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Using System Dynamics to Model the Interaction Among the Factors of Job Satisfaction, Productivity, and Quality of Service in the Health Industry

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ABSTRACT

Management in health organizations is always interested to know whether their employees are satisfied with the type of job that they are doing. The trend of job satisfaction is of great concern to all employers all around the industries. The health industry is one of those industries where job satisfaction plays a vital role in its performance and providing quality service to patients. Knowing that many studies have been done about job satisfaction in the health industry, only a few are paying attention to the dynamic impact of factors on each other, considering feedback loops for real modeling of the problem. This paper proposes a multi-stage model for evaluating job satisfaction by system dynamics in a big hospital in Iran. Firstly, key influenced factors of job satisfaction are listed based on the Job Descriptive Index. In the second stage, after designing influence diagramming, three scenarios are developed for examining the impacts of two crucial financial and nonfinancial rewards factors. Finally, we analyzed the result of the running flow diagram of each scenario. The results show that applying both financial and nonfinancial rewards simultaneously can increase job satisfaction and the organisation's income via applying one of them.

Keywords

System dynamics, Job Satisfaction, Healthcare, Quality of service.

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1. Introduction

There are a few types of Job Satisfaction (JS) models focusing on the thoughts and viewpoints of people about their jobs. Some researchers have concluded that what makes a job satisfying or dissatisfying does not depend only upon the nature of the job but on the expectations that individuals have of what their job should provide. One of the most used definitions of job satisfaction is "an emotional state resulting from appraising one's job (Locke,1969)". Researchers have provided different definitions for JS. Some of these definitions are given below to pay attention to their differences. Herzberg et al., (1959) define JS as "a function of satisfaction with the various elements of the job", while Kuhlen (1963) defines JS as the "individual matching of personal needs to the perceived potential of the occupation for satisfying those needs". Gruneberg (1976) defines that as "all the feelings that an individual has about his job ". Stone et al., (2020) looks into job satisfaction as "the degree to which employees have positive attitudes towards their jobs". According to Locke (1969), "job satisfaction is a pleasurable or positive emotional state resulting from the appraisal of one's job or job experiences". Research has shown that job satisfaction in the fast food industry is very low due to its fast-working environment, hard-working condition, and the part-timing nature with which employees have to deal. A part-time person working at some of the fast food restaurants in the USA has to go back and forth three times a day to work about 6 hours a day while taking low pay home also. These people need cars to go to work three times a day, which is impractical and unmanageable for most employees. These are reasons why the employee turnover rate in the fast food industry is at a record high due to job dissatisfaction. These led us to notice why absenteeism is high and employees are stressed almost all the time for their job and family as they are working. Ivancevich (2007) pointed to this reality that "there should be a feeling of the right job" for every employee to stay productive. This is true that employees spend about one-third of their day at work, so it is better that employers look for the right employee that fits the job and makes the employee happy at the same time for doing job that he likes; good pay gets. Mengistu Bali (2015) studied the factors associated with job satisfaction among healthcare workers at West Shoa zone public hospitals in Ethiopia. Researchers noticed that the correlation between the different aspects of job satisfaction was significant. They found that the respondents' age, profession, education level, future intention, service year and participation in decision-making was significantly associated with job satisfaction. Looking into health center job satisfaction, researcher Krogstad et al., (2006) studied Job satisfaction

among the doctors and nurses in a Norwegian hospital. Researchers found that "the only domain of work significant in predicting high job satisfaction for all groups was the positive evaluation of local leadership". The analysis suggested that professional development was most important for doctors at that health center.

Mental health professionals working in the Italian National Health Service were not satisfied with their jobs. The findings revealed that job satisfaction increased with increasing age. No difference was found between the levels of job satisfaction among different professional roles, as Gigantesco et al., (2003) reported. Job satisfaction of physicians and general practitioners at a health center in Lithuania was studied by Buciuniene et al., (2005). However, doctors who had a longer service were found to be more satisfied with their jobs.

Employees are an organisation's primary asset, so their job satisfaction levels are always of great concern to their employers. How employees have treated at the workplace influences their performances and productivity and impacts the clients and customers. Library's Patron satisfaction trend over time is a highly regarded measure for university and public librarians to know how people think about their performance. Zare Mehrjerdi et al.,(2020) have researched the analysis of health-related factors with their impacts on economic growth. System dynamics was used to model the interactions among key factors to determine the trend as time passes. Through the literature review, authors found that researchers Gupta and Gupta (1990), Mutuc (1994) and Holmström and Elf (2004) have completed research on job satisfaction using a system dynamics approach. Faregh and Zare Mehrjardi (2014) identified effective factors for promoting the therapeutic tourism industry using a system dynamics approach. Faezipour and Ferreira (2013) studied a system dynamics perspective of patient satisfaction in healthcare. Najafi et al., (2019) explored the role of lean thinking in the sustainability of the healthcare supply chain with a system dynamics approach. Zare Mehrjardi (2013) researched weight-related health problems using a system dynamics approach. In 2012, this author studied healthcare costs using a system dynamics approach. The main purpose of this research is "to study the impacts of job satisfaction on the patient's satisfaction and quality of service level provided in health industry taking feedback loops into the modeling of the problem". Such studies are rare in the literature, as the authors show in the literature section of the article.

The rest of this article is organized as below. Section 2 describes the background of the research under study. The literature review is the topic of section 3. Problem description and research contribution is the topic of section 4. Research methodology and model development steps are the topics of section 5. The dynamic hypothesis is discussed in section 7, while stock

and flow diagramming are described in section 7. Scenario analysis is the topic of section 8. Converting a casual loop to a stock-flow diagram and running it by VENSIM is the topic of section 9. Analysis of the result and authors' conclusion is presented in section 10.

2. Research background

The main elements of this research are discussed in the sections below under the subtitles of Job satisfaction, health industry and system dynamics.

2.1. Job satisfaction

What makes a job satisfying or dissatisfying does not depend only upon the nature of the job but on the expectations that individuals have of what their job should provide. As researcher Locke (1969) mentioned, one of the most used definitions of job satisfaction is an emotional state resulting from appraising one's job. However, the individual matching of personal needs to the perceived potential of the occupation for satisfying those needs is another definition of job satisfaction. Guidelines for job satisfaction can be stated, paying attention to key factors such as communication, culture, security, leadership, opportunities, career development, working conditions, employee personality, pay and benefits, rewards and recognitions.

2.2. Health industry

Pay attention to the workers job satisfaction who do the main tasks in health centers daily. Employees' satisfaction directly impacts workers' productivity and hence the health industry's bottom line. Since the health of a society is at the hands of its health workers paying attention to their job satisfaction is a must. AlaviRad et al., (2015) stated that economic growth contributes to better health, leading to a better economy. So, we can claim that workers' physical and mental health increases the efficiency and quality of work at workstations.

Researchers have employed different approaches to studying job satisfaction at health centers. One type of research on this subject was related to the level of satisfaction by considering working conditions, salary and benefits, and supervision. The second group of researchers looked into the personal demographic or workplace characteristics (i.e., age, gender, practice setting, and position) to determine the differences in the overall level of job satisfaction. Other researchers examine employees' qualifications, skills, commitment, and intention to leave the system. Taking system dynamics as a modeling tool to integrate many key factors is rare in the literature. Zare Mehrjerdi and Aliheidari (2014) have employed system dynamics and

artificial neural networks to evaluate job satisfaction in the service industry. However, using system dynamics as an approach for this topic is very suitable because the interactions of several factors affecting job satisfaction are always significant to management and decision-makers.

2.3. System dynamics

System dynamics is a method for learning about a complex system and the development of management simulation that help to understand system complexities and source of resistance against the policies and designing new effective policies (Otto and Simon, 2008). This methodology is used for discovering and presenting feedback processes and searching for the characteristics of the dynamics of complex systems using level and flow structure, delays, and nonlinear relationships (Mella, 2012; Tegegne et al., 2018). Here, the feedback structure, represented as positive and negative feedback loops, is the main guide of system dynamics that helps interpret the observed dynamic behavior and develop practical hypotheses about these behaviors and structural deficiencies of the model (Asere and Blumberga, 2015; Mella, 2012).

System dynamics methodology has some fundamental differences from other modeling methods. Firstly, it highlights the feedback processes or causal relationships in which the variables affect each other. Secondly, behavioral decision-making is represented in the model, while the decision-makers are assumed to be individuals with limited rationality and incomplete information. Thirdly, it estimates processes with continuous time and consequently can be applied in discovering lag effects. Some software has been developed to build and simulate system dynamics models, of which Vensim is one of the best among them. This software is the framework for conceptualizing, building, simulating, analyzing, optimizing, and developing complex dynamic systems. Vensim has great speed and effectiveness as a tool for simulation analysis.

3. Literature review

There is a lot of research in the literature relating to job satisfaction, the factors that influence that, and the tools used for analysis. For example, Brown and Peterson (1993) identified individual-level demographic and dispositional variables, role perceptions, supervisory behaviors, and job characteristics as influences on employees' Job satisfaction. Generally speaking, tools are necessary to evaluate the level of job satisfaction at each organization. Brayfield and Rothe (1951) proposed the Index of Job Satisfaction, while Smith (1969) suggested IDI. The job Satisfaction Scale was introduced by Arnold and Feldman (1982) and

Scholarly Productivity Measure was proposed by Megel et al., (1988). Other tools available in the literature are the Mueller Satisfaction Scale discussed in the Mueller and McCloskey (1990) research. Snarr and Krochalk (1996) introduced Organizational Characteristics Questionnaire as another tool for measuring Job satisfaction in healthcare systems. JID is used many times by many researchers for job satisfaction. It is a tool that has attracted the attention of psychological researchers, practitioners, management and academics. JID comprises five dimensions, as listed in the left column of Table 1. They are (i) Work, (ii) Pay, (iii) Opportunities for promotion, (iv) Supervision, and (v) Coworkers. In this paper, we categorize the most critical influenced factor of job satisfaction based on the JDI approach in Table 1.

Table 1. the table of categorized factors based on JDI and literature

JDI Factors	Factors	Researchers	**Influence**
Work (WO)	Job stress	Shader et al., (2001), Fletcher (2001), Tzeng et al., (2002), Yin and Yang (2002), Das and Baby (2014), Davies (2001)	-
	Job security	Nolan et al., (1995), Fletcher (2001)	+
	Hardiness	Larrabee et al., (2003)	+
	Ambiguity	Acorn (1991), Fain (1987)	-
		Chen et al., (2008), Bowling and Hammond (2008)	-
	Conflict	Acorn (1991), Chen et al., (2008), Bowling and Hammond (2008), Acuña et al., (2009)	-
	Working conditions	Nolan et al., (1995)	+
		Adams and Bond (2001), Tzeng et al., (2002)	-
Pay (PA)	Pay(salary)	Holland (1992), Cavanagh and Coffin (1992), Tzeng et al., (2002), Chen et a., (2008)	+
		Plawecki and Plawecki (1976)	+(min)
		Marriner and Craigie (1977)	+(max)
		Fletcher (2001)	-
Opportunities (OP)	Educational level	Lu et al., (2002), Tzeng et al., (2002), Bowling and Hammond (2008)	-
	Promotion	Holland (1992), Yin and Yang (2002), Aiken et al., (2012), Price (2001), Wang (2002)	+
	Autonomy	Lee (1998), Wang and Netemyer (2002)	+-
		Acuña et al., (2009)	+
		Chen et al., (2008)	+
		Bowling and Hammond (2008)	+
Supervision (SU)	Superior (Leadership style)	Kennerly (1989), Shieh et al., (2001), Yin and Yang (2002)	+
		Fletcher (2001), Lutgen-Sandvik et l., (2011), Chen et al., (2008)	-
Coworkers (CW)	Group cohesion	Shader et al., (2001), Adams and Bond (2000), Larrabee et al., (2003), Acuña et al., (2009)	+

(max): strongest factors, (min): weakest factors, + positive, -negative, +-: no significant, (?): Further research needed to determine the correlation of individual factors and JS.

3.1. Problem elaboration and research contribution

The problem of this study is to investigate the dynamic impacts of JS on the quality of service and patient satisfaction. Hence the aims of this research are: (i) to review the literature on the subject matter taking system dynamics modeling into consideration, (ii) to find key factors

affecting employees' job satisfaction, and (iii) to identify factors that can be used in determining the quality of service and patients' satisfaction within the health organization. This study contributes to considering all criteria using an integrated model to study the key quality of service criteria within the framework of a multi-criteria structure presented by the stock and flow diagram. The questions of concern are:

(1) How do indigenous and exogenous factors affect each other in a cause-and-effect manner for studying the complexity of the quality of service, job satisfaction and the dynamics of influencing patient satisfaction factors through feedback loops?

(2) What factors affect employees' job satisfaction in the health industry?

(3) What factors affect productivity, income, and financial and nonfinancial coefficients?

Researchers have rarely considered a problem with such vast features. This is a legitimate problem and deserves serious attention, however.

4. Research methodology

The current research includes two main phases. In the first phase, factors are extracted. In the second phase, data is collected.

- Phase I: Factors extraction

1- A deep literature review on the subject matter was conducted to extract key factors.

2- A group of experts were consulted to list the most significant factors affecting job satisfaction. Then, our finding from the literature discussed in 1 was shared with the experts to finalize their opinions.

- Phase II: Data Preparation

3- A questionnaire was distributed among the experts and they were asked to determine how one factor influences another, using + and – signs.

4- This process was completed in two rounds to ensure that experts were highly comfortable with the data provided as requested.

The steps to develop this model are listed below:

Step 1: Using appropriate literature review to identify key factors/variables associated with job satisfaction.

Step 2: Determining system boundary by classifying factors/variables obtained in step 1 into endogenous and exogenous types.

Step 3: Developing causal diagrams using endogenous and exogenous variables.

Step 4: Drawing a stock-and-flow diagram using the causal diagram.

Step 5: Developing a mathematical model of the problem and simulate that with vensim computer software.

Figure 1 depicts the usual steps to be followed and the factors to pay attention to in problem definition, system conceptualization, and simulation and validation stages.

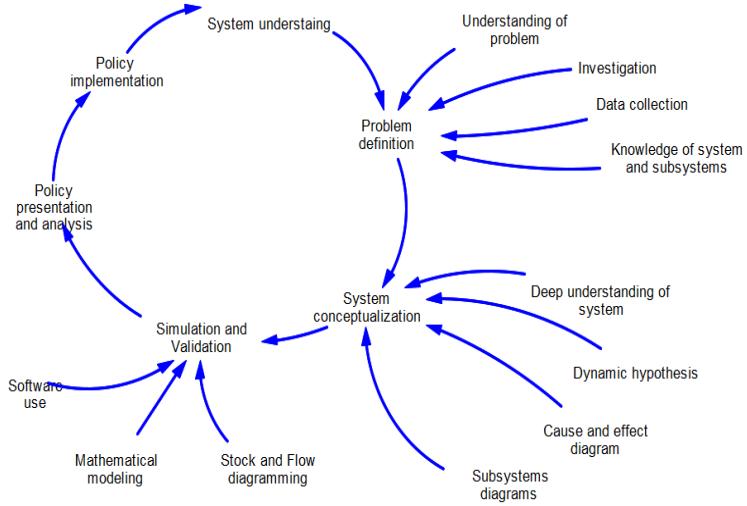

Figure 1. System dynamics steps to solve the problem

5. Dynamic hypothesis

The dynamic hypothesis is a conceptual model that the researcher proposes based on the key variables of the problem. Using main variables, basic reinforcing and balancing loops that are suitable for reasoning and hence knowledge extraction from the expanded model can be drawn. A dynamic hypothesis is an essential tool for being a starting point for model conceptualization. The main benefit of the dynamic hypothesis is that it allows readers to understand the model's complexity better. The dynamic hypothesis of this problem is verbally described below using H1 through H4 signals.

H1: Job satisfaction has positive impacts on quality service and negative impacts on employees' stress

level and absenteeism

H2: Quality service has positive impacts on patient satisfaction

H3: Productivity increases as the stress level in the working environment decreases.

H4: Nonfinancial reward directly impacts the employees' acceptance level of responsibility.

The dynamic hypothesis of the problem under study is depicted in Figure 2 below.

Figure 2. Dynamic hypothesis of the problem

5.1. Factors identification and system's boundary

Because future policies are designed using the influence of independent factors on the dependent ones, it is necessary to consider the affecting factors of job satisfaction. A list of factors affecting job satisfaction was extracted from the literature review and with the help of a questionnaire administered to the experts. In this questionnaire, the following criteria were questioned and assessed regarding affecting or not affecting job satisfaction directly or indirectly. The conceptual relationships between such factors were extracted from the experts' opinions (including specialists in the health and non-health industry).

Table 2. Classification of factors into indigenous and exogenous factors

No.	Factors	
1	**Indigenous factors**	Job Satisfaction
2		Perceived results
3		Expectation
4		Financial rewards, Nonfinancial reward
5		Work Pressure
6		Responsibility
7		Income
8		Task conflict
9		Work itself
10		Stress
11		Absenteeism
12		Productivity
13		Quality of service
14		Patient Satisfaction
15		Level of customer
16		Salary
17		Service Cost
18		Employee level
19		Recruitment
20		Dismissal
21	**Exogenous factors**	Culture
22		Supervision
23		Officialism

6. Stock and flow diagram

In system dynamics modeling, three variables convert the casual loop diagram concept into a stock and flow diagram. Level variables are a type of variables that allow accumulation occurs in that. The population of a city is a kind of Level variable because the arrival of a new citizen through birth and immigration to the city causes the population to increase, and when a person dies or is an immigrant from the city, the population level decreases. What does cause the level variable to increase or decrease is known as the rate variable. The following general formula can show the relationship between level and rate variables. Assuming that the level variable is Job Satisfaction, the following formulas can be used for the mathematical modeling of the problem.

$$\text{Job Satisfaction}(t) = \text{Job Satisfaction}(t-1) + DT * \text{Rate}(t-1, t) \quad (1)$$

This means that

$$\text{Rate}(t-1, t) = \text{Changes in Job Satisfaction variable} / DT \quad (2)$$

The third type of variable is known as the auxiliary variable. It is used to describe better the problem, understanding, discussion, modeling and concept analysis. Parameters and constants are allowed to be used in the mathematical modeling of the problem and hence to see their impacts in the simulation results.

7. Dynamic model of problem

The cause and effect diagram demonstrates the system's structure, considering key factors. This diagram is based on the researcher's dynamic hypothesis for the problem. Cause and effect diagrams are a powerful tool for determining the structure of a problem taking entire factors within the boundary of the problem into consideration. Reinforcing and balancing loops are fundamental tools for casual loop diagram. This diagram is used for developing the stock and flow diagram from that. Where it is used for the mathematical model development and hence the simulation.

7.1. Scenario 1 – financial and nonfinancial reward

Figure 3 shows the casual loop diagram for the job satisfaction problem. The relationships between variables are shown by the arrows with the direction starting from the cause factor and ending with the effecting factor. A group of factors build a loop where it starts from one factor and ends at the starting factor eventually after passing once through each factor of the loop.

Generating loops are either reinforcing type or balancing type loops. A collection of such interrelated loops built a structure known as a cause and effects diagram. As figure 3 shows, several loops pass through the job satisfaction factor, and hence each has some impact on this key criterion under study here. This diagram consideres the starting point for modeling and simulation, would be used for developing the stock and flow.

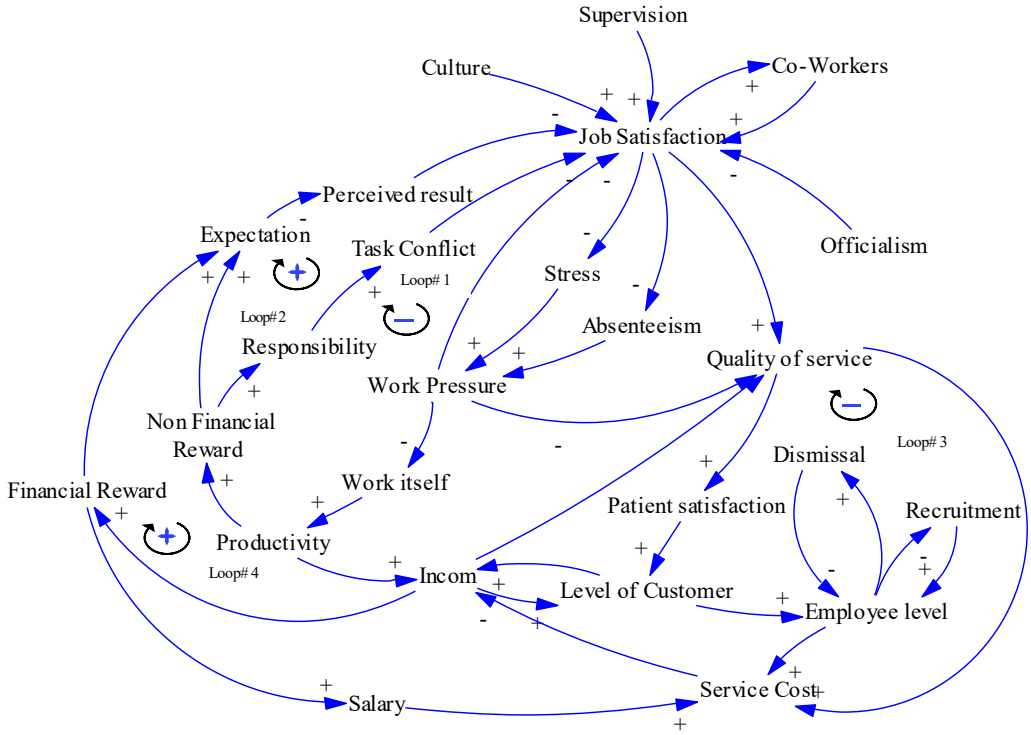

Figure 3. Proposed influence diagram for health care staff job satisfaction.

The causal loop diagram is shown in Figure 3 comprises four loops: loop 1, loop 2, loop 3, and loop 4. Two loops pass through nonfinancial rewards, while the others pass through financial reward factors. Loop 1 passes through factors of job satisfaction, stress, work pressure, work itself, productivity, nonfinancial reward, expectation, perceived results and job satisfaction. As shown, job satisfaction negatively influences job stress and vice versa; in other words, when job satisfaction increases, job stress will decrease, and when job stress increases, job satisfaction will decrease. Job stress positively influences work pressure, which has a counteractive effect on the work itself (workload; scheduling; challenging work; routinization; task requirements) and productivity.

A positive sign produces the multiplication of the signs of arrows (minus or positive, as shown on the arrow). In the current loop (Figure 4), taking the state variable to be job satisfaction, we can expect job satisfaction's trend to be of exponential type, which is the nature

of reinforcing loops always. Other factors that positively influence job satisfaction, as shown in Figure 3, are culture, supervision, co-workers and officialism.

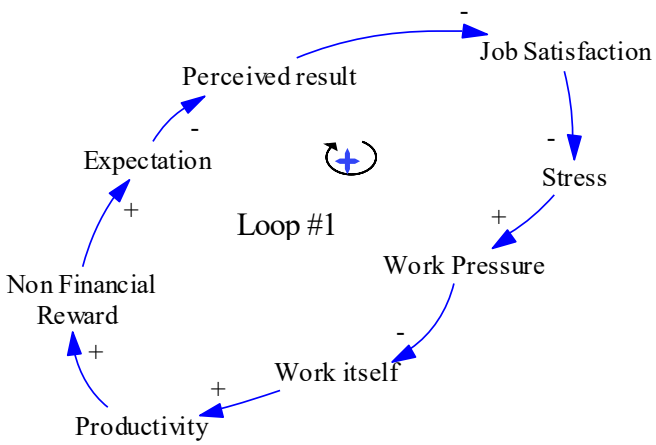

Figure 4. Causal loop diagram of nonfinancial reward (loop1)

7.2. Scenario 2 –financial reward

Scenario one deals with two loops: financial reward and nonfinancial reward as their elements. Now, for scenarios 2 and 3 we consider each sort of reward separately. However, scenario 2 deals with the financial reward only. This means that management is interested in the impacts of financial rewards on job satisfaction.

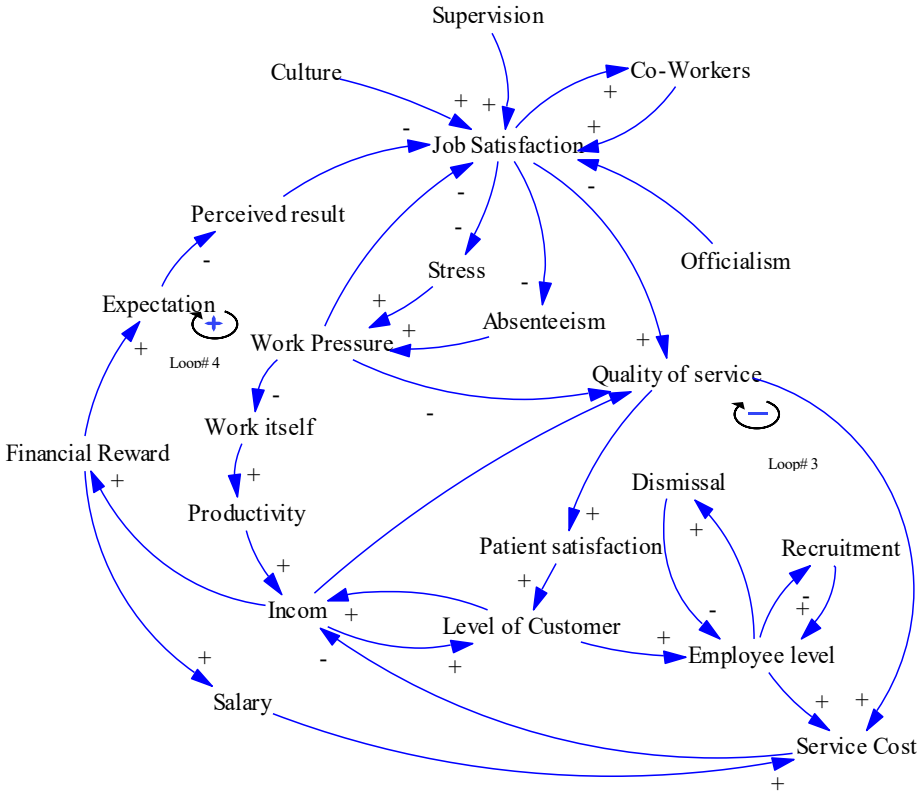

Figure 5. Influence diagram contains financial reward for scenario 2.

As seen from Figure 5, when the income factor increases due to productivity improvement, then financial reward increases. As a result of this phenomenon, expectations increase and hence perceived results decrease. The two most important loops in Figure 5 are loop 3 and loop 4. The overall influence of loop 3 is negative and loop 4 is positive. Therefore, we deal with balancing and reinforcing loops in this model. According to this model, we can analyze all loops and study the effects of any factors, especially financial reward, on job satisfaction.

7.3. Scenario 3 –nonfinancial reward

Many managers believe that nonfinancial rewards work well in many cases to satisfy employees with their job type. For this reason alone, we have proposed this third scenario (See Figure 6). According to the logic proposed in the model below, when productivity increases, nonfinancial reward increases and hence the responsibility and expectation of employees enhances. In loop 1, increasing responsibility causes increasing task conflict and then it causes a decrease in job satisfaction. The overall influence of this loop is negative, while the overall influence of loop 2 is positive.

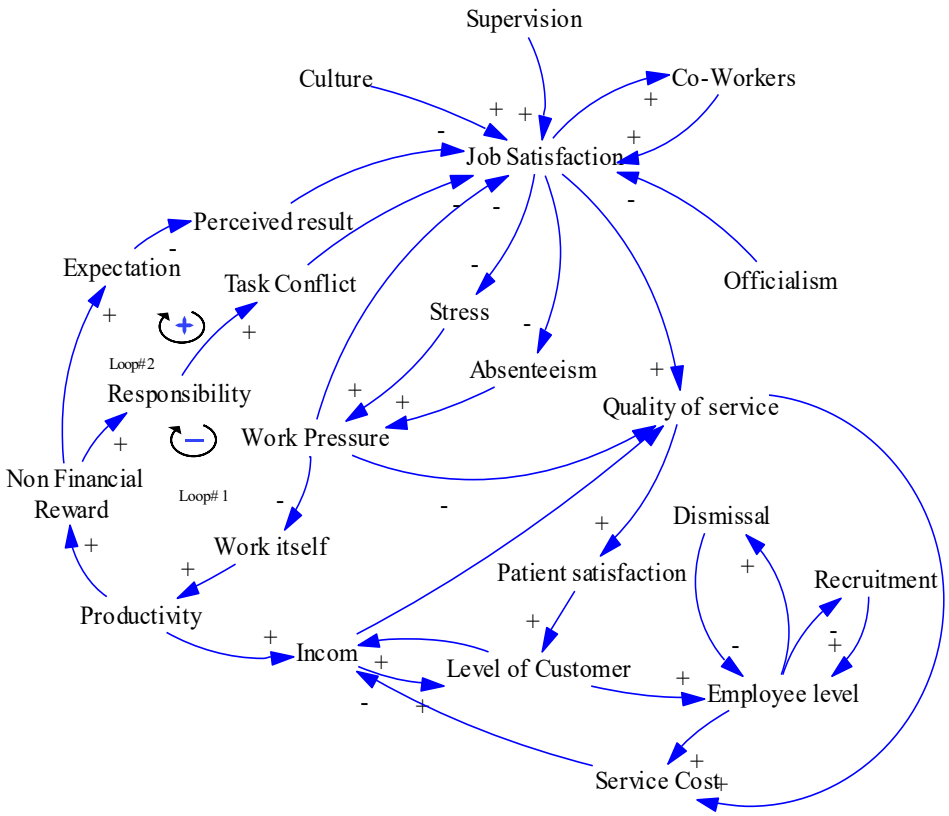

Figure 6. The influence diagram contains a nonfinancial reward for scenario 3

8. Converting casual loop to flow diagram and running it by VENSIM

According to Figure 1, the fourth model stage is converting the casual loop into the stock-flow diagram. We used VENSIM PLE for this stage. These models are explained below.

8.1. Flow diagram of scenario 1 – financial and nonfinancial reward

The stock and flow diagram for financial and nonfinancial rewards is shown in Figure 7, which is identical in the structure of the job satisfaction and influenced factors. According to Figure 7, three main level-variable are defined: job satisfaction, employee level, and income. Other related factors are defined as rate-variable and auxiliary-variable. Incoming and outgoing rates control job satisfaction, and the initial value is assumed to be 20. The balance equation is defined equation 3 (details of other equations are listed in appendix 1):

$$\text{Job satisfactin} = \text{INTEG}(\text{Incoming Rate of JS} - \text{Outcoming Rate of JS}, 20) \quad (3)$$

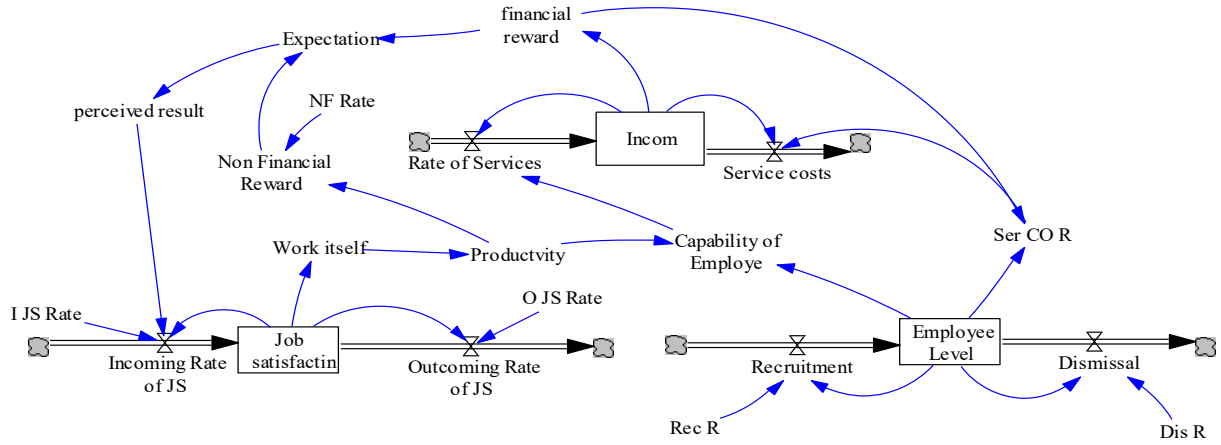

Figure 7. Flow diagram for financial and nonfinancial reward (scenario 1).

The system was first simulated under normal conditions by VENSIM PLE, whereby the final time for the simulation was assumed 100 months. Other equations and assumptions are listed in Appendix 1. The simulated results under normal conditions are shown in Figure 8. The graph shows that job satisfaction and income level changes decrease during the simulation. However, it is observed that using both kinds of rewards (financial and nonfinancial rewards) causes increased job satisfaction and income level. This result is compared with other scenarios in the next sections.

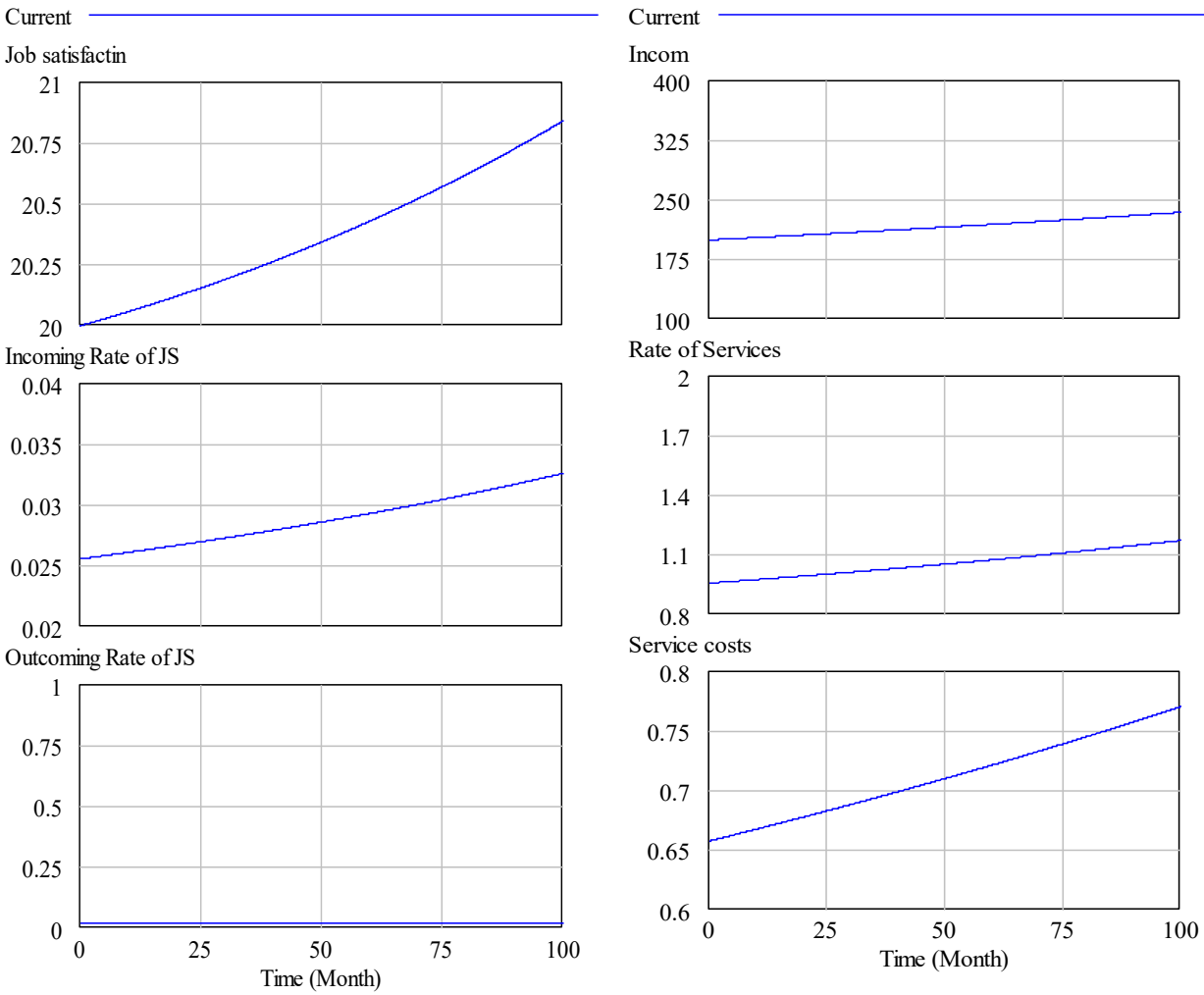

Figure 8. The simulation result of the first scenario.

8.2. Flow diagram of scenario 2 – financial reward

The stock-flow diagram of scenario 2 has been established in Figure 9, which has three main level variables: job satisfaction, income and the number of employees (details of equations are listed in appendix 2). In Figure 9, job conditions and productivity will be improved by increasing job satisfaction. Increasing productivity has a positive effect on the capability of employees, which can increase the rate of services and income level. After increasing the income level, the manager can increase the financial reward. Increasing the financial reward has two crucial effects on the model: increasing expectations and service costs. These two factors prevent the sudden increase in job satisfaction. The results of the simulation model are shown in Figure 10.

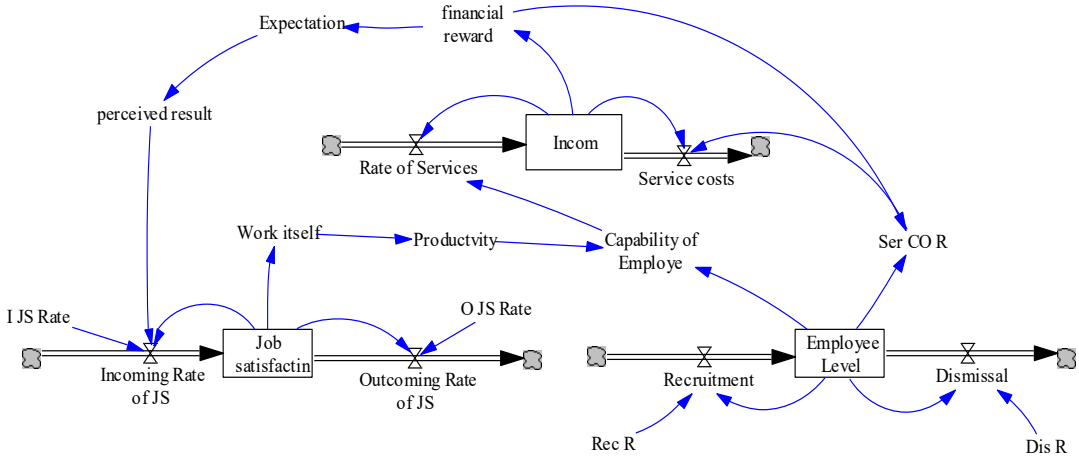

Figure 9. Flow diagram for financial reward (scenario 2).

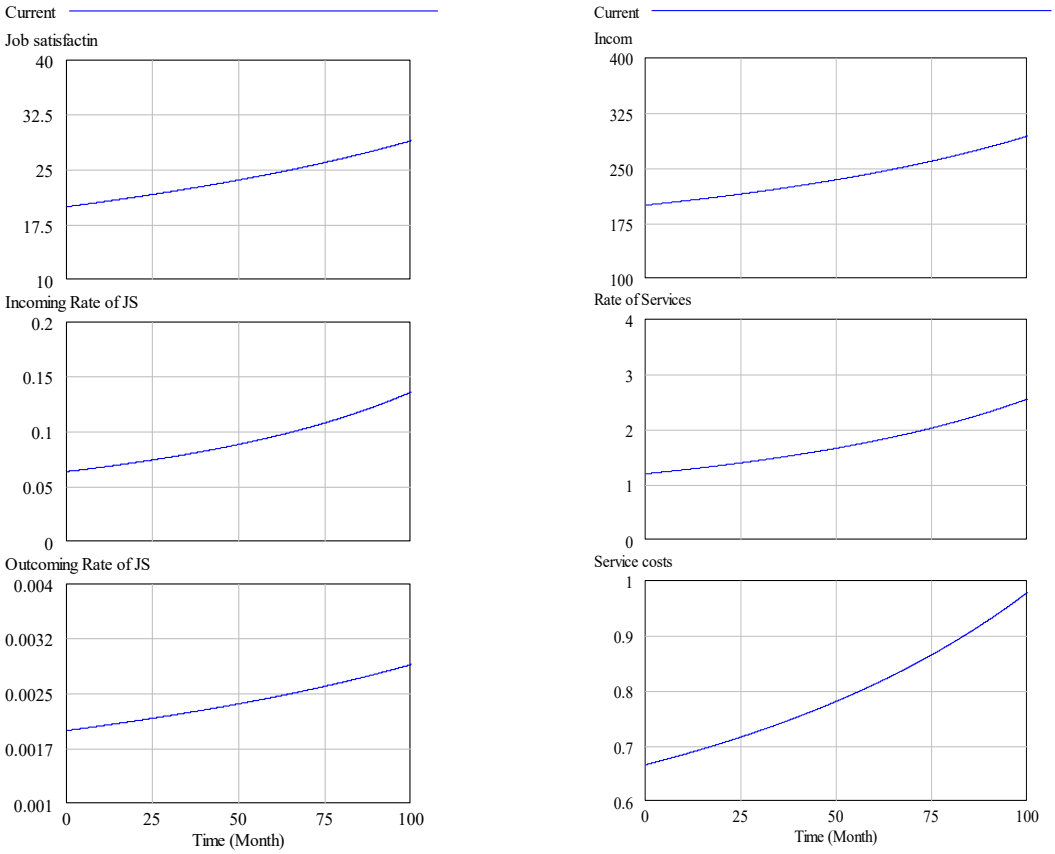

Figure 10. The simulation result of the second scenarios

8.3. Flow Diagram of scenario 3 – nonfinancial reward

For scenario 3, the flow chart model of the three main parts, job satisfaction, income and the number of employees, is used. Figure 11 illustrates a proposed stock-flow diagram, and appendix 3 shows the equation of scenario 3. As it is clear from the diagram, by increasing job satisfaction, the job condition (work itself) will improve, and thus productivity will increase

too. Increased productivity will have two significant effects. One is that management will consider nonfinancial rewards to encourage staff. Second, the capability of employees will increase. Increased capability of employees causes increasing in services and consequently improves revenue. Because of more services, increasing the number of employees will be necessary, and therefore the cost of services will increase and the income will reduce.

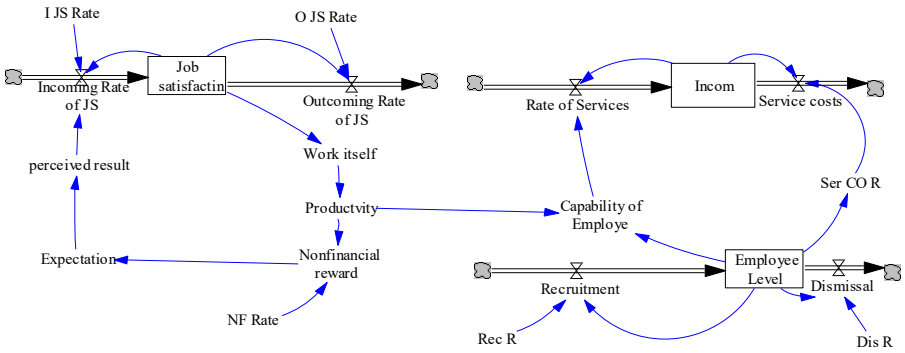

Figure 11. Flow diagram for nonfinancial reward (scenario 3).

Increasing nonfinancial reward causes increasing expectations and thus reduces the perceived result. Therefore, these factors reduce the level of job satisfaction. Using the simulation results shown in Figure 12, we notice that the job satisfaction level will reach a special level after several months and then stay at that level until the simulation period ends.

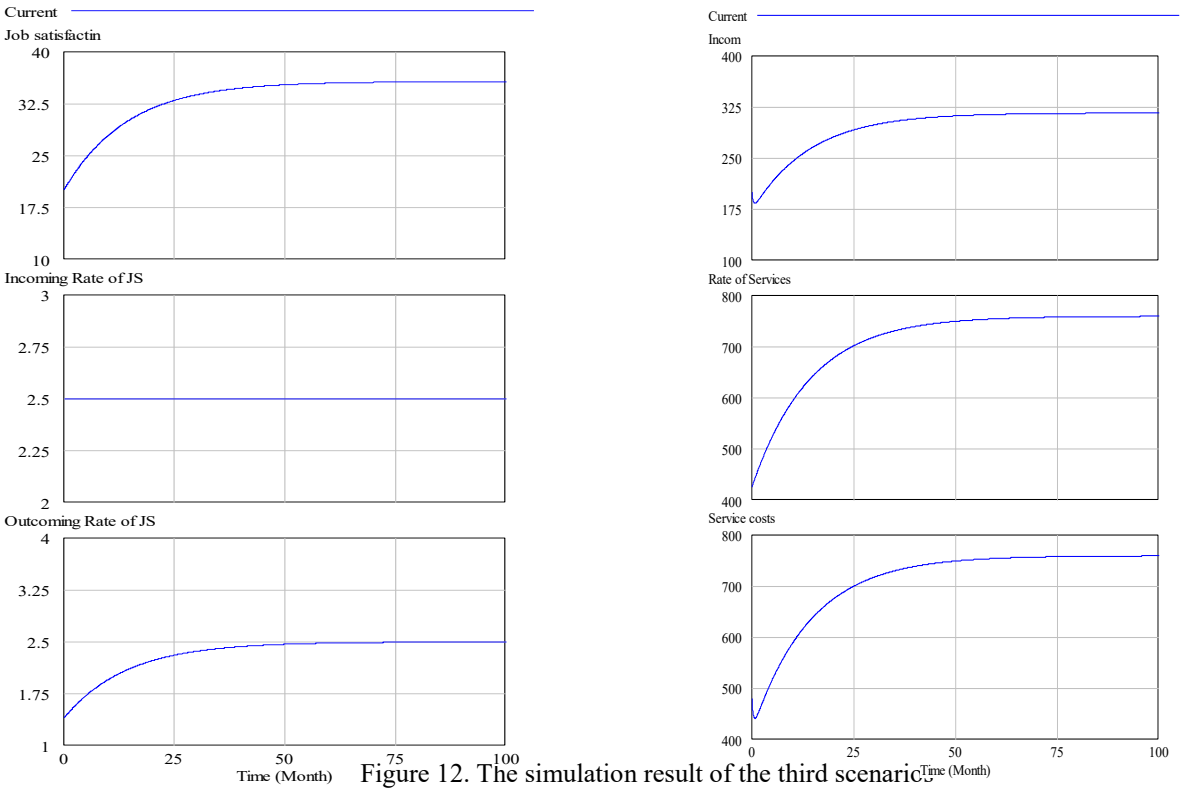

Figure 12. The simulation result of the third scenario.

9. Conclusion

Determining the factors influencing job satisfaction in service organizations, especially in the health industry, is crucial for managers. Dissatisfaction at the hospital has increased and negatively affects organizations' outputs, such as productivity. Job satisfaction has been identified as a key factor in employee turnover, with the empirical literature suggesting that it is related to a number of organizational, professional and personal variables summarized in Table 2. This study found some crucial factors influencing job satisfaction (Table 2). The second important finding of this paper is the identification of conflict and similarity between factors and effects based on the literature review.

We presented a system dynamics-based model for evaluating job satisfaction in the health industry. The methodology constructs job satisfaction evaluation by analyzing three different scenarios. This model can be used to compare three kinds of rewards in order to analyze the effect of each of them on job satisfaction. The proposed model has been implemented for the employees of a big hospital in Iran. In the previous section, we show the effect of both financial and nonfinancial rewards on job satisfaction. Comparing the three results show that (Figure 7, Figure 9, and Figure 11) using the nonfinancial reward have less effect than the other rewards. The model can further be tailored and used in various health industries. Thus, it may be useful to decision-makers dealing with job satisfaction issues.

This research can be extended in three distinct ways. First, an extension of the proposed model can be used in any industry as well as a rough working environment of the mining industry, to determine the trend of job satisfaction. Second, job satisfaction can be studied in the presence of other forms of rewards given away to employees' families to examine the impacts of that on the satisfaction level. Third, the impacts of joyful organization studied by Moubed & Zare Mehrjerdi (2014) and Zare Mehrjerdi & Moubed (2023) on job satisfaction can also be considered in new modeling.

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No potential conflict of interest was reported by the author(s).

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Apendix 1: The details of the first senario equations

1. Capability of Employe=Employee Level*0.2*Productvity
2. Dis R=5e-010
3. Dismissal=Employee Level*Dis R
4. Employee Level= INTEG (Recruitment-Dismissal,300)
5. Expectation=financial reward*Non Financial Reward
6. FINAL TIME = 100 Units: Month. The final time for the simulation.
7. financial reward= 0.02*Incom
8. I JS Rate=0.8
9. Incom= INTEG (Rate of Services-Service costs,200)
10. Incoming Rate of JS=(perceived result)*Job satisfactin*I JS Rate
11. INITIAL TIME = 0 Units: Month. The initial time for the simulation.
12. Job satisfactin= INTEG (Incoming Rate of JS-Outcoming Rate of JS,20)
13. NF Rate=5
14. Non Financial Reward=0.2*Productvity*NF Rate
15. JS Rate=0.001
16. Outcoming Rate of JS=Job satisfactin*O JS Rate
17. perceived result=Expectation
18. Productvity=Work itself*0.01
19. Rate of Services= Incom*0.2*Capability of Employe
20. Rec R=4e-009
21. Recruitment=Employee Level*Rec R
22. SAVEPER = TIME STEP Units: Month. The frequency with which output is stored.
23. Ser CO R=Employee Level+financial reward
24. Service costs=Incom*1/Ser CO R
25. TIME STEP = 0.0625 Units: Month. The time step for the simulation.
26. Work itself=Job satisfactin*0.002

Apendix 2: The details of the second senario equations

1. Capability of Employe=Employee Level*Productvity
2. Dis R=5e-010
3. Dismissal=Employee Level*Dis R
4. Employee Level= INTEG (Recruitment-Dismissal,300)
5. Expectation=financial reward*0.02
6. FINAL TIME = 100 Units: Month . The final time for the simulation.
7. financial reward= 0.001*Incom
8. I JS Rate=0.8
9. Incom= INTEG (Rate of Services-Service costs,200)
10. Incoming Rate of JS=(perceived result)*Job satisfactin*I JS Rate
11. INITIAL TIME = 0 Units: Month. The initial time for the simulation.
12. Job satisfactin= INTEG (Incoming Rate of JS-Outcoming Rate of JS,20)
13. JS Rate=0.0001
14. Outcoming Rate of JS=Job satisfactin*O JS Rate
15. perceived result= expectation
16. Productvity=Work itself*0.001
17. Rate of Services= 0.1*Incom*Capability of Employe
18. Rec R=4e-009
19. Recruitment=Employee Level*Rec R
20. SAVEPER = TIME STEP Units: Month. The frequency with which output is stored.
21. Ser CO R=Employee Level+financial reward
22. Service costs=Incom*1/Ser CO R
23. TIME STEP = 0.0625 Units: Month. The time step for the simulation.
24. Work itself=Job satisfactin*0.01

Appendix 3: The details of the third senario equations.

1. Capability of Employe=Employee Level*Productvity*0.7
2. Dis R=1e-011
3. Dismissal=Employee Level*Dis R
4. Employee Level= INTEG (Recruitment-Dismissal,300)
5. Expectation=Nonfinancial reward*0.02
6. FINAL TIME = 100 Units: Month. The final time for the simulation.
7. I JS Rate=0.1
8. Incom= INTEG (Rate of Services-Service costs,200)
9. Incoming Rate of JS=perceived result*Job satisfactin*I JS Rate
10. INITIAL TIME = 0 Units: Month. The initial time for the simulation.
11. Job satisfactin= INTEG (Incoming Rate of JS-Outcoming Rate of JS,20)
12. NF Rate=20
13. Nonfinancial reward=Productvity*NF Rate
14. JS Rate=0.07
15. Outcoming Rate of JS=Job satisfactin*O JS Rate
16. perceived result= 1/Expectation
17. Productvity=Work itself
18. Rate of Services= Capability of Employe+0.03*Incom
19. Rec R=3e-010
20. Recruitment=Employee Level*Rec R
21. SAVEPER = TIME STEP Units: Month. The frequency with which output is stored.
22. Ser CO R=0.008*Employee Level
23. Service costs=Incom*Ser CO R
24. TIME STEP = 0.0625 Units: Month. The time step for the simulation.
25. Work itself=Job satisfactin*0.1