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## **ANALYSIS OF IMPACT OF KEY STRATEGIC RESOURCES ON THE SUCCESS OF MAINTENANCE PROCESS OF MACHINERY IN CONSTRUCTION COMPANIES IN IRAN**

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### **ABSTRACT**

One of the key elements of organizational success is the organizational analysis power. In fact, the high performance of each organization is the result of its proper interaction with the external and internal environment. This study analyzes the effect of the key strategic resources on the machinery maintenance process in construction companies in Iran. In this way, all effective strategic resources on the maintenance process of the construction machinery and their relationships are considered. Bases of the dynamic system and the Any Logic software are used in order to provide a simulated image of the organizational activity or project. In this study, at first, a maintenance unit in Iran based on the elites' knowledge and then, the effect of each strategic resource are investigated.

**Keywords:** *Organizational Transformation, Maintenance and Repair Management, Any Logic Software, Dynamic System, Strategic Resources*

### **INTRODUCTION**

Due to the importance of physical assets including the machinery in major construction projects such as roads, railways, dams, canals, water transfer channels, oil, and gas, and due to the high dependence on machinery, more than half of the resources in the project including the financial resources have been allocated to the machinery. Undoubtedly, machinery and road-building equipment are play a fundamental role in the construction projects. Maintenance costs are half of operating costs. Maintenance is important for this type of machinery and it is effective during the machinery operation and lifespan. In a sense, achieving the standards of project with no modern machinery and equipment and well-times maintenance will not be possible. Maintenance is one of the most important topics in the machinery and equipment of project that leads to increased productivity and growth and social development and efficiency of the system in different ways. Because due to lack of resources, including energy, labor and capital, etc., can make a major contribution to achieving the aforementioned goals. Therefore, the researcher pursues the following objectives:

1. Identify the key strategic resources in the process of maintenance
2. The effect of the evolution of each of the strategic resources on other resources
3. Strategic Model dynamics in the process of machinery maintenance
4. Modelling of key strategic resources affecting the performance of the machinery maintenance process in construction contractors companies

### **Theoretical Basis**

Maintenance and repair are two important concept and fundamental issues that their realization cause survival and continued different production lines and provide cost savings. As equipment and facilities to meet the needs of human increases, the efficient use and being economic of these equipment and facilities is increasingly considered (NilipourTabatabai *et al.*, 2007).

The main challenges facing those involved in matters relating to maintenance are not only learn the techniques, but also the decision about choosing the best and most effective techniques of maintenance and repairs for their companies.

If the correct option is selected, the possibility to improve the quality of machine performance exists and at the same time maintenance costs will reduce.

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Conversely, if incorrect options are selected, not only we will not be able to solve problem but also previous problems become worse and new problems will be created for the organization. Hence, the vital and strategic maintenance is increasingly remarkable for different industries. This is where the experts faced the major opportunities and challenges in the areas of maintenance and repairs and the need to behavioral changes become stronger and more vital. In the meantime, the need for change in maintenance programs will be crucial so that can help the organization in the international competition (NilipourTabatabai *et al.*, 2007).

Meanwhile, technology is a series of physical tools and intellectual abilities of human in a plant that leads to creation of a product or service (Mehran, 2013). Technology in the production process including machinery is procedures and methods and degree of automated or mechanized production process shows the complexity.

While the organization choose and transfer the technology, it should evaluate technology in different ways. Any accompany or organization that wants to use advanced technology of the day in production part, it should have backup systems of production or fully prepare it. It can be said that using complex production system regardless of Internet technology does not create a coherent and consistent system and it cannot be effective. It has major results and system output does not reduce the costs. Three factors (1) Strategy (2) structure (3) the technology must be compatible.

Especially as circumstances change competitively, an organization that cannot use the appropriate technology or cannot establish the necessary coordination between strategy and organizational structure may not win in this competition. Strategies determine the competitive advantages of organization in long-term periods. Strategy implementation requires that organization considers the annual goals and proceeds to create an effective organizational structure to achieve goals as for used technology by organization (Mehran, 2013).

The dramatic changes in various fields of technology in recent years had a particular influence on the ways of life and human activity. The invention of personal computers and increasing its capabilities, has caused a lot of things that previously seemed impossible become commonplace. Such achievements and thousands of daily innovations in the world of science cause to review constantly the administrative systems and adapt our activities with progresses (Strategic Supervision Department, 2009).

### **Conducted Studies**

Dean *et al.* (2008) analyzed the corrective maintenance and repair process in a case study. To do this, a dynamic system is used for modelling. The results show that the dynamic system is appropriate for problems with group modelling structure.

Hatami *et al.*, (2010) examined the issue "Management of construction and mining machinery using integration model of costs". Information obtained in this study are extracted from 270 roadwork's machinery related to 4 different companies. In this regard, 19 linear and nonlinear models were analyzed proportional to this data. Finally, an equation of 19 models has been selected as a best model.

It should be noted that at the end of the study, a computer program is presented that the plant managers, using the program and information of the machinery, can benefit from it as a tool for better economic decisions. Hesami *et al.*, (2011) studied the impact of preventive maintenance to reduce the cost of repairs and maintenance of construction machinery in the Amol Department of Transportation. Research results indicate that proper and systematic implementation of maintenance programs affected the 6.37% of reduction in maintenance costs.

AbdolvahabKerayizade *et al.*, (2013) examined the "planning the preventative maintenance of cargo wagons using genetic algorithms based on cost and reliability". According to the model presented in this study, the cost and reliability of each component are calculated separately and then it calculates for the whole machine and set in the objective function. The result of the research is introduction of new methods to preventative maintenance activities using the flexible intervals.

Chumayi (2009) compared the maintenance strategy and monitoring technology of condition in a factory in Thailand with general condition of the United States. In this study, a dynamic system for modeling the plant's maintenance system. Plant activity time and operating and maintenance costs were used as output.

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Finally, after modeling, it is suggested that industrial factories in Thailand have reduced preventive maintenance and increased predictive maintenance. Thus, the factory activity time will be increase and maintenance costs will be decrease.

Henrik tone, dynamics studied the dynamic concepts in comprehensive productive maintenance. After discussing the failure to implement these concepts, interactions between the pillars of maintenance and repair are recognized. This paper will help better understand the dynamic behavior of the comprehensive productive maintenance system.

Sundin *et al.*, (2012) indicate in a study entitled "What if reconstruction is useful for the environment" that in order to determine the products which have spent their lifetime, the reconstruction is the best selection due to the reduction of resources use, reduction of pollutants and toxic substances. Hanna Ismail *et al.*, (2014) in the study entitled "The Archives of reconstruction processes and simulating its effects on the environment" addressed the effects of the reconstruction process parts (disassembling, cleaning, repairs, painting, assembly, etc.) on the environment and after preparation of a database and simulate it came to the conclusion that restructuring products is very useful option to protect the environment.

**MATERIALS AND METHODS**

In this research both of the data collection methods (library method and field method) will be used.

- library method: In this method, the data set in the machinery organizations of construction companies will be used.
- Field method: In this method, interviews with experts and a survey of executives and experts in the field of machinery will be used.

This study analyzes the impact of key strategic resources on the success of the maintenance process of construction companies in Iran. In this case, all the strategic resources affects the performance of construction machinery maintenance process and the relationship between them will be examined.

In examining the sources, the resource flow diagrams (input flow charts, output flow charts and numerical charts of resources changes) will be used and finally the overall architectural diagram and its changes will be presented. Independent variable is strategic resources of organization that is listed in tables 1 and 2 and the dependent variable is the process of machinery maintenance in construction companies in Iran.

**Table 1: Countable resources**

Tangible resources	Units of resource	Inflow	Units of inflow	Out flow	Units of out flows	Typical drivers
Staff	People	Hire new staff	People/month	Staff lost	People/month	
Machinery use	in Machine -unit	Buy new machine	Machine/month	Machinery lost	Machine/month	
Net Cash Flow	\$	In flow	\$	expenditure	\$	

**Table 2: Uncountable resources**

Tangible Resources	Units of resource	inflow	Units off inflow	Out flow	Units of flows	out Typical drivers
Average Morale	Staff Index	Increase in morale	Index	Decrease staff morale	Index	
Average Skill Level	Staff Index	Increase skill level	Index	Decrease skill level	Index	

This research consists of CEOs, assistants, machinery managers who have management system of machinery maintenance established in organization which are 35 people and data collection method is census due to the limited availability of population and includes total population. Time domain of research is 93-94 years. The sample of research is non-potential and selective. However, just those

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managers of organization accepted as members of sample who have such a system. In the research, 12 managers and supervisors of construction companies' machineries and executive managers of construction companies assess the maintenance system and variables by completing a questionnaire prepared by the researcher.

The questionnaire of research is the result of interview with some of the managers and senior officials regarding the combination of questionnaire and its planning and in the form of hypotheses and research questions. It is provided using Likert scale in "attitude assessment questionnaire and in order to assess the attitudes of the managers of Machinery Association Commission of construction companies in Iran.

In order to ensure the investigation tools and its verification, the questionnaire is distributed among 7 managers randomly and after solving the problems, the final questionnaire designed based on the logical that it is necessary to offer their evaluations in the more precise form than a general assessment to the researcher.

The effect of the independent variable of automation was evaluated on any of the dependent variables. Scoring of questionnaire will be from 1 to 5 and with regard to the return of 12 questionnaires from 18 given questionnaires, final assessment had been conducted among the 12 returned questionnaires.

**Key Strategic Resources**

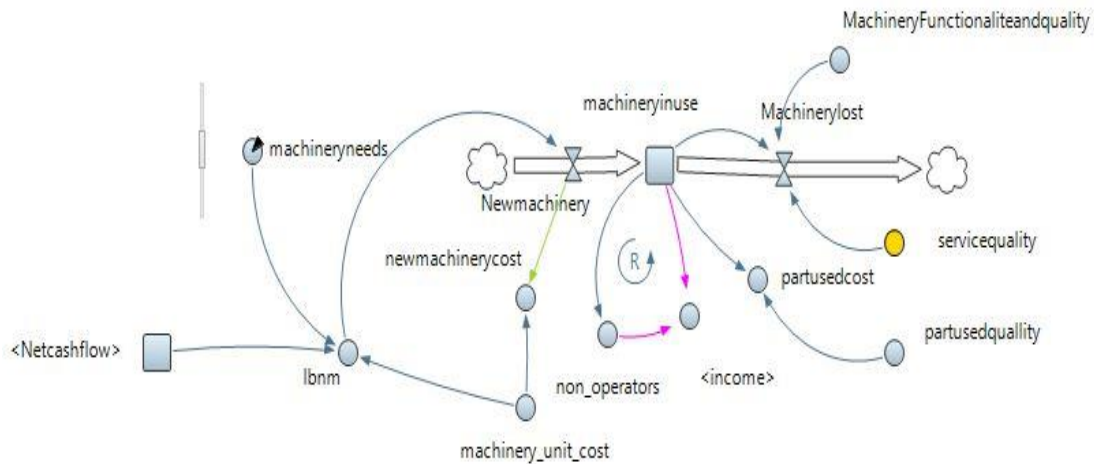
Key strategic resources affecting the performance of the maintenance process in construction companies were determined as follows:

- Machinery
- Staff
- Net cash flow
- Average staff skill
- Moral

IN and OUT flows

IN and OUT flows to each of resources and drivers are:

**Machinery**



**Figure 1: Machinery**

Input: New machineries are affected by net income parameters, new machinery cost and number of required machineries.

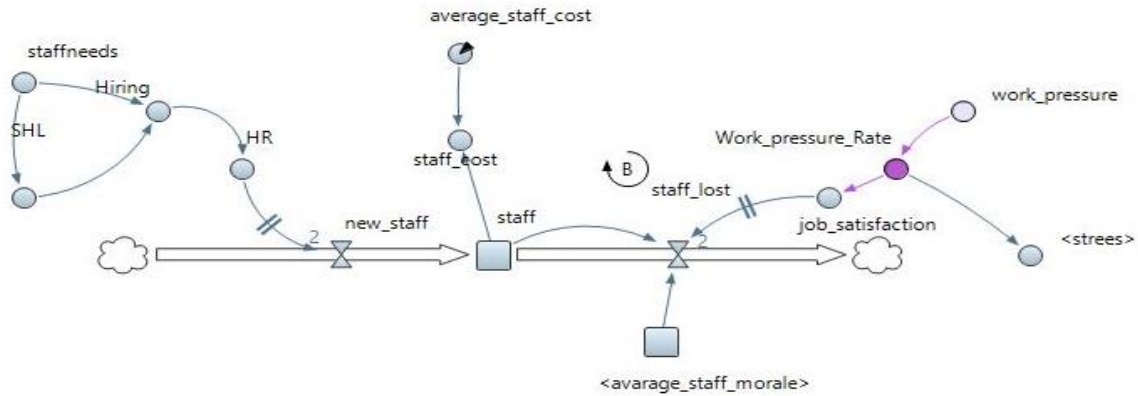
- Net income: affected by the number of machinery in use and machinery income rate
- Machine price: the average cost of buying machinery that is influenced by economic and political factors of country.

Output: depreciate and disabled machineries which are exit the system and affected by service quality and Machinery Functionality and quality.

Service quality is affected by part use quality parameters, Personnel skills and commitment.

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**Human Resources**



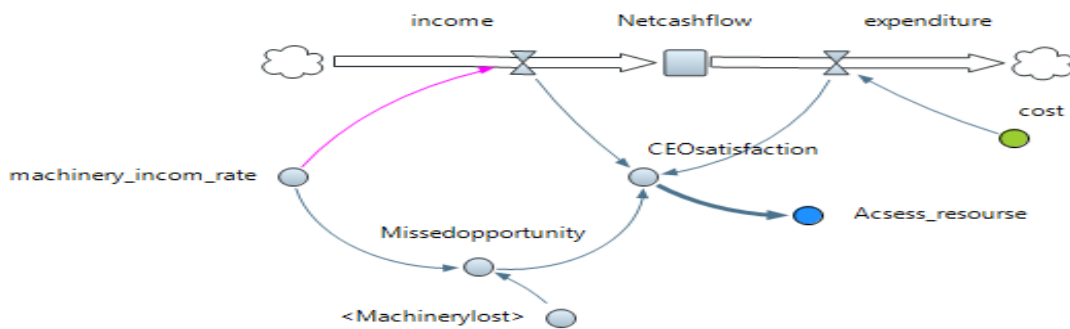
**Figure 2: Human Resources**

Input: Recruited troops that are affected by the need for new recruits and labor market.

Output: troops that leave the system who are affected by commitment and job satisfaction. Job satisfaction in affected by work pressure and stress.

Job Stress: is a function of work pressure, rate, and wage salary system, political, economic and social conditions of country.

**Net Income**

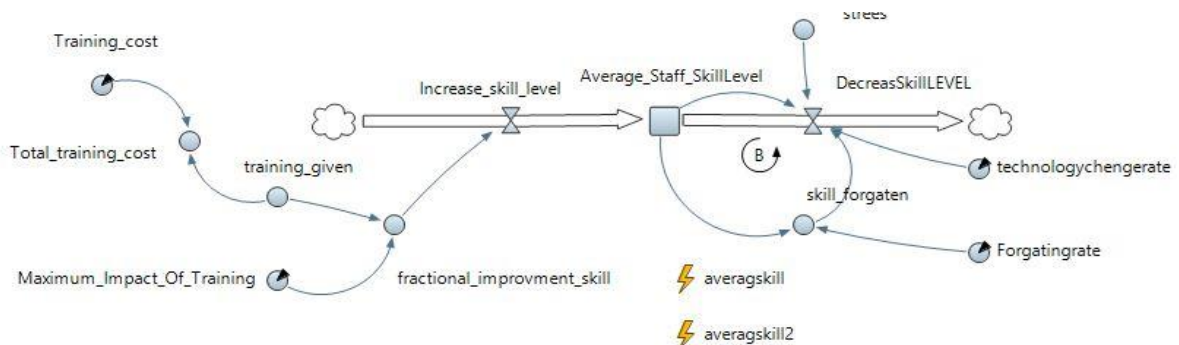


**Figure 3: Net income**

Input: revenue of machinery in use

Output: costs include the costs of machinery, personnel, training and buying new machines.

**Skill**



**Figure 4: Skill**

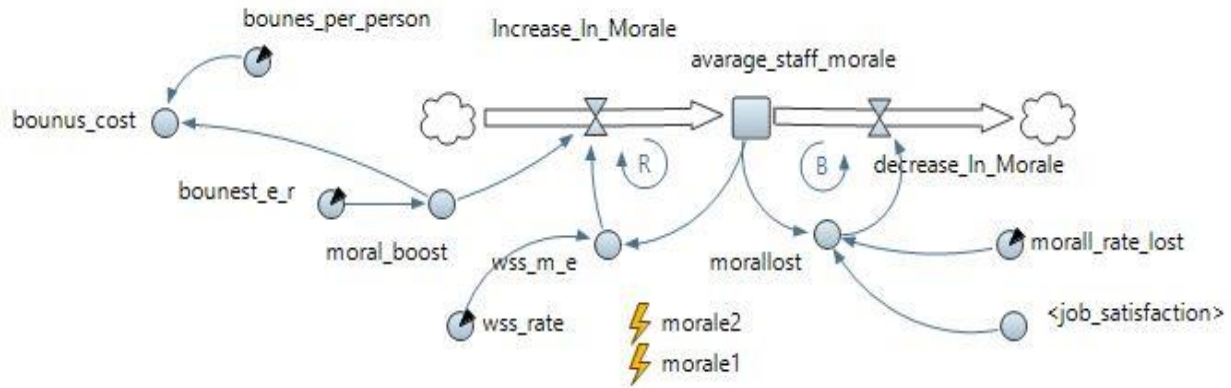


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Input: increase the skills of employees that is affected by education.

Output: decrease the skills of employees that is affected by technological changes, stress and normal forgetfulness.

**Work Commitment**



**Figure 5: Work commitment**

Input: increase staff moral that is affected by payment bonus and legal system.

Output: decrease the staff moral that is affected by job satisfaction and reduction rate of commitment due to the inattention of system to its obligations.

Summary table of the parameters used:

**RESULTS AND DISCUSSION**

**Results**

The main objective of the simulation is analysis the impact of organization strategic resources on the success of machinery maintenance process in construction companies in Iran. This simulation is based on a dynamic system that can extend machinery process for the coming months and years and compare the result with organization's goals. Since the aim of organization is success and growth, all of the analyses are considered based on growth. In other words, since the impacts of some environmental parameters are considered in the model, it is possible to examine the various scenarios in the larger area. Different strategies are outlined to determine the factors.

**The Basic Model**

First we implement the model in the current situation without any changes based on initial parameters of collected information. In this case, the results are as follows:

In this model, no machine has been added to the system for over 10 years, but monthly some machines downtime due to amortization and is outdated. So the number of machines has been reduced and consequently the number of manpower is reduced. Accordingly, income and monthly expenses are reduced and net profit is increasing with decreased slope.

**Development of Machineries Resources**

The first survey on investment in the purchase of machinery in the organization is to develop machineries resources that are one of the most common decisions in machineries organizations. Usually, buying machineries in construction companies is proportional to conditions and project requirement. With this default, we change the number of machineries with the hope of increasing the number of machineries in use and ultimately increase the profits without changing any of these parameters.

In this case, company adds number of machines to the system monthly while recruitment stops. Several modes arise in this circumstance given the number of machines needed. In general, despite the increase of machines, after a while the numbers of machines decreases or remain constant due to the reduced staff and mismatch between manpower and the number of machines. After a while (depending on the number

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of machines added) monthly expenses will be less than monthly income. Therefore, the company's liquidity is reduced gradually.

In this case the company has the ability to buy the machines for a while, but work pressure will be increased due to the lack of manpower and the company's income will decreased because of non-working machines and the ability to purchase will lost due to the high costs in purchasing device. Therefore, output machineries will be higher than input machineries and the number of machines will be decreased.

#### ***Increase Human Resources without Limitation***

In second phase, if organization's strategy for development is just increasing the staff based on the increased human resources, 16 staff will recruit monthly using unlimited resources of market. In this case, we will face with a reduced number of machines per month despite the increase of staff. The costs will be higher than income and thus liquidity is reduced.

In this situation, managers' confidence will be decreased with the recruitment of more staffs than needed and non-increase of machinery.

Therefore, access to resources will be reduced which in turn reduces the skill and commitment. As a result, personnel leave more and then the output of manpower will be higher than input. Manpower will be reduced gradually despite monthly recruiting new staff. Thus, recruitment of staff more than needed not only has negative outcome but also has backfire over time.

#### ***Increase in Machinery and Human Resources with Regard to Human Resource Constraints***

However, considering the limited size of the labor market, 10 machinery will be added monthly. In this case, the need to recruit new members arises with the increased machines, but due to the lack of recruitment requirements, the revenue and costs of company will balance and consequently the company's liquidity remains constant. In fact, after a while, the monthly net income will be zero.

#### ***Discussion***

Given that the main issue of this study was to analyze the impact of the key strategic resources on the success of the maintenance process of machinery maintenance of construction companies in Iran, the results are as follows:

- All sources influence on each other and changes on other sources should be examined with the change of each factor.
- If company does not consider all of the factors proportionally, the impact of lack of attention to one source, will affect other resources.
- Too much attention to one source, without considering other sources may promotes one source at first but ultimately this source will be weakened due to the weakness of other sources.
- The formation of feedbacks in organization whether strengthening or balancing should be identified and taken into consideration.

Inputs and outputs of resources should be controlled continuously.

- According to the results of the simulations, the evolution of each of the key resources will affect other resources as well as the evolution of each of the key resources will affect the whole system.
- One of the most significant problems in the maintenance of machines in Iran is the lack of attention to the impact of strategic resources on each other, which led to the adoption of incorrect strategic decisions in this regard.
- Perhaps one of the main conclusions in this simulation is that the allocation of resources should be performed proportionally and total resources and their impact on each other will be considered to increase the system performance. This factor is one of the most common mistakes of management in construction companies that sometimes lead to the waste of company's resources without the desired result. The impact of this issue is observable with this simulation but identifying this before the crisis is impossible in some cases. These modellings cause to identify the crisis and simulate the effects of organization strategies.

#### ***Recommendations***

- The use of simulation tools allow administrators to properly analyze their performance and learn from the errors in the system.

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- At all stages of simulation, the input information and the logic of it have the important role. It is recommended to have the accurate information from the outside and inside of organization to improve the performance so organization can match itself with the conditions and plan the related strategies and be ready to face the new situations.
- It is necessary to review and re-plan business processes so that they have the lowest equilibrium feedback. Thereby, the costs imposed on the organization will be minimized.

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