Carrying Capacity Erosion Dynamics: How Can Students' Workload Bring Them Gradually to Their Knees?

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Abstract

A few months ago, public opinion was deeply affected by the news of committing suicide of a girl Ph.D. student in Iran. Unfortunately, it is not a rare case limited to a university or a country, in a way we witness such tragic events once in a while from around the world. Based on the report of the Office for National Statistics (ONS), one UK student dies by suicide every four days. Also, according to the World Health Organization (WHO), suicide is the second leading cause of death among 15–29-year-olds. That event invoked me to do research maybe I could alleviate this problem by using system dynamics. The main goal of the study is gaining insight into the factors and mechanisms that are responsible for committing suicide of students. For this purpose, we will use Interpersonal Theory of Suicide (IPTS) to show how "mental pressure" stemming from "workload" and "loneliness" can gradually erode the carrying capacity and make a student prone to commit suicide. We applied qualitative system dynamics method to map the broad feedback mechanism of Carrying Capacity Erosion. The result is a casual loop diagram which defines 12 key reinforcing feedback loops, involving in increasing mental pressure, and three balancing feedback loops which in total can produce overshoot and collapse structure and behavior. Future research is needed to expand upon this initial model of suicide dynamics. Quantitative extensions may result in a better understanding and contribute to personalized methods of evaluation, prevention and intervention.

Keywords

Carrying Capacity Erosion, work pressure, workload, burnout, quality of student life, suicide, loneliness, mental pressure

Introduction & Necessity of doing the Research

According to the World Health Organization (WHO), suicide is the second leading cause of death among 15–29-year-olds [29]. Based on the report of the Office for National Statistics (ONS), one UK student dies by suicide every four days [30]. Though the reduction of suicide-related deaths has been a national priority in the U.S. for over a decade (U.S. Department of Health and Human Services, 2001) and over $22 million per year (National Institutes of Health, 2015) have been invested in preventing suicide, the rates of suicide have remained relatively the same, if not worse, over time (HHS, 2012). The inability to reduce the rate of suicides throughout the past few decades may be attributable to the utilization of research methodologies that are unable to account for the dynamic nature of suicidal processes across the life course [2].

The main goal of the study is gaining insight into the factors and mechanisms that are responsible for committing suicide of students. With this aim, first of all, we review the studies conducted by SD regarding committing suicide. Next, we will speak about the theories trying to explain committing suicide. Then since based on the selected theory for the building an SD model, the main reason for committing suicide is mental pressure caused by workload and loneliness, we will review the studies done by SD regarding "workload", and show that despite many studies about "workload" and its effect, there are no studies focusing on "workload" of students and the effects of these workloads (at least to the best of the author's knowledge). We show how excessive workload can increase mental pressure and erode carrying capacity over time.

Literature Review

Literature Review Part One: Committing Suicide SD Models

Literature review reveals that there are few studies trying to model committing suicide. ***Chung's (2016)*** model includes six stocks [(1) depression levels (2) perceived self-worth (3) desire for suicide (4) capability for suicide (5) suicide attempts (6) fear of death from suicide] and three main loops (R1: demonstrates the relationship between depression and a desire for suicide; R2: an increase in suicide attempts leads to a decrease in one's fear of pain from harming oneself (though habituation and diminishing fear). As the fear of death from harming oneself decreases, one capability for suicide increases, further enhancing one's propensity to attempt suicide; B1: Self-Realization and Worth. People who suffer from low self-worth believe they do not deserve to live and have a tendency to withdraw). The goal of this study was to understand whether Thomas Joiner's interpersonal theory of

suicide (IPTS), when mathematically defined as a system dynamics model, could accurately simulate and predict suicide attempts across time. ***Page et al.'s (2017)*** purpose of the study is suicide prevention in Australia. The model is based on a "people flow" (picture 1). Authors have investigated the hypothesized impacts over the next 10 years (2015–2025) of a combination of current intervention strategies proposed for population interventions in Australia: 1) general practitioner (GP) training, 2) coordinated aftercare in those who have attempted suicide, 3) school-based mental health literacy programs, 4) brief-contact interventions in hospital settings, and 5) psychosocial treatment approaches.

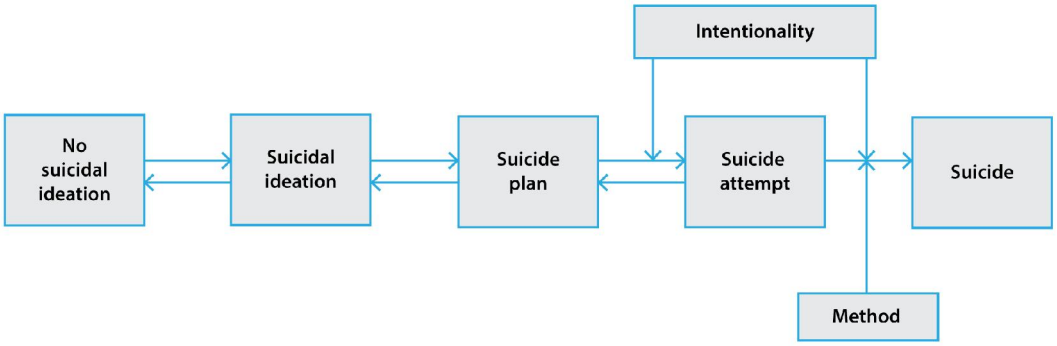


Figure 1: Summary structure of the SD model of Australian suicide

Literature Review Part Two: Suicide Theories

There are many theories trying to explain the suicide including (1) Joiner & Van Orden's view of the interpersonal theory of suicide (Joiner, 2005; Van Orden et al., 2010) (2) David Lester's Paradox Theory of Suicide (Lester, 1989) (3) Durkheim's Theory of Suicide (Durkheim, 1956) (4) Chu's cultural model of suicide (Chu, Goldblum, Floyd, & Bongar, 2010) [2]. The main theory of interest that will be examined in this research is Joiner & Van Orden's view of the interpersonal theory of suicide. Interpersonal Theory of Suicide (**IPTS)** (Joiner, 2005; Van Orden et al., 2010) is grounded on the assumption that people die by suicide because they can and because they want to. In this theory, three constructs are central to suicidal behavior: two constructs are primarily related to suicidal desire (thwarted belongingness and perceived burdensomeness) and one construct focuses on capability (the acquired capability for suicide). The theory also specifies the relationship between these constructs and includes a causal hypothesis for the development of the desire for suicide and the capability to engage in serious suicidal behavior (i.e., lethal or near-lethal attempts). Figure.2 depicts the interpersonal theory of suicide by Van Orden et al. (2010). In this theory, all components

(a feeling of low social belonging, the perception of being a burden, and the capability for suicide) are necessary for lethal (or near lethal) suicide attempts. [2]

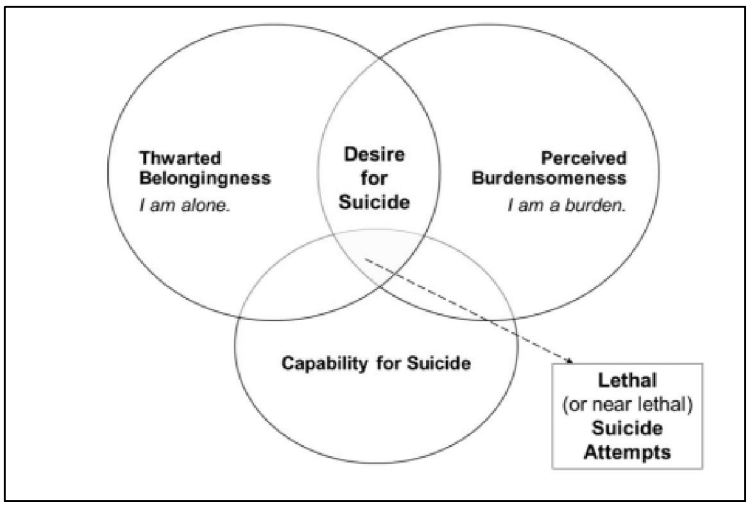


Figure 2. Interpersonal Theory of Suicide

Literature Review Part Three: Workload

This is already quite a broad perspective on the topic of workload and burnout. For instance, ***Larsen (1969)*** builds a model to evaluate Managerial Strategies for Dealing with Work pressure in a Project-Oriented Environment. ***Homer (1985)*** examines the dynamics of "worker burnout", the process in which a hard-working individual becomes increasingly exhausted, frustrated, and unproductive. ***Levine et al.'s (1985)*** model encompasses the literature on burnout and belongs to a general class of stress and motivational models which describe problems of alcoholism and sexual harassment in the workplace, etc. ***Ogunlana, Lim, & Saeed (1995)*** attempt to understand the current practices and problems in design projects, a system dynamics model was developed for the management of detailed design process in a civil engineering project. The model took an integrative approach, consisting of four interrelated subsystems: human resources, design production, controlling and planning. ***Oliva (2001)*** explores how service organizations respond to change in work pressure, why they respond the way they do, and what managers can do about it. ***Holmström & Elf (2004)*** explore staff retention and job satisfaction at a maternity department, which was in an unfavorable spiral of attrition after an expansion period. They integrate factors of attrition and hiring rates, workload and qualitative contents of the work. ***Bayer et al. (2004, 2005, 2006)*** model fluctuating workload. ***Wiik et al. (2009a, 2009b)*** investigate the chronic problems of Computer Security Incident Response Teams (CSIRTs), that is, workload, quality of service, and sustaining their constituency. ***Morrison & Rudolph (2011)*** present a model of how a build-up of interruptions can shift the dynamics of the emergency department (ED) from an adaptive, self-

regulating system into a fragile, crisis-prone one. ***Lopez & Zuniga (2013)*** take into account agent learning, resource utilization, human agent expectations, and target workload and performance goals. The article explores these issues in the context of a case study of a large high contact service operation. ***Lopez (2015)*** examines the effects of organizational responses to work pressure when capacity is managed through active and aggressive use of temporary employment. In ***Deuten (2017)*** the effect of work pressure on nurses' well-being and patient satisfaction is modeled. ***Rahmandad & Reopening (2015)*** model the "*capability erosion dynamics".* To understand erosion, they study two software development organizations that experienced diverging capability trajectories despite similar organizational and technological settings. Building a simulation-based theory, they identify the adaptation trap, a mechanism through which managerial learning can lead to capability erosion.

Conclusion from Literature Review

Literature review demonstrates that there is few system dynamics studies have been done in the field of committing suicide and there is room for doing more research. Also, it shows that in spite of many studies conducted regarding "workload" and its effect, there are no studies focusing on "workload" of students and the effects of these workloads (at least to the best of the author's knowledge). Benefiting from Interpersonal Theory of Suicide (IPTS), we will explore how excessive "workload" can increase mental pressure, erode carrying capacity over time, and end into committing suicide.

Method

We applied qualitative system dynamics methods to map the broad feedback mechanisms of Carrying Capacity Erosion Dynamics. In the first step, the qualitative model was built (based on Interpersonal Theory of Suicide and some assumptions mentioned in the following). Then it was sent to the professors and other students, and they were invited to state whether they "agreed fully", "agreed partially", "disagreed partially", or "disagreed fully" with the casualty relationships and loops? We were not only interested in finding out whether someone agrees or not with a relationship, but we were also interested in discovering all kinds of casual arguments that were generally used by respondents and which were not included in our preliminary model. To extract these causal arguments we asked the respondent to indicate "why" one did or did not agree with the statement. Also, they were asked that is there any part that you think is incomplete or is there any important affecting variable which is missed? (Vennix et al. 1988). Disconfirmatory assessment interviews have three broad

purposes. First, these interviews are used to increase user confidence in the structure and behavior of a model by using a systematically constructed process of disconfirmation. Second, these interviews support efforts to improve model structure by leading to concrete suggestions for how to improve the current version of the model. Finally, these interviews can serve the practical purpose of helping a client focus on the practical question of what should be done in the policy domain of the model's focus—clarifying and agreeing on detailed implementation steps (Andersen et al. 2012). The response rate was three professors of four, and five students of 30 (one reason for a low response rate of students was inappropriate time, because it was in Christmas holidays and after that final exams were coming).

Assumptions

1. The first assumption is that based on Interpersonal Theory of Suicide, the underlying mechanism that a student commits suicide is (1) his/her burden increases gradually over the time (b) he/ she becomes loner & loner over the time (3) in the end, if capable of committing suicide he/she will do that.
2. The second assumption is that every person has a "carrying capacity" to tolerate hardships. This carrying capacity can increase, or vice versa be eroded over time in the influence of some factors. About who commits suicide, accumulated burden & loneliness leads to erosion of the carrying capacity, and when the mental pressure stemming from accumulated burden & loneliness "***overshoot"*** the carrying capacity, "***collapse"*** happens & he/ she drops out of university or, in worse situation, if nothing waits for them outside of the university or the cost of leaving university is too high, he/ she might commit suicide. System dynamically speaking, the underlying structure of committing suicide is an "overshoot and collapse" structure (Figure 3)

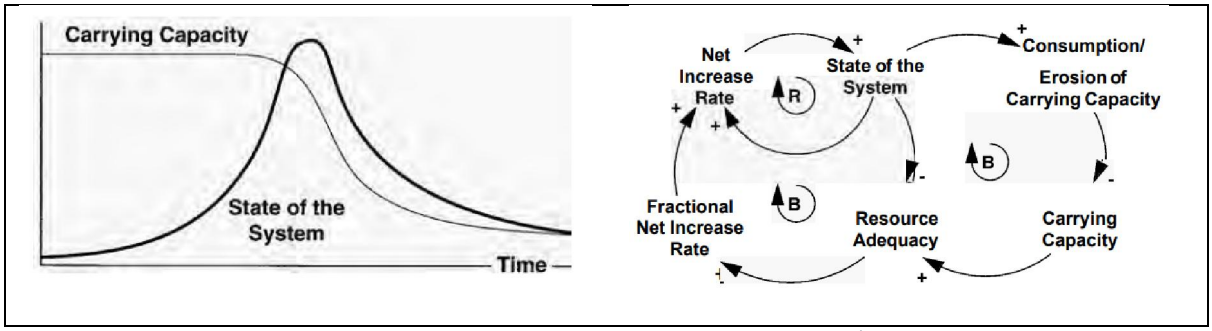


Figure 3: Overshoot & Collapse Structure & Behavior[1]

[1] Sterman. 2000. P.123

3. For modeling the workload, I use my own **experience of students at Radboud University for one semester.** Students every week go to university, take part in three lectures, namely, (GMB1, ATSM, and RM), and get some reading materials (slides, book chapters, and some articles) for each course after each session. Besides, they should search to find their thesis subject.

Conceptual Model

1) "***Total Work to Do"*** & "***Redo***" enforcing loop:

Students every week go to university, take part in three lectures, namely, (GMB1, ATSM, and RM), and get some reading materials (slides, book chapters, and some articles) for each course after each session. Besides, they should search to find their thesis subject.

Among the above duties there is a "***redo***" policy for RM assignments (something similar to models are depicted in Sterman, 2000, pages 58 and 220):

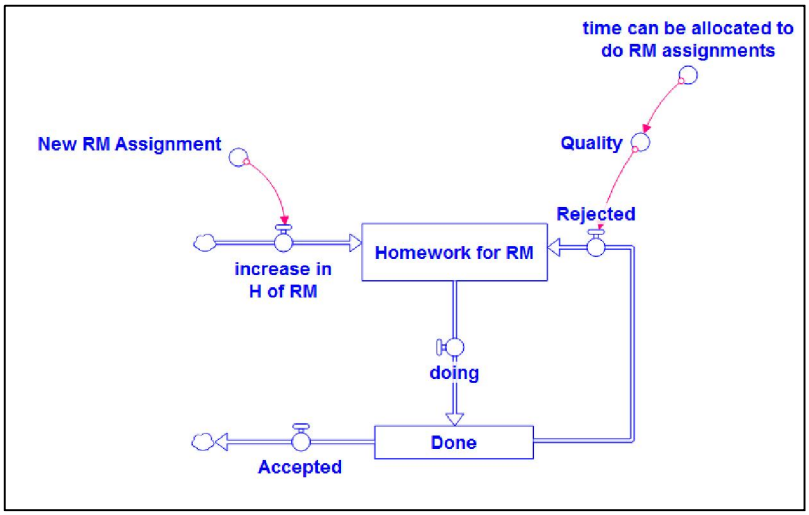


Figure 4: RM Assignments & Redo Policy

To elaborate, "***New RM Assignment***" is given, it goes to "***Homework for RM***" stock, after ***doing*** them, they will go into "***Done***" stock. Now there are two possibilities; it may be ***accepted*** or not; that is, it may be ***rejected***, and will return to the "Homework for RM" stock. The possibility of being rejected is a function of "***Quality***", & the less quality, the more probability to be

rejected. On the other hand, "*Quality*" depends on "*time can be allocated to do RM assignment*".

On the other hand, "*time can be allocated to do RM assignment*" depends on "*Total Work to Do*" & "*Days Left to Deadline*" (Figure 4 & 5):

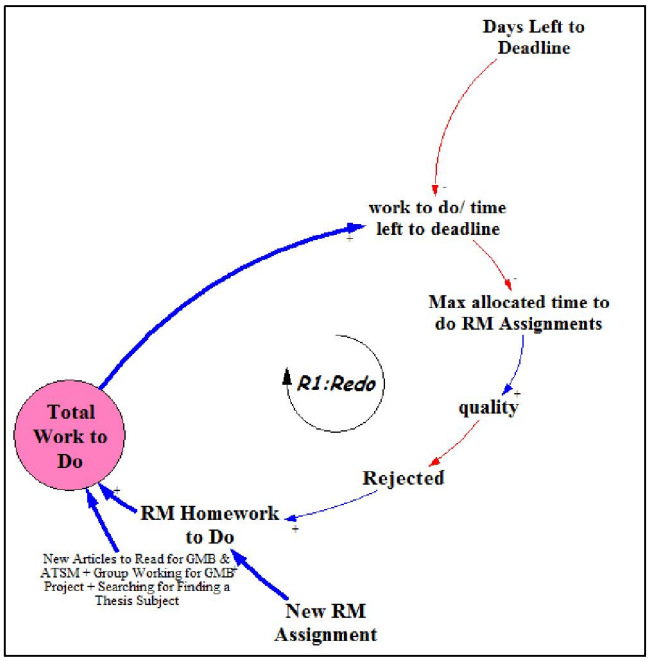


Figure 5: Redo Reinforcing Loop

"*Total Work to Do*" = ["*New RM Assignment*" + "*Rejected*" assignment] + [New Articles to Read for GMB & ATSM + Group Working for GMB Project + Searching for Finding a Thesis Subject]

R1-Redo: The more "*Total Work to Do*", means the more "*work to do/ time left to deadline*", leads to less "*time can be allocated to do RM Assignment*", so the less "*Quality*" & the more probability to be "*Rejected*", which in turn increases "*Total Work to Do*".

2) "*Needed hours to work per day*" & "*Free Time per Day*":

"*Total Work to Do"* dictates the "*Total Hours Needed for Work to Do*." Of course, "*Total Hours Needed for Work to Do"* depends on some other factors such as efficiency, concentration, speed in reading articles, etc. besides "*Knowledge Gained in Lectures"* ("*Knowledge Gained in Lectures"* itself is a function of some other factors such as teaching methods, "brain format"[2], "*Interest in the Course*", etc. which will be discussed later). In

[2] Ned Herrmann identifies four different modes of thinking reflecting a metaphor for how individuals think and learn : (A) Analytical thinking (B) Sequential thinking (C) Interpersonal thinking (D) Imaginative thinking

fact, students who learn more from lectures can read articles and do assignments faster in comparison who learn nothing from lectures and have to read articles and books from scratch (albeit, if lectures have something to do with assignments!)

"*Total Hours Needed for Work to Do"* over *"Days Left to Deadline"* determines "*Needed hours to work per day*" to finish works before the deadline, and rest of the day will be free ("*Free Time per Day*"). Yet, "Needed hours to Work per day" has some limitations, and "*Real Time can be allocated to University works*" may differ with what needed, which can cause some works to accumulate in "Total Work to Do" stock over the time. *"Real Time can be allocated to University works"* determines *"Works Done"*.

B3-Real allocated Time & Total Work to Do: as shown in Figure 6, there is balancing loop here; more "*Total Work to Do"* means more "*Needed time to work per day*", & the more "*Real Time can be allocated to University Works*", the more "*Works Done*", so the less "*Total work to Do*"

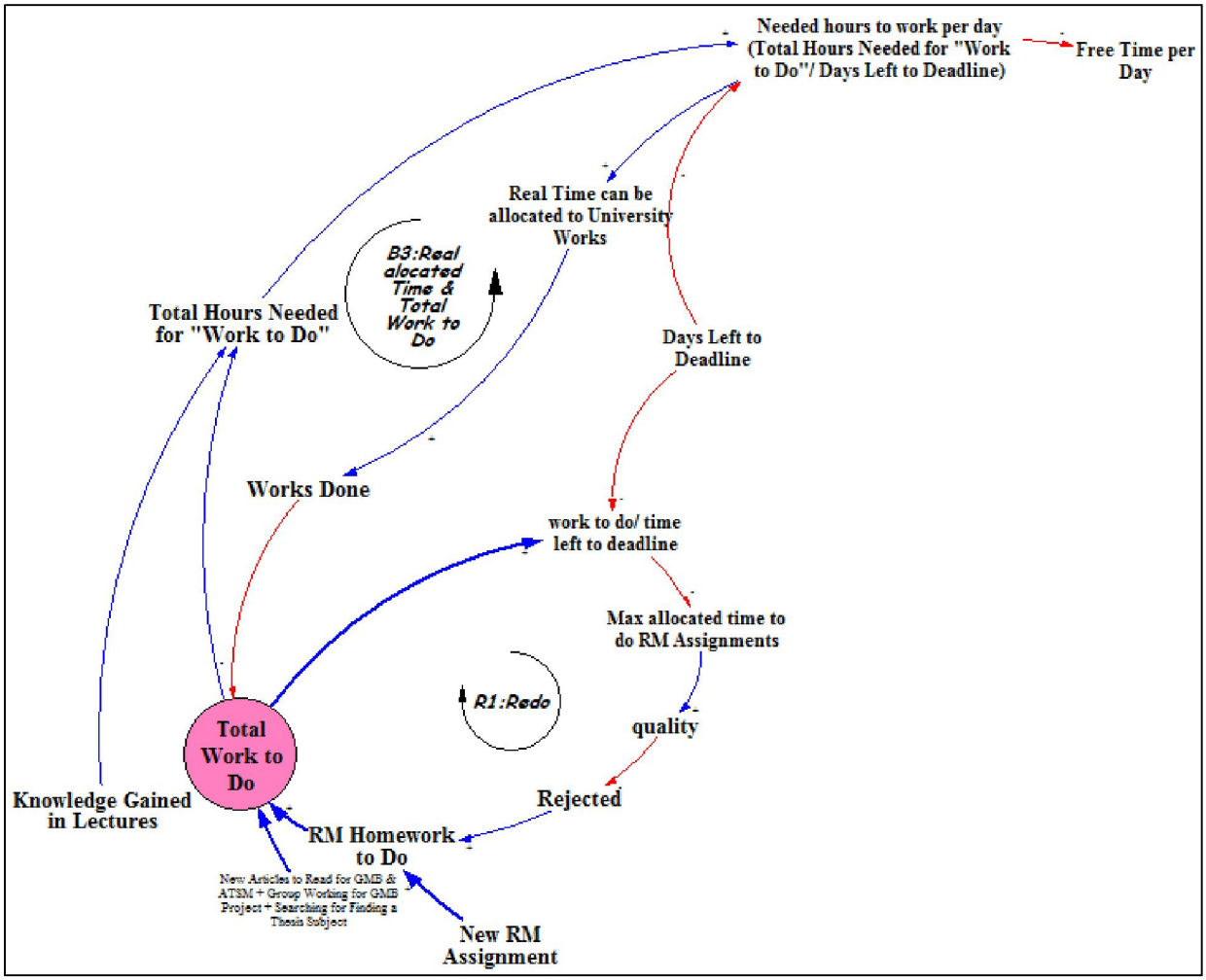


Figure 6: Balancing Loop of Real allocated Time & Total Work to Do

3) The relation between "***Total Work to Do***," "***Free Time per Day***," & "***Mental Pressure":***

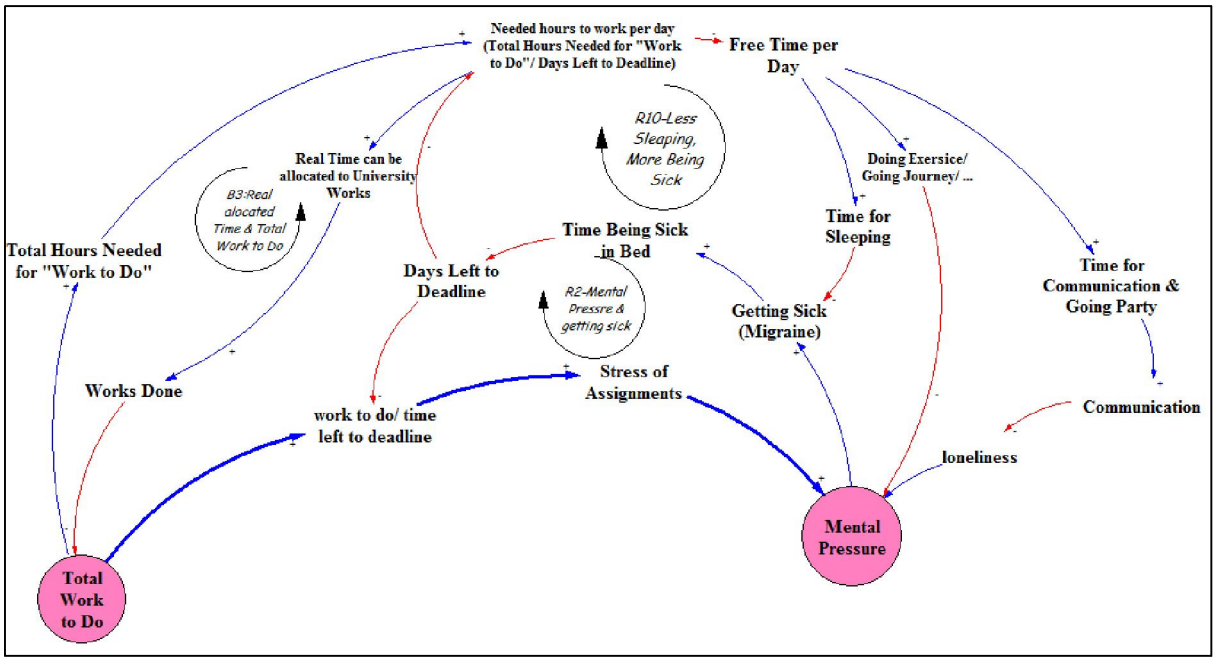


Figure 7: More Mental Pressure & Less Sleeping cause more Being Sick

"***Mental Pressure***" is a stock that can increase & decrease by different factors. For example, "***Stress of Assignments***" & "**loneliness**" will increase it, & "***Doing exercises***" & "***Going Journey***" etc. will decrease it. "***Stress of Assignments***" is raised by "***Work to do/ Time Left to Deadline***"; the more work you have to in a deadline, the more stress & mental pressure you will experience. On the other hand, the more "***Total Work to Do***" means more "***Needed hours to work per day***" & less "***Free Time per Day***." Having less "***Free Time per day***" affects "***Time for Sleeping***," time for "***Doing Exercises/Going Journey/…*** ", & also "***Time for Communication & Going Party***". In short,

- less "***Free Time per Day***" → less "***Time for Communication & Going Party***" → less "***Communication***" → more "***Loneliness***" → more "***Mental Pressure.***"
- less "***Free Time per Day***" → less time for "***Exercises/Going Journey/…***" → more "***Mental Pressure.***"
- less "***Free Time per Day***" → less "***Time for Sleeping.***"

Beside the above relationships, "***Mental Pressure***" & lack of sleep can make people sick, for example, spark a migraine. "***Getting Sick (Migraine)"*** in itself makes people rest & spend some time in bed to get better. Here two other reinforcing loops come up:

R2-Mental Pressure & Getting Sick: the more "***Mental Pressure***", the more "***Getting Sick (Migraine)***", the more "***Time Being Sick in Bed***", so you miss some days due to being sick which means

less "***Days Left to Deadline***", which increases "***Stress of Assignments***" & eventually "***Mental Pressure***" again.

R10-Less Sleeping, More being Sick: less "***Free Time per Day***", less "***Time for Sleeping***", so getting sick & more "***Sick Being Sick in Bed***", losing some days left to deadline, so less "***Days Left to Deadline***", which in turn makes you to allocated more time in other days to compensate backwardness, in the end resulting less "***Free Time per Day***" again.

4) "***Mental Pressure***", "***Loneliness***", & "***Become Nervous***":

As mentioned before, "Loneliness" can cause "Mental Pressure", & this mental pressure after a while makes you nervous & aggressive which will affect your treatment & behavior with others, for instance, causes having a bad discussion with your teachers, friends, & family members. Here four other loops appear:

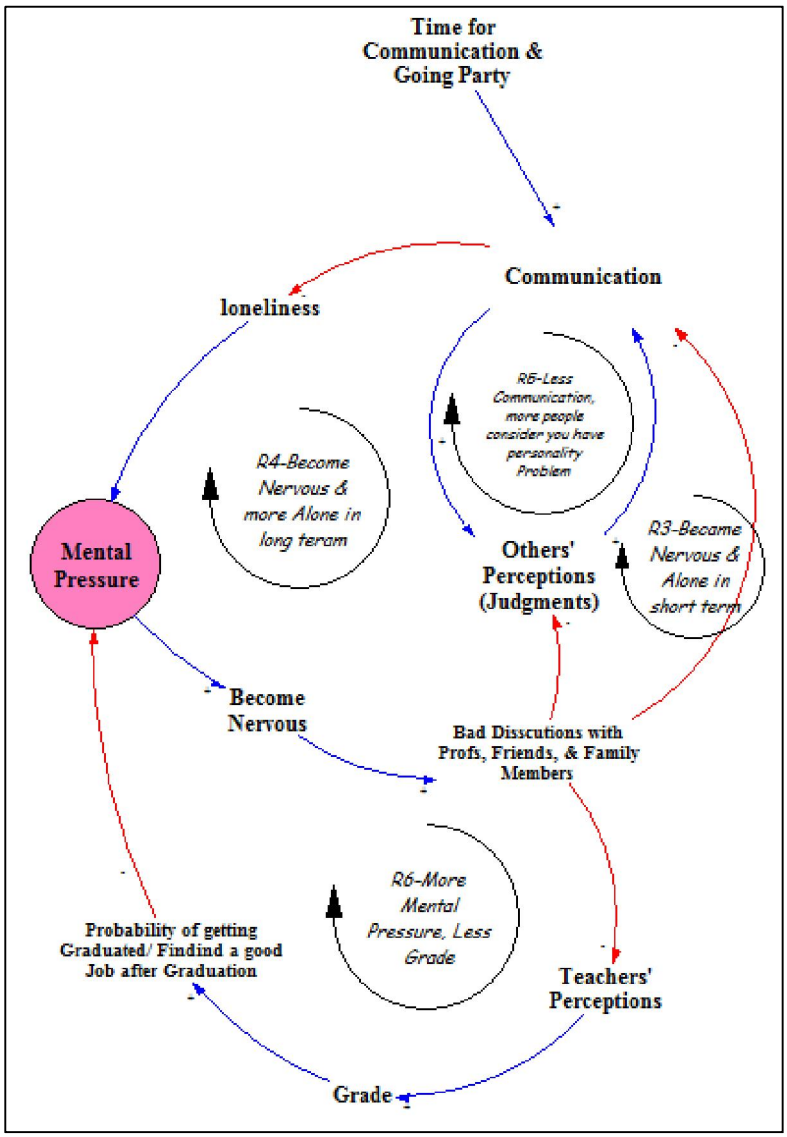


Figure 8

R3-Become Nervous & Become Alone in the short term: the more "***Mental Pressure***", the more "***Become Nervous",*** the more having "***Bad Discussion with Friends & Family Members***", so

the less "***Communication***", the more "***Loneliness***", & again the more "***Mental Pressure".*** (This is short term because friends & family members usually placate a while after getting annoyed & huffing)

R6-More Mental Pressure, Less Grade: the more "***Mental Pressure***", the more "***Become Nervous***", so having "***Bad Discussion with teachers***" which will badly affect "***Teachers' Perception***" (thinking he/she is rude & impolite), and as a result "***Grade***". Less "***Grade***" means less "***Probability of getting graduated of Finding a good Job after graduation***", which these fears & concerns increase "***Mental Pressure".*** (The effect of "***Teachers'' Perception***" on "***Grade***" is not necessary in purpose (for example grading with sticker rulers & standards), but it can affect indirectly, for example, spending more time to understand what he/ she write)

Six points are worth mentioning here: (1) amount of effect of "***Probability of getting graduated of Finding a good Job after graduation"*** on "***Mental Pressure***" clearly is different person to person, for example, for a person who has worked for several years to save some money to be afford to go to university the effect is not as much as a person who is supported financially (2) the effect of teachers' perception can happen when exams are not anonymous and answers are not objective (3) effect of teachers' perception can manifest itself in a "self-fulfilling prophecy" mechanism which will be explained later (4) another factor which affect "Grade" is the amount of works left in "Total Work to Do" stock that we will add it to the model later (5) effect of grade on mental pressure can happens in a different way as well; the gap between "grade" & "expected grade" generates dissatisfaction & mental burden. "expected grade" itself is created by different factors, for instance, amount of time & effort which you put on a course, your previous grade & your perception about your abilities, other students'' grades, your acceptable grade considering your goals (for example studying PhD), …. Another worth-mentioning point is that this dissatisfaction can also happen when there are a big gap between what are taught in class & what affecting your grades, for example, effects of English skills, reporting skill … & this feeling of "unfairness" can cause mental pressure, but we put these issues out of our boundary. (6) Perception about a person can become negative fast, but it could not change easily (due to giving the different weight of importance to new inputs based on current perception)

R4-Become Nervous & Become alone in long-term: "***Mental Pressure***" causes becoming nervous & having bad discussion with acquaintances, but it also badly affects "***Others' Perceptions***" in a way they will not being willing to make intimate relationship with whom, so he/ she will become loner & loner over the time, which increases "***Mental Pressure"*** again.

R5-less communication, more people consider you have personality problem: when you cannot communicate with others & go parties (for any reason including not having free time), it

will affect "Others' Perception" & they start to consider you have personality problem or you do not like to communicate with them, so they keep their distance with you.

5) "***Motivation Adequacy"*** & "***Erosion of Carrying Capacity***":

As you see, until know there are many reinforcing loops which can escalate "Mental Pressure". Nevertheless, "no real quantity can grow (or decline) forever: eventually, one or more constraints halt the growth". A commonly observed mode of behavior in dynamic systems is S-shaped growth-growth is exponential at first, but then gradually slows until the state of the system reaches an equilibrium level"[3]. "S-shaped growth requires the negative feedbacks that constrain growth to act swiftly as the carrying capacity is approached. Often, however, there are significant time delays in these negative loops. Time delays in the negative loops lead to the possibility that the state of the system will ***overshoot and oscillate*** around the carrying capacity"[4]. (Overshoot and oscillation happen usually for many students. When "Mental Pressure" passes their "Carrying Capacity", they try to manage it by allocating more time for resting, asking professors to expand the deadlines & decreasing the workload …)

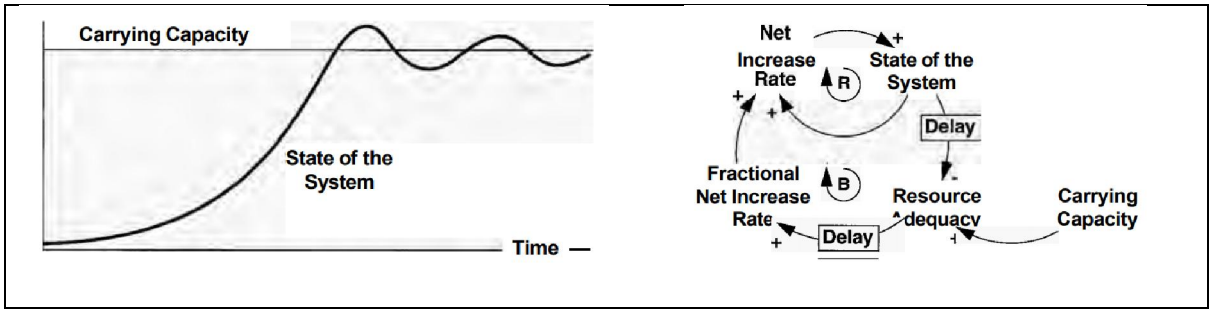


Figure 9: S-Shaped Growth with Overshoot

"The second critical assumption underlying S-shaped growth is that the carrying capacity is fixed. If carrying capacity gets eroded or consumed, it will create a second negative feedback limiting growth… As in the S-shaped growth case, when resources are initially ample the positive growth loop dominates and the state of the system grows exponentially. As it grows, resource adequacy drops. The negative loops gradually gain in strength. At some point, the net increase rate falls to zero, and the [Mental Pressure] reaches its maximum. But unlike the S-shaped growth case, the system does not reach equilibrium. When the [Mental Pressure] reaches its peak, the rate of decline of the carrying capacity is at its maximum. The carrying capacity continues to drop, [Motivation for Going on] fall further and the net increase rate of [Mental Pressure] becomes negative. The state of the system declines. Even as it declines, the remaining [Mental Pressure]

[3] Sterman. 2000. p.118
[4] Sterman. 2000, p.121

continues to erode the carrying capacity, so [motivation for going on] remain insufficient and the [Mental Pressure] keeps falling. If there is no regeneration of the carrying capacity (if it is strictly nonrenewable), the equilibrium of the system is extinction: any nonzero [Mental Pressure] continues to consume [Motivation for Going on], forcing it to zero, and with it, the [Mental Pressure]. If the carrying capacity can be regenerated or supplemented with renewable resources, a nonzero equilibrium can be sustained."[5]

B2-Energy & Motivation Adequacy: the more "***Mental Pressure***", the less "***Energy & Motivation Adequacy to Continue***" life as usual (going to university, attending classes, & taking new assignments), the less "***Total Work to Do***", so the less "***Stress of Assignments***", & the less "***Mental Pressure***".

B1-Erosion of Carrying Capacity: the more "***Mental Pressure***", the more "***Erosion of Carrying Capacity***", so the less "***Carrying Capacity***", the less "***Energy & Motivation to Continue***" life as usual, the less "***Total Work to Do***", the less "***Stress of Assignments***", & in the ends, the less "***Mental Pressure***".

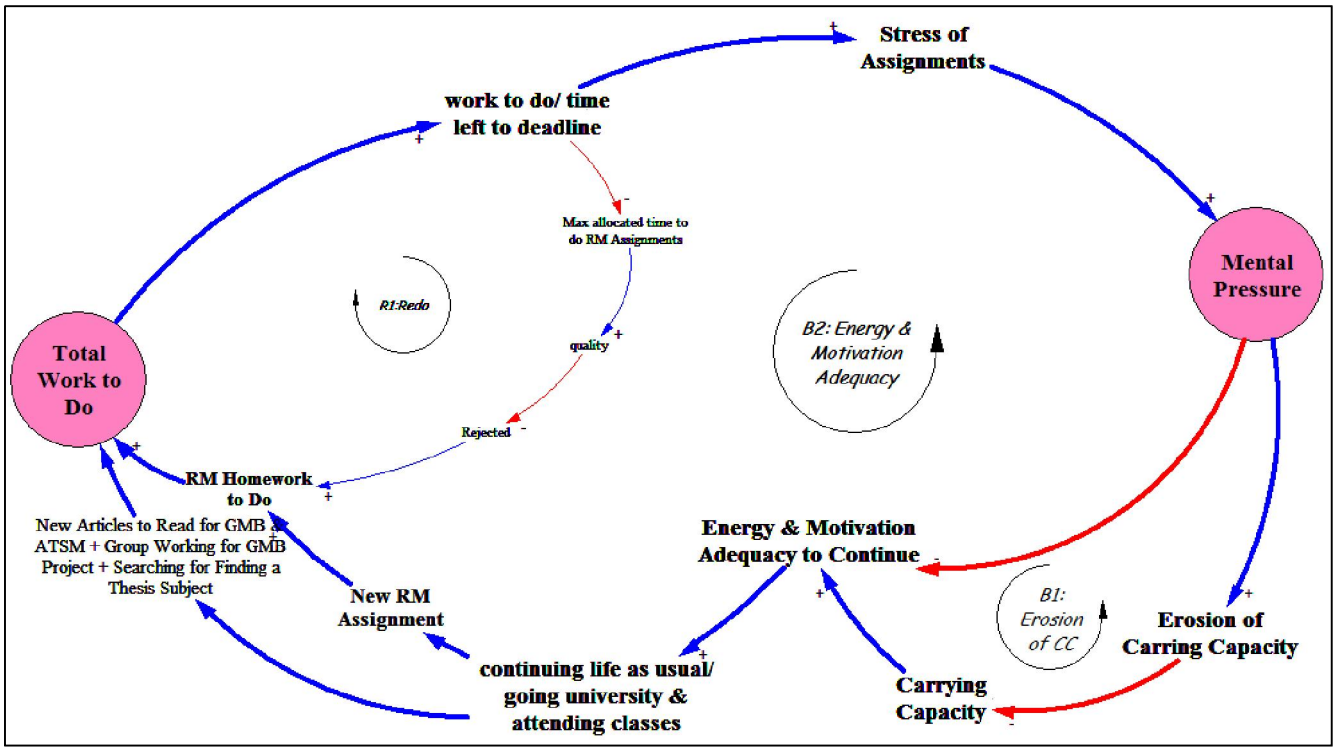


*Figure 10: "**Motivation Adequacy**" & "**Erosion of Carrying Capacity**"*

[5] Sterman. 2000, p.123

6) Other Loops:

R7-the more continue, the less time for Communication: the more "*continue life as usual & going university & attending classes*", the more "*Total to Do*", the more "*Needed hours to work per day*", the less "*Free Time per Day*", so the Less "Time for Communication & Going Party", the more "Loneliness", the more "*Mental Pressure*", and until when it does not overshoot "Carry Capacity" "*continue life as usual*"

R8-the more continue, the less time for Recreation: the more "*continue life as usual & going university & attending classes*", the more "*Total to Do*", the more "*Needed hours to work per day*", the less "*Free Time per Day*", so the Less time for recreation & "*Doing Exercise, Going Journey, …*", the more "*Mental Pressure*", and until when it does not overshoot "Carry Capacity" "*continue life as usual*"

R9-the more continue, the less time for sleeping: the more "*continue life as usual & going university & attending classes*", the more "*Total to Do*", the more "*Needed hours to work per day*", the less "*Free Time per Day*", so the Less "*Time for Sleeping",* the more "Getting Sick (Migraine)", the more "Time Being Seek in Bed", the less "Time Left to Deadline", the more "Stress of Assignments", the more "*Mental Pressure*", and until when it does not overshoot "Carry Capacity" "*continue life as usual*"

R12- Self-Fulfilling Prophecy: the more "*Mental Pressure*", the more "*Being Nervous*", the more "*Bad discussion with Professors*", the more badly "*Teachers' Perceptions*" will be affected, the less "Grade", the less "*interest in the course*", the less "*Knowledge Gained in Lectures*", the more "*Total hours Needed to "Work to Do*"", & since there is limitation for "*Real Time can be allocated to University Works*", the more "*Remained Work at the End of Semester*", so the less "*Grade*" will be gained in the end.

Final Model

The final model is shown Figure 11 and the SFD is shown in Appendix A. It consists of 12 reinforcing and three balancing loops which can produce overshoot and collapse behavior. It is necessary to mention that some points are purposely are ignored in this model for the sake of simplicity which will be mentioned in the following.

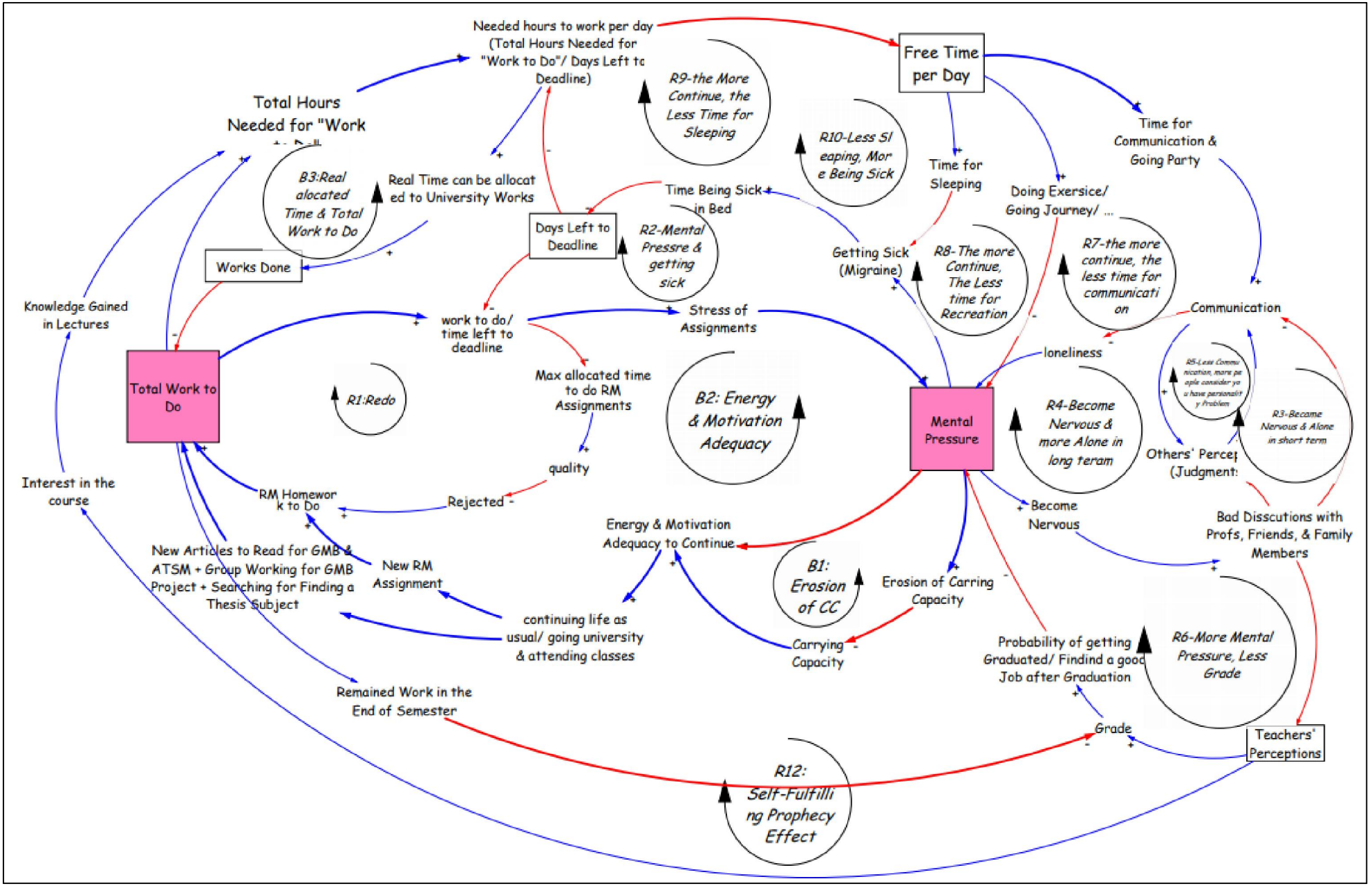
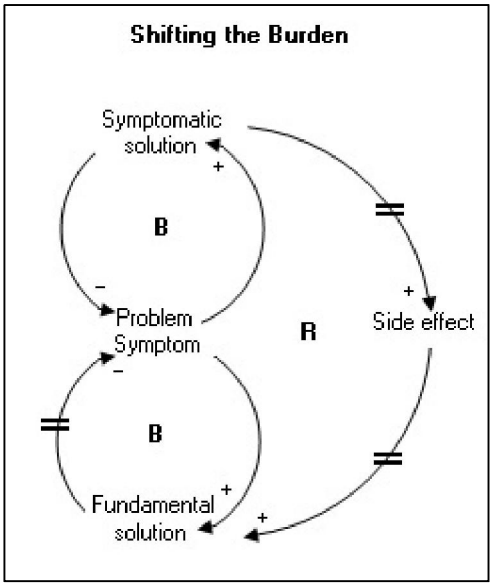


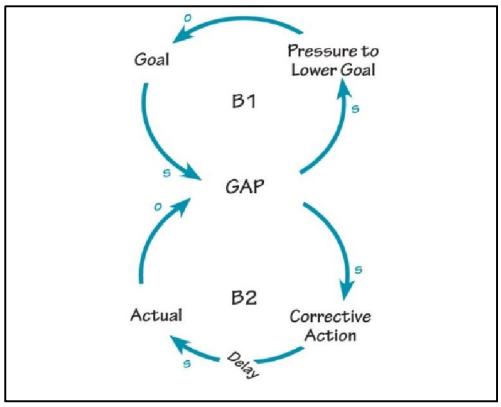
Figure 11: Final Mode

Purposely Ignored Points in the Model

1. As mentioned before "***Total Hours Needed for Work to Do"*** depends on some other factors such as ***efficiency***, ***concentration***, and speed in reading articles. Some points can be added to the model are:
   i. ***Efficiency*** is not constant, and there is a nonlinear relation between efficiency & time allocated to study
   ii. ***Concentration*** which affects efficiency itself is under the effect of "Mental Pressure" & "Time for Sleeping"; sleep deprivation & being on mental burden (for example due to having a lot of work to do before coming near deadline) can harm concentration. Another ignored factor affecting concentration is "number & variety of assignments". Indeed, there is a nonlinearity characteristic in efficiency & in the first efficiency is lower because engaging to a subject take time. For this reason, shifting to different subjects can decrease total efficiency.
2. Shift the Burden Archetype: in response to mental pressure, some students may turn to cigar, alcohol, drug, or sedative pills, & all of the directly or indirectly increase the time of being in bed, so the less time can be allocated to university works & fewer woks will be done … (regarding cigar & alcohol can make people sick (a migraine)).



3. ***Eroding Goals Archetype:***



4. Another ignored mechanism is the ask of the student to extent deadline or delivering assignments with delay (which can affect "teachers' perception")
5. The personality of people is ignored in the model. It goes without saying that all people do not have the same personality, so their reactions & amount of reactions will be different in the same situation. For example, loneliness does not affect extroverted people & introverted people equally.
6. **Pre-reading**: the effect of pre-reading on grasping lectures' materials which can decrease, but at the same time needs allocating enough time
7. **Perfectionism** and nonlinear relationship between quality & spent time
8. **some "Exogenous Factors" can be included to make the model a little more realistic:**

a) Until now we focus on academic factors which affect "***Mental Pressure***". Yet, in real life, there are some other important that should be considered. For example "**emotional problems**"; love failure or death of loved ones (such as parents) suddenly (STEP function) increase "Mental Pressure", and it needs a lot of time to manage them.

b) Another factor is "**financial problems**". financial concerns not only directly affect mental pressures, but also affect some other variables in the model which indirectly cause mental pressure as well: (1) having to work part timely (e.g. stock trading, or distance working) decreases the "***Real Time can be allocated to University Works***" and "***free time"*** for sleeping, recreation, and communication (2) lack of financial security increases the importance of "***Grades***" & the effect of low grades on "***Mental Pressure***" (3) food habit & probability of getting sick & spending more "***Time Being Sick in Bed***" (4) "***Communication***" behavior (not going out and party with friends to save some money)

c) **English Skills for international students**: English skills can affect mental pressure in different channels:

   1. The gap between English skills of one student with others can harm "**self-confidence**" & "***Communication***", & intensify "***Loneliness***" & "***Mental Pressure***" (relation between English skills & "***Communication***" is an enforcing loop)
   2. It will increase "***Total Hours Needed for Work to Do***" (for example more needed time for reading each article), which in turn will decrease "***Free Time***", "Time for Sleeping", "Time for Recreation", & "Time for Communication" that all of them lead to more "Mental Pressure".

3. Less grasping materials from lectures, that is less "*Knowledge Gained in Lectures*", which again means more "*Total Hours Needed for Work to Do*", less "Free Time", "Time for Sleeping", "Time for Recreation", & "Time for Communication" which all of them lead to more "Mental Pressure"
4. Less grasping materials from lectures ("*Knowledge Gained in Lectures*") & lack of self-confident (due to the gap between English skills with others) cause less "contribution in class" which affect "*Teachers' Perception*" & "*Grade*"
5. Having to allocate some time for practicing to improve English skills, so less "*Free Time*", & less "*Real Time can be allocated to University Works*" which both of them affect "Mental Pressure" eventually. "*Mental Pressure*" due to fear from "*Probability of Finding a good job after Graduation*" which beside other bad effects of not advanced English skills (such as loneliness, lack of self-confidence, less gaining knowledge in class, less contribution in class, more time needed to read the articles & doing assignments) also make he/ she to put some time for improving English skills.
6. It also can directly affect "*Grades*" depending on how much exams are attached to English skills (for example writing a report, summary, or being obsessive & strict regarding "words" instead of concepts)
7. The manner of speaking with other when becoming nervous (the better English skills, the more politely expressing objections & criticisms, so the less probability of having "*Bad discussion with teachers & friends*". Another point is that the better English skills not only help to object more respectfully, but also help to express it sooner, while someone suffers from not being advanced in English skills waits & waits & suddenly loses his/ her temper.
8. English skills also can affect group assignment. Needing more time to finish an assignment, he/ she is not able to finish a job before deadline, so other students are not interested to be his/ her teammates, so he/ she will have to do group assignments lonely, which means less "*Free Time*", "*Time for Sleeping*", "*Time for Recreation*", & "*Time for Communication*" which all of them lead to more "*Mental Pressure*". Also, he/ she can allocate less time for doing other university jobs, so the more "*Remained work at the End of Semester*", leading to less "*Grade*" & more "*Mental Pressure*"

Results

The result of this study is the first casual loop diagram of reinforcing and balancing feedback processes of carrying capacity erosion of students resulted in mental pressure stemming from workload and loneliness. The final causal loop diagram defines 12 reinforcing and three balancing feedback loops which can produce overshoot and collapse behavior.

Four Main Objections Received by Participants

We received four main objections from respondents:

1. Choosing the wrong participants: selected students & professors are not expert in "suicide". Instead, two other groups should be asked in this regard (a) psychologists who work in this area (b) students who did commit suicide & are still alive! Although some of them might have committed suicide just to attract some attention. In other words, we should ask students who committed suicide unsuccessfully, but for these people, really "work pressures" are the underlying reason, or "lack of attention"? And whether they did that just for attracting more attention?
2. The assumption three is not valid because never any commitment suicide has happened in Radboud University (as far as I know)
3. Study pressure will have less effect on committing suicide than "mental problems", and there is no representative for "mental problem" in the model
4. The focus of the paper is on mental pressure from the study workload while other burdens might have much more effect than study workload.

Conclusions and Future Prospects

Future research is needed to expand upon this initial model of suicide dynamics. Quantitative extensions may result in a better understanding and contribute to personalized methods of evaluation, prevention, and intervention. For instance how can make students more resilient? How can redesign the teaching method to decrease the workload, increase the quality of student life, and at the same time increase the productivity for students of different brain format and different learning method? What can do students in confronting with the excessive workload to manage their mental pressure? Where are the leverage points for increasing productivity?

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Appendix 1: SFD of the Conceptual Model