BURNOUT EFFECT: SIMULATION MODELLING APPROACH FOR LEARNING

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Abstract
Modern society is a fast-moving, achievement-oriented, very competitive and lead to many stressful situations, which individuals cannot handle always. The consequence of that state is burnout effect. We propose usage of system dynamics methodology in exploration of burnout effect. Several experiments have been conducted and presented which indicate increase and collapse behaviour in case of burnout experience by the individual.
Key words: burnout, system dynamics, employment, human resources

1. Introduction

Burnout effect affects individuals when they work hard and become exhausted, frustrated and unproductive. It is not just a problem of a lot of work but the attitude the person has towards its work and obligations [7, 9]. Burnout effect can also be described as a process of emotional exhaustion, depersonalisation and decreased personal accomplishment especially related to those who worked in human services [3, 11].

Psychological, medical and behaviour problems such as irritation, depression, violence, alcoholism, mental illness, heart disease and loss of appetite of over eating can be described to explain the burnout effect [14]. The source of burnout effect is trying to fulfil high expectations in a very short time period [7].

There are some careers where burnout effect is more obviously such as teacher comparing with doctors, nurses and other who works in client-related professions [3, 8]. In order to avoid burnout effect individuals should relax, looking for help at work, defined limitations, find compromise for situations, gave realistic deadlines. There are also some strategies to prevent burnout effect such as: work less, minimize the stress and more relax [7, 14].

Goal of the paper is to demonstrate the usage of system dynamics methodology in the exploration of the burnout effect. The model used is based on the assignment of MIT, named GSP-A27, where we propose usage of more simplified model in the class [6].

The paper is organized as follows. Introduction part is the first section. In the second section research methodology and analysis are presented. The model diagram is explained in the third section. Experiments with the model are described in the fourth section. In the fifth section model behaviour is very concise explained. At the end there is a conclusion part of the paper.

2. Methodology

System dynamics models are used in many different disciplines [2] because they can give a very good overview of the structure and behaviour of the system using nonlinear links and feedback [1, 10]. It is important that the approach to the development of the model is gradual in order to understand better the model behaviour [4, 12]. In the next section, we propose gradual approach of exploration of system dynamics model which provide better understanding of the model.

3. Model

Model consists on two levels and three rates. It also contains 4 constant variables, and 5 auxiliary variables (Fig. 1).

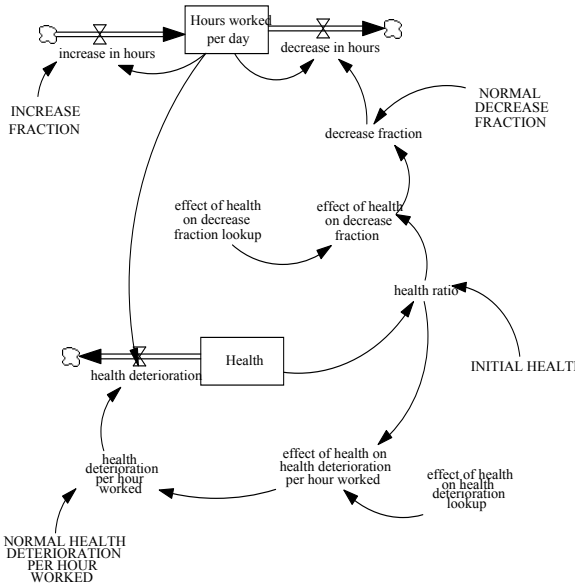

Figure 1. Model diagram

Hours worked per day= INTEG (+increase in hours-decrease in hours,8)
Units: hours per day
Number of hours that person works per day.

increase in hours=Hours worked per day*INCREASE FRACTION
Units: hours per day/Day
The number of hours by which person daily increases the number of hours he/she works per day.

decrease in hours=Hours worked per day*DECREASE FRACTION
Units: hours per day/Day
The number of hours by which person daily decreases the number of hours he/she works per day.

Health= INTEG (-health deterioration,100)
Units: units of health
State of person's health. A perfect health is defined to have the value of 100, as in 100%.

Health deterioration=Hours worked per day*health deterioration per hour worked
Units: units of health/Day
Person's health gets worse as he works more.

Decrease fraction=
NORMAL DECREASE FRACTION*effect of health on decrease fraction
Units: 1/Day
The fraction of an hour by which person decreases the number of hours he/she works per day.

effect of health on decrease fraction=
effect of health on decrease fraction lookup(health ratio)
Units: dmnl
The effect of person's health on the "decrease fraction". As his health deteriorates, person realizes that he/she has to stop working so many hours every day, so the "decreases fraction" grows (Fig. 2)

effect of health on decrease fraction lookup
([(0,0)-
(1,100)],(0,100),(0.1,100),(0.2,100),(0.3,100),(0.4,50),(0.5,26),
(0.6,10),(0.7,2),(0.8,1.2),(0.9,1.05),(1,1))
Units: dmnl
Lookup function for effect of health on decrease fraction.

effect of health on health deterioration lookup
([(0,0)-
(1,1)],(0,0),(0.1,0.435),(0.2,0.645),(0.3,0.79),(0.4,0.87),
(0.5,0.915),(0.6,0.945),(0.7,0.97),(0.8,0.985),(0.9,0.995),(1,1))
Units: dmnl
Lookup function for the effect of health on health deterioration per hour worked (Fig. 3)

effect of health on health deterioration per hour worked=
effect of health on health deterioration lookup(health ratio)
Units: dmnl
The effect of person's health on the "health deterioration per hour".

As person's health gets worse, the fraction of his/her health that deteriorates for every hour he works becomes smaller.
health deterioration per hour worked=NORMAL HEALTH DETERIORATION PER HOUR WORKED*effect of health on health deterioration per hour worked
Units: (units of health/hours per day)/Day
The fraction by which person's health deteriorates each day for every hour he/she works.

health ratio=Health/INITIAL HEALTH
Units: dmnl
Ratio of current state of person's health and his initial health.

INCREASE FRACTION=0.1
Units: 1/Day
The fraction by which person increases the number of hours he/she works each day.
As person spends more hours working on the project, he/she likes it more and becomes more addicted to his/her work, so he/she spends even more hours working.

INITIAL HEALTH=100
Units: units of health
The initial state of person's health. Assume person is initially perfectly healthy, so his/her health is at 100%.

NORMAL DECREASE FRACTION=0.05
Units: 1/Day
The fraction by which person decreases the number of hours he/she works each day while his/her health is perfect.

NORMAL HEALTH DETERIORATION PER HOUR WORKED=0.15
Units: units of health/(Day*hours per day)
The fraction by which person health deteriorates with every hour he/she works.

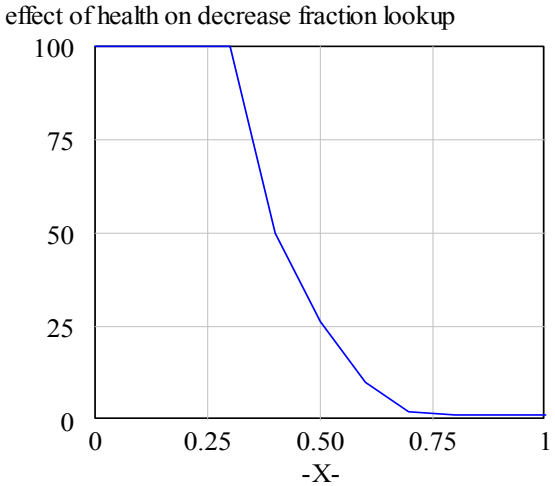

Figure 2. Lookup function for effect of health on decrease fraction

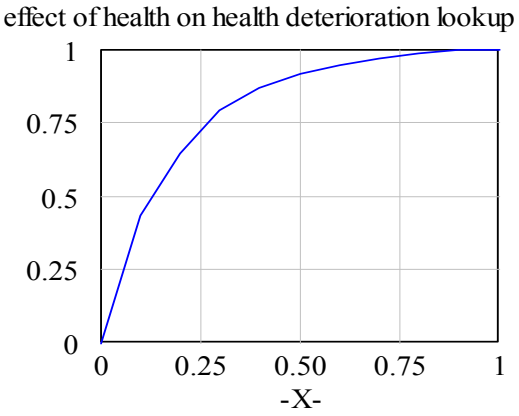

Figure 3. Lookup function for effect of health deterioration

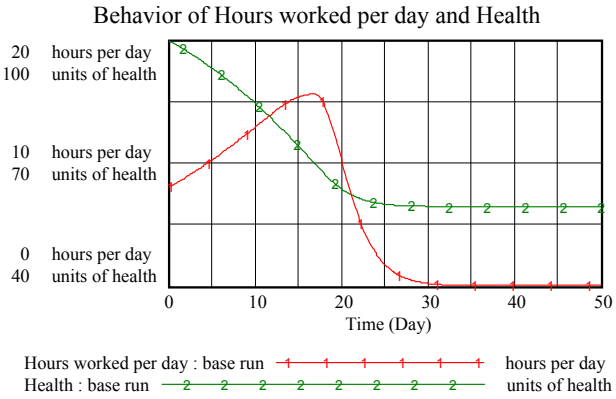

Figure 4. Behaviour of hours worked per day and health (base run)

4. Experiments with the model

Table function in the base run

In the model described in the "Generic Structures: Overshoot and Collapse" paper table function for the "effect of health on decrease fraction" is constructed according to the following assumptions.

The lookup function for the "effect of health on decrease fraction" is a curve whose negative slope decreases in magnitude. The curve ranges from 0 to 1 for the "health ratio" which is the ratio of "Health" to INITIAL HEALTH, and from 1 to 100 for the "effect of health on decrease fraction". For higher values of "health ratio" table function outputs values close to 1, and for lower values of "health ratio" table function outputs values close to 0.

The "effect of health on decrease fraction" table function has a negative slope that decreases in magnitude. When fraction of "Health" remaining is still high, the depletion of "Health" will not have strong impact on "decrease fraction". As "Health" decreases, impact of depletion of "Health" is stronger. Also, when "Health" is equal to INITIAL HEALTH ("health ratio" is 1), "decrease fraction" is equal to NORMAL DECREASE FRACTION, and the table outputs a value of 1. As the fraction of "Health" remaining decreases, table output values higher than 1 and "decrease fraction" is higher than NORMAL DECREASE FRACTION.

In the base run, when table function is formulated according to the above description model exhibits overshoot and collapse behaviour. "Hours worked per day" reaches maximum value of 15, 60 at 17th simulation day, and "Health" is depleted after 30 days and it decreases from initial value of 100% to 59, 36%.

We wanted to see what will happen if table function is constructed under different assumptions [13]. We have simulated the model behaviour under following scenarios:

- table function is linear and has negative slope
- table function is flatter than in the base run
- table function is steeper than in the base run

Table function is linear with negative slope

Table function has again decreasing slope, but which is equal for the entire range of input values. Therefore, an increase in the "health ratio" for the one unit causes the decrease in the "effect of health on decrease fraction" for the one unit. Besides of that, table function is constructed according to the same assumptions as under base run.

Again, model behaviour has remain unchanged, and model exhibits overshoot and collapse behaviour. "Hours worked per day" reaches maximum value of 8, 56 days at 1st simulation day, and "Health" deteriorates to the level of 91, 90% from initial value of 100%.

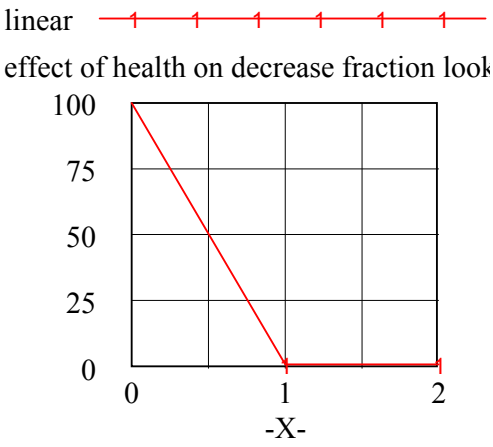

Figure 5. Lookup function for effect of health on decrease fraction (function is linear and has negative slope)

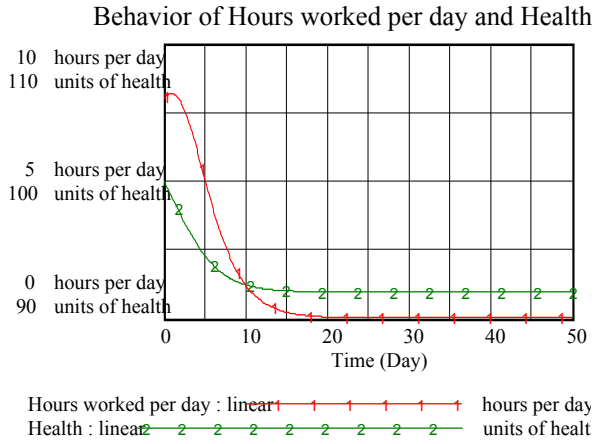

Figure 6. Behaviour of hours worked per day and health (function is linear and has negative slope)

Table function is flatter than in the base run

Table function for the "effect of health on decrease fraction" is constructed under same assumptions as in the base run, but maximum value for the table function is lower and is set to 10 instead to 100. Therefore, the "decrease fraction" becomes 10 times larger than NORMAL DECREASE FRACTION. Model still exhibits overshoot and collapse behaviour. Number of "Hours worked per day" decreases slower than in the base run, and it reaches maximum value of 16, 98 days at 20th simulation day. After 50 days "Health" decreases from initial value of 100% to 34, 59%.

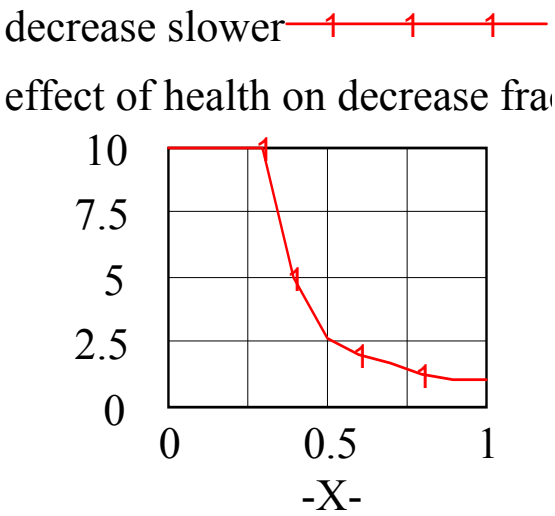

Figure 7. Lookup function for effect of health on decrease fraction (function is flatter than in the base run)

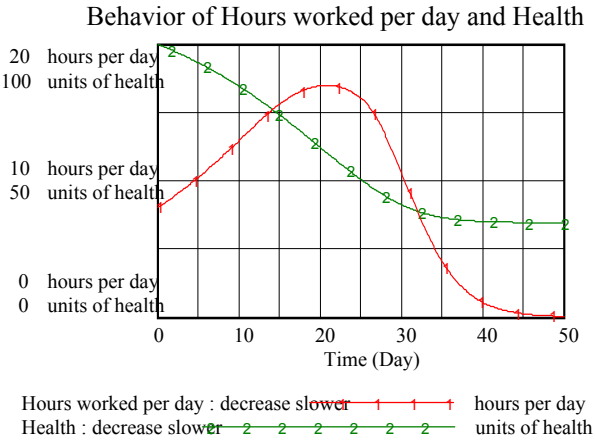

Figure 8. Behaviour of hours worked per day and health (function is flatter than in the base run)

Table function is steeper than in the base run

Table function for the "effect of health on decrease fraction" is again constructed under same assumptions as in the base run, but maximum value for the table function is higher and is set to 200 instead to 100. Therefore, the "decrease fraction" becomes 200 times larger than NORMAL DECREASE FRACTION. Model still exhibits overshoot and collapse behaviour. Number of "Hours worked per day" decreases faster than in the base run and it reaches maximum value of 8, 42 days at 1st simulation day. After 15 days "Health" decreases from initial value of 100% to 93, 33%.

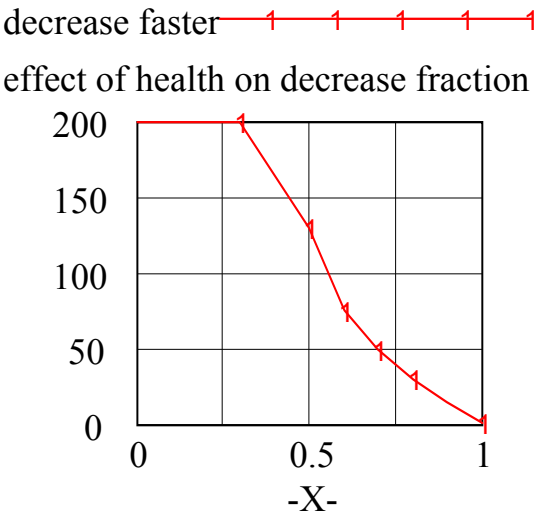

Figure 9. Lookup function for effect of health on decrease fraction (function is steeper than in the base run)

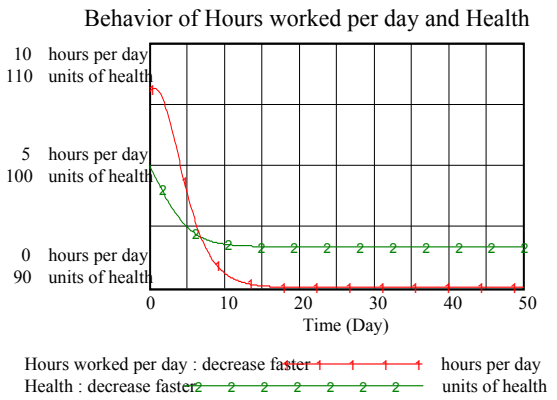

Figure 10. Behaviour of hours worked per day and health (function is steeper than in the base run)

5. Model behaviour

According to different assumptions we have constructed several table functions for "effect of health on health deterioration" and for each specification we have simulated the model.

Summary is presented in the Table 1. It is obvious that table function for "effect of health on health deterioration" does not have strong impact on model behaviour. For every specification of the table function, model exhibits overshoot and collapse behaviour.

Number of "Hours worked per day" reached lowest maximum value (12,57 days) with bell-shaped table function, and highest maximum value for table function with positive and increasing slope (17,54 days). Number of "Hours worked per day" reaches maximum value in shortest time (10th simulation day) with bell-shaped table function and in longest time (20th simulation day) when table function with positive and increasing slope. "Health" decreases to lowest value (52, 15%) when table function is bell-shaped and to highest value (60, 99%) when table function has positive and increasing slope. Clearly, differences between model behaviour with different table functions could be ignored. Graphs of the model behaviour confirm the conclusions.

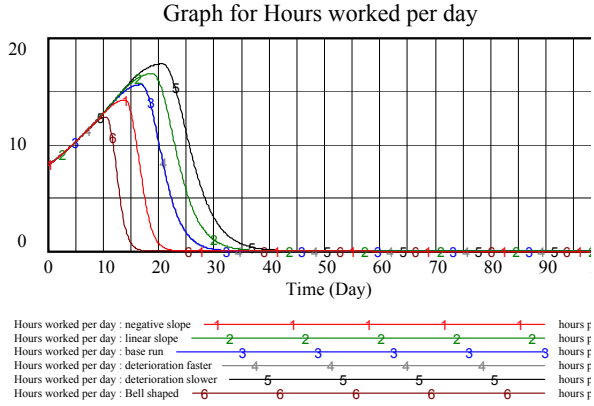

Figure 11. Graph for hours worked per day (100 days)

Table 1. Results of the simulation for different table function specifications for "effect of health on health deterioration"

Scenario	Maximum value for "Hours worked per day"	Time at which "Hours worked per day" reaches maximum value	Equilibrium level for "Health"
Table function has positive and decreasing slope	15,60 hours	17th day	59,36%
Table function is shifted to the left	15,60 hours	17th day	59,20%
Table function is linear and has positive slope	16,62 hours	19th day	60,99%
Table function has positive and increasing slope	17,54 hours	20th day	62,19%
Table function has negative and decreasing slope	14,17 hours	14th day	54,67%
Table function is bell-shaped	12,57 hours	10th day	52,15%

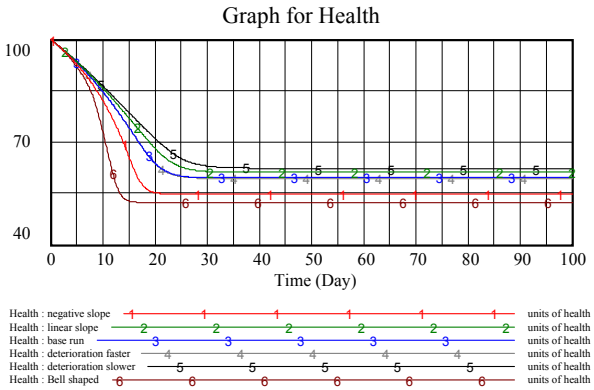

Figure 12. Graph for health (100 days)

We have constructed several table functions for "effect of health on decrease fraction" and for each specification we have simulated the model. Table 2. contains the summary. Although model exhibits overshoot and collapse behaviour for every one of table functions, there are important differences between simulation runs. When table function was steeper than in the base run and when it was linear model shows unrealistic behaviour because number of "Hours worked per day" reaches maximum value in only one day and it is just a little bit higher than initial. Also, "Health" decreases for less than 10%.

Model exhibits overshoot and collapse behaviour but to such a small magnitude that it could be ignored because it is not realistic [5]. When table function was flatter than in the base run, number of "Hours worked per day" reaches maximum value later than in the base run, but model behaviour is still realistic.

Graphs of the model behaviour confirm the conclusions.

Table 2. Results of the simulation for different table function specifications for "effect of health on decrease fraction"

Scenario	Maximum value for "Hours worked per day"	Time at which "Hours worked per day" reaches maximum value	Equilibrium level for "Health"
Table function has positive and decreasing slope	15,60 hours	17th day	59,36%
Table function is linear with negative slope	8,56 hours	1st day	91,90%
Table function is flatter	16,98 hours	20th day	34,59%
Table function is steeper	8,42 hours	1st day	93,33%

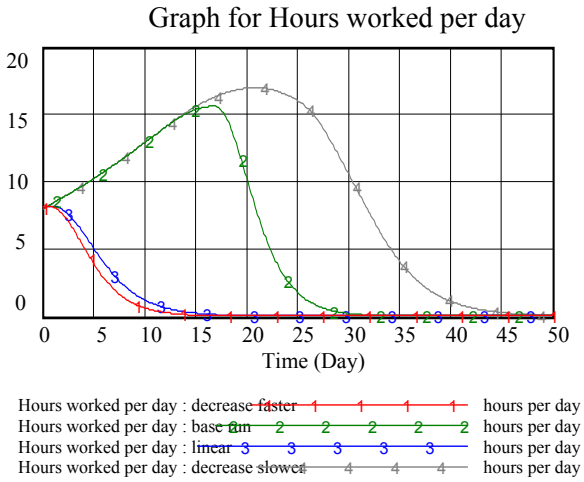

Figure 14. Graph for hours worked per day (50 days)

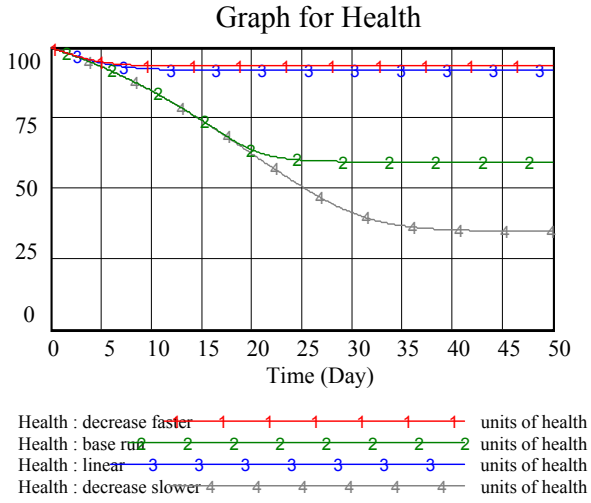

Figure 15. Graph for health (50 days)

Conclusion

Individuals are affected by the burnout effect in situations when they work too hard and become exhausted, frustrated and unproductive. Behaviour of burnout effect has been explored by the usage of system dynamics approach. We have demonstrated presence of burnout effect in several different situations presenting different effects of health on health deterioration and different effects of health on decrease fraction.

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