Dynamics of Workforce in Iranian National Petrochemical Company

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Abstract: Iranian National Petrochemical Company (NPC) has recently started a fast development. Because of the imbalance in development of NPC, despite of its reputation and history, is not able to recruit qualified workforce. Managers concern the future of the industry as this flow of low qualified human resources accedes to the top of the organizational pyramid. In this paper, a system dynamics model has been used to consider the impact of structural development on human resources of NPC. The results of simulation show that if managers of NPC desire the industry to grow faster than a particular rate, it will finally collapse. It is a quite counter intuitive result. A number of insights have been obtained through the simulations and some practical policies have been suggested and simulated.

Keywords: System Dynamics, Human Resource Management, Organizational Development

Introduction

Iranian National Petrochemical Company (NPC) has had a reputation for recruitment of talented students in engineering programs of top ranked universities in Iran from the time of establishment. Unfortunately, recently, they have not been much successful in their plan. The concerns of top managers of the industry are increased as this new flow of workforces is occupying the managerial level.

It is a belief in the industrial atmosphere of Iran that managers should be almost familiar with the technical aspects of industry. Consequently, almost all of the managers of many industries, including NPC, are quite experienced technical engineers who are promoted to higher organizational level. Looking at the managers' databases of NPC, it is easily verified that the most of organizational opportunities are occupied by technical engineers.

What is the reason for this assumption that engineers graduated from top ranked universities demonstrate better management performance in comparison with other engineers? For answering to this question we should emphasize on two established fact in education of

students in Iran. First, after finishing the first year in high school, students are forced to choose a field of study for the remained years of high school from the set of “Mathematics-Physics, Natural Sciences, Humanities, and Art”. Those who have demonstrated a better academic standing will choose Mathematics-Physics or Natural Sciences. Those who do not see any chance of success for their selves in these fields would choose Humanities or Art. After finishing the high school, students take the nationwide entrance exam for universities in their field. Those who rank high enter the engineering programs. Almost all the first 1000 ranked students among 450,000 taking mathematics-physics exam each year choose engineering programs as their undergraduate field of study. Therefore the most talented students enter the engineering programs. On the other hand, in the group of humanities students, management sciences will be given less priority in comparison with law and other fields. Second, following the latter fact and observations, engineers on average have demonstrated far better abilities of management than the other educated groups.

According to the interviews with top managers of NPC and their mental models, the fall in ability to recruit talented engineers has been started since NPC attempted to grow with a fast rate. There is a common gas field in South Pars region between Iran and Qatar. It is estimated that it will have gas until 2100. Qatar had started extracting the gas ten years prior to Iran. Therefore, NPC started to grow fast to acquire the desired market share of South Pars region. Their goal is to become about three times bigger in size. Before starting the project of Asaluye, NPC had about 7 petrochemical plants placed in different points of Iran. Development has a variety of aspects including development in plants, workforce, facilities and etc. Unfortunately because of the large gap between current market share and the desired market share and the small desired time to fill the gap, policy makers have not invested on facilities proportional to plants. They have had a great desire to develop the industry in the number of the plants to extract more gas and reach to a better market share instead of investing money on facilities to provide a comfortable environment for engineers.

Asaluye region is a desert in south of Iran which is quite close to South Pars gas field. Almost all the new and future plants are placed and will be located in this region. No city was established when the constructions initiated. Having these in minds, supporting facilities become extremely important in the view of the workforce. It includes constructing a city for workers and their families, suitable houses, educational opportunities for children, entertainment opportunities including restaurants, cinemas, medical facilities, and etc.

Talented engineers are the brightest students of Iran. They have all kind of opportunities for being employed anywhere and therefore they have high standards for their working environment. This makes recruitment and retention of them extremely difficult and competitive.

According to the managers and the engineers who have been interviewed, because of the shortage in facilities, the industry has not even one engineer graduated from top universities applicant for working in NPC anymore.

Modeling

The model consists of four main sections[1]:

Section 1:

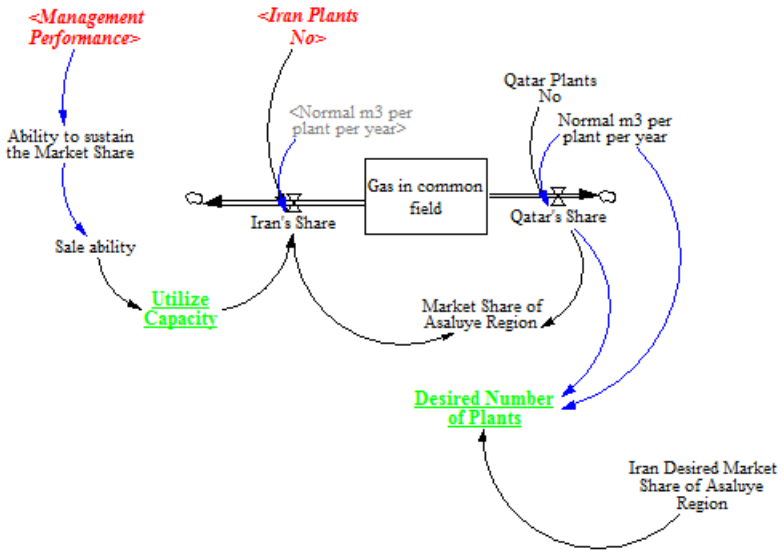


Figure 1.Model's Section 1

There is a common gas field between Iran and Qatar. Qatar has started its first extraction of gas ten years prior to Iran's. NPC has a desired market share of this common gas field. The volume of gas extraction per year for Iran is proportional to the number of current plants and utilization capacity. Therefore NPC needs to reach to a desired number of plants. This discrepancy is the main force for development. (Figure 1)

[1] In figures 1-5, variables underlined and in green are the output variables of that section to the others and variables in red and italic are input variables from other sections

Section 2:

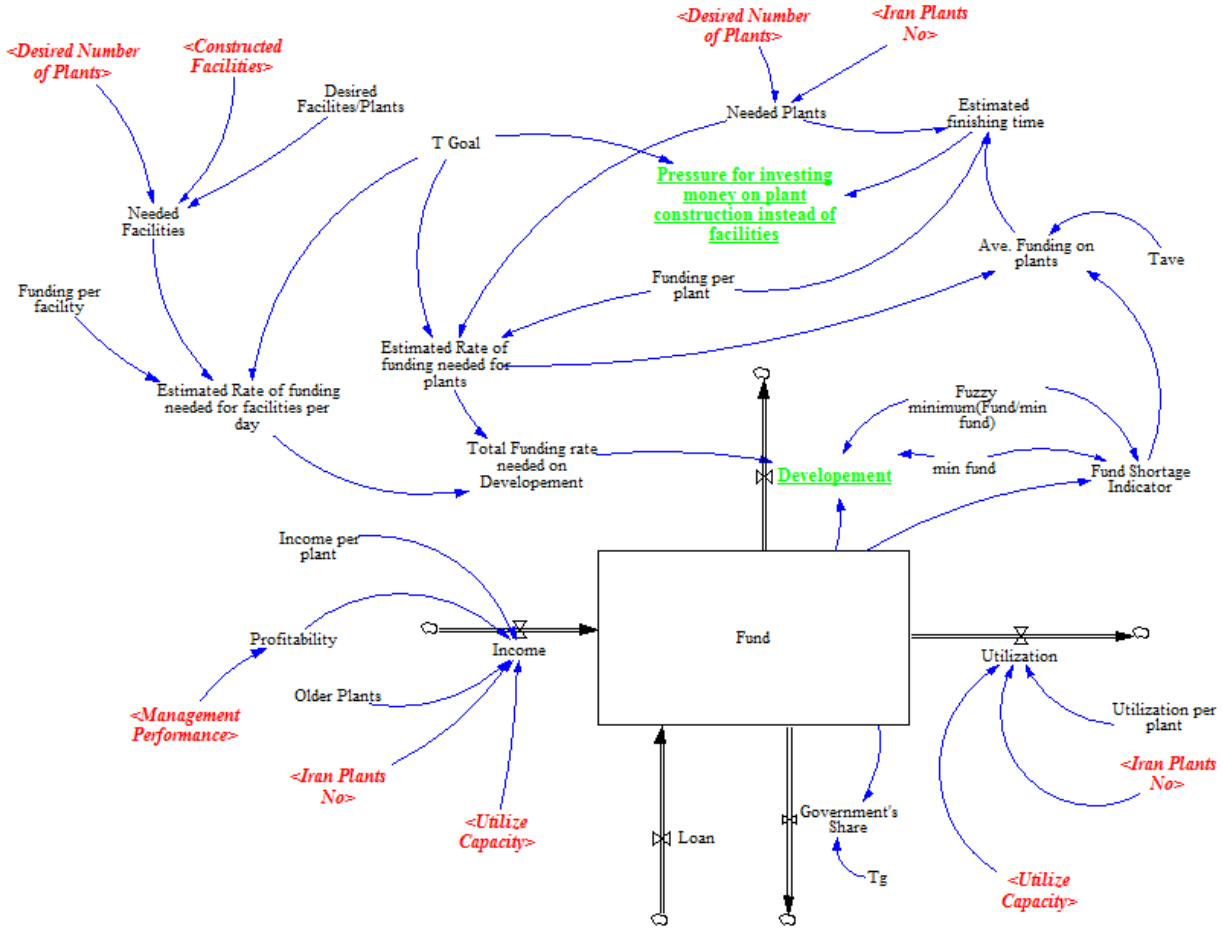


Figure 2.Model's Section 2

The *total funding rate needed on development* is a result of difference between the *desired number of plants & facilities* and current *number of plants & facilities* and the time to meet this desire, *Tgoal* which is a factor of the speed of development. The *development* rate will be equal to the *total funding rate needed on development* until there is sufficient *fund*. If a shortage in fund occurs, the projects will finish in a time more than *Tgoal*. The ratio of *estimated finishing time* and *Tgoal* sets the variable *pressure for investing money on plant construction instead of facilities*. (Figure 2)

Section 3:

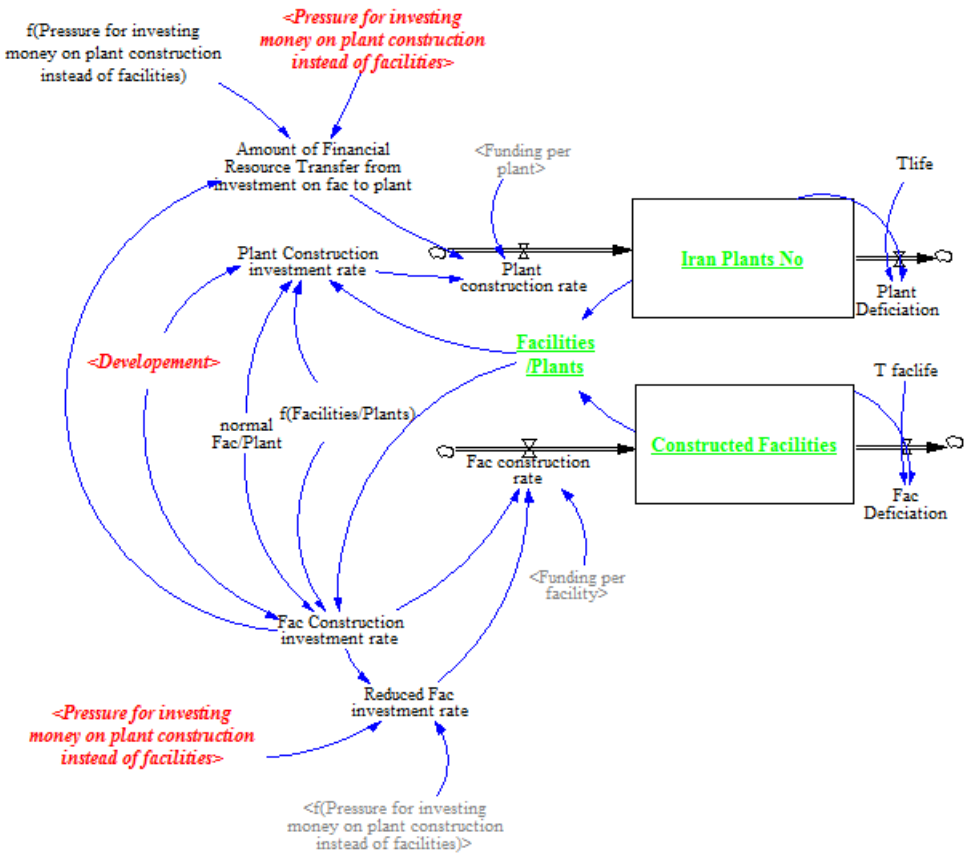


Figure 3.Model's Section 3

Normally the development rate determines the plant construction rate and facilities construction rate. However, if we face a pressure for investing money on plant construction instead of facilities (which is a result of shortage in fund), a part of money resource which is normally assigned for construction of facilities is transferred to construction of plants. (Figure 3.)

Section 4:

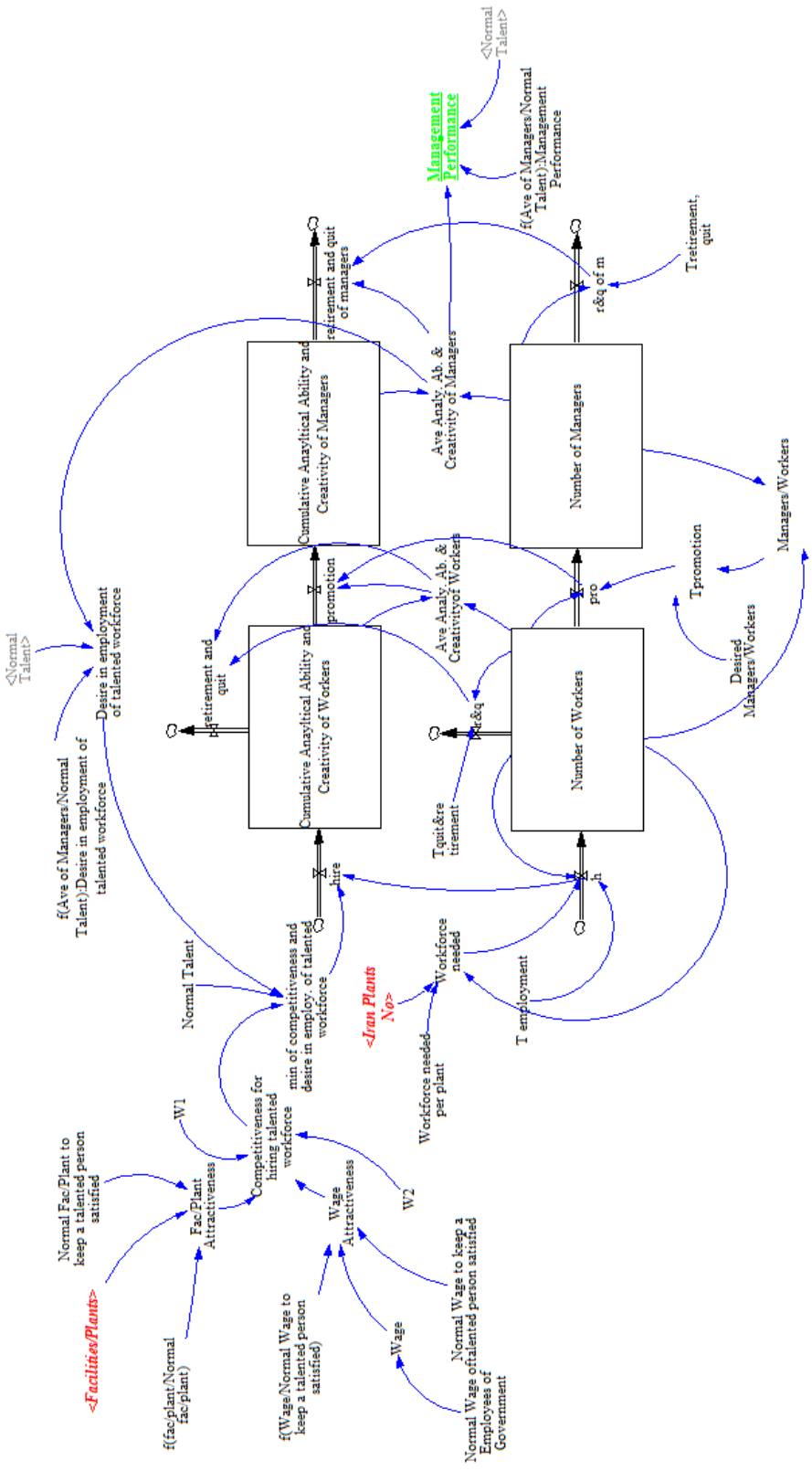


Figure 4.Model's Section 4

In NPC, engineers first enter the technical level. After spending a number of years in technical level, some of them are promoted to the managerial level. The factors facilities/plants and wage (which is a constant in this stage) determine the ability of NPC for recruiting talented engineers. Also, the managers look for their own desired talent of engineers. The minimum of these two determines the average talent of engineers who enter the industry. (Figure 4.)

Dynamics

The difference between reached market share and desired market share forces the industry to develop in the number of plants. Investing money proportionally both on plants and facilities is mandatory for sustain development. Facilities have no direct effect on the market share. So there is a temptation to transfer the money resource in the periods of fund shortage from facilities construction to plant construction. This will cause in low facilities/plants ratio for a period of time. In this period, the NPC loses competitiveness in recruiting the talented engineers for technical positions.

It results in a continuous flow of poor engineers occupying technical positions. As this flow is promoted, management positions occupies with poor managers. Consequently, three dynamics begin to take place:

First, if the talent of the managers falls significantly below a minimum talent, they will have no more desire to recruit talented engineers since they like to sustain their power.

Second, poor managers will have less management performance. Therefore managers will not be able to sustain the reached market share. They will also be less profitable and this will affect the money resources.

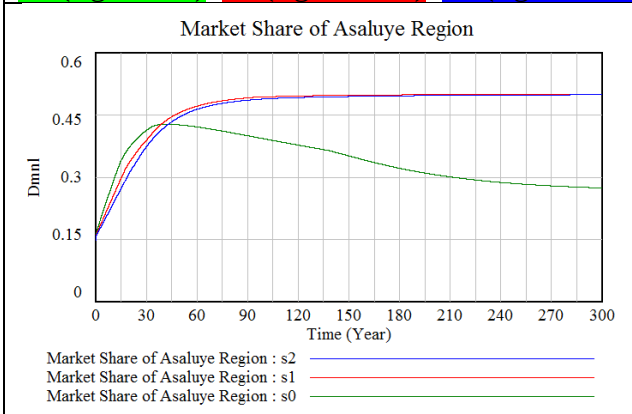
Third, there is a dynamic happening in the real world which did not need further modeling since the natural structure of the model was already producing it. According to the importance of this dynamic, an explanation seems to be useful. Through the interviews with managers, they explained that beliefs of managers are changing and they are starting to think that NPC does not need talented engineers. NPC have always had a reputation for recruiting the most talented engineers. But now, they have recruited less talented engineers for a period of at least 10 years and they are all doing the jobs as well. So what is the point in recruitment of such talented people who are less loyal to the organization and are so sensitive about their working environment? By the way, retention of them needs a huge amount of effort. The key to this puzzle is that they are right. When the most talented engineers enter the technical level of the industry, they are not really different in performance with less talented engineers. The reason is that in NPC, R&D, innovation and scientific works are not well respected. NPC imports new technologies and instruments from western countries and so. Therefore, a less talented engineer can perform equally in technical level in the plants. So why to recruit talented engineers and why

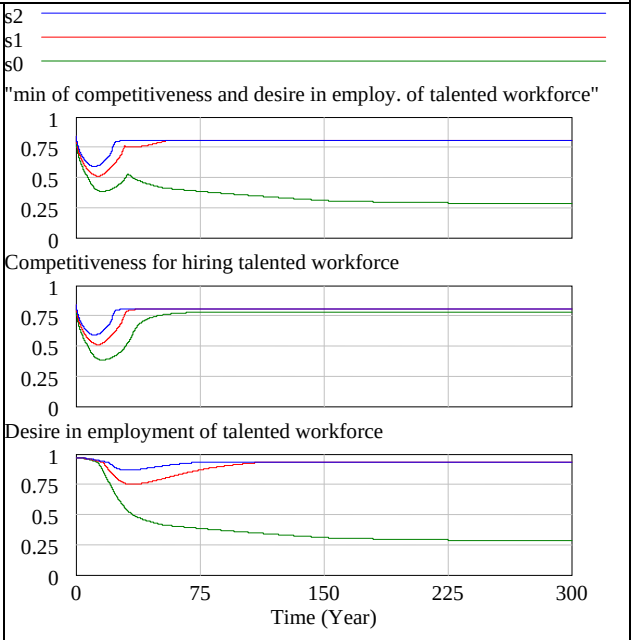
to compete for it? Here is the answer: because those who are promoted to the managerial level according to the organizational structure and the established traditions of NPC are these engineers. If poor engineers are recruited, we will end in poor managers. The main point can be seen in the model that average talent of workers is not affecting the output of NPC. Therefore managers have no indicator to distinguish between the output of highly talented engineers and poor engineers at least for 20 years until they are promoted to the managerial level. It is the reason that managers are not willing to solve the problem of recruiting poor engineers and their beliefs are even changing. This is the case until the engineers enter the managerial level and the management performance falls significantly. It is not known what policies managers are going to make after facing the crisis. However, the conditions in which these policies will be made are discussed briefly in next part.

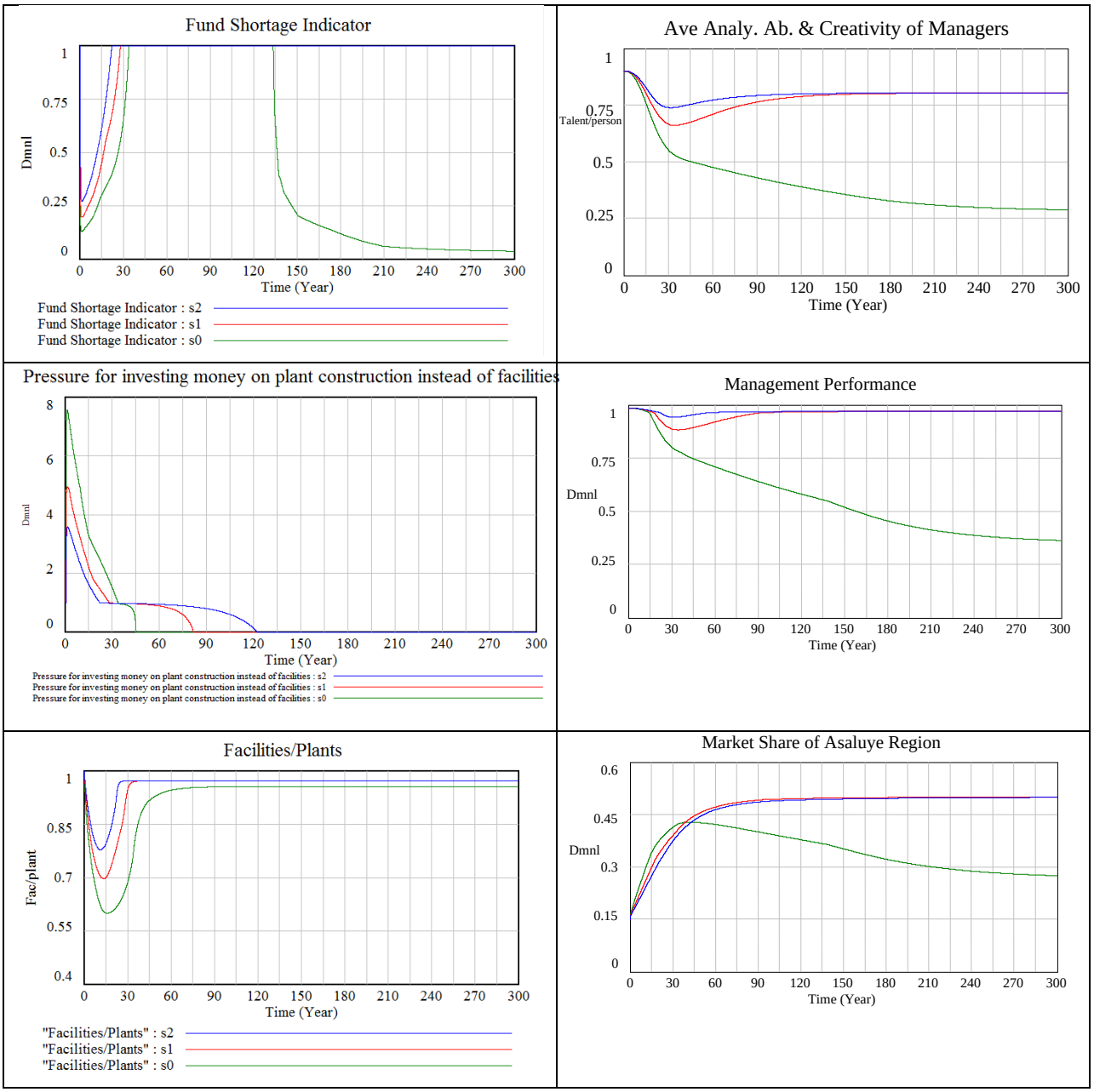
Simulations and Discussions:

Table 1.Results of Simulations when no policy is made

Desired Market Share = 50%
S0 (Tgoal = 7), S1 (Tgoal = 15), S2 (Tgoal = 25)







The result of simulations is quite insightful and counter intuitive. When Tgoal is given lower values, we expect NPC to reach faster to its desired market share. However, by going below a critical point for Tgoal, the industry will collapse. To explain this, we investigate the behavior of variable *Fund Shortage Indicator* which is formulated as the ratio of needed development money (to meet the time Tgoal for completing the projects) and the amount of money can be provided. Lower Tgoal results in longer and harder period of fund shortage. Fund shortage will force managers to transfer the money resource assigned to facilities construction to plants construction. The variable *pressure for investing money on plant construction instead of facilities* is formulated as the ratio of estimated finishing time to Tgoal. A smaller Tgoal, results

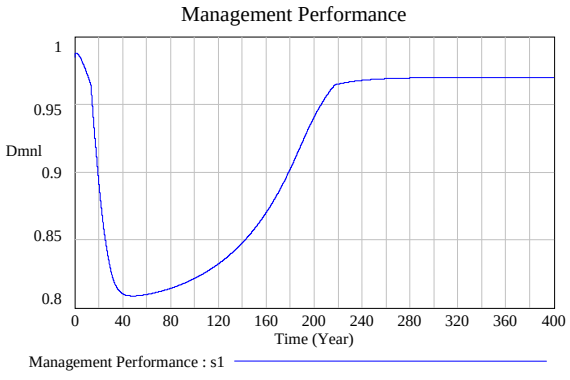
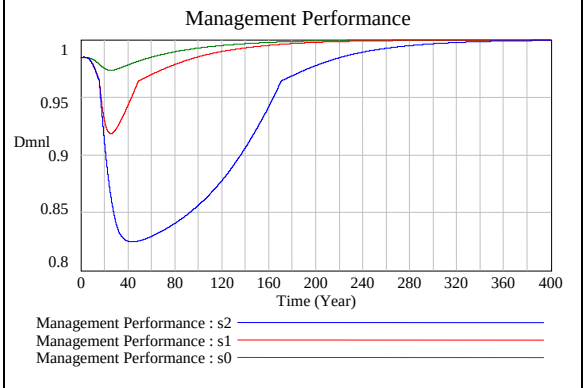
in longer and worse period of low facilities/plants. Low facilities/plants causes low competitiveness of NPC in recruiting talented engineers. A longer period of low facilities/plants results in longer flow of poor engineers. The organization occupies with the poor engineers and as they are promoted to the managerial level, they will have no more desire to recruit talented engineers. At the end, poor managers will have low management performance. NPC will lose its ability to sale and sustain the reached market share as a result.

It is not known what policies the poor managers are going to make to sustain the falling market share. However, according to the structure of the model, in all of the policies, the managers will become aware of the problem when they see the management performance falls below a threshold. In other words, they are notified about the problem when the entire workforces –even managers themselves- are less talented in average. In fact, it takes time for them to observe and judge a fall in market share and relate it to low management performance. Intuitively when we fall below a threshold in average talent of managers, the dynamics of collapse will begin and is not reversible. It is because the main problem is the managers are not willing to recruit any talented person and allow him/her to enter managerial level in any policies they make. So there will be no hope to manage this crisis with the help of the forces inside the organization and it seems we need outside forces to solve the problem.

Policy design

There are two policies thought to be quite practical.

Table 2.Results of simulation when policies are made

First Policy (Tgoal = 10)	Second Policy (Tgoal = 7;So:T0=0,S1:T0=15,S2:T0=30)
	

First Policy[2]:

A solution is to recruit talented engineers for the managerial level without sending them into the plants for 30 years performing technical jobs which can be done by average engineers. Providing them with periods of management education can improve their management ability. Right now, it is the policy of NPC that educates its potential managers who are promoted engineers. So fortunately there is an organization already available for executing this policy. Fortunately talented engineers are interested in managerial positions. In addition, managers are benefited from a very good working environment.

Still we can occupy a part of management positions with promoted engineers from technical level. The results of this policy when half of the managers are recruited from outside is shown in table 2.

Second Policy[3] :

NPC can attract the talented engineers with other factors. A very obvious factor is wage. This is an ideally inexpensive policy to make when we look. NPC expenditure on human resource is at most 1% of its total expenses in a year. Therefore with increasing the wages to 3% of the expenses, facing a problem is unlikely. However, unfortunately, NPC is a governmental organization and wages are fixed by government. Government does not allow NPC to raise the wages due to the inequality which occurs in society between employees of government. So it seems that if we start privatization of NPC, we can attract the talented engineers to NPC again. Luckily, there is news that NPC is already on the process of becoming a private company.

To run this policy the wages are increased by a factor of 3. If we start to increase it very early at the time t0=0, we will face no problem at all. However If t0 is substantially bigger than 30, this policy is not effective. In other words, NPC has not much time for becoming private.

Conclusion

The results of simulations indicate that if NPC develops faster than a particular rate to acquire a better market share, it will collapse due to the continuous entry of low-qualified workforce and reaching of this flow to the managerial level. The low-qualified managers are not welcome to recruitment of talented workforce who threatens the authority of them. Due to the low management performance, NPC will face inability to sale and sustain the reached market share, low utilize capacity and lower profitability. A number of policies have been designed and simulated and satisfying results were obtained.

[2] Small adjustments are made to the section 4 of the model for this policy. Other sections remained unchanged. See figures 1-3, 5.

[3] The modeling sketch for this policy is similar to the case no policy has been made. See figures 1-4

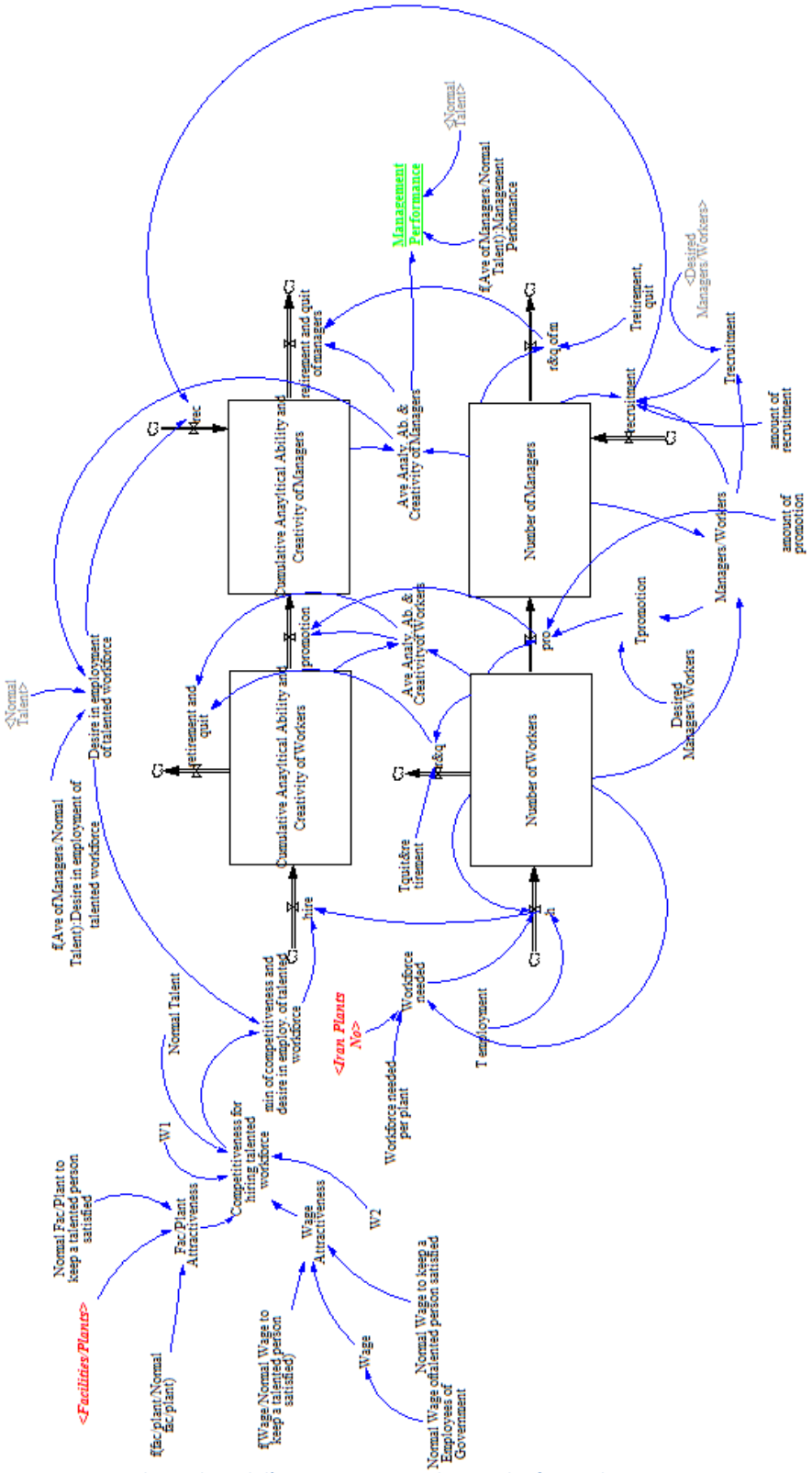


Figure 5.Adjusted Model's section 4, according to the first policy

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Appendix A: Formulation

Due to the large volume of equations, the formulations are provided in supporting materials.