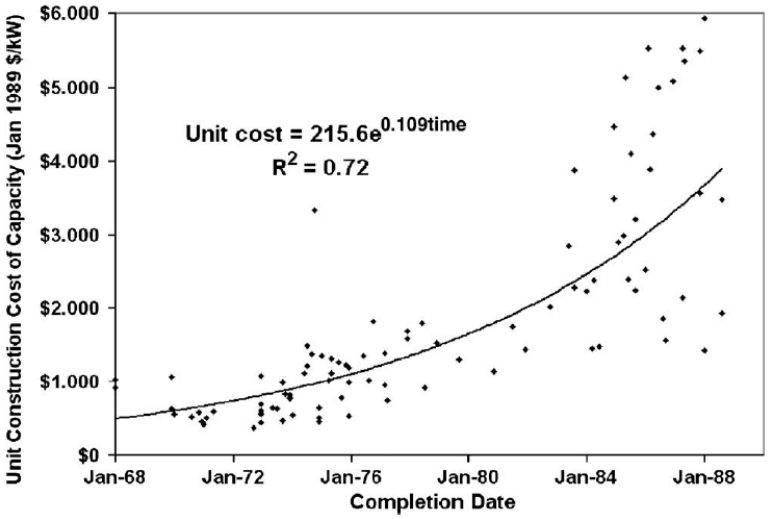


**Figure 2.** The costs of constructing the first generation of the US nuclear power plant [29].

After reviewing the literature, in Section 2, the research methodology is described. In Section 3, the impact of the work ethic culture on rework is addressed with a systematic approach by providing the definition of the problem, the dynamic hypothesis, the subsystem diagram and the causal loops diagram. In Sections 4 and 5, discussion and conclusion are presented.

## RESEARCH METHOD

Initially, through the study of papers and research on project management and HR rework as a factor in project management failure, factors affecting work ethics culture were identified. Then interviews were conducted with the research population, i.e. project managers, senior executives and senior experts as project experts. In the next step, the data was collected and the modeling was done using the System Dynamics (SD) methodology and, finally, the outputs were obtained. Figure 3 illustrates the steps and problem solving tools in SD.

System Dynamics was first introduced by J. Forrester [30] at MIT as one of the first responses to research weaknesses in operations and other management science techniques. From Forrester's point of view, the research modeling techniques in the operation are only able to have a limited number of variables in a system, and on the other hand, the relationships between these variables are seen linearly. Forrester had a subjective mindset of electrical circuits and servo-mechanisms. He used his knowledge of the theory of feedback control and the use of modern computers to develop methods for modeling and analyzing problems in complex systems. This approach focuses on the dynamic and systemic behavior of the system, and has been developed based on the results of previous studies by Tustin [31] about electrical and mechanical control systems.

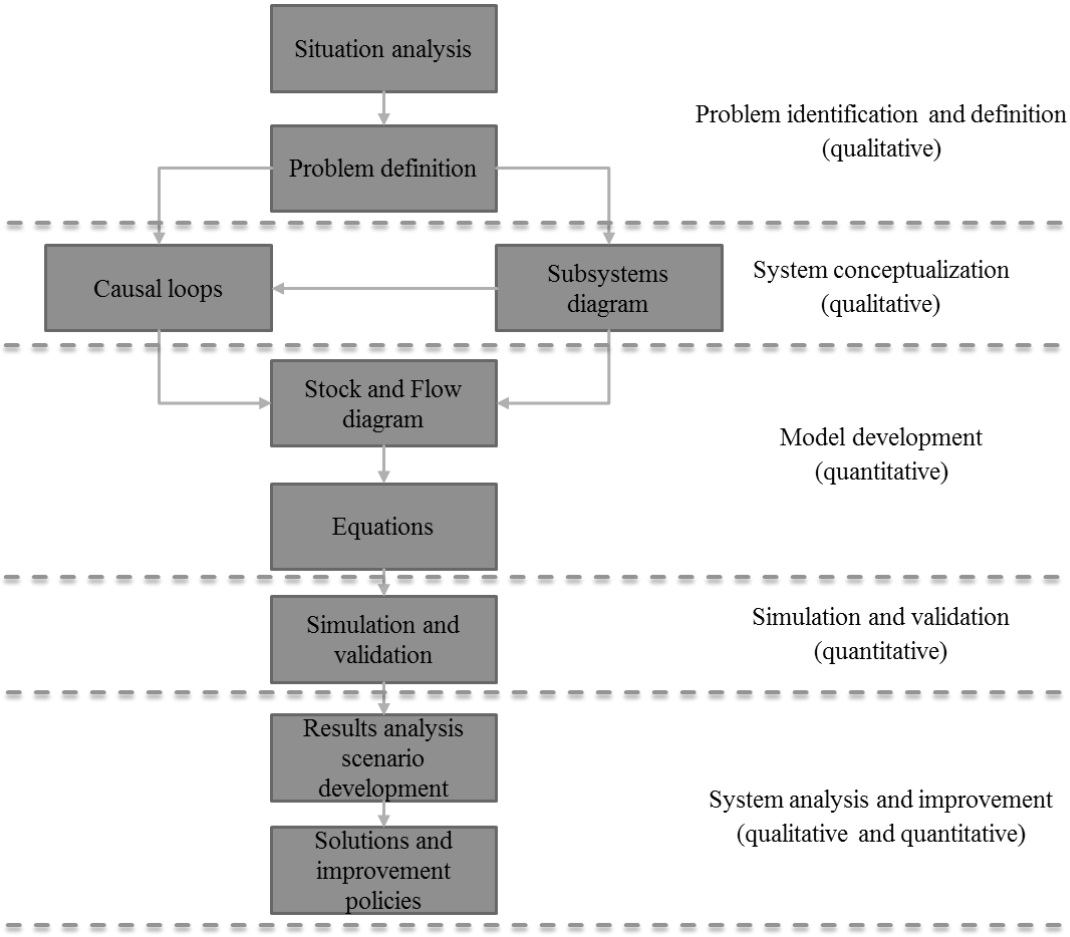


**Figure 3.** Problem-solving steps and tools in SD.

## MODEL OF SYSTEM DYNAMICS OF THE EFFECT OF WORK ETHIC CULTURE ON REWORK

There are many influential factors in the project management system that have dynamics over time. The major processes affecting this system are the total work done in the project, the remaining work, the work done, and the confirmed and done work. Some of the existing dynamics include productivity, fatigue, overtime working, progress rate, project deadline, expected time, project completion, required manpower, project cost, etc.

Table 1 shows the model boundary chart. The main variables of the model are divided into three categories of endogenous, exogenous, and exceptional.

Endogenous variables are variables whose dynamics are created within the boundaries of the model and the exogenous variables are variables that are externally entered into the model [32]. Exceptional variables are variables that have been studied in literature studies and interviews with some building industry experts, but have been eliminated from the final model due to some limitations such as the lack of officially published statistical data, the politicality of decisions, and so on. These main variables are introduced in Table 1.

### DYNAMIC HYPOTHESIS

The dominance of work ethic culture in construction projects, influenced by motivating factors such as education, financial incentives and language incentives and taking into account the level of education and knowledge and other quantitative social indicators, causes active human resources in the project employ their ability, talent and expertise not only

**Table 1.** Model boundary chart.

| Endogenous | Exogenous | Exceptional |
|---|---|---|
| **1. Remaining work** | 1. The project deadline (contract) | 1. Changes in the project scope |
| **2. Work rate** | 2. Delay in getting hired | 2. Changes in project timing |
| **3. Work done** | 3. Man hour / activity | 3. Changes in project budget |
| **4. The whole work done in the project** | 4. Overtime working | |
| **5. Verification level of work** | 5. Amount of remaining initial work | |
| **6. Confirmed done work** | | |
| **7. Rework rate** | | |
| **8. Total rework rate of project** | | |
| **9. Number of manpower** | | |
| **10. Project cost** | | |
| **11. Employment rate** | | |
| **12. Quality of work** | | |

without any control, but although voluntarily in order to achieve project goals, which will reduce the rework of the project, followed by increased project progress, lower cost and higher quality.

The quality of work done in rework in construction projects is very important, so you can expect a successful project by supporting or assisting the workforce in the project. Some of the auxiliary factors are: adequate funding, facilities and equipment that are suitable for doing work [33]. Utilizing human resource talent, creating a climate of ethics and commitment, sharing workforce in productivity, motivating through incentive and punitive factors, establishing healthy relationships between project manager and labor force, and etc. are the prerequisites for the impact of ethic on quality and rework reduction [34]. For example, if there is a good or high investment in human resources education, considering the advancement of technology, the cost savings will eventually be reduced. Project management can morally make the work force to do tasks in an optimum level by creating an ethic charter. It is necessary to note that the characteristics of encouragement and punishment vary in various steps from design to the end of the project. That is why it is seen in the operational phase of the project in the current research.

In the process of increasing motivation, we also see these issues as motivation stimulates people and encourage them to work more effortfully. Workers who have a strong motivation feel more committed and happier in their work. Motivated people are affected by a variety of factors. Each person has basic needs such as food and shelter, which can be obtained by paying money. However, there are many different factors that motivate people. A creative environment can be very stimulating. By empowering people, they can be promoted to improve the process. With more motivation, more work is done to achieve the required results. These people feel that their work has exceptional features. Hence, they are proud of it. So even the amount of absenteeism is very low. For example, if a worker who has the responsibility of a wall drain feels more loyal by reference to his ethics, that wall will be better prepared to carry out other thinning operations. In this place, the needs of individuals are being met by training and encouraging and establishing work ethics.

At the beginning of the project, the project manager has to spend on personnel training to get more profit at the end of the project, while most project managers are unaware of this. In this study, we want to examine rework reduction with the consideration of work ethics and

without its consideration. In this regard, Figure 4 shows the hypothesis of this study in the form of a reference mode for this system. In the presence of work ethic improvement policies, although the organization has incurred more costs at the beginning of the project, but more savings is experienced and the total cumulative cost of the project will be less at the end of the project. In this study, we will examine this behavior by creating a dynamic model.

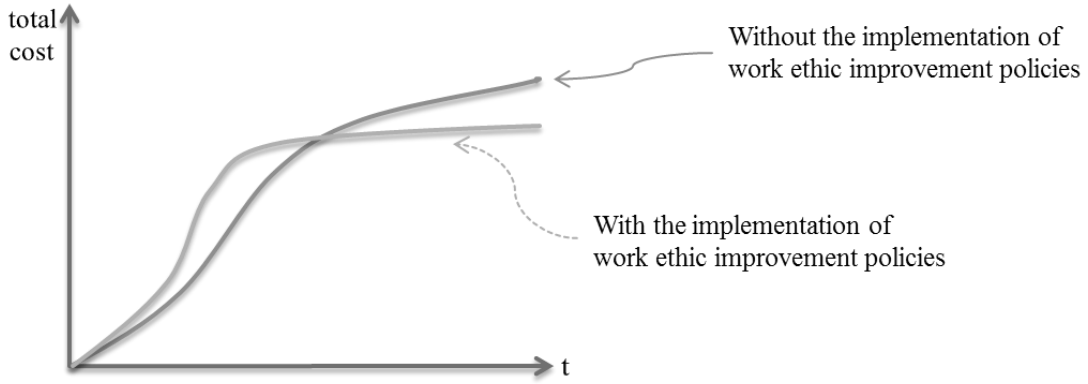


**Figure 4.** Reference mode.

## SUBSYSTEMS DIAGRAM

Figure 5 shows the subsystem diagram of the system under study. The work subsystem operates by carrying out activities related to work ethic, the quality of work, and the amount of investment and allocation of funds, and provides the remainder of the work to the human resources subsystem. On the other hand, it provides the cost and income information to the financial subsystem. The human resources subsystem also delivers cost information to the financial subsystem, and it also plays an essential role in the prosperity of work, human resources and management subsystems by investing in these three subsystems.

The quality of the project, which is influenced by the percentage of work ethic (which is itself a function of normal work ethic, financial and language incentives, and knowledge maturity) and the fatigue caused by project progress variances, is the amount that the project's existing profiles meet its needs. Project quality management includes all stages and sections of the project including the initial definition of the project through project processes, project team management, delivery and project closure.

## THE CAUSAL LOOPS DIAGRAM

Figure 6 illustrates the causal loops of the study system. One of the influential factors in drawing up the causal loops is their simplicity and comprehensiveness. Therefore, only the main causal loops are shown in the following figure, and further details will be given in the stock and flow diagram. In the following, we explain the causal loops of the system that generate the system's main behavior.

As shown in Figure 7, the first loop is called the "Percentage of Normal Work Ethic" loop. As the percentage of variance in the project increases, work ethic increases depending on the cost of the allocated training budget, the project diversion rate and the percentage of rework, as well as financial and language incentives [35]. This increase will increase the quality factor and the effective man hours of the project and will increase the work rate. This will increase the work done. On the other hand, reducing the variance reduces the training budget, which means that there is no need to allocate training budget uniformly throughout the project. So, it can be said that the increase in costs is temporary, and by strengthening work ethic, we will eventually see a reduction in costs on one side, and an increase in the progress of the project, which will result in a reduction in the level of rework.

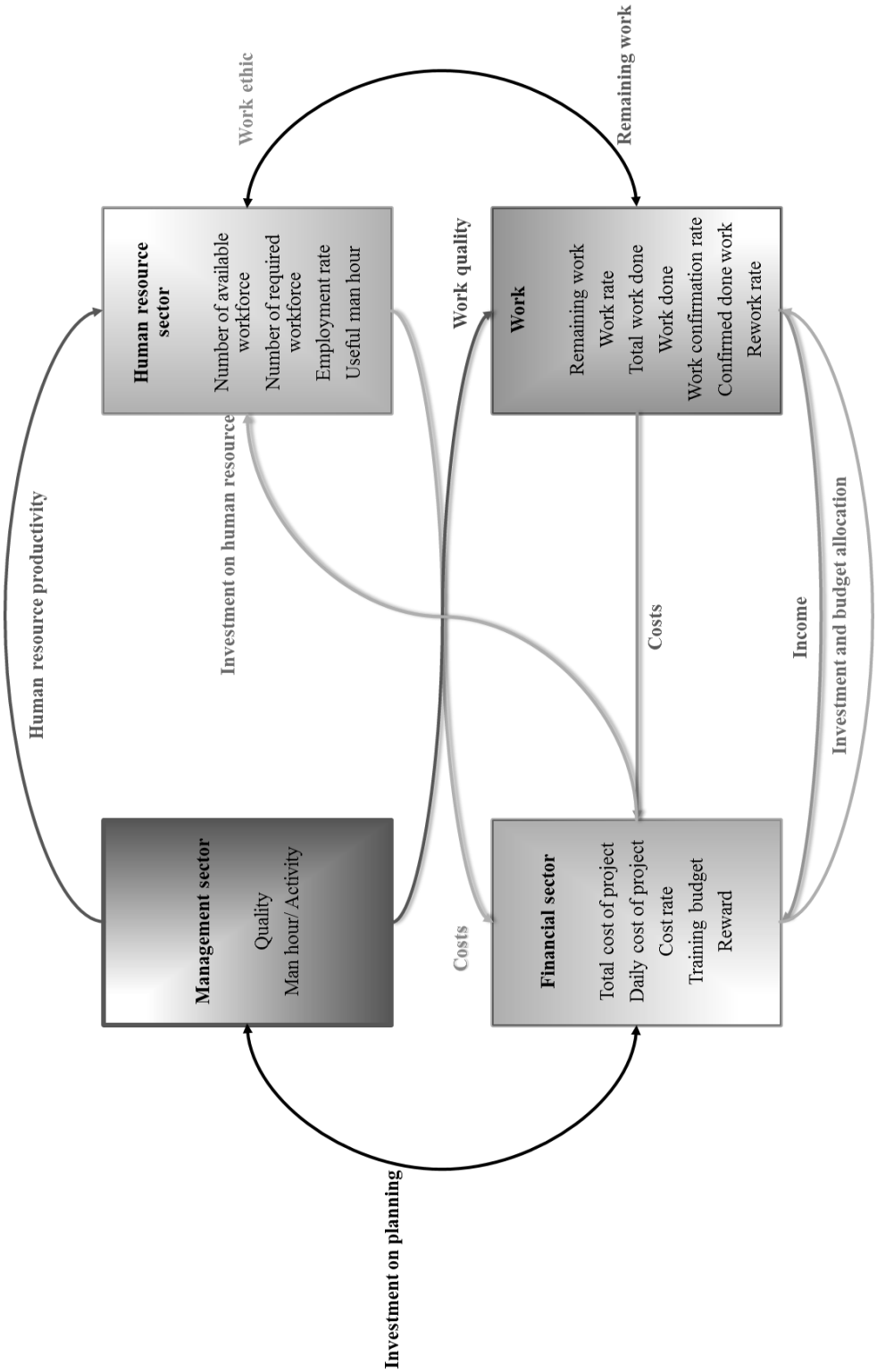


**Figure 5.** Subsystems diagram.

As shown in Figure 8, the second loop is called the "percentage of variance" loop. By reducing the percentage of actual progress, influenced by the approved work and the initial remaining work, the percentage of the variance that is the index of project variance from the scheduled plan, increases relative to the percentage of program progress. Consequently, the level of work-related fatigue increases as the project takes longer [36], which reduces the quality of work.

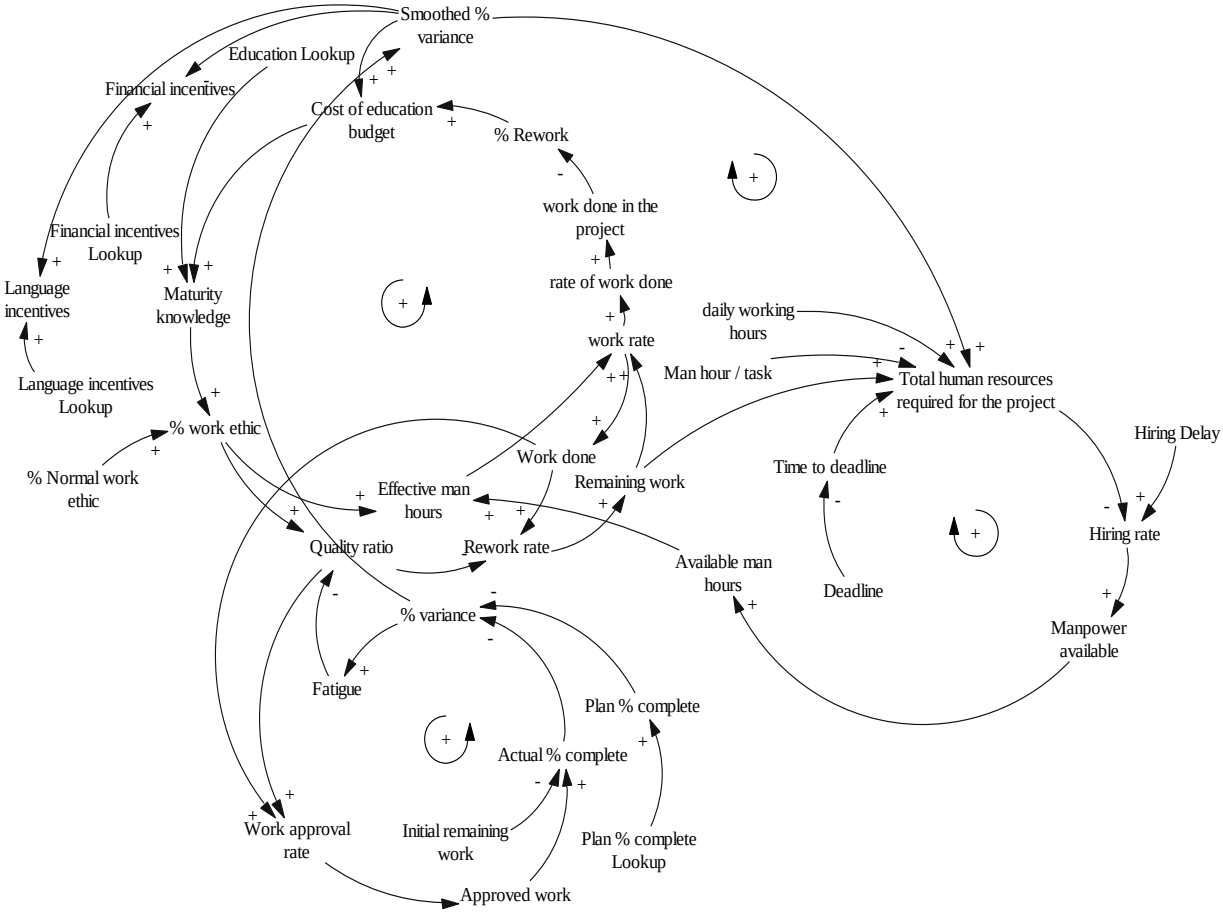


**Figure 6.** Causal loops of project management rework system.

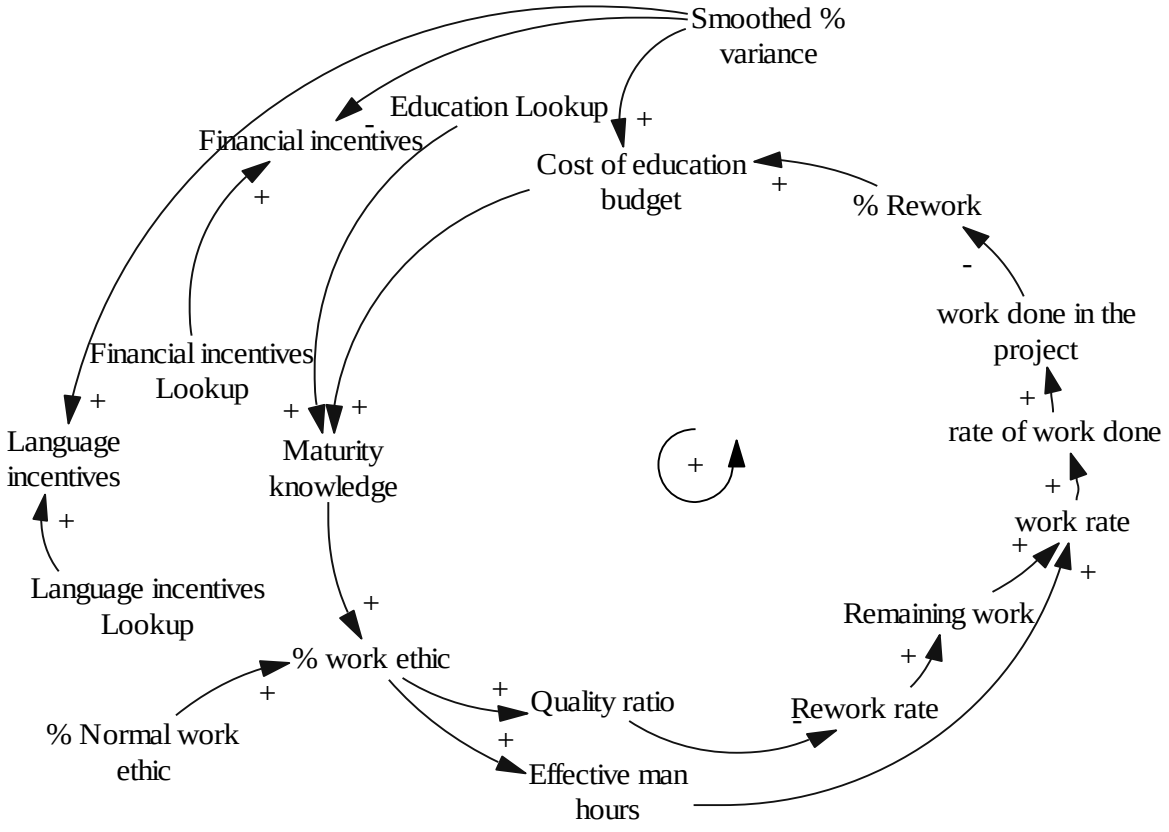


**Figure 7.** Causal loops – percentage of normal work ethic.

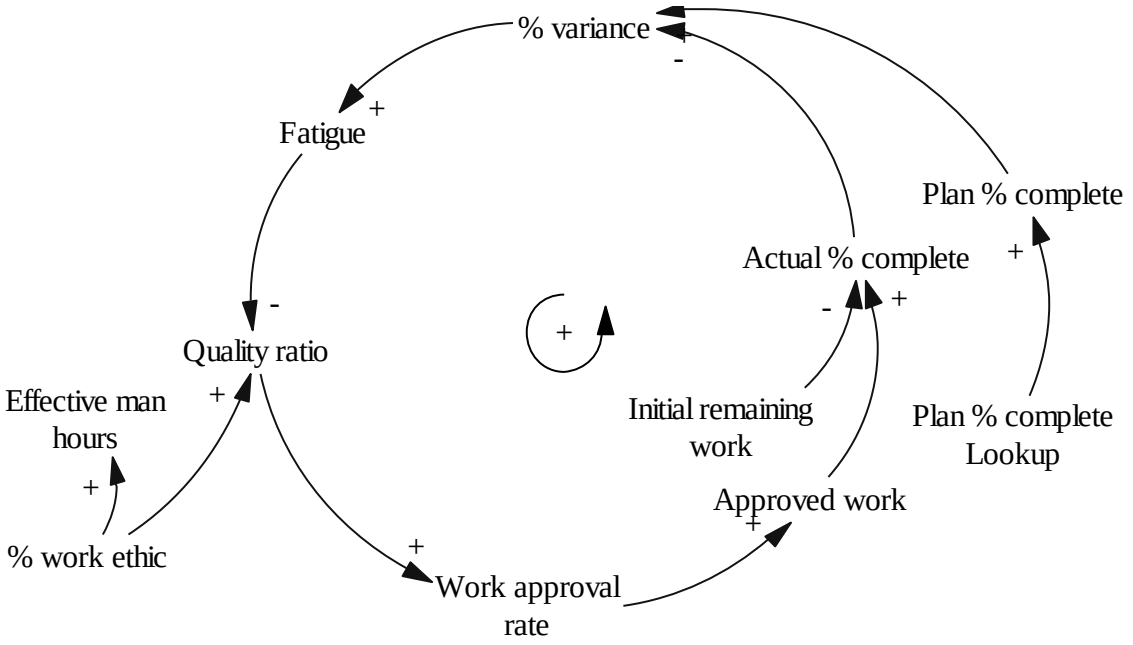


**Figure 8.** Causal loops – percentage of variance.

As shown in Figure 9, the third loop is called "manpower hiring" loop. As the project completion time increases relative to the contract deadline, actual progress is reduced and the project variance increases. In such a situation, there are many remaining work in the project, which necessitates the hiring of the required manpower, while taking into account the hiring time limit to compensate for the time and progress of the project.

The next section discusses the assumptions that have been used in modeling. The main reason for the limitations is the lack of quantitative information. Therefore, in some cases, it is tried to use appropriate and close approximations using the organization's expertise in the case study body.

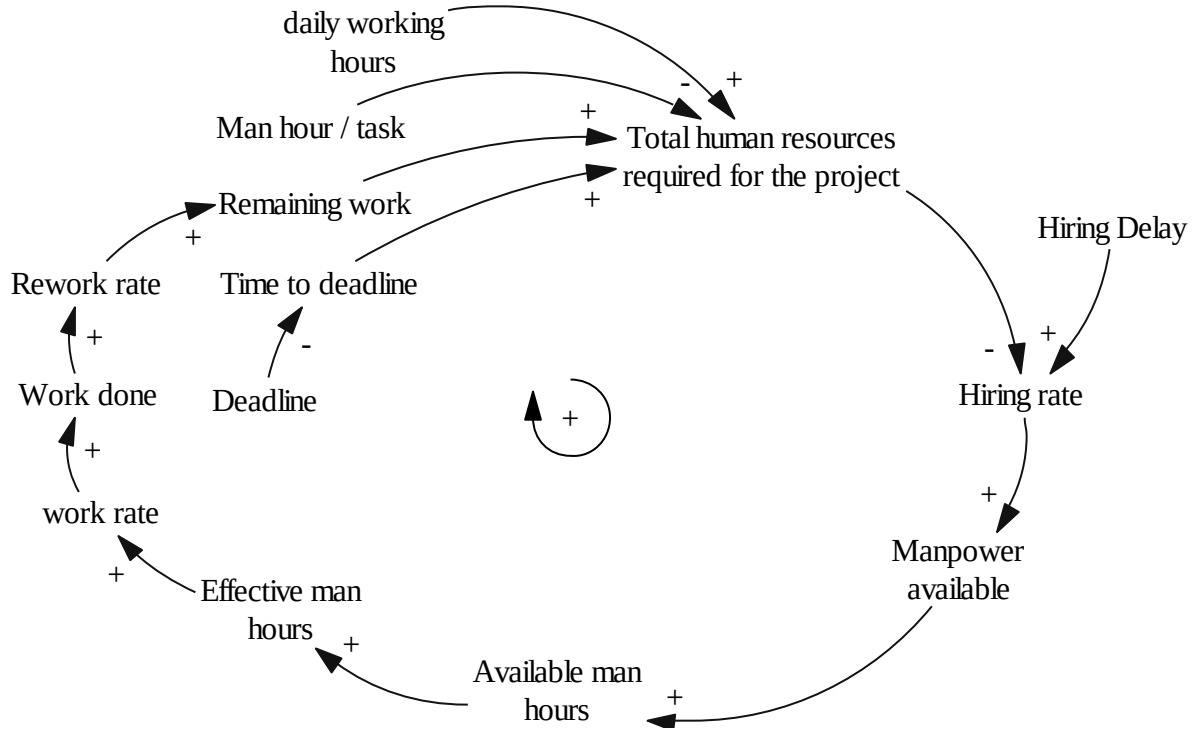


**Figure 9.** Causal loops – manpower hiring.

## STOCK AND FLOW DIAGRAM

Figure 10 shows the stock and flow diagram of the overall results of simulation of the project management rework System Dynamics model. This model consists of 6 level variables, 6 rate variables and 35 auxiliary variables (which include coefficients, exogenous variables, and correction variables of units of equations).

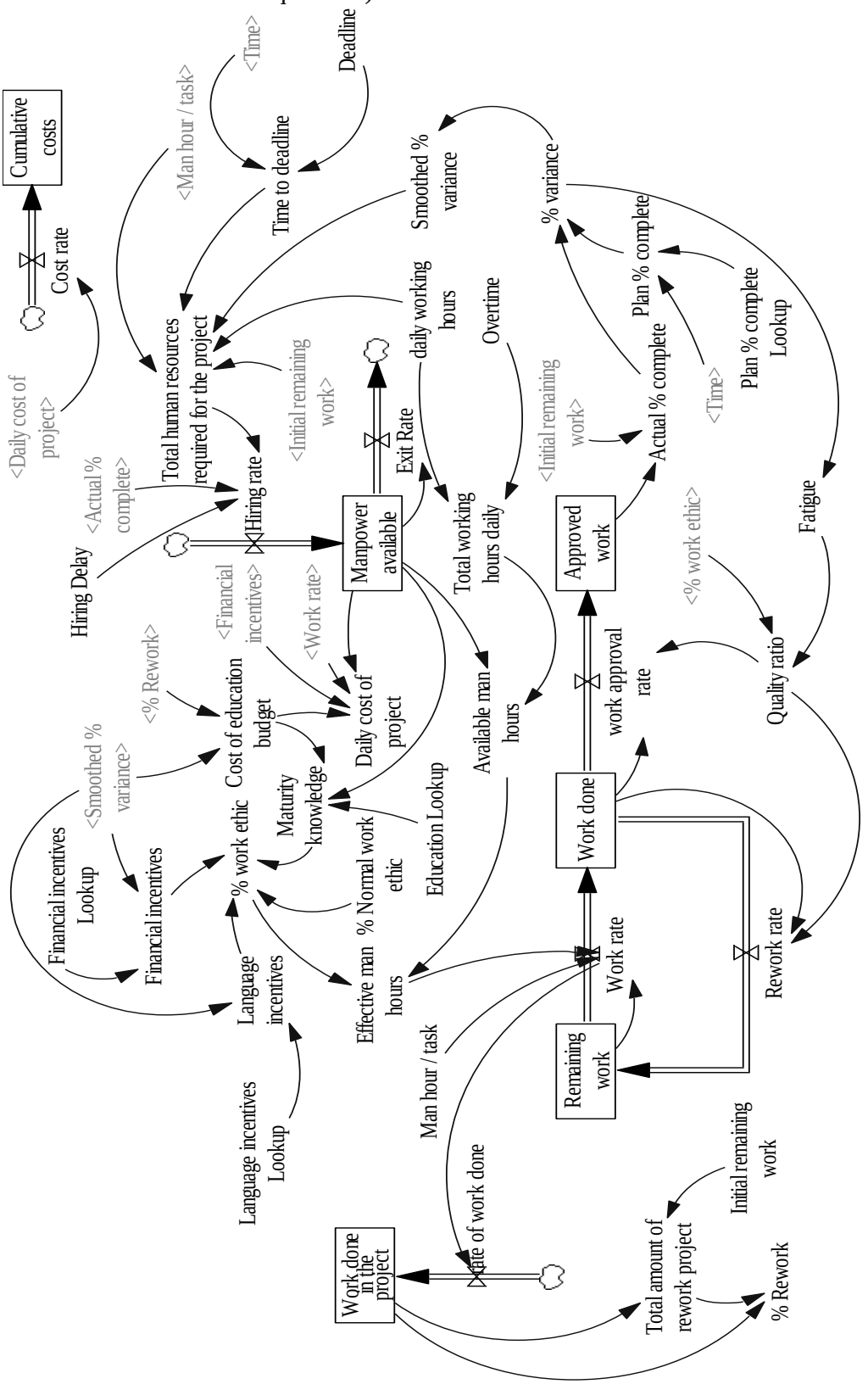


**Figure 10.** Overall results of simulation.

## RATES

### Work Rate

As shown in Figure 11, factors affecting the determination of work rate are remaining work, effective man hour, and man hour/activity.

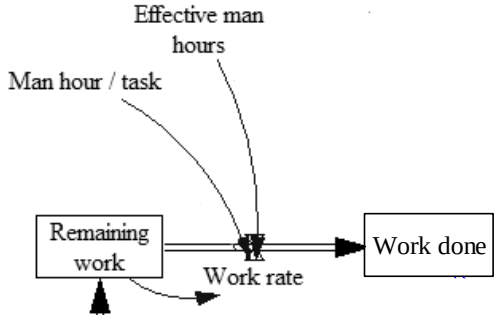


**Figure 11.** Stock and flow diagram – work rate.

### Approved Work Rate

As shown in Figure 12, approved work rate is obtained by multiplying quality ratio by work done.

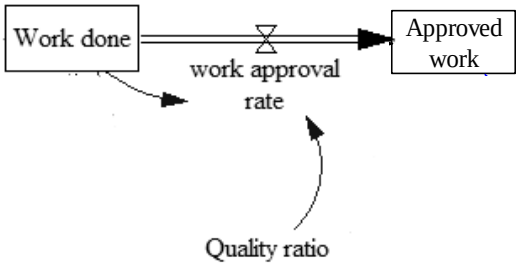


**Figure 12.** Stock and flow diagram – approved work rate.

### Rework Rate

As shown in Figure 13, rework rate is obtained by multiplying quality ratio by work done.

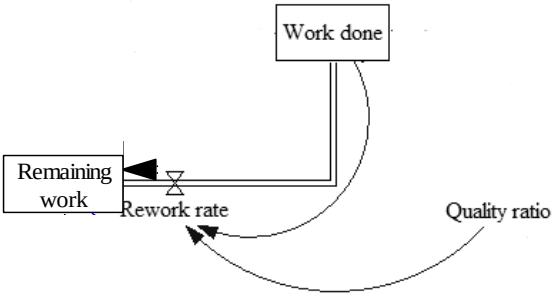


**Figure 13.** Stock and flow diagram – rework rate.

### Hiring Rate

As shown in Figure 14, hiring rate is affected by actual progress percentage, total manpower required, and hiring delay. Therefore, considering hiring delay, if the actual progress percentage is 50 %, 70 %, 80 %, and 90 %, then 2; 1,5; 1 and 0,5 people would be hired, respectively.

### Percentage Of Work Ethic

According to Figure 15, the percentage of work ethic is influenced by the constant coefficient of normal work ethic and three parameters of knowledge maturity, financial incentives and

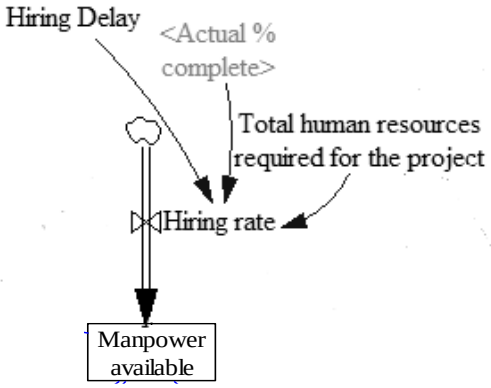


**Figure 14.** Stock and flow diagram – rework rate.

language incentives. All of the three parameters are qualitative parameters, which is why they have been converted into quantitative variables using the Fuzzy Inference System in MATLAB software and the mamdani type. First, the input and output variables and their range were determined (Except for the financial incentive input because of the punitive factor; if the percentage of rework that is in the range of -1 to 1 is high, other factors are defined in the range of 0 to 1).

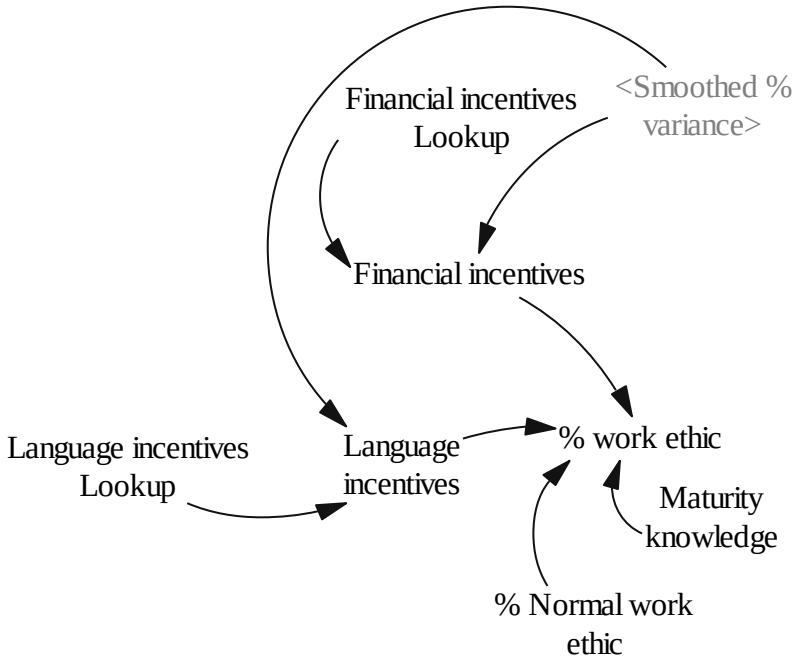


**Figure 15.** Stock and flow diagram – percentage of work ethic.

## Quality Ratio

As shown in Figure 16, work quality ratio is affected by fatigue caused by project variance and work ethic. These two parameters are qualitative and have been converted into quantitative type with the help of fuzzy inference system.

## MODEL VALIDATION

In this model, the adequacy of the boundaries was checked through expert opinion.

Regarding the meetings held with experts in the development of the model, the model is clearly compatible with what is happening in the real world in terms of the evaluation of the structure and the parameters. There is also compatibility with similar models in the literature.

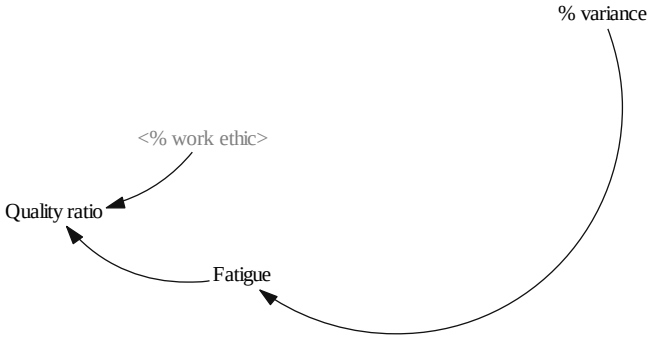


**Figure 16.** Stock and flow diagram – percentage of work ethic.

In the end-test, as shown in Figure 17, if the daily working hour parameter suddenly changes from 6 to .5 hours, the percentage of project progress after the end of 3 years will fall from 100 % to 39 %.

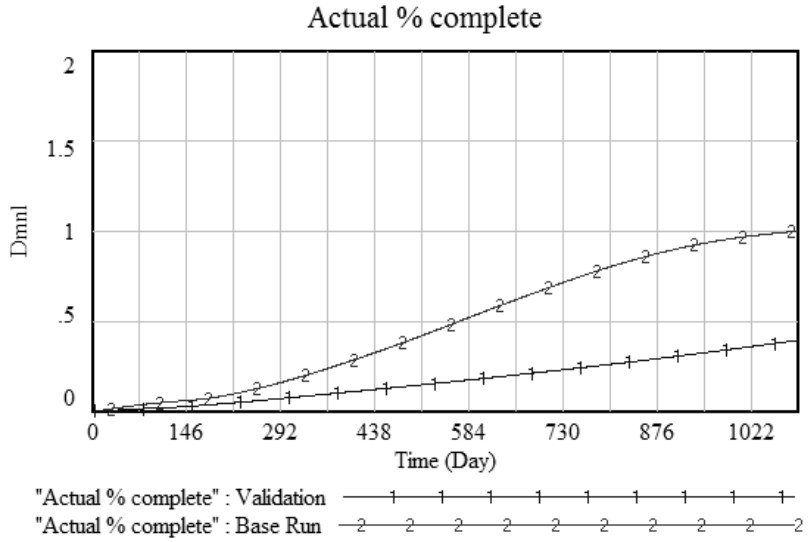


**Figure 17.** Validation – end-test – progress percentage.

In the study, there were no definite historical data, but in order to reproduce the behavior using simulated values, as shown in Figure 18, the model behavior had a perfect match with that mentioned in reference mode (Fig. 4).

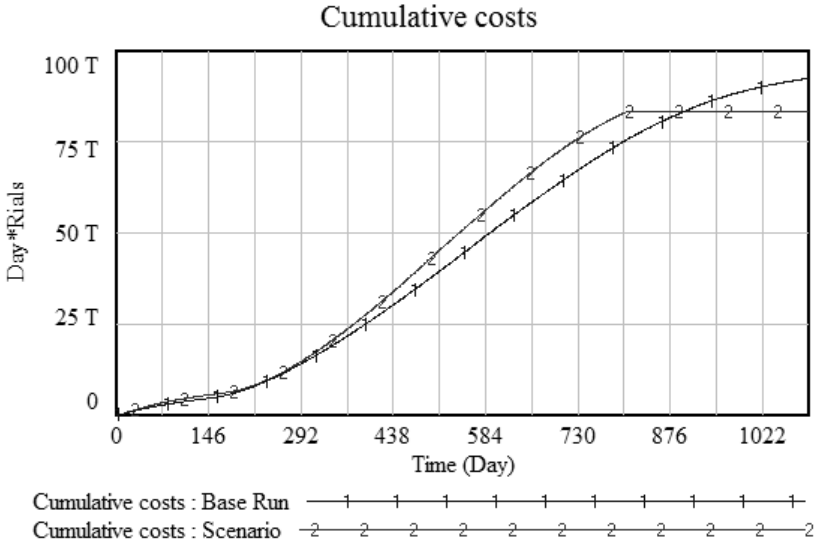


**Figure 18.** Validation – behavior reproduction test – costs.

# SIMULATION RESULTS

## SIMULATION RESULTS IN THE BASE MODE

Figure 19 shows the work rate behavior. According to this figure, the model has been able to produce work rate behavior. On the peak, 2,67 works are done per working day.

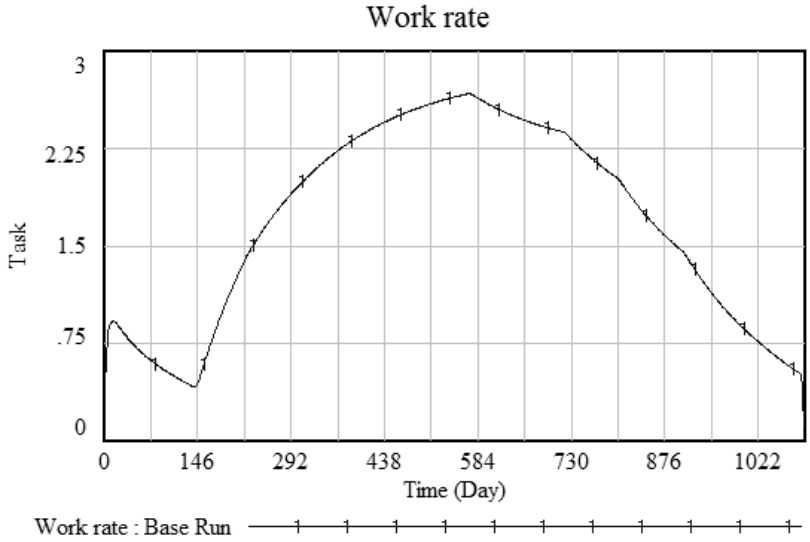


**Figure 19.** simulation results – in the base mode – work rate.

Figure 20 shows the rework rate. According to this figure, on the peak, 1,67 reworks are done per working day.

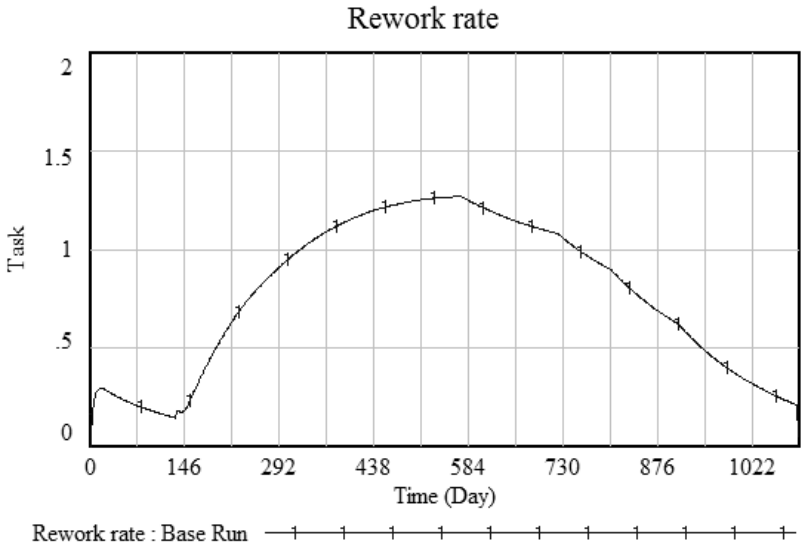


**Figure 20.** simulation results – in the base mode – rework rate.

Figure 21 shows hiring rate in the base mode. Hiring rate varies depending on the actual progress rate that is itself affected by project variance and hiring delay in different time periods.

## SIMULATION RESULTS UNDER IMPROVEMENT SCENARIO

The findings showed that, with special attention to work ethic as can be seen in Figure 22, the work rate increases. This means that effective work force performs more activities during daily working hours, and the maximum number of activities performed from 2,67 in the base mode increases to 3,17 under the improvement scenario.


**Figure 21.** simulation results – in the base mode – hiring rate.

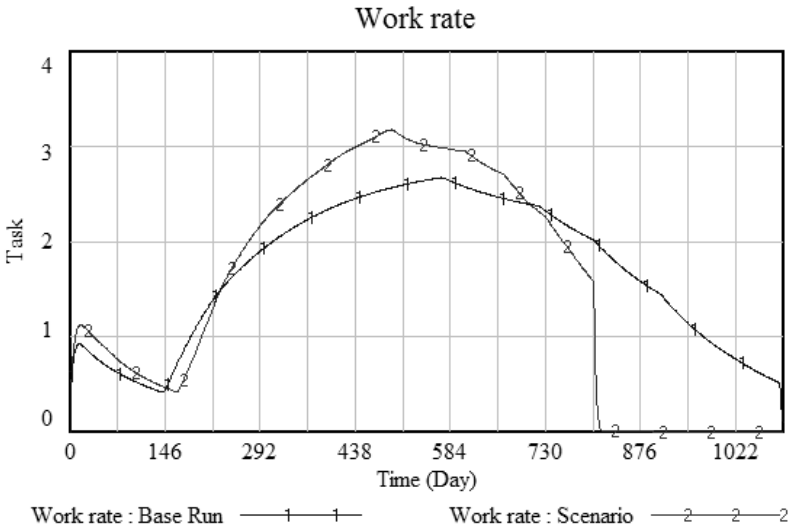


**Figure 22.** Simulation results – in the base mode and improvement scenario – work rate.

Figure 23 shows that except for a short period, rework rate has decreased during the project.

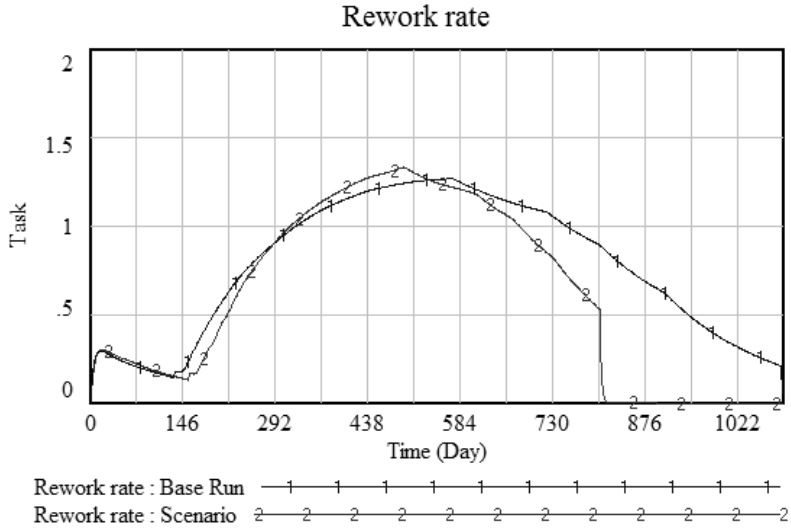


**Figure 23.** Simulation results – in the base mode and improvement scenario – rework rate.

As shown in Figure 24, hiring rate has significantly decreased in the simulation under improvement scenario compared to the base mode.

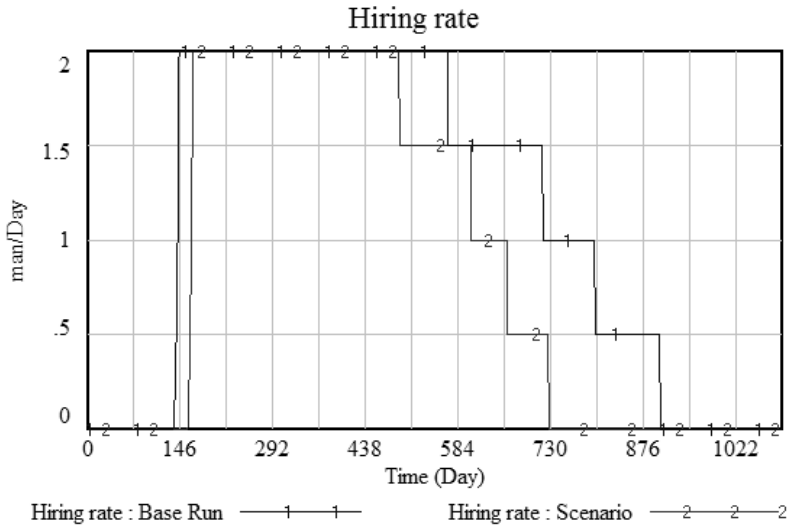


**Figure 24.** Simulation results – in the base mode and improvement scenario – hiring rate.

## DISCUSSION

Regarding the model investigation and information analysis, it was found that the impact of the work ethic culture on rework in construction projects cannot be ignored. Managers of large projects can better manage project costs and time by allocating budgets to training and financial and language incentives. It seems that this solution has the ability to be generalized to other projects in non-construction fields after the need-assessment and identification of the problem, and the concept of this research can be used to achieve desirable results in other sciences, including the humanities and engineering. The dynamics presented in this study through expert opinion were selected as items and main variables.

Based on the causal loops that their impact mechanism was described, it can be concluded that if the percentage of project variance increases, work ethic increases by increasing the training budget depending on the degree of project variance and the percentage of rework, as well as financial and language incentives. With this solution, the quality of the desired work, which is one of the project management strategies, is realized. Also, the causal loops emphasize that fatigue due to the prolongation of the project reduces the quality of work, so in order to cope with this problem, we should seek a solution to reduce the time variance in the project. In this study, the suggested strategy considering the dynamics and existing loops is to strengthen work ethic. Hiring manpower was also suggested as a solution to compensate for delays in the time table.

The results of the study in the base mode indicated that despite the financial rewards, language incentives and costs for training and upgrading the personnel knowledge, the maximum level of work ethic was 65 % during the implementation of the project, but after simulation, if the budget is allocated to training and financial incentives, it can also be expected to maximize the growth of work ethic by 86 %. In addition, the total cost in the improvement scenario is reduced by 10 % compared to the base mode, and the 730-day project (2-year-olds) is scheduled to reach 100 % completion over the course of 823 days, while this number is 1095 days in the base mode (3 years). This means that the cost of the project, which is affected by the daily cost of the project, is maximized with the application of work ethic policy. However, because of the completion of the project in a shorter time period, it actually leads to a significant decrease, which confirms the dynamic hypothesis of the research.

## CONCLUSION

The dynamics of the construction industry is one of the most important factors in the development of economic activities. Therefore, this industry is very important in economic development. Due to this importance, the research was carried out on the impact of work ethic on the degree of rework in the construction industry. In this study, it was investigated to see whether increasing the cost of training and incentives and, consequently, motivating people to strengthen work ethic could improve the cost performance and project time.

The results of the research showed that despite the financial rewards, language incentives and costs for training and upgrading the personnel knowledge, a significant level of work ethic cannot be considered, but after allocating budget to training and financial incentives, it can also be expected to maximize the growth of work ethic. In addition, the total cost is reduced and the project ends in a shorter period. The present research can be the basis for planning human resources in the field of project control and identifying the major human resources strategies in the field of human resource management in projects because construction industry planning is known as a complex system with high effective factors. The limitation of the lack of quantitative information prevented further development of some parts of the model. Therefore, in some cases, it was tried to use appropriate and close approximations using the organizational expertise in the case study body.

The purpose of this article was to study the effect of work ethic culture on rework in construction projects through modeling and analyzing information using the system dynamics approach.

In the current study, the relations of the fuzzy inference system were linear and it is suggested to consider them as non-linear in future investigations. Moreover, in this study, just one project was investigated and it's better to study more projects in future studies.

In this research, only rework in construction projects were considered, it is suggested that the research should be carried out on projects where the role of manpower is more important in terms of precision, such as research projects, handicrafts, etc.

Furthermore, in this research, the dynamics of the effect of education and financial and language incentives on work ethic was investigated. It is suggested to investigate the dynamics of other factors affecting work ethic such as paying attention to individual characteristics, the nature and type of occupation, employee evaluation, the strengthening of faith and piety in the community and the economic supply of the workforce due to cultural differences and differences in education levels, and the same feedback.

## REFERENCES

[1] Vahedi Diz, A.: *Gained Value Project Management.* 2nd edition. Asia Publishing, Tehran, 2008,
[2] Naderipour, M.: *Planning and control of the project.* 4th edition. Publications of Management and Planning Organization, Tehran, 2000,
[3] Pourbakhshae, A.: *Gained Value Management Performance in Project Management*. Sepid Barg Publications, Tehran, 2008,
[4] Westland, J.: *The Project Management Life Cycle: A Complete Step-By-Step Methodology for Initiating, Planning, Executing & Closing a Project Success.* Kogan Page Publishers, 2007,
[5] Ajorlo, M.: *Project Management Roadmap (Project Management Guide).* Imam Hossein University Press and Publishing Institute, Tehran, 2005,
[6] Ardeshir, A.: *Effective management of project planning and control.* Amirkabir University of Technology Publishing Center (Tehran Polytechnic), Tehran, 2003,
[7] Salahshour, J. and Misaghi Farouji, M.: *Human resource management in civil projects*. First National Conference on Civil and Development, 2011,

[8] Afjeh, S.: *Organizational Behavior Theories.* 3rd edition.
Allameh Tabataba'i University Press, 2014,

[9] Bazeli, A.: *Targeted planning for human resource management in the construction and mass urbanization industry.*
Journal of Civil Engineering Islamic Azad University **3**(4), 41-50, 2010,

[10] Farrokhizadeh, S.; Kamalvand, A. and Kamalvand, A.: *The role of resource management and human resources required in civil projects.*
First National Conference on Civil Engineering, Architecture, Electrical and Mechanical Engineering, 2014,

[11] Azhdari, A.: *Relationship of human resource management with ethics.*
Academic Management Articles (Human Resource Management), 2010,

[12] Robbins, S.P.: *Organizational behavior.*
Pearson Education, 2001,

[13] Amiri, A.; Hemati, M. and Mobini, M.: *Professional ethics for the organization. In Persian.*
Ethics in Science and Technology, Tehran, 2010,

[14] Cherrington, D.: *The Work Ethic: Working Values and Values that Work.*
AMACOM, New York, 1980,

[15] Love, P.E.D.; Mandal, P. and Li, H.: *Determining the causal structure of rework influences in construction.*
Construction Management & Economics **17**(4), 505-517, 1999,
http://dx.doi.org/10.1080/014461999371420,

[16] Hosseini, S.H. and Shakouri Ganjavi, H.: *A Study on the future of Unconventional Oil Development under different Oil Price Scenarios: a System Dynamics Approach*.
Energy Policy **91**, 64-74, 2016,
http://dx.doi.org/10.1016/j.enpol.2015.12.027,

[17] Hosseini, S.H.; Shakouri Ganjavi, H. and Akhlaghi, R.: *A Study on The Near Future of Wind Power Development in Iran: a System Dynamics Approach.*
The Second Iranian Conference on Renewable Energy and Distributed Generation. Tehran, pp.183-188, 2012,
http://dx.doi.org/10.1109/ICREDG.2012.6190459,

[18] Hosseini, S.H.; Shakouri Ganjavi, H.; Kiani, B.; Mohammadi Pour, M. and Ghanbari, M.: *Examination of Iran's Crude Oil Production Peak and Evaluating the Consequences: a System Dynamics Approach*.
Energy Exploration & Exploitation, Multi-Science Publishing **32**(4), 673-690, 2014,
http://dx.doi.org/10.1260/0144-5987.32.4.673,

[19] Rafiei, H.; Rabbani, M. and Hosseini, S.H.: *Capacity Coordination under Demand Uncertainty in a Hybrid Make-To-Stock/Make-To-Order Environment: A System Dynamics Approach.*
Scientia Iranica, Transactions E: Industrial Engineering **21**(36), 2315-2325, 2014,

[20] Fiddaman, T.: *Dynamics of climate policy.*
System Dynamics Review **23**(1), 21-34, 2007,

[21] Lyneis, J.M.; and Ford, D.N.: *System dynamics applied to project management: a survey, assessment, and directions for future research.*
System Dynamics Review **23**(2-3), 157-189, 2007,

[22] Bastan, M.; Ramazani Khorshid-Doust, R.; Delshad Sisi, S. and Ahmadvand, A.: *Sustainable development of agriculture: a system dynamics model.*
Kybernetes **47**(1), 142-162, 2018,

[23] Lashgharian Azad, H.R.; Akbarzade Khorshidi, H.; Hosseini, S.H. and Mirzamohammadi, S.: *Fight or flight: Using Causal Loop Diagram to Investigate Brain Drain in Developing Countries.*
International Journal of Society Systems Science **2**(3), 285-296, 2010,

[24] Saleck Pay, B.; Hosseini, S.H. and Shakouri Ganjavi, H.: *Why do Students use Virtual Social Networks in Iran: a System Approach.*
Interdisciplinary Description of Complex Systems **11**(1), 108-122, 2013,
http://dx.doi.org/10.7906/indecs.11.1.9,

[25] International Organization for Standardization, 2018,
http://www.iso.org,

[26] Li, J.; Taylor, T.R.B. and Ford, D.N.: *Impacts of Project Controls on Tipping Point Dynamics in Construction Projects.*
In Proceedings of the 29th Annual International Conference of the System Dynamics Society, pp.1-12, 2011,

[27] Friedrich, D.R.; Daly Jr, J.P. and Dick, W.G.: *Revisions, repairs, and rework on large projects.*
Journal of Construction Engineering and Management **113**(3), 488-500, 1987,

[28] Taylor, T.; and Ford, D. N.: *Tipping point failure and robustness in single development projects.*
System Dynamics Review **22**(1), 51-71, 2006,

[29] Taylor, T.R.B.; and Ford, D.N.: *Managing tipping point dynamics in complex construction projects.*
Journal of Construction Engineering and Management **134**(6), 421-431, 2008,

[30] Sterman, J.D.: *Business dynamics: systems thinking and modeling for a complex world*.
McGraw-Hill Education, 2000,

[31] Forrester, J.W.: *Industrial dynamics.*
MIT Press, Cambridge, 1961,

[32] Tustin, A.: *Mechanism of economic systems*.
William Heinemann, 1953,

[33] Hersey, P.; Blanchard, H.K. and Dowey, J.: *Management of Organizational Behavior*. 6th edition.
Prentice-Hall, Englewood Cliffs, 1996,

[34] –: *Guide to measuring the productivity of industrial units.*
Iranian National Productivity Organization, 1997,

[35] Eden, C.; Williams, T.; Ackermann, F. and Howick, S.: *The role of feedback dynamics in disruption and delay on the nature of disruption and delay (D&D) in major projects.*
Journal of the Operational Research Society **51**(3), 291-300, 2000,
http://dx.doi.org/10.1057/palgrave.jors.2600919,

[36] Taylor, T.; Ford, D. and Lyneis, J.: *Project Controls to Minimize Cost and Schedule Overruns: A Model, Research Agenda, and Initial Results.*
In: Sterman, J.D., ed.: *Proceedings of the 2007 International System Dynamics Conference*. System Dynamics Society, Boston, pp.4798-4824, 2007.